

WICHITA RIVER BASIN, TEXAS
REEVALUATION REPORT

ENGINEERING APPENDIX

JUNE 2002

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
OKLAHOMA

**WICHITA RIVER BASIN, TEXAS
REEVALUATION REPORT
ENGINEERING APPENDIX**

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	Pertinent Data	a
	<u>I - GENERAL</u>	
1-01	Purpose	1-1
1-02	Authority	1-1
1-03	Plan Formulation and Selected Plan	1-1
1-04	Project Location	1-1
1-05	Description of Work	1-2
	a. Collection Facility	1-2
	b. Evaporation Field	1-2
	c. Access Road	1-2
	d. Conveyance Facility	1-2
	e. Truscott Brine Lake	1-2
1-06	Departure from the Previous Plan	1-2
1-07	Current Status of Design and Construction	1-3
	a. Area VII	1-3
	b. Area VIII	1-3
	c. Area X	1-3
	d. Truscott Brine Lake	1-3
1-08	Quality Control and Technical Review	1-3
1-09	Estimated Costs	1-3
1-10	Additional Service Alternatives	1-4
	a. Design	1-4
	b. Costs	1-4
	<u>II- CIVIL</u>	
2-01	Introduction	2-1
2-02	Service Road	2-1
2-03	Low Water Crossings	2-1
2-04	Erosion Control	2-1
	a. Temporary	2-1
	b. Permanent	2-2
2-05	Access Roads	2-2
	<u>III - HYDROLOGY AND HYDRAULICS (H-H)</u>	
3-01	General	3-1
3-02	Alternative Analysis	3-1
3-03	Selected Plan	3-1
3-04	Drainage Basins	3-1
	a. General	3-1
	b. Area VII (Y-Ranch Pump Station)	3-1
	c. Area X (Lowrance Ranch Pump Station)	3-1
3-05	Precipitation, Evaporation, and Streamflow Records	3-1
3-06	Streamflow - Chloride Load	3-2
	a. Area VII	3-2

TABLE OF CONTENTS (cont.)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	b. Area VIII	3-2
	c. Area X	3-2
3-07	Evaporation Field Development	3-3
3-08	Dam Height Evaluation	3-4
<u>IV - GEOTECHNICAL INVESTIGATION AND DESIGN</u>		
4-01	General	4-1
4-02	Selected Plan	4-1
4-03	Background	4-1
	a. Geologic Information	4-1
	b. Groundwater Information	4-2
4-04	Foundation Exploration	4-2
	a. Exploration Plan	4-2
	b. Field Tests	4-2
<u>V - STRUCTURAL DESIGN</u>		
5-01	General	5-1
5-02	Selected Plan	5-1
5-03	Raising Truscott Brine Lake Dam	5-1
<u>VI - MECHANICAL DESIGN</u>		
6-01	General	6-1
6-02	Selected Plan	6-1
6-03	Design Features	6-1
	a. Collection Facilities	6-1
	b. Conveyance Facilities	6-2
	c. Evaporation Fields	6-2
<u>VII - ELECTRICAL DESIGN</u>		
7-01	General	7-1
7-02	Selected Plan	7-1
7-03	Design Features	7-1
	a. Collection Facilities	7-1
	b. Conveyance Facilities	7-1
<u>VIII - REAL ESTATE</u>		
8-01	Project Location and Description	8-1
	a. Introduction	8-1
	b. Location	8-1
	c. Ownerships	8-1
8-02	Real Estate Requirements	8-2
	a. Area VII	8-2
	b. Area VIII	8-2
	c. Area X	8-3
8-03	Additional Service Alternatives	8-3
	a. Raggedy Creek	8-3
	b. Paradise Creek	8-4

TABLE OF CONTENTS (cont.)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
8-04	Estates to be Acquired	8-4
	a. Area VII	8-4
	b. Area VIII, Evaporation Areas	8-6
	c. Area X	8-6
	d. Creek Alignment	8-7
8-05	Government-Owned Land	8-7
	a. Area VII	8-7
	b. Area VIII	8-7
	c. Area X	8-7
8-06	Relocation Assistance	8-7
8-07	Severance	8-7
	a. Area VII	8-7
	b. Area VIII	8-7
	c. Area X	8-7
8-08	Relocations	8-7
	a. Area VII	8-7
	b. Area VIII	8-8
	c. Area X	8-8
8-09	Opposition	8-8
	a. Area VII	8-8
	b. Area VIII	8-8
	c. Area X	8-8
8-10	Highest and Best Use	8-8
8-11	Environmental Impact	8-8
8-12	Acquisition Schedule	8-8
8-13	Cost Estimate Summary	8-8

IX - RELOCATIONS

9-01	General	9-1
	a. Pipelines	9-1
	b. Roads	9-1
	c. Fences	9-1

X- COST ESTIMATE & OPERATIONS, MAINTENANCE
REPAIR, REPLACEMENT AND REHABILITATION (OMRR&R)

10-01	Introduction	10-1
10-02	Basic Cost Data	10-1
10-03	Summary of Estimated Costs	10-1
10-04	Details of Estimated Costs	10-2
10-05	Operation, Maintenance and Repair (OM&R) Costs	10-2
	a. Operating Personnel	10-3
	b. Electric Power	10-3
	c. Pump Overhauls	10-3
	d. In-situ Relining of Pipe	10-3
	e. Inflatable Dam Replacement	10-3
	f. Raise Truscott Brine Dam	10-3

XI - ENVIRONMENTAL CONSIDERATIONS

11-01	General	11-1
11-02	Impact	11-1

TABLE OF CONTENTS (cont.)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	<u>XII - APPROVAL</u>	
12-01	Approval	12-1

TABLE INDEX

<u>Table</u>	<u>Title</u>	<u>Page</u>
1-1	Alternative Descriptions	1-4
1-2	Formulation Stage Costs	1-6
1-3	Fish and Wildlife Alternative and Costs	1-7
3-1	Streamflow Data	3-3
3-2	Evaporation Data	3-4
3-3	Routing Results	3-5
8-1	Estimated Real Estate Costs	8-9
8-2	Estimated Costs	8-11
10-1	Summary of Estimated Costs	10-2
10-2	Equivalent Annual Cost by Category & Area At 6.38% for 100-Year Duration	10-4

APPENDIX INDEX

<u>Appendix</u>	<u>Title</u>
A	Schedule
B	Quality Control and Technical Review Plan, Independent Review Comments & Annotations
C	MCACES Cost Estimate
D	Fish and Wildlife Alternatives

DRAWING INDEX

<u>Drawing No.</u>	<u>Title</u>
1/1	Vicinity Map
1/2	Index of Drawings
12/01	Site Plan - Area VII & Access Road
12/02	Site Plan - Area VIII
12/03	Site Plan - Area X
12/04	Truscott Brine Lake General Plan
12/05	Outlet Area VII and X
12/06	Outlet Area VIII
12/07	Plan & Profile - Area VII Access Road
12/10	Area VII Pipeline Realignment
12/11	Plan & Profile - Area VII Pipeline Sta. 0+00 to 100+00
12/12	Plan & Profile - Area VII Pipeline Sta. 100+00 to 200+00
12/13	Plan & Profile - Area VII Pipeline Sta. 200+00 to 300+00
12/14	Plan & Profile - Area VII Pipeline Sta. 300+00 to 400+00
12/15	Plan & Profile - Area VII Pipeline Sta. 400+00 to 500+00
12/16	Plan & Profile - Area VII Pipeline Sta. 500+00 to 600+00
12/17	Plan & Profile - Area VII Pipeline Sta. 600+00 to 700+00
12/18	Plan & Profile - Area VII Pipeline Sta. 700+00 to 790+40

TABLE OF CONTENTS (cont.)

12/31	Plan & Section - Area VII Evaporation Area
12/32	Plan & Section - Area VIII Evaporation Field Collection Area
12/33	Plan & Section - Area X Evaporation Field Collection Area
12/34	Plan & Section - Area VII & X Evaporation Field Outlet Area
12/35	Plan & Section - Area VIII Evaporation Field Outlet Area
12/36	Details
12/40	Typical Collection Area
169/1	Collection Facilities - Pump Station Piping
169/2	Collection Facilities - Pump Station Piping
169/3	Collection Facilities - Pump Station Piping
169/4	Conveyance Facilities - Pump Station Piping
169/5	Conveyance Facilities - Pump Station Piping
169/6	Conveyance Facilities - Pump Station Piping
279/1	Area VII, VIII, & X Electrical Legend of Symbols
279/2	Area VII Collection Facilities One-Line Diagram
279/3	Area VIII Collection Facilities One-Line Diagram
279/4	Area VII, VIII, & X Pump Motor Control Schematic
279/5	Area X Collection Facilities One-Line Diagram
279/6	Area X Collection Facilities Pump Motor Control Schematic
279/7	Area X Collection Facilities Pump Station Control Logic Ladder Diagram
279/8	Area VII Conveyance Facilities One-Line Diagram
279/9	Area VII Conveyance Facilities Pump Motor Control Schematic
279/10	Area VII Conveyance Facilities Pump Station Control Logic Ladder Diagram
279/11	Area VIII Conveyance Facilities One-Line Diagram
279/12	Area VIII Conveyance Facilities Pump Motor Control Schematic
279/13	Area VIII Conveyance Facilities Control Logic Ladder Diagram
279/14	Area VIII Conveyance Facilities Control Logic Ladder Diagram
279/15	Area VIII Conveyance Facilities Control Logic Ladder Diagram
279/16	Area X Conveyance Facilities One-Line Diagram

**WITCHITA RIVER BASIN, TEXAS
REEVALUATION
ENGINEERING APPENDIX**

PERTINENT DATA

<u>Item</u>	<u>Area VII</u>	<u>Area VIII</u>	<u>Area X</u>
Collection Capacity (Max)	20 cfs	15 cfs	10 cfs
Pipeline			
Pressure: Material (Dia.)	Steel (24")	Fiberglass (24")	Steel (18")
Gravity: Material (Dia.)	N/A	Fiberglass (27-30")	PVC (18")
Length	15.0 Mi.	22 Mi.	10.4 Mi.
Collection Pumps			
Vertical Turbine	3 @ 200 hp	3 @ 200 hp	3 @ 100 hp
Conveyance Pumps			
Vertical Turbine	3 @ 550 hp	3 @ 250 hp	3 @ 200 hp
Evaporation Field, Collection			
Num. Nozzles	90	66	42
Acres	42	37	32
Evaporation Field, Truscott			
Num. Nozzles	90	66	42
Acres	28	37	25
Truscott Brine Dam	Existing Top of Dam Elev. 1512.5		
	Revised Elevation 1514.9		
Truscott Spillway	Existing Crest 1502.0		
	Revised Crest 1505.3		

All Collection and Conveyance Structures:

Sumps:

Reinforced Concrete

Building:

Dimensions:

50' x 60'

Minimum eave height:

21'-10"

Type:

Pre-fabricated metal

Electrical/control room dimensions:

14'-10" x 50'-0"

Collection Dam:

Inflatable Weir

Access Road:

Width, feet:

22

Length, feet:

8,500 feet Area VII

Surface

Gravel

Land Requirements:

Fee

19.63 acres

Temporary work area easement

20.94 acres

Perpetual joint-use easement for road

28.63 acres

**WICHITA RIVER BASIN, TEXAS
REEVALUATION REPORT
ENGINEERING APPENDIX**

I - GENERAL

1-01. Purpose. The Wichita River Basin Reevaluation (Reevaluation) was conducted to evaluate the economic viability and environmental acceptability of chloride control measures within the Wichita River Basin -a reduced scope from the Red River Chloride Control Project. This Engineering Appendix presents the basis for the preparation of design and cost data for the formulation alternatives studied and design and cost data prepared for the selected plan. The areas being reevaluated include Areas VII, VIII, X, and Truscott Brine Lake.

1-02. Authority. The authority to construct this project is contained in the following:

a. Section 203, Flood Control Act of 1966, Public Law 89-789, 7 November 1966, Arkansas-Red River Basins, TX, OK, and KS, Part I.

b. Section 201, Flood Control Act of 1970, Public Law 91-611, 31 December 1970, Arkansas-Red River Basins Water Quality Control Study, TX, OK and KS, Part II.

c. Section 74, Water Resources Development Act of 1974, Public Law 93-251, 7 March 1974.

d. Section 153, Water Resources Development Act of 1976, Public Law 94-587, 22 October 1976.

e. Section 1107, Water Resources Development Act of 1986, Public Law 99-662, 17 November 1986, General Design Phase I Plan Formulation, Volumes I and II (DM 25, November 1980).

1-03. Plan Formulation. Alternatives for completing the Wichita Basin were investigated during the plan formulation stage of the reevaluation. The alternatives consisted of varying the sites being pumped to Truscott Brine Lake; deep well injection; and utilization of evaporation fields to reduce the flows to Truscott. The Truscott Brine Lake was initially designed to handle flows from Areas VIII and X. Some alternatives added additional flows and estimates indicated the Truscott embankment needed to be raised. See Table 1-1 (located at the end of this section) for a description of the alternatives and Table 1-2 for the costs and OMR&RR costs for the formulation stage.

1-04. Project Location. All sites are shown on the location map located at the end of this report.

a. The Area VII collection facility is located in Cottle County, Texas, near river mile 209.6 of the North Wichita River. The site lies approximately 19 miles west and 3 miles south of Crowell, Texas. The Area VII pipeline runs southeast to Truscott Brine Lake.

b. The Area VIII collection facility is located in King County, Texas, on the South Fork of the Wichita River about 4 miles north of US Highway 82. Its pipeline runs about 22 miles to the northeast to Truscott Brine Lake.

c. The Area X collection facility is located about 13 miles northeast of Guthrie in King County, Texas, on the Middle Fork of the Wichita River. The pipeline runs east about 14 miles to the Truscott Brine Lake.

1-05. Description of Selected Plan 7A. The purpose of these facilities is to impound low river flows with high chloride concentrations behind an inflatable weir in the river and then pump them to Truscott Brine Lake. All the areas require the same method for the collection of brine and the disposal to Truscott Brine Lake. A general plan of the collection facilities is shown on drawings 12/01, 12/02, and 12/03. All areas will have the following components as described below.

a. Collection Facility. The inflatable weir provides an impoundment area approximately 5-feet deep in the river. An intake structure is built behind the weir and is used to withdraw water from the impoundment. Water flows through an underground conduit to a sump below the collection pump station building. The pump will then pump the brine to an evaporation field at the collection area.

b. Evaporation Field. The evaporation field will consist of a number of nozzles spaced over an area surrounded by a buffer zone to prevent damage from spray drifting to adjacent landowners. The nozzles will spray the brine into the atmosphere allowing evaporation of the brine and the reduction of brine to be pumped and also reduces the storage capacity required at Truscott Brine Lake. The field will be graded and the surfaced to allow the remaining brine to drain to the conveyance facility. The conveyance facility consists of a prefabricated metal building sized to house the pumps, controls, and communication equipment. It is similar to the building being constructed for the Lowrance Pumping Station at Area X. The conveyance pumps will be located in the sump and will pump the brine water into a pipeline for conveyance to Truscott Brine Lake.

c. Access Road. Access to the site will be provided by improving existing ranch roads to the collection site. The access road will be 18-foot wide with 2-foot shoulders constructed of 3 inches of gravel surfacing over 6 inches of lime-stabilized subgrade. The roadway will be a crowned section with 1/2-inch per foot cross slopes. A 3-foot horizontal by 1-foot vertical slope will be maintained on all side and back slopes. The maximum roadway gradient will not exceed 8 percent. Stone ditch checks will be used as needed to control erosion.

d. Conveyance Facility. The conveyance facility will consist of a pump sump, which will accept runoff from the evaporation field and pump the brine through a pipeline to the Truscott Brine Lake. At the Brine Lake outlet discharge valve, an additional evaporation field will spray the brine into the atmosphere; and the remaining runoff will be piped or ditched to the lake. The pipeline will be accompanied by a service road. The service road will utilize low-water crossings to cross creeks and drainage ditches.

e. Truscott Brine Lake. The additional flow from the Area VII collection, which was previously planned for Crowell Brine Lake, will require the dam at Truscott to be raised 2.4 feet. This will be accomplished by installing a reinforced concrete stem wall. The construction of the stem wall has been deferred until project year 75, when it is expected to be required.

1-06. Departure from the Previous Plan. The addition of the evaporation field and the conveyance facility located at the collection facility and the addition of the evaporation field at the Truscott Brine Lake affects all three areas. In addition, the previous design required brine from Area VII be pumped to Crowell Brine Lake, and now it will be pumped to Truscott Brine Lake.

1-07. Current Status of Design and Construction. A current schedule for supplementing DMs, preparing plans and specifications, advertising and constructing the proposed project is contained in Appendix A. Current status of each area is contained in the following paragraphs.

a. Area VII. No construction has been completed on Area VII. Plans and specifications have been completed; however, they will require extensive revisions to incorporate the departures from the previous plan.

b. Area VIII. Area VIII has been fully operational since October 1986. Plans and specification will be required to incorporate the departures from the previous plan.

c. Area X. Area X has the low flow dam, sump and building, and access road completed. Plans and specifications have been completed for the conveyance facility, but will require revisions to incorporate the departures from the previous plan.

d. Truscott Brine Lake. The Truscott Brine Lake has been operating since October 1986. Plans and specifications will be required to raise the dam approximately 2.4 feet using a concrete reinforced stem wall. Hydrologic and hydraulic studies show that the need for the additional height of the Truscott Dam will not be required until the 75th year of operation. Therefore, the cost for this feature is not included in the estimated cost. This cost was \$2,765,700 including Engineering, Design, Supervision and Inspection. This cost is included in the O&M cost at year 75.

1-08. Quality Control and Technical Review. The Quality Control and Technical Review Plan for the Engineering Appendix is presented in Appendix B.

1-09. Estimated Costs. A summary of estimated costs for 01 Lands and Damages, 04 Dams, 08 Roads, Railroads and Bridges, 13 Pumping Plant (includes pipeline), 30 Engineering and Design and 31 Construction Management for Areas VII, VIII, X and Truscott Brine Lake follows. Also presented below is the cost estimate for the next likely alternate for implementation, Alternative 8a. This alternative has the same features for Area VII and VIII. Area X has been eliminated, and no work is required at Truscott Brine Lake.

ESTIMATED COST TOTALS - ALTERNATIVE 7A (SELECTED PLAN)

01	Lands & Damages	\$ 1,174,000
04	Dams	788,000
08	Roads, Railroads & Bridges	498,000
13	Pumping Plants	43,372,000
30	Engineering & Design	2,200,000
31	Construction Management	<u>2,000,000</u>
TOTAL PROJECT COST		\$50,032,000

ESTIMATED COST TOTALS - ALTERNATIVE 8A

01	Lands & Damages	\$ 739,000
04	Dams	788,000
08	Roads, Railroads & Bridges	498,000
13	Pumping Plants	30,452,000
30	Engineering & Design	1,600,000
31	Construction Management	<u>1,300,000</u>
TOTAL PROJECT COST		\$35,377,000

1-10. Additional Service Alternatives. The U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department (Service) recommended the Corps investigate additional alternatives for the disposal of the collected brines. Their recommendation was to dispose of the brines into small intermittent creeks in the area. These alternatives were suggested to provide aquatic habitat that would offset the reduction of aquatic habitat below the collection low flow dams. These creeks were identified as Raggedy, Paradise, and Beaver Creeks. A field review of these creeks was performed and the hydrology reviewed. It was determined Beaver Creek was not a viable option since it represented a continuous fresh water stream and also fed the privately owned Santa Rosa Lake. Beaver was eliminated from further study. Table 1-3 shows the alternative description, design and construction cost, and equivalent annual OMRR&R costs. Pipeline routes for each alternative are shown on drawings 4a1 thru 4d2 in Appendix D.

a. Design. The design for these alternatives was derived from the design effort prepared for the selected Alternative 7a. This included collection facilities, pipelines, real estate, E&D and S&I.

b. Costs. All costs presented in Table 1-3 were derived from the updated component cost for the selected alternative. The costs include escalation, contingencies, overhead, profit, L&D, construction, E&D and S&I. Lands and Damages includes a cost for a conservation easement along the receiving creek to its confluence at the Pease River.

TABLE 1-1

ALTERNATIVE DESCRIPTIONS

ALTERNATIVE	COMPONENT OUTLINE
1	<ul style="list-style-type: none"> • Deep well inject Area VII • Continue to pump Area VIII to Truscott (average 5.2 cfs) • Deep well inject Area X • No Truscott embankment change
2	<ul style="list-style-type: none"> • Deep well inject Area VII • Continue to pump Area VIII to Truscott • Pump Area X to Truscott • No Truscott embankment change
3	<ul style="list-style-type: none"> • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (average 5.2 cfs) • Deep well inject Area X • Raise Truscott embankment 17.2 ft.
4	<ul style="list-style-type: none"> • Deep well inject Area VII • Continue to pump Area VIII to Truscott (average 5.2 cfs) • Do nothing at Area X • No Truscott embankment change
5	<ul style="list-style-type: none"> • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (average 5.2 cfs) • Pump Area X to Truscott • Raise Truscott embankment 33.2 ft.
6	<ul style="list-style-type: none"> • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (average 5.2 cfs) • Do nothing at Area X • Raise Truscott embankment 17.2 ft.
7	<ul style="list-style-type: none"> • Assume a 25% reduction of water volume at Truscott achieved by spray field evaporation at Truscott outfall: • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (average 5.2 cfs) • Pump Area X to Truscott • Raise Truscott embankment 17.2 ft.
7A	<ul style="list-style-type: none"> • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott • Pump Area X to Truscott • Evaporation fields at intake and outfall of each pipeline • Projection to raise top of Truscott dam 2.4 ft. using a stemwall
8	<ul style="list-style-type: none"> • Assume a 25% reduction of water volume at Truscott achieved by spray field evaporation • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (average 5.2 cfs) • No nothing at Area X • Raise top of Truscott dam 2.4 ft. using a stemwall
8A	<ul style="list-style-type: none"> • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (increase pumped flow to 6.2 cfs) • Do nothing at Area X • Evaporation fields at intake and outfall of each pipeline • No Truscott embankment change

TABLE 1-1 (CONT.)
ALTERNATE DESCRIPTIONS

ALTERNATIVE	COMPONENT OUTLINE
9	<ul style="list-style-type: none"> • Assume a 25% reduction of water volume at Truscott achieved by spray field evaporation at Truscott and Area VIII pumped flow increased to 5.7 cfs. • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott • Do nothing at Area X • Raise Truscott embankment 4.4 ft.
10	<ul style="list-style-type: none"> • Assume a 25% reduction of water volume at Truscott achieved by spray field evaporation at Truscott and Area VIII pumped flow increased to 5.7 cfs. • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (increase pumped flow to 5.7 cfs) • Do nothing at Area X • Raise Truscott Dam 4.4 ft. using stemwall.
11	<ul style="list-style-type: none"> • Pump Area VII to Truscott • Continue to pump Area VIII to Truscott (increase pumped flow to 5.7 cfs) • Do nothing at Area X • Raise Truscott embankment 19.2 ft.
12	<ul style="list-style-type: none"> • Do nothing at Area VII • Continue to pump Area VIII to Truscott (increase pumped flow to 5.7 cfs) • Pump Area X to Truscott • No Truscott embankment change

TABLE 1-2
FORMULATION STAGE COSTS

Feature*	Alternate No. (In \$1000)													
	1	2	3	4	5	6	7	7A**	8	8A**	9	10	11	12
01	153	336	468	112	621	417	682	1,174	468	739	519	519	417	203
04	969	969	13,770	969	26,096	14,083	12,737	788	1,907	788	5,925	2,957	15,592	-
08	610	8,648	600	600	610	610	610	498	610	498	610	610	610	-
13	85,310	55,513	45,737	55,462	23,879	15,817	26,542	43,372	17,889	30,452	17,868	17,868	15,817	8,062
30	7,041	5,000	6,000	4,694	5,204	3,653	4,439	2,200	2,755	1,600	3,174	2,755	3,817	306
31	4,286	4,286	3,745	2,857	4,592	2,286	4,082	2,000	1,735	1,300	2,143	1,765	2,408	1,531
TOTALS	98,369	74,751	70,593	64,694	61,002	36,867	49,092	50,032	25,364	35,377	30,239	26,475	38,662	10,102
OMRR&R	15,205	10,511	5,613	10,205	918	612	1,225	1,341	816	987	816	816	714	612

*Feature
01 Lands & Damages
04 Dams
08 Roads, Railroads & Bridges
13 Pumping Plants
30 Engineering & Design
31 Construction Management

**From final formulation design of selected alternative.

TABLE 1-3

FISH AND WILDLIFE ALTERNATIVES AND COSTS

Alternative	Description/Cost
4a1	Pump Area VII to Raggedy Creek Area VIII as is Area X, abandon Cost: \$27,000,000
4a2	Pump VII to Paradise Creek Area VIII as is Area X, abandon Cost \$43,000,000
4b1	Pump Areas VII and X to Raggedy Creek Area VII as is Cost: \$50,500,000
4b2	Pump Areas VII and X to Paradise Creek Area VIII as is Cost: \$75,100,000
4c1	Pump Areas VII and VIII to Raggedy Creek Drain Truscott Brine Lake Area X, abandon Cost: \$58,200,000
4c2	Pump Areas VII and VIII to Paradise Creek Drain Truscott Brine Lake Area X, abandon Cost: \$80,500,000
4d1	Pump Areas VII, VIII, X to Raggedy Creek Drain Truscott Brine Lake Cost: \$81,100,00
4d2	Pump Areas VII, VIII, X to Paradise Creek Drain Truscott Brine Lake Cost: \$112,000,000

II - CIVIL DESIGN

2-01. Introduction. This section provides information on the service road and low water crossings for the pipelines. It also includes a general discussion of temporary and permanent erosion control measures which will be installed as part of the project.

2-02. Service Road. The service road along the pipeline route will not be constructed as part of the pipeline project. Project operations personnel will improve the pipeline contractor's construction road after construction is complete. Access to the pipeline facilities (vent tanks, outlet structures, and pigging facilities) will be along this service road.

2-03. Low Water Crossings.

a. Low water crossings will be constructed over creeks and streams crossed by the pipeline to allow project personnel to drive the pipeline right-of-way. These crossings will be constructed of reinforced concrete.

b. At each tributary crossing of the pipeline, the drainage areas were calculated for the basin area upstream of the pipeline. The rational formula and Soil Conservation Service (SCS) method were utilized to develop maximum flowrates from runoff at the crossings. The rational formula was used for drainage areas less than 6,400 acres in size. The SCS method was used for areas greater than 6,400 acres in size. The Manning equation was then used to determine the cross sectional area required at the crossings. From that data, the length of each low water crossing was determined. The flowline of the low water crossing will be set to match the flowline of the creek at that location. A maximum 5H:1V slope will be used on the crossing to provide a transition from the flowline elevation to the end of the crossing on each side of the watercourse.

2-04. Erosion Control. Temporary and permanent erosion control measures will be used to prevent soil erosion on the right-of-way during and after construction, respectively. All erosion control measures will be in accordance with the Storm Water Pollution Prevention Plan developed for this project in compliance with the Clean Water Act, as amended (33 U.S.C. 1251 et seq.).

a. Temporary. Temporary erosion control measures are materials such as straw bales and temporary dikes or swales that are installed by the contractor during construction. These measures help prevent erosion and topsoil loss from the construction site. They are usually removed by the contractor after construction is completed. The following paragraphs describe temporary erosion control measures which will be utilized for this project.

(1) Straw bales. Straw bales will be installed along both sides of each stream crossed to prevent sediment-laden runoff from entering the watercourse. Each straw bale will be securely anchored with two wooden stakes or two No. 3 re-bars.

(2) Temporary dikes. Temporary earthen dikes will be constructed across the right-of-way on slopes greater than 5 percent to

prevent sheet flow down the alignment. These dikes will either be removed after construction is completed or converted into permanent dikes. Temporary dikes may also be placed around excavations to route runoff away from the site.

(3) Stormwater holding ponds. Runoff from large areas of disturbed ground will be routed through a holding pond prior to entering a creek or watercourse. The pond will be sized in accordance with the EPA regulations.

b. Permanent. Permanent erosion control measures will include diversion dikes, ditch breakers, right-of-way re-vegetation, and stream bank protection. The following paragraphs describe each measure.

(1) Diversion dikes. Diversion dikes are low, earthen berms constructed at a 60-degree angle across the right-of-way on slopes greater than 5 percent. Their purpose is to intercept flow traveling downhill, reduce the velocity and convey it from the right-of-way to areas of existing vegetation. The dikes will be approximately 1.5 feet high.

(2) Ditch breakers. Ditch breakers are used to prevent groundwater flow along the pipeline which causes erosion to the pipe bedding material. The breakers are constructed of sandbags placed under, beside, and over the pipe in the trench. The breakers are taken to within 6 inches of the surface. On long slopes, the breakers will be installed at intervals that will ensure that the top of the downstream breaker will be above the bottom of the next up hill breaker. Ditch breakers will also be installed on each side of every creek crossing.

(3) Re-vegetation. Once construction is completed and final grading of the right-of-way is finished, seed will be spread over all disturbed areas to provide erosion protection. Vegetative material will be consistent with surrounding vegetation and selected specifically for the climate of the project area.

(4) Stream bank protection. Rock riprap will be installed upstream and downstream of each low water crossing to prevent bank and slope erosion. The channels will be dressed to a trapezoidal shape and riprap lined for a distance of 12 feet upstream and downstream of the crossing. The proposed riprap will be as shown on the drawings.

2-05. Access Roads. All access roads will have a width of 22 feet and will have a 3-inch aggregate base.

III - HYDROLOGY AND HYDRAULICS (H-H)

3-01. General. This section presents the H-H prepared for this Engineering Appendix to the Wichita Basin Re-evaluation Report. The H-H previously prepared for this basin was presented in Design Memorandum (DM) No. 3, General Design for Area VIII and Truscott Brine Lake, DM No. 8, Area X Conveyance Facilities, DM No. 11, Area VII Collection Facilities, and DM No. 12, Area VII and IX Conveyance Facilities. The collection and conveyance facilities for Area VIII are in place and operating. Area VIII includes low flow dam, pipeline pumps and controls and Truscott Brine Lake. The collection facility at Area X is constructed and includes the low flow dam, sump, building and access road.

3-02. Alternative Analysis. Initial H-H studies in this re-evaluation required the analysis of pumping various combinations of source areas to Truscott. Some alternatives required the dam to be raised to accept additional flows from Area VII, which was previously scheduled to be pumped to Crowell Brine Lake. Table 3-3 shows the pertinent data computed for Truscott Dam for the alternatives used in this formulation.

3-03. Selected Plan. The selected plan from the formulation phase of the re-evaluation is Alternative 7A. This plan includes the pumping of Area VIII, Area VII and Area X to Truscott. This alternative will require a 2.4-foot increase in dam height. In addition, evaporation fields will be constructed at each collection and discharge area.

3-04. Drainage Basins.

a. General. The North and Middle Forks of the Wichita River originate in the rolling hill country of western Texas and flow eastward into the rolling prairie lands of north central Texas. The streams develop from small intermittent gullies in the upper reaches to well defined streams with narrow flood plains bordered by high bluffs in the lower reaches of the project area.

b. Area VII (Y-Ranch Pump Station). The Area VII collection structure is located at river mile 213 of the North Fork of the Wichita River and has a drainage area of 492 square miles. The drainage basin has a length of about 45 miles and a width varying from 7 to 20 miles. The weighted slope of the streambed above the damsite is 17 feet per mile, with the slope of the streambed near the collection area about 8 feet per mile.

c. Area X (Lowrance Ranch Pump Station). The Area X collection structure is located on the Middle Fork of the Wichita River at mile 20.5 with a drainage area of 60.4 miles. The drainage basin begins about 9 miles north of Guthrie, Texas, and extends eastward about 14 miles to the damsite. The area is wedge-shaped from the upper limits to near the center and fairly uniform in width to the collection area, with width varying from 6 to 8 miles.

3-05. Precipitation, Evaporation, and Streamflow Records.

a. The original period of record studied during the design phases of this project was water year (WY) 62-70. As the current study progressed, it became apparent that there was a lot of data that was not being utilized. The original period of record was considerably drier than the WY87-97 period. It seemed appropriate to combine the periods to obtain

a better feel for the basin hydrology and water quality. A period of record of October 1961 through September 1998 was ultimately chosen due to the fact that it included the original study period and also the wet years of 1987-1998. It appears to have encompassed a full hydrologic cycle and if not, it did include some very dry periods and some very wet periods.

b. Evaporation data for the upper Wichita River basin was obtained from stations at Spur, TX, Denison Dam, TX, and Lake Kemp, TX, with Lake Kemp having the most consistent records. Precipitation data was obtained from the Truscott, Benjamin, and Paducah gages. The net evaporation rate [unadjusted for chloride (ClG) concentration] used in the brine lake routings was computed by taking 0.7 of the pan evaporation.

c. An analysis of the available data indicated the major gage for this study was to be the Benjamin gage on the South Wichita River, the Truscott gage on the North Wichita River, and the Mabelle gage on the Wichita River below Lake Kemp.

d. The above gages had continuous recorded flow records for the entire study period. They also had continuous specific conductance records for all but about 10 percent of the study period at Truscott and Mabelle. The longest continuous unrecorded period is approximately 2 years in length at these two gages.

3-06. Streamflow - Chloride Load. Daily flows and chloride loads were recomputed at the three source areas. Data available for the evaluation are listed in Table 3-1. The derivation of the computed and natural flows and loads is explained in the following paragraphs.

a. Area VII. The Paducah gage, located near Area VII, was in operation for WY62-82 and WY95-98. The ratio of the flows for Paducah and Truscott [North Fork (N.F.)] for those periods was 0.39. This value was used to synthesize the flows for Area VII for the WY83-94. A flow/concentration correlation study was made and a log-log plot for the chloride and sulfate (SO₄) concentrations. The average flow and chloride load for the 37-year period of record was computed as 26.98 cfs and 244 tons per day.

b. Area VIII. Flows were computed for WY 76-84 by using a flow vs. flow correlation curve of Guthrie vs. Benjamin gages. An analysis of the Guthrie gage WY71-76 showed that the minimum flow was 2 cfs. A minimum of 2 cfs flow was allowed in the synthesized flows. Using synthesized Guthrie flows, water quality data was computed from flow vs. chlorine concentration and flow vs. sulfur concentration curves. The average flow and chloride load for the 37-year period of record was computed as 10.18 cfs and 189 tons per day.

c. Area X. To determine the best method of synthesizing the flows for Area X, correlation curves were plotted using the Truscott [Middle Fork (M.F.)] and Guthrie gages vs. Truscott (N.F.). This plot looked like a shotgun pattern. The same plot was made by lagging the upstream flows by 1 day with the same results. A ratio of the Area X flows from the original study, WY62-70, to the Truscott (N.F.) gage was made along with similar ratios using the Truscott (M.F.) and Guthrie gages. The results of these computations are shown in table with the drainage area ratio. The Guthrie gage data had some higher flows missing in 1995 which would have made the

ratio a little larger. The Truscott gage is downstream from the Area VIII collection site location. It was decided to use the original study value of 0.13 with a minimum flow of 2.4 cfs. This was used since the source area flows are spring fed and very seldom get below this flow. Flow vs. Concentration plots were made using the same three periods for comparison. The original correlation was chosen to compute the ClG and SO₄ concentrations. For the Truscott (M.F.) and Guthrie gages, the [NaClG+Ca(SO₄)]/TDS factor used to compute the TDS concentrations was 0.97. For the period, June through September 1994, flows were available but no specific conductance data was available. For this period, a flow-conductance relationship was used to compute specific conductance. There was a very good correlation between conductance and concentrations for this period; therefore, concentrations were computed based on these correlations. The average flow and chloride load for the 37-year period of record was computed as 8.25 cfs and 244 tons per day.

TABLE 3-1
STREAMFLOW DATA

LOCATION	PERIOD OF RECORD	TYPE OF DATA	FLOW (cfs)	LOADS (TONS/DAY)		
				CHLORIDES	SULFATES	TDS*
AREA VII	WY 62-98	GAGED/SYN**	26.98	244	87	539
		PUMPED	10.15	195	63	419
AREA VIII	WY 62-98	GAGED/SYN	10.18	189	49	380
		PUMPED	5.56	165	42	332
AREA X	WY 62-98	GAGED/SYN	8.25	58	43	161
		PUMPED	4.84	49	36	137

*Total Dissolved Solids

**Synthesized

3-07. Evaporation Field Development.

a. In the early stages of the re-evaluation, evaporation was considered as a method to reduce pumped flows to Truscott Brine Lake. It was generally agreed that evaporation could reduce flows by as much as 25 percent.

b. An evaporation field was installed at the outfall of the Area VIII pipeline to evaluate the effectiveness of this alternative. The evaporation field consists of 32 spray nozzles arranged in an area 245 ft. by 145 ft. Each spray nozzle has a coverage of 35 feet in diameter with 10 nozzles having overlapping coverage.

c. A 37-day period of record was evaluated. Pumped flows were measured using inline flowmeters. Flows after the evaporation field were measured using a 120-degree v-notch weir. Differences in flow before and after the evaporation field indicate a reduction in flow of 37.89 percent for the period of record evaluated. This value was weighted, based on monthly average evaporation, to arrive at an estimated 25 percent annual reduction in flows from the operation of one evaporation field. The evaporation data are presented in Table 3-2. The operation of two evaporation fields is expected to yield a reduction of 44 percent.

TABLE 3-2
EVAPORATION DATA

MONTH	AVERAGE PAN EVAPORATION (INCHES)	PERCENT FLOW REDUCTION
Jan	2.54	8.23
Feb	3.81	12.34
Mar	6.76	21.89
Apr	9.40	30.44
May	10.30	33.36
Jun	11.17	36.17
Jul	13.52	43.78
Aug	11.37	36.82
Sep	8.95	28.98
Oct	7.58	24.55
Nov	4.73	15.32
Dec	2.94	9.52
Total	93.07	301.4
Average	7.76	25.13

3-08. Dam Height Evaluation.

a. The alternatives for plan formulation were evaluated to determine the necessity to raise the Truscott embankment. Each alternative was evaluated using the Corps of Engineers (COE) developed brine pond routing program BRNPND.

b. Data used in the evaluation were rainfall and evaporation data for 1962-1999. Local flow was calculated from change in storage values at Truscott from 1988 through 1999 and design inflow data to obtain a weighted average of 4.1 cfs (design = 3.0 cfs). After several routings, local flow data was decreased by 20 percent to result in an elevation near the observed elevation. This reduced the local flow from 4.1 cfs to 3.28 cfs. Existing flow/pump data was used as pumped flow data for Area VIII (5.7 cfs, design = 5.2 cfs). Design flow data was used for Areas VII and X, 8.2 cfs and 4.2 cfs respectively.

c. The brine pond routing results for each alternative are presented in Table 3-3. The selected plan will require an embankment increase of 2.4 feet. This will be accomplished by the construction of a stemwall. The selected plan will also require a 3.3 foot increase in spillway elevation. The spillway and maximum pool elevations were estimated using original design volumes.

d. The filling rate of Truscott Lake was evaluated based on the estimated 43.75 percent reduction in pumped inflows and a reduced local inflow rate. Projected pump rates for Areas VII, VIII and X, local inflow, precipitation, and evaporation were routed through Truscott Lake using the routing program WSRT. A starting elevation of 1470.00 for Truscott Lake was chosen. A review the routing output indicates that a need to increase dam height at Truscott would not be necessary for at least 75 years into project life.

TABLE 3-3
ROUTING RESULTS

ALTERNATIVE	CONSERVATION POOL	SPILLWAY	MAX. POOL	TOP OF DAM
1	No Embankment Change Required			
2	No Embankment Change Required			
3	1516.9	1520.1	1525.2	1529.7
4	No Embankment Change Required			
5	1533.0	1536.1	1541.2	1545.7
6	1504.2	1507.3	1512.4	1529.7
7	1504.2	1507.3	1512.4	1529.7
7A	1502.2	1505.3	1510.4	1514.9
8	1502.2	1505.3	1510.4	1514.9
8A	No Embankment Change Required			
9	1504.2	1507.3	1512.4	1516.9
10	1504.2	1507.3	1512.4	1516.9
11	1519.0	1522.1	1527.2	1531.7
12	No Embankment Change Required			

IV - GEOTECHNICAL INVESTIGATION AND DESIGN

4-01. General. This section presents the geotechnical investigation and design prepared for this Engineering Appendix to the Wichita Basin Reevaluation. The geotechnical design previously prepared for this basin was presented in Design Memorandum (DM) No. 3, General Design for Area VIII and Truscott Brine Lake, DM No. 8, Area X Conveyance Facilities, DM No. 11, Area VII Collection Facilities and DM No. 12, Area VII and IX Conveyance Facilities. The collection and conveyance facilities for Area VIII are in place and operating. Area VIII includes the low-flow dam, pipeline pumps and controls and Truscott Brine Lake. The collection facility at Area X is constructed and includes the low-flow dam, sump and building and access road.

4-02. Selected Plan. The selected plan from the plan formulation phase of the re-evaluation is Alternative 7A. This plan includes the pumping of Area VIII, Area VII and Area X to Truscott; and the Truscott Dam will require a 2.4-foot dam raise. In addition, evaporation fields will be constructed at each collection area and at the discharge into Truscott.

4-03. Background.

a. Geologic Information.

(1) General. Areas VII, VIII and X project sites are located in north central Texas in a region dominated by Permian Age sedimentary rocks. The projects lie near the southwestern edge of the Osage Plains section of the Central Lowlands Physiographic Province; they are adjacent to the High Plains Physiographic Province to the west. The areas are drained by the North, Middle and South Wichita Rivers. Topography consists of relatively flat to rolling plains with a moderate growth of grasses, mesquite, and juniper. The area is arid with only a few year-round streams.

(2) Foundation material. The project sites are underlain by the relatively flat lying Permian age Flowerpot Shale and Blaine Formation. The Flowerpot Shale is a thick unit of impervious red-bed shales, interbedded with some thin green-gray shales, and, in the upper part of the formation, with beds of gypsum and dolomite. The overlying Blaine Formation consists of interbedded gypsum, dolomite, and shale. The dolomite and gypsum units are the most resistant to erosion and are generally found capping the upper surfaces while the softer, less resistant shales are exposed on the slopes of the steeper topography. The dolomite and gypsum units range from light gray to white in color, while the shale units are reddish brown to gray in color. With the exception of the low-lying drainage areas, bedrock consisting of the above described units are exposed or are anticipated to be present at shallow depths across most of the upland surfaces.

(3) Soils. Soils along the pipeline alignment routes consist primarily of colluvial deposits on the upland areas and sidehill slopes. These deposits consist primarily of silt and clay with varying amounts of bedrock float fragments and are interpreted to be the product of weathering of the underlying bedrock. These deposits range in depth from zero (0) feet, where bedrock is exposed on the surface, to a depth of several feet,

generally near the base of the slopes. Alluvial deposits are present in the drainage areas which cross the project routes. The deposits are generally in the form of flat surfaced terraces. In some of the larger drainage areas, two levels of terraces are present - a low narrow terrace adjacent to the active stream channel and a higher level terrace beyond. The thickness of the deposits are thinnest near the margins of the drainage and adjacent to the steeper slopes and range from 10 to 20 feet in thickness near the drainage proper. These deposits generally consist of an upper portion of sandy, silty clay underlain by coarse grain sediments consisting of silt, sand, and gravel with occasional cobbles.

b. Groundwater Information. Shallow groundwater is generally perched within the coarse grain alluvial deposits, especially adjacent to year round streams. Precipitation that does not flow directly into drainages generally filters downward through the more permanent soils and, upon reaching a less permeable unit, such as shale, moves laterally and exits slope areas in the form of seeps.

4-04. Foundation Exploration. As discussed earlier, the previously approved DMs discussed the results of the geotechnical investigations. This Appendix will discuss deviations from the previous design. These deviations are: (1) The pipeline alignment change from going to Crowell to Truscott; (2) The addition of evaporation fields at each collection site and at the discharge into Truscott and the site adaptation of the current collection site design at the evaporation field. The following discussion indicates the proposed geotechnical investigation.

a. Exploration Plan. Subsurface geotechnical investigations will be made to identify the depth and type of overburden at various locations along the pipeline route and to characterize bedrock formations that might be encountered during pipeline construction. In addition, investigations will be conducted at the conveyance facilities and evaporation fields

b. Field Tests. Overburden samples will be obtained using the split-spoon and thin-walled sampling procedures, as specified by ASTM D-1586 and D-1587, respectively. Preliminary data for estimating soil bearing capacities was obtained through the use of a hand-held penetrometer. Bedrock samples were obtained by using the split-barrel sampling procedure and by coring with an NX diamond bit core barrel. Test pits will be dug with a backhoe to obtain samples. Soil and rock materials will be visually classified at the site and logged by the drilling firm.

V - STRUCTURAL DESIGN

5-01. General. This section presents the structural design prepared for this Engineering Appendix to the Wichita Basin Re-evaluation Report. The structural design previously prepared for this basin was presented in Design Memorandum (DM) No. 3, General Design for Area VIII and Truscott Brine Lake, DM No. 8, Area X Conveyance Facilities, DM No. 11, Area VII Collection Facilities and DM No. 12, Area VII and IX Conveyance Facilities. The collection and conveyance facilities for Area VIII are in place and operating. Area VIII includes the low-flow dam, pipeline pumps and controls and Truscott Brine Lake. The collection facility at Area X is constructed and includes the low-flow dam, sump and building and access road.

5-02. Selected Plan. The selected plan from the plan formulation phase of the re-evaluation is Alternative 7A. This plan includes the pumping of Area VIII, Area VII and Area X to Truscott and the Truscott Dam will require a 2.4-foot dam increase. In addition, evaporation fields will be constructed at each collection area and at the discharge into Truscott.

5-03. Raising Truscott Brine Lake Dam. The only deviation from the previous design is the raising the dam 2.4 feet. The design was completed utilizing Archon "Retaining/Flood Wall" program Version 1.0. The retaining wall of structural reinforced concrete stands 4.2 feet above its 8-foot wide base. The wall is 1-foot wide, and the base is 1.5-feet thick.

VI - MECHANICAL DESIGN

6-01. General. This section presents the mechanical design prepared for this Engineering Appendix to the Wichita Basin Re-evaluation Report. The mechanical design previously prepared for this basin was presented in Design Memorandum (DM) No. 3, General Design for Area VIII and Truscott Brine Lake, DM No. 8, Area X Conveyance Facilities, DM No. 11, Area VII Collection Facilities and DM No. 12, Area VII and IX Conveyance Facilities. The collection and conveyance facilities for Area VIII are in place and operating. Area VIII include low-flow dam, pipeline pumps and controls and Truscott Brine Lake. The collection facility at Area X is constructed and includes the low-flow dam, sump and building and access road.

6-02. Selected Plan. The selected plan from the plan formulation phase of the re-evaluation is Alternative 7A. This plan includes the pumping of Area VIII, Area VII and Area X to Truscott and the Truscott Dam will require a 2.4-foot dam increase. In addition at each collection area and at the discharge into Truscott evaporation fields will be constructed.

6-03. Design Features. This section will present the design of the selected plans departures from previous design documents. The departures are:

a. Collection Facilities. All three areas previously pumped brine directly to the brine lake. With the addition of evaporation fields at the collection sites, additional sets of pumps are required. The collection pumps will now pump to the collection area evaporation fields, which reduce the head requirements.

(1) Area VII. Pumps for this site will consist of three vertical turbine pumps driven by electric motors. Each pump will be capable of pumping 3000 gpm at a total dynamic head of 201 feet. The pumps will operate in parallel to provide a pumping rate of approximately 3200 gpm with one pump running and 9000 gpm with three pumps running. The pump curves were developed using a Fairbanks Morris model 15H 7000 with a 9.00-inch diameter impeller and three stages. The pumps will operate at 82 percent efficiency. The motor for these pumps will be 200 hp, 3-phase, 60 cycle, 480 volt running at a nominal speed of 1770 rpm.

(2) Area VIII. Pumps for this site will consist of three vertical turbine pumps driven by electric motors. Each pump will be capable of pumping 2250 gpm at a total dynamic head of 222 feet. The pumps will operate in parallel to provide a pumping rate of slightly more than 2250 gpm with one pump running and 6750 gpm with three pumps running. The pump curves were developed using a Fairbanks Morris model 15H 7000 with an 8.5-inch diameter impeller and three stages. The pumps will operate at 81 percent efficiency. The motor for these pumps will be 200 hp, 3-phase, 60 cycle, 480 volt running at a nominal speed of 1770 rpm.

(3) Area X. Pumps for this site will consist of three vertical turbine pumps driven by electric motors. Each pump will be capable of pumping 1500 gpm at a total dynamic head of 186 feet. The pumps will operate in parallel to provide a pumping rate of slightly more than 1500 gpm with one pump running and 4500 gpm with three pumps running. The pump curves were developed using a Fairbanks Morris model 14M 7000 with a 10-inch diameter impeller and two stages. The pumps will operate at 84

percent efficiency. The motor for these pumps will be 100 hp, 3-phase, 60 cycle, 480 volt running at a nominal speed of 1770 rpm.

b. Conveyance Facilities. At the collection area evaporation fields, the brine not evaporated will drain back to conveyance pumps and be pumped to the evaporation fields located at Truscott Brine Lake. The original collection pumping plants at Area VIII and X were site adapted for the conveyance pumps, and the original design did not change. The pipelines for Areas VIII and X did not change from previous designs. Since Area VII was originally designed to be pumped to Crowell Brine Lake, the change to being pumped to Truscott required the pumps and motors to be redesigned. The original pipeline design was to have an initial pressure segment to a vent tank at the high point between the two locations. From the vent tank, the pipeline was unrestricted gravity flow. The new pipeline route, although traversing similar terrain and approximately the same distance, did not encounter this high point. Therefore, the pipeline is all pressure flow. The original size and strength were analyzed and found to be appropriate for the new design.

(1) Area VII Conveyance. Pumps for this site will consist of three vertical turbine pumps driven by electric motors. Each pump will be capable of pumping 3000 gpm at a total dynamic head of 551 feet. The pumps will operate in parallel to provide a pumping rate of approximately 4000 gpm with one pump running and 9000 gpm with three pumps running. The pump curves were developed using a Fairbanks Morris model 16HC 6920 with a 12.12-inch diameter impeller and five stages. The pumps will operate at 82 percent efficiency. The motor for these pumps will be 550 hp, 3-phase, 60 cycle, 480 volt running at a nominal speed of 1770 rpm.

(2) Area VIII and X Conveyance. Pumps for these sites did not change.

c. Evaporation Fields. As discussed earlier, evaporation fields were added at the collection area and at the discharge outlet into Truscott Brine Lake. Utilizing the provided required flows, number of nozzles, configuration and spacing, piping and valving was designed.

(1) Nozzles. The evaporation fields have been designed around the Bete Model TFXP TF48 spiral nozzle. The system is designed for a residual pressure of approximately 45 psig at the nozzle. The nozzles will flow approximately 100 gpm at 45 psig. The spray cone diameter will be about 35 feet at 45 psig. Nozzle spacing will be 50 feet.

(2) Piping and valving. Piping for the evaporation fields will be AWWA C900 PVC water distribution pipe. The pipe will be DR18 with a 150 psi working pressure rating. Motorized butterfly valves will be used to limit the number of sprinklers flowing.

(3) Hydraulic analysis. The Sigma Hydraulics program was used for the hydraulic design of the systems. The program was written for fire protection sprinkler systems.

(4) Area VII. The evaporation field is designed for a flow rate of 20 cfs (9000 gpm). A total of 90 nozzles are indicated. Thirty nozzles will be flowing for each pump operating. The evaporation area at the outlet will require an automatic flow control valve to limit the flow to 4000 gpm when only one pump is operating. This valve will prevent the

pump from operating beyond the published pump curve. The manufacturer does not recommend pump operation beyond the curve.

(5) Area VIII. The evaporation field is designed for a flow rate of 15 cfs (6750 gpm). A total of 66 nozzles are indicated. Twenty-two nozzles will be flowing for each pump operating. With three pumps operating, the friction loss in the gravity line will be too high to maintain 45 psig at the nozzles. To compensate, an additional outlet with motorized butterfly valve and pressure sustaining valve will be provided. The pressure-sustaining valve will be sized and adjusted to maintain approximately 30 psi at the nozzles when 3 pumps are operating. Actual flow rate from each nozzle at 30 psig is 82 gpm.

(6) Area X. The evaporation field is designed for a flow rate of 10 cfs (4500 gpm). A total of 42 nozzles are indicated. Fourteen nozzles will be flowing for each pump operating. With three pumps operating, the friction loss in the gravity line may be too high to maintain 45 psig at the nozzles. To compensate, an additional outlet with motorized butterfly valve and pressure sustaining valve will be provided. The pressure-sustaining valve for this area may not be required, but it will be provided for a factor of safety.

VII - ELECTRICAL DESIGN

7-01. General. This section presents the electrical design prepared for this Engineering Appendix to the Wichita Basin Reevaluation. The electrical design previously prepared for this basin was presented in Design Memorandum (DM) No. 3, General Design for Area VIII and Truscott Brine Lake, DM No. 8, Area X Conveyance Facilities, DM No. 11, Area VII Collection Facilities and DM No. 12, Areas VII and IX Conveyance Facilities. The collection and conveyance facilities for Area VIII are in place and operating. Area VIII includes the low flow dam, pipeline pumps and controls and Truscott Brine Lake. The collection facility at Area X is constructed and includes the low flow dam, sump and building and access road.

7-02. Selected Plan. The selected plan from the plan formulation phase of the re-evaluation is Alternative 7A. This plan includes the pumping of Area VIII, Area VII and Area X to Truscott. The Truscott Dam will require a 2.4-foot dam increase. In addition, at each collection area and at the discharge into Truscott, evaporation fields will be constructed.

7-03. Design Features. This section will present the design of the selected plan's departures from the previous design documents. The departures are:

a. Collection Facilities. All three areas previously pumped brine directly to the brine lake. With the addition of the evaporation fields, the collection pumps will pump to the evaporation fields thereby reducing the head requirements. Areas VII and VIII will utilize 200 horse power pump motors. Area X will utilize a 100 horse power pump motor. The pump motors will be 3-phase, 2400 Volts, 60 Hz. The protective fuse device and feeder sizes will be as shown on the one-line diagrams. The sequence of operations for the pump motors will be as shown on the pump motor controls schematics.

b. Conveyance Facilities. At the evaporation fields, the brine which is not evaporated will drain back to a pump conveyance and be pumped to the brine lake. The original collection pumping plants at Areas VIII and X were site adapted at this location, and the original design was not changed. The pipelines for Areas VIII and X did not change from previous designs. Since Area VII's original design was to pump brine to Crowell Brine Lake, the change to pump brine to Truscott required the redesign of the pumps and motors. The original pipeline design was to have an initial pressure segment to a vent tank at the high point between the two locations. From the vent tank, the pipeline was unrestricted gravity flow. The new pipeline route, although traversing similar terrain and approximately the same distance, did not encounter this high point; therefore, the pipeline is all pressure flow. Area VII will utilize a 550 horse power pump motor. Area VIII will utilize a 250 horse power pump motor. Area X will utilize a 200 horse power pump motor. The pump motor for Area VII will be 3-phase, 4160 Volts, 60 Hz. The pump motors for Areas VIII and X will be 3-phase, 2400 Volts, 60 Hz. The protective fuse device and feeder sizes will be as shown on the one-line diagrams. The sequence of operations for the pump motors will be as shown on the pump motor controls schematics.

VIII - REAL ESTATE

8-01. Project Location and Description.

a. Introduction. This section provides information regarding the real estate and real property acquisition issues related to the construction and operation of the proposed Area VII collection area, pipeline, and evaporation areas; Area VIII evaporation areas; and Area X evaporation area and saltwater transport pipeline.

b. Location.

(1) Area VII. The proposed Area VII system is located in the northwestern region of Texas. This proposed project begins with the collection and evaporation area at the North Wichita River approximately 11 miles northwest of Truscott, Texas. The brine would then be transported via pipeline southeasterly to the destination consisting of a proposed evaporation area and outfall at Truscott Brine Lake. The destination evaporation area would also be shared with the Area X pipeline.

The proposed Area VII system would occupy portions of Cottle, Foard, and Knox Counties. These counties are predominantly rangeland. The principal enterprise is beef cattle ranching; and the principal crops are cotton, grain sorghum, and wheat. The proposed structures would occupy native short-grass prairie rangelands and some croplands. The topography of the land crossed by the pipeline ranges from gently sloping to rough breaks with several stream crossings.

(2) Area VIII. Area VIII is located in the northwestern region of Texas. The two evaporation features of this proposal would be located at the ends of the existing Area VIII brine pipeline. That pipeline originates on the South Wichita River and transports brine approximately 22 miles in a northeasterly direction to the Truscott Brine Lake.

The proposed Area VIII evaporation areas are located in King and Knox Counties. These counties are predominantly rangeland. The principal enterprise is beef cattle ranching; and the principal crops are cotton, grain sorghum, and wheat. The proposed structures would occupy native short-grass prairie rangeland and some cropland.

(3) Area X. The proposed Area X evaporation area and pipeline would be located in the northwestern part of Texas approximately 6 miles west of Truscott in Knox County and 13 miles northeast of Guthrie in King county, Texas. Knox County is accessed via Highways 283 and 92. Access to King County is by Highways 93 and 92. Western Knox County and King County are predominantly rangelands. Raising beef cattle is the principal ranching enterprise and the principal crops are cotton, grain sorghum, and wheat.

The proposed evaporation area and pipeline alignment would occupy native short-grass prairie rangelands. The topography of the land crossed by the pipeline ranges from gently sloping to rough breaks.

c. Ownerships.

(1) Area VII. The various features of this proposed system would be located on five distinct real estate ownerships.

(2) Area VIII. The evaporation area associated with the pipeline collection area would occupy a single ownership. At the outfall end, it would occupy two separate ownerships.

(3) Area X. There are four ownerships associated with the evaporation area and pipeline.

8-02. Real Estate Requirements.

a. Area VII.

(1) Collection Area. The collection facility would consist of a low-water dam and pipeline intake structure. Approximately 20 acres of land would be required for these permanent structures.

(2) Evaporation Area at the Collection Facility. Approximately 42 acres of land would be required for the construction and operation of the proposed evaporation field. The evaporation area would be located adjacent to the Area VII collection facility. It would be used to accumulate salt associated with the operation of the system.

(3) Collection Area Access Road. Access to the collection and associated evaporation area would be on an existing roadway constructed and maintained by the landowner. The Government would need to use approximately 8,700 linear feet of this 50-foot wide roadway.

(4) Pipeline and Road Right-of-Way. Approximately 181 acres of right-of-way would be acquired for the saltwater transport pipeline and maintenance road to Truscott Brine Lake. The pipeline alignment will generally traverse southeast of the collection area to Truscott Brine Lake. A service road for maintaining the pipeline would be located on top of the pipeline easement. A pipeline/road easement would be required for this feature. The pipeline/road easement would be 100-feet wide for the approximately 15 miles from the collection and evaporation area to the evaporation area and outfall at Truscott Brine Lake. A few expanded widths may be required in the immediate vicinity of surface structures.

(5) Evaporation Area at the Truscott Brine Lake. This area of land would be approximately 28 acres in size. It would be used to reduce the water fraction and accumulate salt from the brine transported from Areas VII.

(6) Temporary Work Areas. The temporary use of several areas of land would be required during the construction phase of this proposed project. These areas would be associated with the collection facility, and borrow site. At the borrow site, the Government would excavate and remove soil, dirt, and other materials from the land.

(7) Acquisition Requirements. The real estate interests to be acquired for the evaporation area and pipeline are shown in Table 8-1.

b. Area VIII.

(1) Evaporation Area at the Collection Facility. Approximately 37 acres of land would be required for the construction and operation of this proposed evaporation area. This evaporation area would be located adjacent to the Area VIII collection facility. It would be used to accumulate salt associated with the operation of the system and thereby reduce pumping requirements.

(2) Evaporation Area at the Outfall Facility. This area of land would also be approximately 37 acres in size. It would be also concentrate salt associated with Area VIII.

(3) Area VIII Acquisition Requirements. The required land acreages to be acquired for Area VIII evaporation areas are shown in Table 8-1.

c. Area X.

(1) Evaporation Area. Area X would consist of the fee acquisition of approximately 32 acres for the construction and operation of an evaporation field located approximately 350 feet southeast of the existing Area X collection facility.

(2) Pipeline and Road Right-of-Way. Approximately 126 acres of right-of-way would be acquired for the saltwater transport pipeline and maintenance road to Truscott Brine Lake. The pipeline alignment will generally traverse east of the collection area to Truscott Brine Lake with a few short bends to the north and south. A service road for maintaining the pipeline would be located on top of the pipeline easement. A pipeline/road easement will be required for this feature. The pipeline/road easement would be 100-foot wide for the approximately 10 miles from the collection and evaporation area to the Truscott Brine Lake. A few expanded widths would be required in the immediate vicinity of surface structures.

(3) Acquisition Requirements. The real estate interests to be acquired for the evaporation area and pipeline are shown in Table 8-1.

8-03. Additional Service Alternatives. The U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department (Service) recommended the Corps investigate additional alternatives for the disposal of the collected brines. Their recommendation was to dispose of the brines into small intermittent creeks in the area. These alternatives were suggested to provide aquatic habitat that would offset the reduction of aquatic habitat below the collection low flow dams. These creeks were identified as Raggedy and Paradise Creeks.

A non-standard perpetual conservation easement for these alternatives is the recommended estate for a 100-foot wide corridor along the stream alignment. The easement will allow for the introduction of brine water into the freshwater creeks and prohibit any structural changes to the streambed. It will also allow for riparian habitat.

The pipelines and other real estate requirements associated with this alternative have been addressed previously in this report.

The real estate cost estimate for conservation easement was based on the assumption that brine water pumped into the freshwater creeks does not damage the adjoining ownership, nor the groundwater beyond the easement area.

a. Raggedy Creek. Raggedy Creek rises at Dixie Mound, 3 miles west of Crowell in Central Foard County and runs 14 miles northeast to its mouth on the Pease River, 8 miles north of Crowell. The creek is dammed 2 miles northwest of Crowell to form Crowell City Lake. At the Creek's headwaters, steep to moderately sloping hills are surfaced by shallow, stony sandy and clay loams that support mesquite, oak, and grasses; in the lower reaches, the flat to rolling terrain with local escarpments is surfaced by deep, fine sandy loam that supports hardwoods, conifers, brush, and grasses.

Approximately 61 acres of non-standard perpetual conservation easements will be acquired over the 100-foot wide, 5-mile stretch of freshwater creek to be injected with brine water.

b. Paradise Creek. Paradise Creek, also known as Ennis Creek and as Pool Creek, rises 9 miles east of Crowell and 1 mile west of Thalia in northeastern Foard County and runs northeast for 35 miles to its mouth on the Pease River, northeast of Vernon in southern Wilbarger County. It is intermittent in its upper reaches. Near the creek bed is flat to rolling terrain with local escarpments and deep, fine, sandy loam soils that support hardwoods, conifers, brush, and grasses. Farther out from the creek is flat to rolling land with locally active dune blowout areas and bunch grasses growing in sand. Near the stream's mouth, the terrain becomes flat with local shallow depressions, and water-tolerant hardwoods, conifers, and grasses grow in the clay and sandy loams.

Approximately 242 acres of a non-standard perpetual conservation easement will be acquired over the 100-foot wide, 20-mile stretch of freshwater creek to be injected with brine water.

8-04. Estates to be Acquired.

a. Area VII.

(1) Collection and Evaporation Areas. A fee estate would be recommended for each of these areas due to their nature and surface impacts resulting from their operation. A non-standard fee estate, entitled "Fee Estate, Excepting Minerals" is recommended, because of the improbability of any mineral development in the affected area. This non-standard estate was approved by HQUSACE in May 1991, and reads as follows:

"FEE ESTATE, EXCEPTING MINERALS. The fee simple title to Tract No. _____, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; excepting and excluding from the taking all interests in the oil, gas and other minerals and all appurtenant rights for the exploration, development, and removal of said oil, gas, and other minerals so excluded."

(2) Collection Area Access Road. The shared use and maintenance of this existing private ranch road between the landowner and Government would require a perpetual joint-use road easement. This non-standard estate reads as follows:

"JOINT-USE ROAD EASEMENT. A joint-use perpetual and assignable easement and right-of-way in, on, over and across said land for the location, construction, operation, maintenance, alteration and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the owners, their heirs and assigns, the right to use the surface of the land as access to their adjoining land; subject, however, to existing easement for public roads and

highways, public utilities, railroads and pipelines."

(3) Pipeline and Road Right-of-Way. The minimum estate requirement for this area, based upon the nature of the Governments proposed use, would be a perpetual pipeline/road easement. The recommended estate is as follows:

"PIPELINE/ROAD EASEMENT. A perpetual and assignable easement and right-of-way in, on, over, and across (the land described in Schedule A) (Tracts Nos. ____, ____, and ____), for the location, construction, operation, maintenance, alteration, repair, replacement, and patrol of underground pipeline and roads, appurtenant facilities, including, but not limited to, microwave towers, low water crossings, stormwater holding ponds, diversion dikes, ditch breakers, and stream bank protection measures; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement thereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines."

(4) Temporary Work Areas. Several 5-year temporary work area easements, totaling approximately 21 acres would be required at various locations. These would be required for both construction activities and borrow areas. The recommended estate is as follows:

"A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____) for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fall and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines."

b. Area VIII, Evaporation Areas. A fee estate would be recommended for each of these areas due to their nature and surface impacts resulting from their operation. A non-standard fee estate, entitled "Fee Estate, Excepting Minerals" is recommended, because of the improbability of any mineral development in the affected area. This non-standard estate was approved by HQUSACE in May 1991, and reads as follows:

"FEE ESTATE, EXCEPTING MINERALS. The fee simple title to Tract No. _____, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; excepting and excluding from the taking all interests in the oil, gas and other minerals and all appurtenant rights for the exploration, development, and removal of said oil, gas, and other minerals so excluded."

c. Area X.

(1) Fee Estate. The evaporation area would be acquired in fee. A non-standard fee estate, entitled "Fee Estate, Excepting Minerals" has been recommended. Due to the numerous, widely-scattered mineral interests and the improbability of any mineral development in the affected area, it was determined that the minerals could be excluded from the acquisition. This non-standard estate was approved by HQUSACE in May 1991, and reads as follows:

"FEE ESTATE, EXCEPTING MINERALS. The fee simple title to Tract No. _____, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; excepting and excluding from the taking all interests in the oil, gas and other minerals and all appurtenant rights for the exploration, development, and removal of said oil, gas, and other minerals so excluded."

(2) Permanent Easements. A perpetual pipeline/road easement would be acquired for the pipeline and overlapping service road. The recommended estate is as follows:

"PIPELINE/ROAD EASEMENT. A perpetual and assignable easement and right-of-way in, on, over, and across (the land described in Schedule A) (Tracts Nos. ____, ____, and ____), for the location, construction, operation, maintenance, alteration, repair, replacement, and patrol of underground pipeline and roads, appurtenant facilities, including, but not limited to, microwave towers, low water crossings, stormwater holding ponds, diversion dikes, ditch breakers, and stream bank protection measures; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement thereby acquired; subject, however, to

existing easements for public roads and highways, public utilities, railroads and pipelines."

d. Creek Alignment. A non-standard perpetual conservation easement would be acquired for the 100-foot strip of land which encompasses the creek. The recommended estate is as follows:

"CONSERVATION EASEMENT. A perpetual and assignable easement and right-of-way in, on, over and across said land for the right to discharge brine water into the creek and the right to prohibit alteration or dams in the creek alignment; together with the right to prohibit the removal of trees, underbrush, and other riparian habitat within the limits of the right-of-way; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging their rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines."

8-05. Government-Owned Land.

a. Area VII. There are no known Government-owned lands in the immediate area proposed for acquisition for this proposal.

b. Area VIII. The land required for each evaporation area is privately owned. Government-owned lands and easements associated with the existing collection area pipeline and Truscott Brine Lake are nearby.

c. Area X. There are no known Government-owned lands affected by either the evaporation or pipeline area. The Government previously acquired the Area X collection area (low-flow dam and pump station).

8-06. Relocation Assistance. There would be no displaced families, businesses, or farm operations as a result of the acquisition of the properties.

8-07. Severance.

a. Area VII. Severance damages would be associated with the evaporation areas, new roads, borrow area, joint-use road, and the pipeline.

b. Area VIII. Severance damages would be associated with the acquisition of both evaporation areas.

c. Area X. Severance damages would be associated with both the evaporation area and pipeline alignment.

8-08. Relocations.

a. Area VII. Minimal initial information has been obtained regarding utility or facility relocations. Subsequent title research would identify whether any utility or facility relocations would be required for this proposal. The project area is sparsely developed which allows minimum impact to existing facilities. All ranch roads are dirt roads. The roads will be graded and graveled over the disturbed portion after construction

across the roads is completed. The surface of county roads will be removed where the pipeline will be installed and replaced after construction is completed. Gates will be installed in all fences crossed by the pipeline.

b. Area VIII. Minimal initial information is currently available regarding potentially impacted utilities or facilities. Subsequent title research would identify whether any utility or facility relocations would be required for this proposal. Due to the limited size of the area involved, the risk of impacts to existing utilities or facilities would be low.

c. Area X. Based upon initial information, no utility or facility relocations would be required for this proposal. The project area is sparsely developed which allows minimum impact to existing facilities. All ranch roads are dirt roads. The roads will be graded and graveled over the disturbed portion after construction across the roads is completed. The surface of county roads will be removed where the pipeline will be installed and replaced after construction is completed. Gates will be installed in all fences crossed by the pipeline.

8-09. Opposition.

a. Area VII. Project management coordination with the landowners for location of the pipeline has minimized some inconveniences for the landowners. Required improvements to the joint-use roadway would tend to mitigate any opposition to the project from the beneficiating owner. Hopefully, opposition to the project is minimal.

b. Area VIII. These proposals would be expected to result in some adverse impacts to the private landowners. Negotiation efforts associated with arriving at a mutually satisfactory, just compensation for the acquisition areas would be expected to mitigate these impacts.

c. Area X. Project management coordination with the landowners for location of the pipeline has minimized some inconveniences for the landowners. Hopefully, opposition to the project is minimal.

8-10. Highest and Best Use. The highest and best use coincides with current use, which is agricultural or range land.

8-11. Environmental Impact. There are no known environmental concerns including potential hazardous and toxic waste.

8-12. Acquisition Schedule. Real Estate acquisition, commencing with mapping, descriptions, title, and appraisal should be completed within 2 years from the date of authorization and receipt of funding.

8-13. Cost Estimate Summary. A summary of the estimated costs to acquire the necessary real estate interests based on present-day values is shown in Table 8-1. Costs for the additional service alternatives are shown in Table 8-3.

TABLE 8-1
ESTIMATED REAL ESTATE COSTS

Area VII Collection, Pipeline, and Evaporation Facilities				
Lands and Damages	Unit	Quantity	Unit Cost	Amount
Fee:				
Collection Facility	Acre	20	\$ 200	\$ 4,000
Evaporation Area at Collection Area	Acre	42	400	16,800
Evaporation Area at Truscott	Acre	28	400	11,200
Perpetual Road Easement	Acre	10	100	1,000
Temporary Work Area Easement:				
Collection Facility		7	160	1,100
Borrow Area	Acre	12.4	150	1,900
Road Construction	Acre	0.1		100
Access Road to Borrow Area	Acre	1.3	160	200
Severance:				
Perpetual Pipeline Easement	Acre	181	1,717	311,500
Contingencies 40% +/-				160,100
Subtotal				\$ 550,400
Administration				
Prep. Attorney Opin. - Compensability	Opinion	1	\$ 3,000	\$ 3,000
Mapping, Survey & Legal Description	Tract	5	3,000	15,000
Prepare Title Evidence Documents	Tract	5	3,000	15,000
Prepare Appraisals	Tract	5	7,000	35,000
Negotiating and Closing	Tract	5	7,000	35,000
Subtotal				\$ 103,000
AREA VII TOTAL				\$ 653,400
AREA VIII EVAPORATION AREAS				
Lands and Damages	Unit	Quantity	Unit Cost	Amount
Fee:				
Evaporation Area at Collection Area	Acres	37	\$ 300	\$ 11,100
Evaporation Area at Truscott	Acres	37	300	11,100
Severance				4,400
Contingencies 60% +/-				16,000
Subtotal				\$ 42,600

TABLE 8-1 (CONT.)
ESTIMATED REAL ESTATE COSTS

AREA VIII EVAPORATION AREAS (CONT.)				
Administration				
Prep. Attorney Opin. - Compensability	Tract	1	\$ 3,000	\$ 3,000
Mapping, Survey & Legal Description	Tract	2	3,000	6,000
Prepare Title Evidence Documents	Tract	2	3,000	6,000
Prepare Appraisals	Tract	2	7,000	14,000
Negotiating and Closing	Tract	2	7,000	14,000
Subtotal				\$ 43,000
AREA VIII TOTAL				\$ 85,600
AREA X PIPELINE AND EVAPORATION FACILITY				
Lands and Damages	Unit	Quantity	Unit Cost	Amount
Fee:				
Evaporation Area at Collection Area	Acre	32	\$ 300	\$ 9,600
Evaporation Area at Truscott	Acre	25	400	10,000
Severance				1,900
Perpetual Pipeline Easement	Acre	126	1,714	216,000
Contingencies 50% +/-				114,000
Subtotal				\$ 351,500
Administration				
Prep. Attorney Opin. - Compensability	Tract	1	\$ 3,000	\$ 3,000
Mapping, Survey & Legal Description	Tract	4	3,000	12,000
Prepare Title Evidence Documents	Tract	4	3,000	12,000
Prepare Appraisals	Tract	4	7,000	28,000
Negotiating and Closing	Tract	4	7,000	28,000
Subtotal				\$ 83,000
AREA X TOTAL				\$ 434,500
TOTAL AREAS VII, VIII, & X				\$1,173,500

TABLE 8-2
ESTIMATED COSTS

Additional Service Alternatives				
Lands and Damages	Unit	Quantity	Unit Cost	Amount
<u>Raggedy Creek:</u>				
Conservation Easement	Acre	61	\$303	\$ 18,500
Severance				100,000
Contingencies 100% +/-				118,500
Administrative				225,000
TOTAL				\$462,000
<u>Paradise Creek:</u>				
Conservation Easement	Acre	242	\$454	\$110,000
Severance				300,000
Contingencies 100% +/-				410,000
Administrative				600,000
TOTAL				\$1,420,000

IX - RELOCATIONS

9-01. General. There are no major relocations planned for this project. The sparsely developed nature of the project area will allow construction with minimum impact to existing facilities. The following paragraphs describe how existing facilities will be handled during construction to avoid major relocation costs. All landowners will be shown preliminary maps of the proposed alignment so they can make suggestions about alternate alignments.

a. Pipelines. The proposed Area X pipeline crosses eight known existing pipelines. The owners of these pipelines will be determined during the preparation of construction plans and specifications. The proposed Area X pipeline will cross under all foreign pipelines with a minimum 1 foot of clearance between the pipes. If necessary, measures will be taken to insulate the Area X pipeline from the cathodic protection systems of other pipelines. The Area VII crosses no pipelines.

b. Roads.

(1) All ranch roads crossed by the Area X and VII pipelines are dirt roads. After construction across a road is completed, the road will be graded and gravel will be installed over the entire disturbed portion of the road to insure travel across the pipeline.

(2) The county road located about 0.5 miles west of the Area X outlet structure is a gravel road. The pipeline will be constructed across the road by cut and cover methods. The traffic-bound surface course will be removed where the pipeline will be installed and replaced after construction is completed.

c. Fences. Gates will be installed in all fences crossed by the pipeline. These gates will be either 16-foot or double 8-foot, galvanized steel gates. All gates will have chains and locks if requested by the landowner.

X - COST ESTIMATE &
OPERATIONS, MAINTENANCE REPAIR,
REPLACEMENT AND REHABILITATION (OMRR&R)

10-01. Introduction.

a. This section presents cost data for the selected alternative. It includes details of the construction costs for each project feature, estimated costs for operation and maintenance of the project and a summary of the total cost for this project. Costs were prepared in accordance with the following guidelines:

EC 1110-2-538 Civil Works Project Cost Estimating - Code of Accounts
EC 1110-2-263 Civil Works Cost Estimating
EM 1110-2-1301 Cost Estimates - Planning and Design Stages

b. Costs were prepared using the Composer GOLD, Release 5.31 program. Construction costs were estimated based on July 1991 prices.

c. The following paragraphs contain a discussion of how the cost estimates were prepared.

10-02. Basic Cost Data.

a. The following percentages and indexes were used in the preparation of the cost estimate for this project:

<u>Unit Price Base</u>	<u>July 1991</u>
Contingency	10%
Escalation:	16%
Contractor Settings:	
Overhead	15%
Home Office	3%
Profit	10%
Bond	1.5%

10-03. Summary of Estimated Costs. Table 10-1 shows a Summary of Estimated Costs. Included in this table are costs for 01 Lands and Damages, 04 Dams, 08 Roads, Railroads and Bridges, 13 Pumping Plant (includes pipeline), 30 Engineering and Design and 31 Construction Management. Prices were based on the following:

<u>July 1991 Unit Price Book</u>	<u>July 2001 Prices</u>
04 Dams	01 Lands & Damages
08 Roads, Railroads & Bridges	30 Engineering & Design
13 Pumping Plants	31 Construction Management

TABLE 10-1
SUMMARY OF ESTIMATED COSTS

<u>AREA VII</u>	<u>Current Estimate</u>
01 Lands & Damages	\$ 653,000
04 Dams	788,000
08 Roads, Railroads & Bridges	498,000
13 Pumping Plants	24,129,000
30 Engineering & Design	1,000,000
31 Construction Management	<u>700,000</u>
Subtotal	\$27,768,000
<u>AREA VIII</u>	<u>Current Estimate</u>
01 Lands & Damages	\$ 86,000
13 Pumping Plants	6,323,000
30 Engineering & Design	600,000
31 Construction Management	<u>600,000</u>
Subtotal	\$ 7,609,000
<u>AREA X</u>	<u>Current Estimate</u>
01 Lands & Damages	\$ 435,000
13 Pumping Plants	12,920,000
30 Engineering & Design	600,000
31 Construction Management	<u>700,000</u>
Subtotal	\$14,654,000

ESTIMATED COST TOTALS

01 Lands & Damages	\$ 1,174,000
04 Dams	788,000
06 Fish & Wildlife	415,000
08 Roads, Railroads & Bridges	498,000
13 Pumping Plants	43,372,000
30 Engineering & Design	2,200,000
31 Construction Management	<u>2,000,000</u>
TOTAL PROJECT COST	\$50,032,000

10-04. Details of Estimated Costs. These costs are shown to Level 4 in the Composer GOLD format. The summary pages of the estimate for this project are included in [Appendix C](#).

10-05. Operation, Maintenance and Repair (OMRR&R) Costs. Operation, maintenance and major repair costs are shown in Table 10-2. The cost for OMRR&R, Area VIII is considered sunk and not included. The following paragraphs describe how each cost was determined.

a. Operating Personnel. Costs for operating personnel as currently staffed is not included. It is estimated that two additional workers will be required to operate the additional areas at a total of \$200,000 annually.

b. Electric Power. The principal source of power consumption will be the energy and demand costs for operating the pumps. The other power demands are so small in comparison that they are not calculated at this time. Energy and demand costs were calculated from the hydraulic analysis of the pumps, based on the percentage of time one, two and three pump operation will occur. Area VIII costs are additional costs for operating the additional pumps.

c. Pump Overhauls. Based upon discussions with a pump manufacturer's representative, it was decided that the pumps would have to be overhauled once every 10 years. The estimated cost for pulling a pump, transporting it to the manufacturer's repair facility, overhauling the pump, transporting it back to the site and re-installing it will cost about \$32,700 per pump. Table 10-2 shows the equivalent annual cost by area.

d. In-situ Relining of Pipe. The fusion-bonded epoxy lining on the steel pipe and the polyethylene lining on the ductile iron pipe each have an expected life of 25 years. The steel pipe can be relined with liquid epoxy by sending a cleaning and application train through the pipe. The cost for this relining will be about \$22,000 per mile for the 7.32 miles for Area X and 15 miles for Area VII of steel pipe. This relining would be done every 25 years.

e. Inflatable Dam Replacement. The inflatable dams will require replacement every 20 years. The cost will be \$200,000 per dam.

f. Raise Truscott Brine Dam. The construction of the stemwall to raise the dam has been deferred to year 75; that is when it will be needed.

g. Environmental Operating Plan. The Environmental Operating Plan (EOP) will assess the impacts of the project on the existing ecosystem. It will include stream gaging, water testing and wildlife observation and testing.

TABLE 10-2
EQUIVALENT ANNUAL COST BY CATEGORY & AREA
AT 6 1/8% FOR 100-YEAR DURATION
(IN \$1,000)

CATEGORY	AREA VII	AREA VIII	AREA X	TOTAL
Personnel	100.0	0.0	100.0	200.0
Electrical Power	255.0	95.0	173.0	523.0
Pump Overhaul	14.1	7.0	14.1	35.2
Reline Pipes	5.6	0.0	2.7	8.3
Evaporation Fields	1.1	0.7	0.5	2.3
Inflatable Dams	5.1	0.0	5.1	10.2
Raise Truscott Dam in 2080	0.0	0.0	1.8	1.8
Environmental Operating Plan	186.0	187.0	187.0	560
Total	567.0	290.0	484.0	1341.0

XI - ENVIRONMENTAL CONSIDERATIONS

11-01. General. For the complete analysis of the environmental impacts of the project, reference the Supplement to the Environmental Impact Statement, Section B4 of this report.

11-02. Impact. With the project in place, the Lake Kemp lake level fluctuations will increase. This adversely impacts the fish habitat. Therefore, to provide more habitat, trees will be bundles and sunk in the lake to add habitat.

XII - APPROVAL

12-01. Approval. The Engineering Appendix is approved as the basis for developing plans and specifications for the Areas VII, VIII, X and Truscott Brine Lake of the Wichita River Basin, Texas.

FOR THE COMMANDER:

G. DAVID STEELE, P.E.
Chief, Engineering and
Construction Division

APPENDIX A
SCHEDULE

ID	Task Name	Duration	Start	Finish	2001		2002		2003		2004		2005		2006		2007		2008	
					H1	H2	H1													
1	Suppl DMs/Prep RE maps	260 days	Tue 4/1/03	Mon 3/29/04																
2	Area X DM 7 & 8	260 days	Tue 4/1/03	Mon 3/29/04																
3	Area VII DM 11 & 12	260 days	Tue 4/1/03	Mon 3/29/04																
4	Area VIII DM 3	260 days	Tue 4/1/03	Mon 3/29/04																
5	RE Acquisition All Areas	260 days	Wed 3/31/04	Tue 3/29/05																
6	Prepare Plans and Specs	260 days	Mon 3/29/04	Fri 3/25/05																
7	Area X	260 days	Mon 3/29/04	Fri 3/25/05																
8	Area VII	260 days	Mon 3/29/04	Fri 3/25/05																
9	Area VIII	260 days	Mon 3/29/04	Fri 3/25/05																
10	Adv And Award	65 days	Mon 3/28/05	Fri 6/24/05																
11	Area X	65 days	Mon 3/28/05	Fri 6/24/05																
12	Area VII	65 days	Mon 3/28/05	Fri 6/24/05																
13	Area VIII	65 days	Mon 3/28/05	Fri 6/24/05																
14	Construction	780 days	Mon 6/27/05	Fri 6/20/08																
15	Area X	650 days	Mon 6/27/05	Fri 12/21/07																
16	Area VII	780 days	Mon 6/27/05	Fri 6/20/08																
17	Area VIII	520 days	Mon 6/27/05	Fri 6/22/07																

--	--	--	--	--	--

Project: WRBBigSch
Date: Fri 5/24/02

Task		Summary		Rolled Up Progress	
Split		Rolled Up Task		External Tasks	
Progress		Rolled Up Split		Project Summary	
Milestone		Rolled Up Milestone			

APPENDIX B

QUALITY CONTROL AND TECHNICAL REVIEW PLAN,
INDEPENDENT REVIEW COMMENTS & ANNOTATIONS

QUALITY CONTROL AND TECHNICAL REVIEW PLAN
FOR THE ENGINEERING APPENDIX TO THE
WICHITA BASIN REEVALUATION

1-01. General. This plan is presented for the preparation and technical review of the Engineering Appendix to the Wichita Basin Re-evaluation Report. The design previously prepared for this basin was presented in Design Memorandum (DM) No. 3, General Design for Area VIII and Truscott Brine Lake, DM No. 8, Area X Conveyance Facilities, DM No. 11, Area VII Collection Facilities and DM No. 12, Area VII and IX Conveyance Facilities. The collection and conveyance facilities for Area VIII are in place and operating. Area VIII includes the low-flow dam, pipeline pumps and controls and Truscott Brine Lake. The collection facility at Area X is constructed and includes the low-flow dam, sump and building and access road.

1-02. Alternative Analysis. Initial alternatives studied in this re-evaluation required the analysis of pumping various combinations of Areas to Truscott. Some alternatives required the dam to be raised to accept additional flows from Area VII, which was previously scheduled to be pumped to Crowell Brine Lake.

1-03. Selected Plan. The selected plan from the plan formulation phase of the re-evaluation is Alternative 7A. This plan includes the pumping of Area VIII, Area VII and Area X to Truscott and the Truscott Dam will require a 2.4-foot dam increase. In addition at each collection area and at the discharge into Truscott evaporation fields will be constructed.

1-04. Project Engineer. The project engineer for Engineering and Construction Division is Fred Kloeckler. He has approximately 12 years experience with this project preparing Design Memoranda and plans and specifications.

1-05. Design and Technical Review Teams. Listed below are the design and review team members:

Design Team Members:

Lead Designer and Civil Engr: Randy Beauchamp, EC-DC
Structural Engr: Mark McVay, EC-DC
H/H Engr: Dallas Tomlinson, EC-HM
Geotech Engr: Mike Southern, EC-DD
Engr Documents: Colleen Diven, EC-DA
Cost Engr: Ted McCleary, EC-DA
Mechanical Engr, EC-DS
Electrical Engr, Tony Bezingue EC-DS
Real Estate: Angela McPhee

Technical Review Team Members:

Civil - Bob Goranson, EC-DC
Structural - Bob Tucker, EC-DC
H/H - Ron Bell, EC-HM
Geotech - Randy Meade, EC-DD
Cost Engr: Larry Gage, EC-DA
Mechanical: Tim Peasley, EC-DM
Electrical: Dave Urbon, EC-DS
Real Estate: Angela McPhee

Over-all Project Operations: Dennis Duke, Truscott
Project Office

1-06. Design Criteria. All appropriate design criteria is presented in the previously stated DMs, which all offices involved with the design and review should have in their possession.

1-07. Method of Design. Due to the available experience at the District level, in-house forces are completing the design.

1-08. Quality Control and Reviews. The quality of the product consists of three main elements: (1) The product must meet all design criteria and function to collect brine flows and convey these flows by pipeline to the Truscott Brine Lake; (2) the product must be completed on schedule; and (3) the project engineer shall establish and provide to all individual technical elements, a schedule, and budget for completing all tasks. The lead designer is responsible for coordinating these activities and monitoring their progress. Any complications will be coordinated with the project engineer for resolution. Coordination meetings will be scheduled as necessary. The Engineering Appendix will be prepared in review form for a review before final approval. The Chief of Engineering and Construction Division will approve the Appendix at the District level.

1-09. Site Visits. Site visits will be scheduled as needed during the design.

Fred Kloeckler P.E.
Project Engineer

INDEPENDENT TECHNICAL REVIEW COMMENTS
AND ANNOTATIONS

Reviewer: Ron Bell, H&H Section

1.	Page 1-2 1-05. b.	Chg.: "and storage capacity at Truscott" To: "and also reduces the storage capacity required at Truscott"	Concur	
2.	Page 1-3 1-07. b.	States that Area VIII has been fully operational since October 1986. Other reports indicate that pumping to Truscott did not start until May 1987. Please clarify.	Concur	
3.	Page 1-3 1-07. d.	Same as comment # 2.	Concur	
4.	Page 3-2 3-05. c.	Delete the word " observed"	Concur	
5.	Page 3-2 3-06. a.	Last sentence - Chloride load should be 244 tons/day	Concur	
6.	Page 3-4 3-08. d.	Change the last sentence to read, " A review of the routing output indicates that an increase of the dam height at Truscott would not be necessary for at least 75 years into the project life.	Concur	
7.	Page 3-5 Table 3-3	No elevation requirements are shown for Alternative 10.	Concur	Will add.
8.	Page 11-1 11-02.	Change first sentence to read, "With the project in place, the Lake Kemp lake level fluctuations will increase."	Concur	

Reviewer: Ted McCleary, EC-DA

9.	Cost Estimate	Escalating decade old pricing data is risky. Some unit costs look as if they would need to be escalated by far more than the average of 16% used in the estimate.		Concur. However some of the items were verified by vender contact.
10.	Cost Estimate	The cost estimate has been compressed such that detail items cannot be tracked to a particular item of work (only to a general feature).		Concur but for this level of design (feasibility) this detail is sufficient.
11.	Cost Estimate	Contingencies of 10% seem low.		Concur. The estimated quantities were taken from approved and completed Dms and 10% seems adequate.
12.	Cost Estimate	Costs for re-use of some mechanical equipment maybe inadequate. The condition of the equipment is an unknown.		Do not concur. Reused equipment is well maintained and is currently in operation.

Reviewer: Bob Tucker, EC-DC

13.	Spec 5-01	Recommend final design based on the revised versions of DM No. 3, No.8, and No.12.	Concur		
-----	-----------	--	--------	--	--

Reviewer: Bob Goranson, EC-DC

14.	12/05	Coordinate Drwg Title with index	Concur		
15.	12/6	Same as 1	Concur		
16.	12/31	Same as 1	Concur		
17.	12/34	Same as 1	Concur		
18.	12/35	Same as 1	Concur		
19.	169/4 169/5 169/6	Show on index sheet	Concur		
20.	12/31	Sect Profile change slope from 2% to 1.5% to reduce excavation and velocity. Do this on evap areas.	Concur		
21.	12/36	Spillway section reduce downstream slope to 1.2% from 3% to reduce velocity for erosion.	Concur		

Reviewer: Dave Urbon, EC-HF

22.	Engineering Appendix 7-1	Engineer details provide in the engineering appendix and on the drawings are adequate for a feasibility submittal. Recommend future designs follow guidance given in DM 8 for area X conveyance and DM 12 for area VII conveyance electrical design.	Concur	Will consider guidance given in DM8 and DM 12	
23.	Engineering Appendix	Due to the corrosive properties of the brine recommend that electrical enclosures and equipment be specified of suitable material for the environment.	Concur	Will include suitable material in next phase.	
24.	Drawings	Verify legend and drawing concur.	Concur	Will compare drawing and legend for match.	

Reviewer: Mike Southern, EC-DD

1. Page ii. Change title of Section IV from "Inspection and Operation" to "Geotechnical Investigation and Design". Concur.

2. Page 4-1. Section 4-02. Selected Plan. Recommend changing last word in first sentence from "increase" to "raise". Concur.

3. Page 4-2. Section 4-04. Foundation Exploration. Need to add the following paragraph to end of paragraph (c) Field Tests:

Additionally, there is some concern about the abutment seepage at Truscott Brine Lake Dam, especially at higher pools. Raising the Dam 2.4 feet will likely magnify this concern. Additional exploration, field and laboratory testing will need to be conducted to adequately assess the implications of raising the Dam 2.4 feet. Southwest Division recommended Tulsa District investigate the potential abutment seepage. The recommendation was included in the Endorsement to Periodic Inspection Number 8 and a memo dated 31 May 2000. The investigation should be performed using O&M funds because this problem will impact the current operation of the reservoir. The dam should not be raised until an investigation and any required remedial measures are completed.

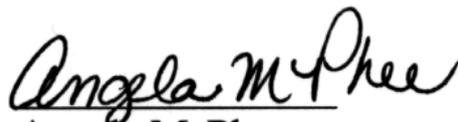
Do not concur. This is an O&M project. Truscott Brine Dam costs are sunk costs and will not affect the cost estimate for this project as currently presented.

Reviewer: Angela McPhee, Real Estate Div (see attached sheet).

Wichita River Chloride Control

June 20, 2002

I have reviewed the write-up in "Section VIII-Real Estate" and found it to be technically sufficient.

A handwritten signature in black ink that reads "Angela McPhee". The signature is written in a cursive style with a horizontal line underlining the name.

Angela McPhee

Chief, Acquisition and Realty Services Branch

APPENDIX C
MCACES COST ESTIMATE

Wed 15 May 2002
Eff. Date 08/02/01

U.S. Army Corps of Engineers
PROJECT ALT7A1: ALT. 7A-SELECTED PLAN (PART 1) - CWE FOR WICHITA BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 1)

TIME 09:42:22

TITLE PAGE 1

ALT. 7A-SELECTED PLAN (PART 1)
CWE FOR WICHITA BASIN
REEVALUATION STUDY BASED ON A/E
ESTIMATE FROM CHLORIDE CONTROL
STUDIES

Designed By: IN HOUSE
Estimated By: IN HOUSE

Prepared By: TED MCCLEARY

Preparation Date: 08/02/01
Effective Date of Pricing: 08/02/01

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

SUMMARY REPORTS	SUMMARY PAGE
PROJECT INDIRECT SUMMARY - Facility.....	1
PROJECT INDIRECT SUMMARY - WBS Code.....	2

No Detailed Estimate...

No Backup Reports...

*** END TABLE OF CONTENTS ***

	QUANTITY	UCM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST	
1 AREA VII COLLECTION										
1/ A	AREA VII COLLECTION FACILITY	1.00 EA	2,369,000	355,000	82,000	281,000	46,000	3,133,000	3132660	
1/B8	ESCALATION	1.00 EA	887,000	0	0	0	0	887,000	887000.00	
1/B9	CONTINGENCY	1.00 EA	442,000	0	0	0	0	442,000	442000.00	
1/C1	ENGINEERING & DESIGN	1.00 EA	300,000	0	0	0	0	300,000	300000.00	
1/C2	CONSTRUCTION MANAGEMENT	1.00 EA	300,000	0	0	0	0	300,000	300000.00	
TOTAL AREA VII COLLECTION			1.00 EA	4,298,000	355,000	82,000	281,000	46,000	5,062,000	5061660
2 AREA VII CONVEYANCE										
2/7A	AREA VII CONVEYANCE FACILITY	1.00 EA	11,801,000	1,770,000	407,000	1,398,000	231,000	15,607,000	15607059	
2/B8	ESCALATION	1.00 EA	2,500,000	0	0	0	0	2,500,000	2500000	
2/B9	CONTINGENCY	1.00 EA	1,560,000	0	0	0	0	1,560,000	1560000	
2/C1	ENGINEERING & DESIGN	1.00 EA	700,000	0	0	0	0	700,000	700000.00	
2/C2	CONSTRUCTION MANAGEMENT	1.00 EA	400,000	0	0	0	0	400,000	400000.00	
TOTAL AREA VII CONVEYANCE			1.00 EA	16,961,000	1,770,000	407,000	1,398,000	231,000	20,767,000	20767059
3 AREA VII LANDS										
3/ 1	LANDS AND DAMAGES	1.00 EA	653,000	0	0	0	0	653,000	653400.00	
TOTAL AREA VII LANDS			1.00 EA	653,000	0	0	0	653,000	653400.00	
4 AREA VII DAM										
4/ 4	AREA VII DAM	1.00 EA	596,000	89,000	21,000	71,000	12,000	788,000	787818.10	
TOTAL AREA VII DAM			1.00 EA	596,000	89,000	21,000	71,000	12,000	788,000	787818.10
5 AREA VII ROAD										
5/ 8	AREA VII ROADWAY	1.00 EA	377,000	57,000	13,000	45,000	7,000	498,000	498456.28	
TOTAL AREA VII ROAD			1.00 EA	377,000	57,000	13,000	45,000	7,000	498,000	498456.28
TOTAL ALT. 7A-SELECTED PLAN (PART 1)			1.00 EA	22,885,000	2,271,000	522,000	1,794,000	296,000	27,768,000	27768393

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
1 AREA VII COLLECTION									
1/ A AREA VII COLLECTION FACILITY									
1/ A/13 Pumping Plants	1.00	EA	2,369,000	355,000	82,000	281,000	46,000	3,133,000	3132660
TOTAL AREA VII COLLECTION FACILITY	1.00	EA	2,369,000	355,000	82,000	281,000	46,000	3,133,000	3132660
1/B8 ESCALATION									
1/B8/99 ESCALATION-16% OF CONST. COST	1.00	EA	887,000	0	0	0	0	887,000	887000.00
TOTAL ESCALATION	1.00	EA	887,000	0	0	0	0	887,000	887000.00
1/B9 CONTINGENCY									
1/B9/99 CONTINGENCY-10% OF CONST. COS	1.00	EA	442,000	0	0	0	0	442,000	442000.00
TOTAL CONTINGENCY	1.00	EA	442,000	0	0	0	0	442,000	442000.00
1/C1 ENGINEERING & DESIGN									
1/C1/30 E & D	1.00	EA	300,000	0	0	0	0	300,000	300000.00
TOTAL ENGINEERING & DESIGN	1.00	EA	300,000	0	0	0	0	300,000	300000.00
1/C2 CONSTRUCTION MANAGEMENT									
1/C2/31 S AND I	1.00	EA	300,000	0	0	0	0	300,000	300000.00
TOTAL CONSTRUCTION MANAGEMENT	1.00	EA	300,000	0	0	0	0	300,000	300000.00
TOTAL AREA VII COLLECTION	1.00	EA	4,298,000	355,000	82,000	281,000	46,000	5,062,000	5061660
2 AREA VII CONVEYANCE									
2/7A AREA VII CONVEYANCE FACILITY									
2/7A/13 Pumping Plants	1.00	EA	11,801,000	1,770,000	407,000	1,398,000	231,000	15,607,000	15607059
TOTAL AREA VII CONVEYANCE FACILITY	1.00	EA	11,801,000	1,770,000	407,000	1,398,000	231,000	15,607,000	15607059
2/B8 ESCALATION									

Wed 15 May 2002
 Eff. Date 08/02/01

U.S. Army Corps of Engineers
 PROJECT ALT7A1: ALT. 7A-SELECTED PLAN (PART 1) - CWE FOR WICHITA BASIN
 CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 1)
 ** PROJECT INDIRECT SUMMARY - WBS Code (Rounded to 1000's) **

TIME 09:42:22

SUMMARY PAGE 3

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
2/B8/99	ESCALATION-16% OF CONST. COST	1.00	EA	2,500,000	0	0	0	0	2,500,000	2500000
	TOTAL ESCALATION	1.00	EA	2,500,000	0	0	0	0	2,500,000	2500000
2/B9 CONTINGENCY										
2/B9/99	CONTINGENCY-10% OF CONST. COS	1.00	EA	1,560,000	0	0	0	0	1,560,000	1560000
	TOTAL CONTINGENCY	1.00	EA	1,560,000	0	0	0	0	1,560,000	1560000
2/C1 ENGINEERING & DESIGN										
2/C1/30	E & D	1.00	EA	700,000	0	0	0	0	700,000	700000.00
	TOTAL ENGINEERING & DESIGN	1.00	EA	700,000	0	0	0	0	700,000	700000.00
2/C2 CONSTRUCTION MANAGEMENT										
2/C2/31	S AND I	1.00	EA	400,000	0	0	0	0	400,000	400000.00
	TOTAL CONSTRUCTION MANAGEMENT	1.00	EA	400,000	0	0	0	0	400,000	400000.00
	TOTAL AREA VII CONVEYANCE	1.00	EA	16,961,000	1,770,000	407,000	1,398,000	231,000	20,767,000	20767059
3 AREA VII LANDS										
3/ 1 LANDS AND DAMAGES										
3/ 1/01	LANDS AND DAMAGES	1.00	EA	653,000	0	0	0	0	653,000	653400.00
	TOTAL LANDS AND DAMAGES	1.00	EA	653,000	0	0	0	0	653,000	653400.00
	TOTAL AREA VII LANDS	1.00	EA	653,000	0	0	0	0	653,000	653400.00
4 AREA VII DAM										
4/ 4 AREA VII DAM										
4/ 4/04	Dams	1.00	EA	596,000	89,000	21,000	71,000	12,000	788,000	787818.10
	TOTAL AREA VII DAM	1.00	EA	596,000	89,000	21,000	71,000	12,000	788,000	787818.10
	TOTAL AREA VII DAM	1.00	EA	596,000	89,000	21,000	71,000	12,000	788,000	787818.10
5 AREA VII ROAD										

Wed 15 May 2002
Eff. Date 08/02/01

U.S. Army Corps of Engineers
PROJECT ALT7A1: ALT. 7A-SELECTED PLAN (PART 1) - CWE FOR WICHITA BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 1)
** PROJECT INDIRECT SUMMARY - WBS Code (Rounded to 1000's) **

TIME 09:42:22

SUMMARY PAGE 4

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST

5/ 8 AREA VII ROADWAY									
5/ 8/08 Roads, Railroads and Bridges	1.00	EA	377,000	57,000	13,000	45,000	7,000	498,000	498456.28

TOTAL AREA VII ROADWAY	1.00	EA	377,000	57,000	13,000	45,000	7,000	498,000	498456.28

TOTAL AREA VII ROAD	1.00	EA	377,000	57,000	13,000	45,000	7,000	498,000	498456.28

TOTAL ALT. 7A-SELECTED PLAN (PART 1	1.00	EA	22,885,000	2,271,000	522,000	1,794,000	296,000	27,768,000	27768393

Wed 15 May 2002
Eff. Date 08/02/01
ERROR REPORT

U.S. Army Corps of Engineers
PROJECT ALT7A1: ALT. 7A-SELECTED PLAN (PART 1) - CWE FOR WICHITA BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 1)

TIME 09:42:22
ERROR PAGE 1

No errors detected...

* * * END OF ERROR REPORT * * *

Wed 15 May 2002
Eff. Date 08/02/01

U.S. Army Corps of Engineers
PROJECT ALT7A2: ALT. 7A-SELECTED PLAN (PART 2) - CWE FOR WICHITA RIVER BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 2)

TIME 09:42:40

TITLE PAGE 1

ALT. 7A-SELECTED PLAN (PART 2)
CWE FOR WICHITA RIVER BASIN
REEVALUATION STUDY
ADAPTED FROM CHLORIDE CONTROL
STUDY DATA

Designed By: IN HOUSE
Estimated By: IN HOUSE

Prepared By: TED MCCLEARY

Preparation Date: 08/02/01
Effective Date of Pricing: 08/02/01

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

SUMMARY REPORTS	SUMMARY PAGE
PROJECT INDIRECT SUMMARY - Facility.....	1
PROJECT INDIRECT SUMMARY - WBS Code.....	2

No Detailed Estimate...

No Backup Reports...

*** END TABLE OF CONTENTS ***

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST	
3 AREA VIII COLLECTION										
3/ 1	AREA VIII COLLECTION FACILITY	1.00 EA	1,461,000	219,000	50,000	173,000	29,000	1,932,000	1931942	
3/B8	ESCALATION	1.00 EA	309,000	0	0	0	0	309,000	309000.00	
3/B9	CONTINGENCY	1.00 EA	193,000	0	0	0	0	193,000	193300.00	
3/C1	ENGINEERING & DESIGN	1.00 EA	300,000	0	0	0	0	300,000	300000.00	
3/C2	CONSTRUCTION MANAGEMENT	1.00 EA	300,000	0	0	0	0	300,000	300000.00	
TOTAL AREA VIII COLLECTION			1.00 EA	2,563,000	219,000	50,000	173,000	29,000	3,034,000	3034242
4 AREA VIII CONVEYANCE										
4/B8	AREA VIII CONVEYANCE FACILITY	1.00 EA	2,334,000	350,000	81,000	276,000	46,000	3,086,000	3086465	
4/B8	ESCALATION	1.00 EA	494,000	0	0	0	0	494,000	494000.00	
4/B9	CONTINGENCY	1.00 EA	309,000	0	0	0	0	309,000	308800.00	
4/C1	ENGINEERING & DESIGN	1.00 EA	300,000	0	0	0	0	300,000	300000.00	
4/C2	CONSTRUCTION MANAGEMENT	1.00 EA	300,000	0	0	0	0	300,000	300000.00	
TOTAL AREA VIII CONVEYANCE			1.00 EA	3,737,000	350,000	81,000	276,000	46,000	4,489,000	4489265
BB AREA VIII LANDS										
BB/C8	AREA VIII LANDS AND DAMAGES	1.00 EA	86,000	0	0	0	0	86,000	85600.00	
TOTAL AREA VIII LANDS			1.00 EA	86,000	0	0	0	86,000	85600.00	
TOTAL ALT. 7A-SELECTED PLAN (PART 2)			1.00 EA	6,385,000	569,000	131,000	449,000	74,000	7,609,000	7609107

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST

3 AREA VIII COLLECTION									
3/ 1 AREA VIII COLLECTION FACILITY									
3/ 1/13 Pumping Plants	1.00	EA	1,461,000	219,000	50,000	173,000	29,000	1,932,000	1931942

TOTAL AREA VIII COLLECTION FACILITY	1.00	EA	1,461,000	219,000	50,000	173,000	29,000	1,932,000	1931942
3/B8 ESCALATION									
3/B8/99 ESCALATION-16% OF CONST. COST	1.00	EA	309,000	0	0	0	0	309,000	309000.00

TOTAL ESCALATION	1.00	EA	309,000	0	0	0	0	309,000	309000.00
3/B9 CONTINGENCY									
3/B9/99 CONTINGENCY-10% OF CONST. COS	1.00	EA	193,000	0	0	0	0	193,000	193300.00

TOTAL CONTINGENCY	1.00	EA	193,000	0	0	0	0	193,000	193300.00
3/C1 ENGINEERING & DESIGN									
3/C1/30 E & D	1.00	EA	300,000	0	0	0	0	300,000	300000.00

TOTAL ENGINEERING & DESIGN	1.00	EA	300,000	0	0	0	0	300,000	300000.00
3/C2 CONSTRUCTION MANAGEMENT									
3/C2/31 S AND I	1.00	EA	300,000	0	0	0	0	300,000	300000.00

TOTAL CONSTRUCTION MANAGEMENT	1.00	EA	300,000	0	0	0	0	300,000	300000.00

TOTAL AREA VIII COLLECTION	1.00	EA	2,563,000	219,000	50,000	173,000	29,000	3,034,000	3034242
4 AREA VIII CONVEYANCE									
4/88 AREA VIII CONVEYANCE FACILITY									
4/88/13 Pumping Plants	1.00	EA	2,334,000	350,000	81,000	276,000	46,000	3,086,000	3086465

TOTAL AREA VIII CONVEYANCE FACILITY	1.00	EA	2,334,000	350,000	81,000	276,000	46,000	3,086,000	3086465
4/B8 ESCALATION									

		QUANTITY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
4/B8/99	ESCALATION-16% OF CONST. COST	1.00 EA	494,000	0	0	0	0	494,000	494000.00
TOTAL ESCALATION		1.00 EA	494,000	0	0	0	0	494,000	494000.00
4/B9 CONTINGENCY									
4/B9/99	CONTINGENCY-10% OF CONST. COS	1.00 EA	309,000	0	0	0	0	309,000	308800.00
TOTAL CONTINGENCY		1.00 EA	309,000	0	0	0	0	309,000	308800.00
4/C1 ENGINEERING & DESIGN									
4/C1/30	E & D	1.00 EA	300,000	0	0	0	0	300,000	300000.00
TOTAL ENGINEERING & DESIGN		1.00 EA	300,000	0	0	0	0	300,000	300000.00
4/C2 CONSTRUCTION MANAGEMENT									
4/C2/31	S AND I	1.00 EA	300,000	0	0	0	0	300,000	300000.00
TOTAL CONSTRUCTION MANAGEMENT		1.00 EA	300,000	0	0	0	0	300,000	300000.00
TOTAL AREA VIII CONVEYANCE		1.00 EA	3,737,000	350,000	81,000	276,000	46,000	4,489,000	4489265
BB AREA VIII LANDS									
BB/C8 AREA VIII LANDS AND DAMAGES									
BB/C8/01	Lands and Damages	1.00 EA	86,000	0	0	0	0	86,000	85600.00
TOTAL AREA VIII LANDS AND DAMAGES		1.00 EA	86,000	0	0	0	0	86,000	85600.00
TOTAL AREA VIII LANDS		1.00 EA	86,000	0	0	0	0	86,000	85600.00
TOTAL ALT. 7A-SELECTED PLAN (PART 2)		1.00 EA	6,385,000	569,000	131,000	449,000	74,000	7,609,000	7609107

Wed 15 May 2002
Eff. Date 08/02/01
ERROR REPORT

U.S. Army Corps of Engineers
PROJECT ALT7A2: ALT. 7A-SELECTED PLAN (PART 2) - CWE FOR WICHITA RIVER BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 2)

TIME 09:42:40
ERROR PAGE 1

No errors detected...

* * * END OF ERROR REPORT * * *

Wed 15 May 2002
Eff. Date 08/08/94

U.S. Army Corps of Engineers
PROJECT ALT7A3: ALT. 7A-SELECTED PLAN (PART 3) - CWE FOR WICHITA RIVER BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 3)

TIME 09:42:56

TITLE PAGE 1

ALT. 7A-SELECTED PLAN (PART 3)
CWE FOR WICHITA RIVER BASIN
REEVALUATION STUDY

Designed By: Willbros Butler Engineers, Inc.
Estimated By: Willbros Butler Engineers, Inc.

Prepared By: Greg Phillips
UPDATED BY TED MCCLEARY

Preparation Date: 08/08/94
Effective Date of Pricing: 08/08/94
Est Construction Time: 365 Days

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

Wed 15 May 2002
Eff. Date 08/08/94
TABLE OF CONTENTS

U.S. Army Corps of Engineers
PROJECT ALT7A3: ALT. 7A-SELECTED PLAN (PART 3) - CWE FOR WICHITA RIVER BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 3)

TIME 09:42:56
CONTENTS PAGE 1

SUMMARY REPORTS	SUMMARY PAGE
PROJECT INDIRECT SUMMARY - Facility.....	1
PROJECT INDIRECT SUMMARY - WBS Code.....	2

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
5 AREA X COLLECTION									
5/C2	1.00	EA	1,573,000	236,000	54,000	186,000	31,000	2,080,000	2079957
5/C3	1.00	EA	333,000	0	0	0	0	333,000	332800.00
5/C4	1.00	EA	300,000	0	0	0	0	300,000	300000.00
5/C5	1.00	EA	300,000	0	0	0	0	300,000	300000.00
5/C6	1.00	EA	208,000	0	0	0	0	208,000	208000.00
TOTAL AREA X COLLECTION	1.00	EA	2,714,000	236,000	54,000	186,000	31,000	3,221,000	3220757
9 AREA X CONVEYANCE									
9/10	1.00	EA	6,177,000	927,000	213,000	732,000	121,000	8,169,000	8168926
9/C3	1.00	EA	1,310,000	0	0	0	0	1,310,000	1310000
9/C4	1.00	EA	300,000	0	0	0	0	300,000	300000.00
9/C5	1.00	EA	400,000	0	0	0	0	400,000	400000.00
9/C6	1.00	EA	820,000	0	0	0	0	820,000	820000.00
TOTAL AREA X CONVEYANCE	1.00	EA	9,007,000	927,000	213,000	732,000	121,000	10,999,000	10998926
CC AREA X LANDS									
CC/C3	1.00	EA	435,000	0	0	0	0	435,000	434500.00
TOTAL AREA X LANDS	1.00	EA	435,000	0	0	0	0	435,000	434500.00
TOTAL ALT. 7A-SELECTED PLAN (PART 3)	1.00	EA	12,155,000	1,162,000	267,000	918,000	151,000	14,654,000	14654183

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST

5 AREA X COLLECTION										
5/C2 AREA X COLLECTION FACILITY										
5/C2/13	Pumping Plants	1.00	EA	1,573,000	236,000	54,000	186,000	31,000	2,080,000	2079957

	TOTAL AREA X COLLECTION FACILITY	1.00	EA	1,573,000	236,000	54,000	186,000	31,000	2,080,000	2079957
5/C3 ESCALATION										
5/C3/99	ESCALATION-16% OF CONST. COST	1.00	EA	333,000	0	0	0	0	333,000	332800.00

	TOTAL ESCALATION	1.00	EA	333,000	0	0	0	0	333,000	332800.00
5/C4 ENGINEERING AND DESIGN										
5/C4/30	E AND D	1.00	EA	300,000	0	0	0	0	300,000	300000.00

	TOTAL ENGINEERING AND DESIGN	1.00	EA	300,000	0	0	0	0	300,000	300000.00
5/C5 SUPERVISION AND INSPECTION										
5/C5/31	S AND I	1.00	EA	300,000	0	0	0	0	300,000	300000.00

	TOTAL SUPERVISION AND INSPECTION	1.00	EA	300,000	0	0	0	0	300,000	300000.00
5/C6 CONTINGENCIES										
5/C6/99	CONTINGENCIES-10% OF CONST. C	1.00	EA	208,000	0	0	0	0	208,000	208000.00

	TOTAL CONTINGENCIES	1.00	EA	208,000	0	0	0	0	208,000	208000.00

	TOTAL AREA X COLLECTION	1.00	EA	2,714,000	236,000	54,000	186,000	31,000	3,221,000	3220757
9 AREA X CONVEYANCE										
9/10 AREA X CONVEYANCE FACILITY										
9/10/13	Pumping Plants	1.00	EA	6,177,000	927,000	213,000	732,000	121,000	8,169,000	8168926

	TOTAL AREA X CONVEYANCE FACILITY	1.00	EA	6,177,000	927,000	213,000	732,000	121,000	8,169,000	8168926
9/C3 ESCALATION										

Wed 15 May 2002
 Eff. Date 08/08/94

U.S. Army Corps of Engineers
 PROJECT ALT7A3: ALT. 7A-SELECTED PLAN (PART 3) - CWE FOR WICHITA RIVER BASIN
 CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 3)
 ** PROJECT INDIRECT SUMMARY - WBS Code (Rounded to 1000's) **

TIME 09:42:56

SUMMARY PAGE 3

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
9/C3/99	ESCALATION-16% OF CONST. COST	1.00	EA	1,310,000	0	0	0	0	1,310,000	1310000
	TOTAL ESCALATION	1.00	EA	1,310,000	0	0	0	0	1,310,000	1310000
9/C4 ENGINEERING AND DESIGN										
9/C4/30	E AND D	1.00	EA	300,000	0	0	0	0	300,000	300000.00
	TOTAL ENGINEERING AND DESIGN	1.00	EA	300,000	0	0	0	0	300,000	300000.00
9/C5 SUPERVISION AND INSPECTION										
9/C5/31	S AND I	1.00	EA	400,000	0	0	0	0	400,000	400000.00
	TOTAL SUPERVISION AND INSPECTION	1.00	EA	400,000	0	0	0	0	400,000	400000.00
9/C6 CONTINGENCIES										
9/C6/99	CONTINGENCIES-10% OF CONST. C	1.00	EA	820,000	0	0	0	0	820,000	820000.00
	TOTAL CONTINGENCIES	1.00	EA	820,000	0	0	0	0	820,000	820000.00
	TOTAL AREA X CONVEYANCE	1.00	EA	9,007,000	927,000	213,000	732,000	121,000	10,999,000	10998926
CC AREA X LANDS										
CC/C3 AREA X LANDS AND DAMAGES										
CC/C3/01	Lands and Damages	1.00	EA	435,000	0	0	0	0	435,000	434500.00
	TOTAL AREA X LANDS AND DAMAGES	1.00	EA	435,000	0	0	0	0	435,000	434500.00
	TOTAL AREA X LANDS	1.00	EA	435,000	0	0	0	0	435,000	434500.00
	TOTAL ALT. 7A-SELECTED PLAN (PART 3)	1.00	EA	12,155,000	1,162,000	267,000	918,000	151,000	14,654,000	14654183

Wed 15 May 2002
Eff. Date 08/08/94
ERROR REPORT

U.S. Army Corps of Engineers
PROJECT ALT7A3: ALT. 7A-SELECTED PLAN (PART 3) - CWE FOR WICHITA RIVER BASIN
CWE-WICHITA BASIN REEVALUATION-ALT 7A (PART 3)

TIME 09:42:56
ERROR PAGE 1

No errors detected...

* * * END OF ERROR REPORT * * *

APPENDIX D

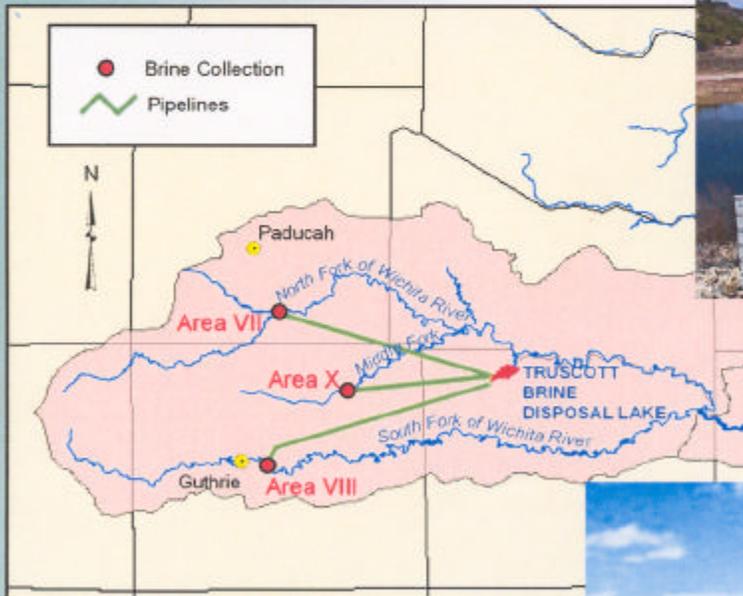
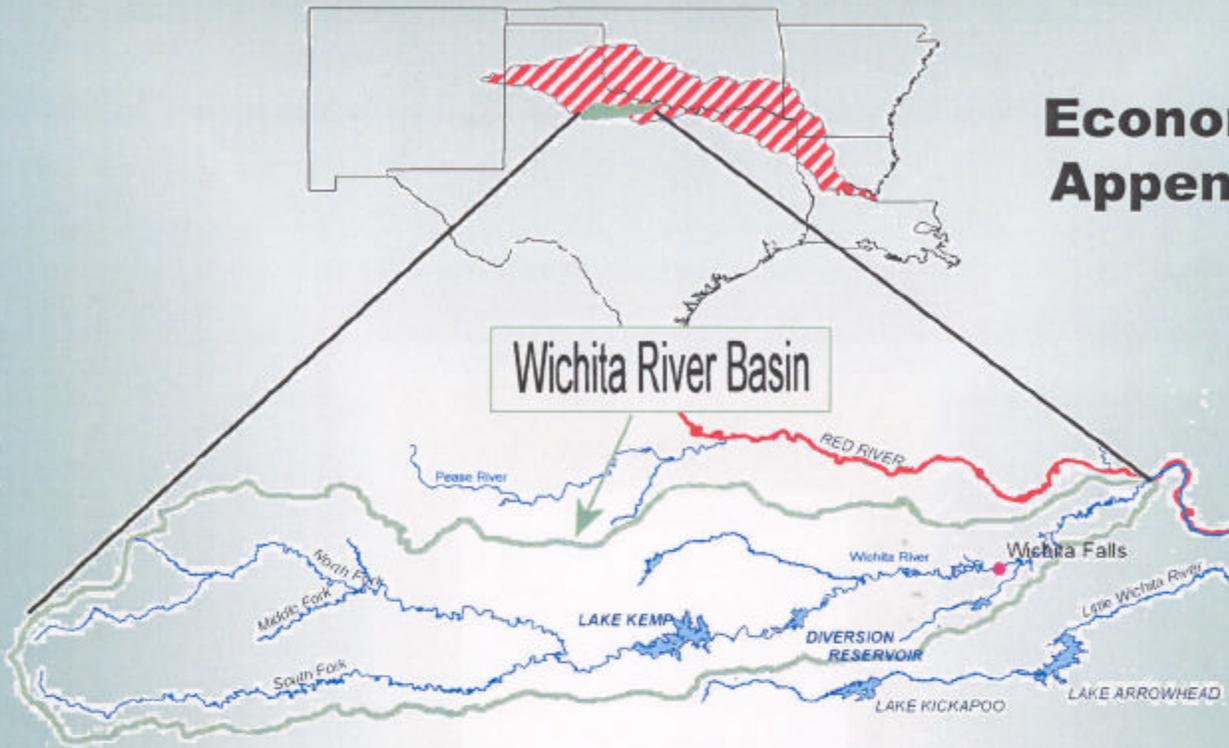
Fish & Wildlife Alternatives

Viewed using MaxView. May be accessed under the "Plans" button
on the Document Viewer Bar.

Wichita River Basin Project Reevaluation

Red River Chloride Control Project

Economic Appendix



US Army Corps
of Engineers
Tulsa District

DRAFT June 2002