LAKE TEXOMA REGIONAL SEWER SYSTEM STUDY PHASE II
TEXAS REGIONS

PLANNING ASSISTANCE TO STATES PROGRAM

Prepared For

The Greater Texoma Utility Authority

By

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Final Report

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS (Continued)

Appendices

LAKE TEXOMA REGIONAL SEWER SYSTEM STUDY
PHASE II
TEXAS REGIONS
FINAL

PLANNING ASSISTANCE TO STATES PROGRAM

INTRODUCTION

This report continues the analysis done in The Lake Texoma Regional Sewer System Study Phase I, which was completed in November 2001. This study addresses only the Texas regions. The Texas service regions were revised as recommended in the Phase I report. Three alternatives to address the sewer needs in the Texas regions were developed through conceptual design level.

STUDY AUTHORITY

The U.S. Army Corps of Engineers (COE), Tulsa District conducted the study for the Greater Texoma Utility Authority (GTUA), under authority of Section 22 of the Water Resources Development Act of 1974 (Public Law 93-251). This authority establishes cooperative assistance to states for preparation of comprehensive water plans.

Section 319 of the Water Resource Development Act of 1990 (Public Law 101-640) provides authority for cost sharing of the Planning Assistance to States Program. The cost-sharing ratio for this study is 50% Federal and 50% non-Federal. A Letter Agreement for this study between the COE, Tulsa District and the GTUA was signed on June 24, 2002. The Letter Agreement is shown in Appendix 1.

PURPOSE

The Phase I report concluded that creation of regional wastewater treatment systems would be the best option to meet current and future needs of the Lake Texoma area. Based on that conclusion, the Greater Texoma Utility Authority decided to move forward with development of concept designs for regional wastewater treatment systems in Texas. The purpose of this study, Phase II, is to develop, through a conceptual-level design, three alternative plans to provide regional sewer systems serving each of the four study regions on the Texas side of the Lake Texoma area.

A cost analysis is included to provide an estimate of monthly cost per connection. Study results can be used to determine the economic feasibility of establishing one or more regional sewer systems to serve the Texas side of the Lake Texoma area.

PROJECT LOCATION AND DESCRIPTION

Under current conditions, State legislators, community leaders, residents, and local leaders have expressed concern about potential water quality problems at Lake Texoma. These groups consider residential and commercial wastewater treatment practices as one potential source of water quality degradation at the lake. Residents around Texoma have limited access to sewer system services and many depend on private individual septic systems to meet their wastewater treatment needs. Aging septic systems have a high potential for contamination of surface and groundwater in the Red River watershed. Some communities surrounding the lake have sewer service, but have limited financial and physical capacity for expansion. The number of residents involved and the geographic distribution of the residents make wastewater treatment an issue beyond the scope of any one municipality or water supply entity.

The Phase II study area is on the south central and southeast end of Lake Texoma in northern Grayson County, Texas, as shown in Figure 1. Lake Texoma has a surface

area of approximately 89,000 acres at normal pool. Construction of the lake was completed in 1944. Residential and commercial development of lands around the lake since 1944 has been substantial. Most of the homes were constructed as summer or weekend homes, but in recent years the trend has been toward construction of homes for year-round living. Due to the rural setting of the developed areas adjacent to the lake, the majority of landowners are on septic systems. Some of the septic systems are as much as 50 years old, and many are located in soils that are not well suited for septic systems.

PROBLEMS AND OPPORTUNITIES

Interest in studying the feasibility of constructing regional sewer systems to serve the Lake Texoma area began in 1997 at a Lake Texoma Advisory Board meeting. The Board members expressed concern over potential water quality impacts from continued lakeside development. Factors contributing to water quality degradation include undersized or improperly operating septic systems, livestock and agricultural operations in the watershed, and direct discharge of human waste from boats into the lake.

The Lake Texoma watershed is predominantly rural, with land used primarily for grazing of cattle and other agricultural uses. Runoff from cropland and grazing lands contributes to nutrient loading and coliform concentration in the lake. Dumping of human waste from boats on the lake is also a problem. While this activity is illegal, manpower is not available in sufficient quantities to stop dumping in Lake Texoma.

Opportunities exist in the Lake Texoma area for economic development and for reducing some sources of contamination to the lake. By serving the area with regional sewer systems, developers would be able to sell smaller lots, thus bringing a larger population to the region. Providing sewer service for existing homes would ensure that waste from aging septic systems did not enter the lake.

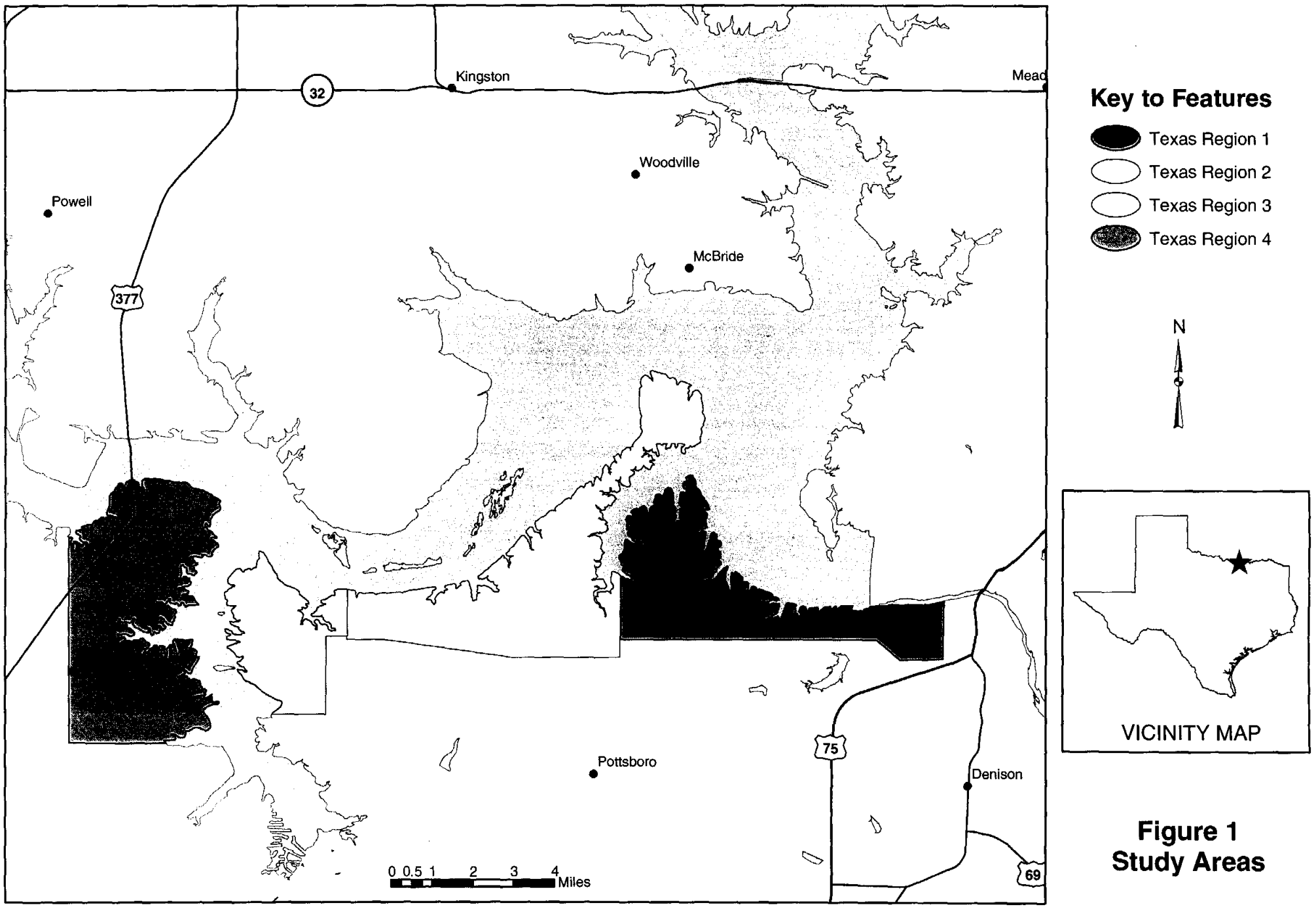


Figure 1
Study Areas

INSTITUTIONAL OPTIONS

The Phase I report identified seven options for addressing wastewater treatment needs in the Lake Texoma area. The seven options are summarized below. The Phase I report includes a detailed description of each option.

A. No Action. There would be no change to the current regulations. Most new development would be on septic systems.

B. Inspection of Existing Septic Systems. Under this option the State of Texas would require an inspection of septic systems. Users would be faced with upgrading aging septic systems to meet requirements.

C. Mandating More Effective Septic Systems. This option would require selection of new septic technologies, such as aerobic systems using land applications of treated effluent. These types of systems produce a higher quality outflow than conventional septic systems.

D. Expanding Existing Sewer Systems. This option would involve expanding the largest existing systems in the area and extending lines to areas currently not served by a sewer system.

E. Mandating New Development to be Connected to Existing Systems. County governments would require any new development to connect with a sewer, if available.

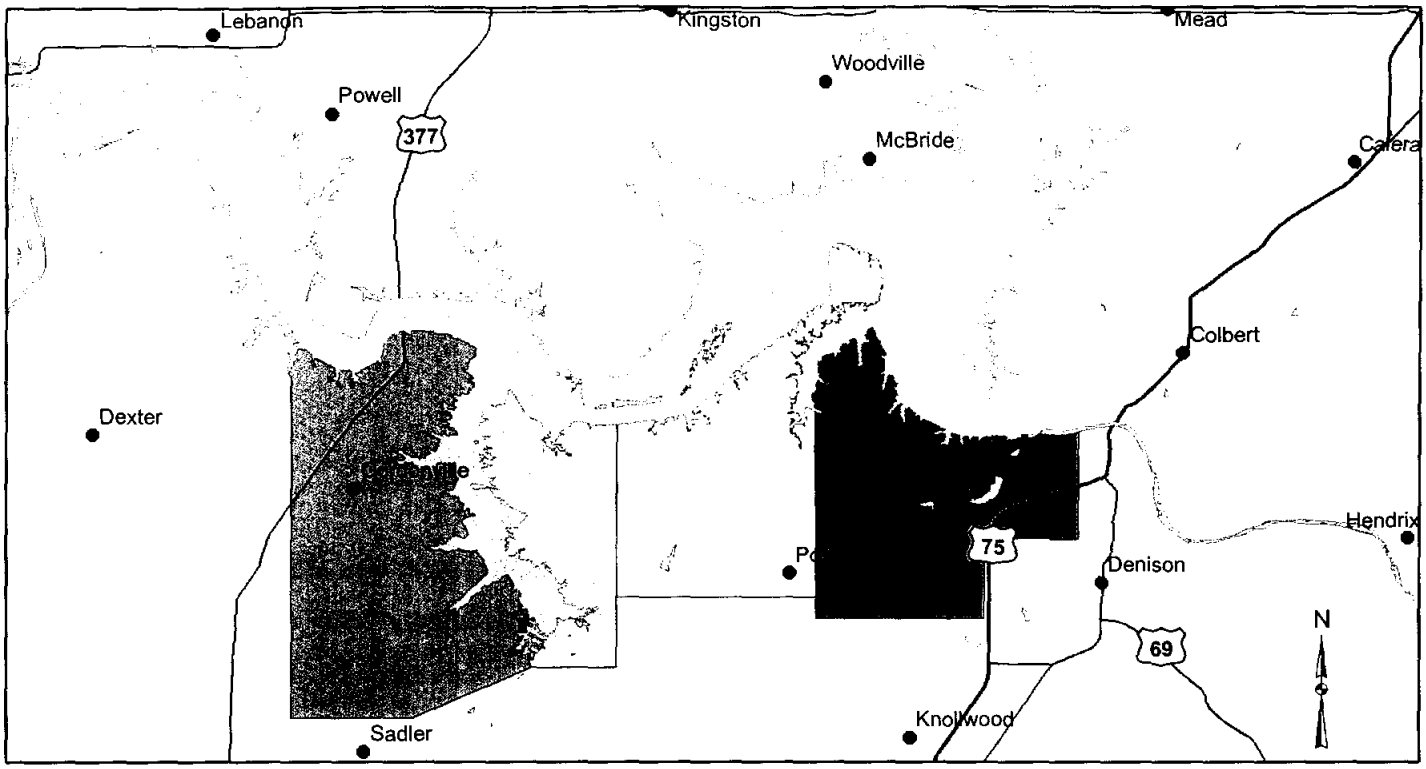
F. Creation of New Regional Sewer System. Under this option, a new regional sewer system authority would build and operate a sanitary sewer system serving communities and those living in unincorporated areas.

G. Privatization. Under this option, privately owned companies would provide wastewater treatment.

The creation of wastewater conveyance and treatment infrastructure requires more than just identifying potential service regions and quantifying the amounts of wastewater to be treated. For each region, an entity must be identified or created to design, construct, and run the proposed sewer system. The Phase I report provided some discussion of institutional goals and concerns that could assist local groups in making decisions on wastewater issues. This report presents concept designs based on the options to expand existing sewer systems (Option D) and creation of new regional sewer systems (Option F).

DETERMINATION OF SERVICE REGIONS

Service regions presented in the Phase I report were selected in coordination with the study sponsor and public input on the study and the service regions which was solicited at public meetings held in March and June 2000. However, much of the area in those regions is undeveloped. Providing sewage collection to a sparsely populated area would substantially increase the cost for each user. For this report, the Texas service regions were revised to connect the largest number of users for the least amount of collection line. Most of the service regions extend only 1 or 2 miles away from the lakeshore. The Phase I service regions and the Phase II service regions for the Texas side are shown in Figure 2.

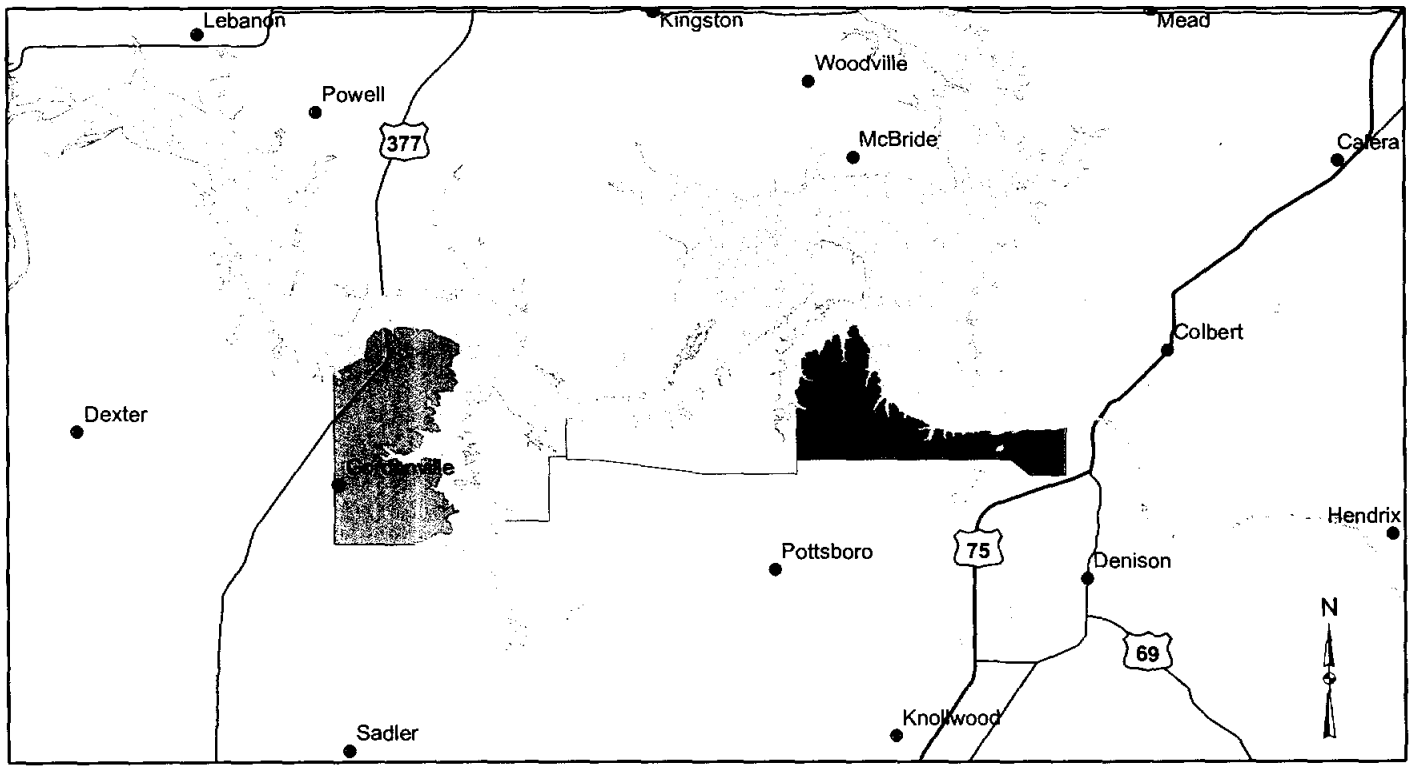


Lake Texoma Regional Sewer System Study
Phase I Service Regions

Key to Features

- Original Texas Region 4
- Original Texas Region 3
- Original Texas Region 2
- Original Texas Region 1

0 1.25 2.5 5 7.5 10 Miles



Lake Texoma Regional Sewer System Study
Phase II Service Regions

Figure 2

TEXAS SERVICE REGIONS

REGION TX1

Geographic Description. The TX1 region occupies approximately 11 square miles extending from roughly 1 mile east of Denison Dam to the Little Mineral Creek area in the west. The southern limits are approximately 0.25 miles north of Randall Lake. This area is heavily populated near the lake, from west of the spillway to Grandpappy Point. The section of TX1 east and south of the spillway was recently annexed by Denison and is expected to grow quickly. Figure 3 shows the detail of Region TX1.

Description of Facilities/Existing Infrastructure. No large-scale public sewer facilities exist in TX1. The city of Denison, located outside the limits of TX1, has most of this region covered by a Certificate of Convenience and Necessity (CCN) and would be the entity most capable of providing large-scale sewer service in the region. The Texas Commission on Environmental Quality grants a CCN to a water or sewer provider for a specific service area. No other provider may furnish water or sewer service within a certificated region without the consent of the utility provider that has been granted the CCN. Certificates of Convenience and Necessity are described in the Texas Water Code Chapter 13, Subchapter G. For purposes of this study, it was assumed that the city of Denison is not interested in providing sewer service to the study area.

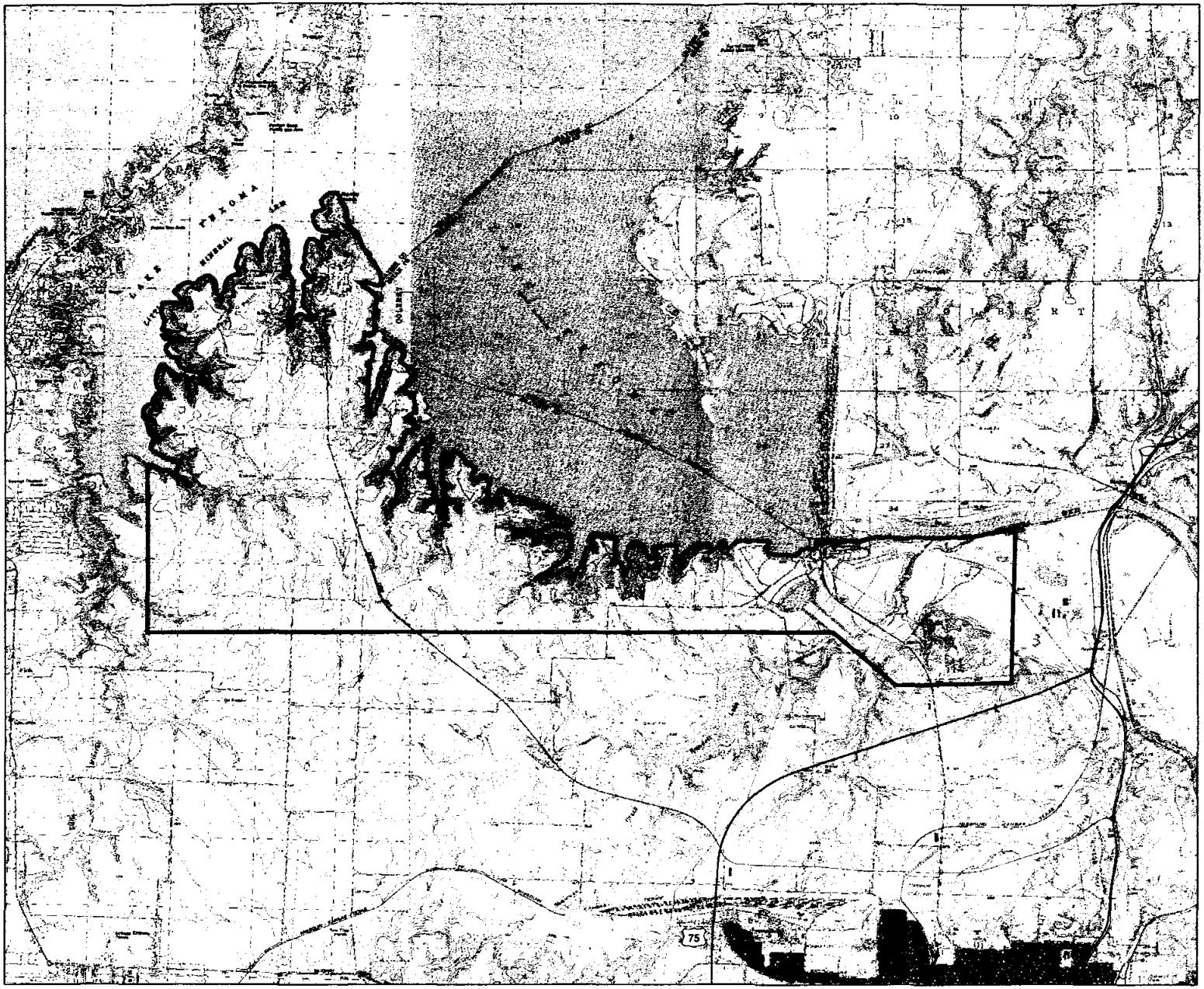


Figure 3
Service Region TX 1

REGION TX2

Geographic Description. Region TX2 is approximately 14.9 square miles and covers the Preston Peninsula area. Starting just east of the Little Mineral Creek area, TX2 extends west to the Cambridge Shores area. The southernmost limit of the region is about 2 miles south of the lake, just south of Fink. A topographic map of the region is shown in Figure 4.

Description of Facilities/Existing Infrastructure. The city of Pottsboro is not included in the revised Region TX2; however, Pottsboro Public Works provides sewer service to approximately 700 connections, including Tanglewood and Summer Cove. Pottsboro treatment facilities were considered during the development of alternatives (see Alternative 2). The Pottsboro plant's extended aeration treatment facilities were expanded in 2000 from 0.21 million gallons per day to 0.35 million gallons per day. Tecon provides most water service in the region but some areas receive water from the Red River Authority.

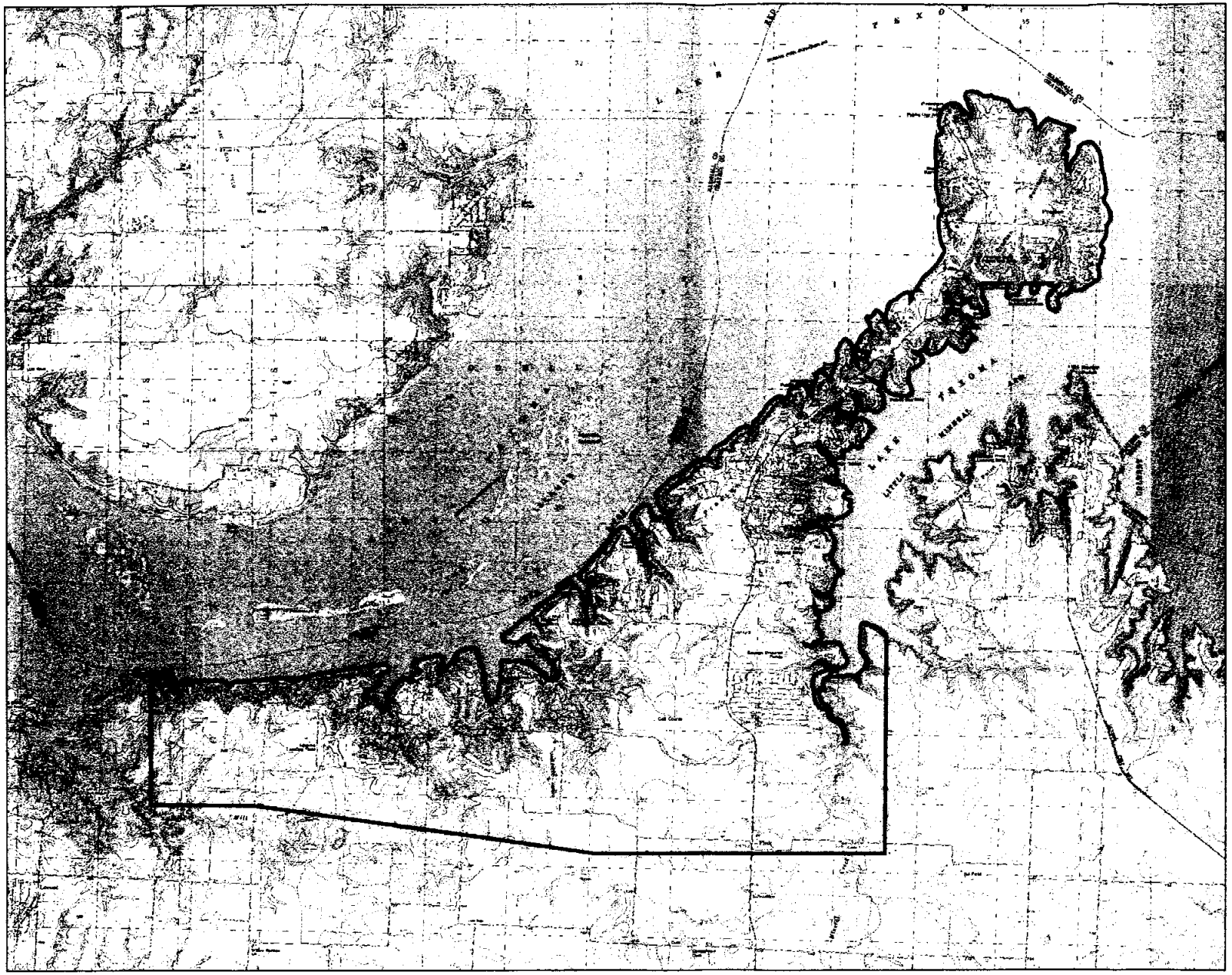


Figure 4
Service Region TX2

REGION TX3

Geographic Description. Region TX3 extends from the Big Mineral Arm east to Region TX2 and south to just below Paradise Cove. Region TX3 covers only about 5.8 square miles and is the smallest of the regions studied. Major developments include Mill Creek and Paradise Cove. Region TX3 is depicted in Figure 5.

Description of Facilities/Existing Infrastructure. There are no large-scale public sewer facilities in TX3. Small-scale facilities may be present in some of the developed areas but would be of insufficient size to serve as the basis for a regional system. Tecon provides water service in the area.

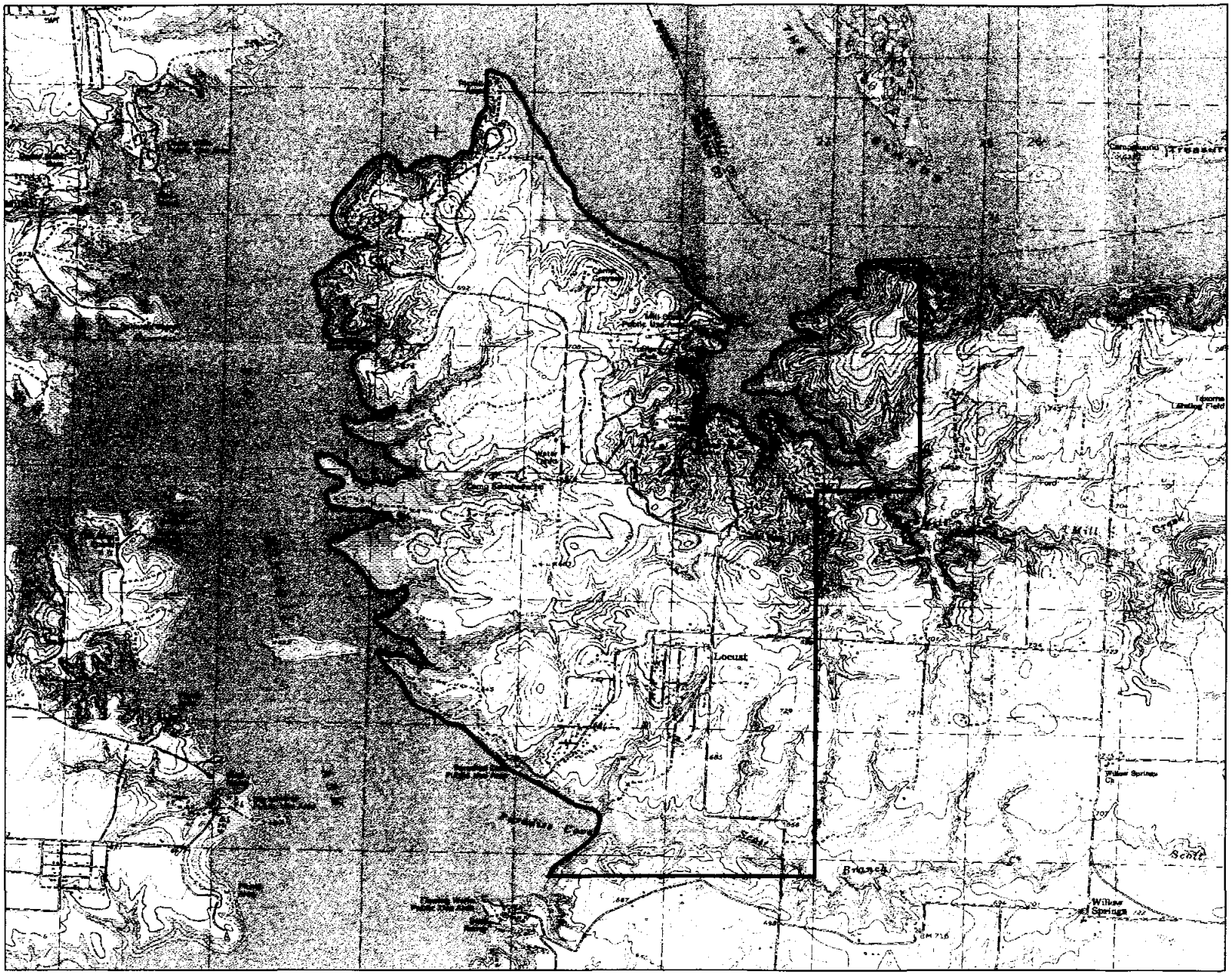
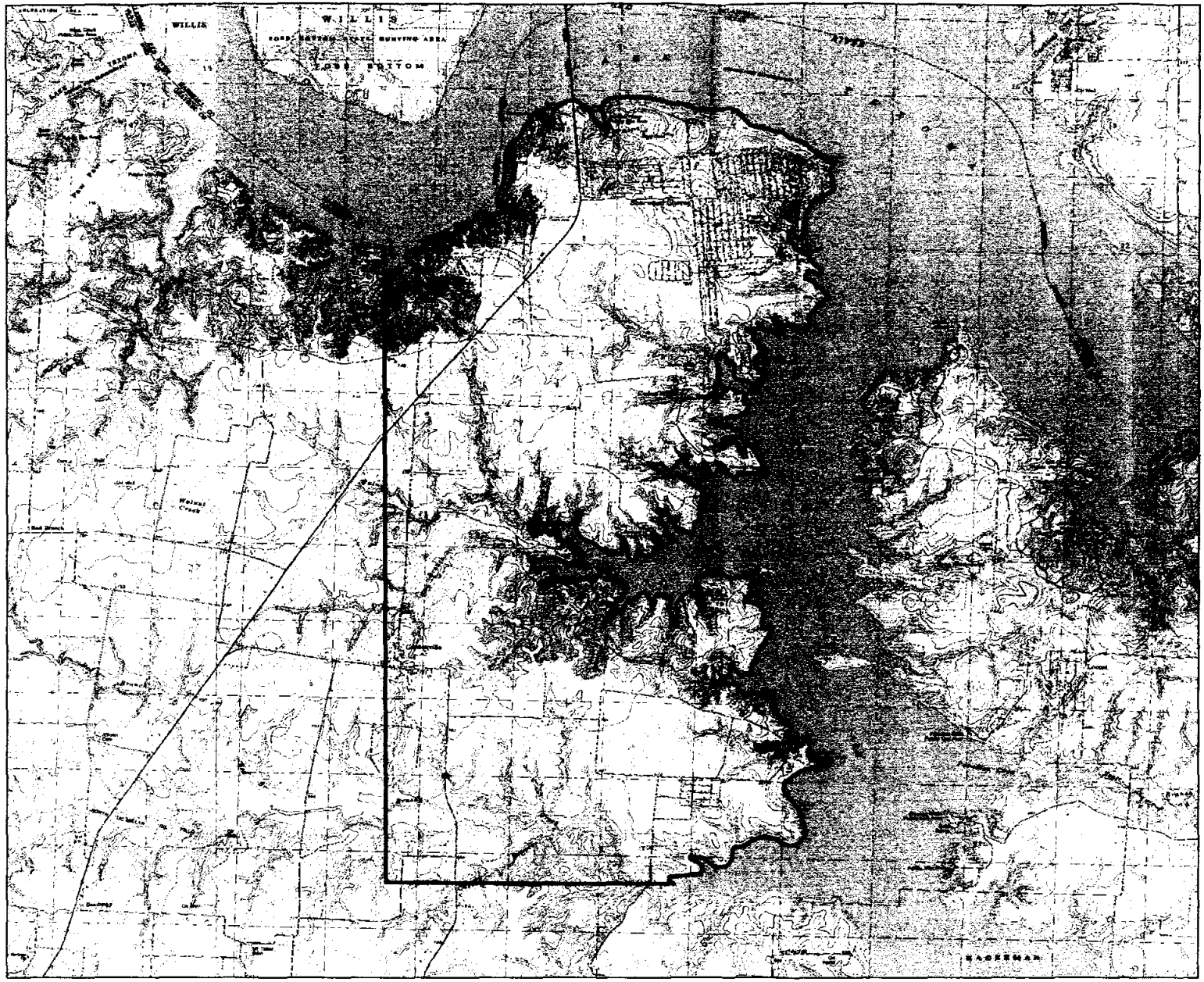


Figure 5
Service Region TX3

REGION TX4

Geographic Description. Region TX4 occupies approximately 15 square miles, bounded on the east by the Big Mineral Arm and extending to just west of Gordonville. The southern boundary is just below Brushy Creek. Major developments include Sherwood Shores, Cedar Bayou, and Walnut Creek. Region TX4 is shown in Figure 6.

Description of Facilities/Existing Infrastructure. There are no large-scale public sewer facilities in TX4. Limited facilities, serving a cluster of homes, may be present in the region but would not be large enough to serve as the basis for a regional system. Tecon provides water in Region TX4.



Key to Features

Texas Region 4

N

0 0.25 0.5 1 1.5 Miles

Figure 6
Service Region TX 4

WASTEWATER PROJECTIONS

Sizing wastewater treatment facilities is a function of the number of connections and the volume of wastewater. The number of connections depends on the number of household and RV and campsites that will be connected to the system. Wastewater volume is based on population. The Texas Commission on Environmental Quality (TCEQ) sets the standards for design of wastewater treatment facilities in Texas.

Projections for the number of connections and wastewater volume that were developed in the Phase I report were revised to fit the new service regions and more recent data available from Grayson County. A digital drawing provided by Grayson County was used for a housing count of each study region. Table 1 shows the baseline number of connections for the Texas study regions. Decennial growth rates shown in Table 2 were developed during the Phase I study.

The projected number of connections was calculated for each study region by applying the decennial growth rates from Table 2 to the number of baseline connections in Table 1. The projections for household sewer connections are shown in Table 3. Projections for RV and campsite connections are shown in Table 4. The projected total number of sewer connections for each study region is shown in Table 5 below. The collection facilities for each alternative were designed to accommodate needs for 2050 based on the projected number of connections, as required by the TCEQ Standard Chapter 317, Design Criteria for Sewerage Systems.

Table 1. Baseline Sewer Connections (2003)

Study Region	Housing Units	Persons per Household	Household Population	RV/ Campsites	Baseline Connections
TX1	385	2.6	1,001	335	720
TX2	2,983	2.4	7,159	0	2,983
TX3	519	2.6	1,349	84	603
TX4	1,573	2.3	3,618	407	1,980

Table 2. Decennial Growth Rates for County Population					
County	**2000-2010**	**2010-2020**	**2020-2030**	**2030-2040**	**2040-2050**
Grayson	12.2%	8.0%	6.4%	5.4%	5.1%

Table 3. Projections of Household Sewer Connections						
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**
TX1	385	432	467	496	523	550
TX2	2,983	3,347	3,615	3,846	4,054	4,260
TX3	519	582	629	669	705	741
TX4	1,573	1,765	1,906	2,028	2,138	2,247

Table 4. Projections of RV/Campsite Sewer Connections						
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**
TX1	335	376	406	432	455	478
TX2	0	0	0	0	0	0
TX3	84	94	102	108	114	120
TX4	407	457	493	525	553	581

Table 5. Projections of Total Sewer Connections						
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**
TX1	720	808	872	928	978	1,028
TX2	2,983	3,347	3,615	3,846	4,054	4,260
TX3	603	677	731	777	819	861
TX4	1,980	2,222	2,553	2,553	2,691	2,828

Estimates for wastewater generation were calculated as required by TCEQ Standard Chapter 317. Wastewater generation is estimated at 100 gallons per person per day for residential connections. Projections for wastewater generation from household connections were calculated according to the following equation: 100 gallons/person/day * persons/household (from Table 1) * number of household connections (from Table 3) = volume of wastewater per day. For example, wastewater volume for TX1 in 2020 would be calculated as follows: 100 gallons/person/day * 2.6 persons/household * 467 household connections = 121,420 gallons per day. Wastewater volume projections for RV/campsite connections were calculated according to the following equation: 50

gallons/connection/day * number of RV/campsite connections (from Table 4) = volume of wastewater per day. For example, wastewater generation for recreation areas in TX1 for 2020 would be calculated as follows: 50gallons/day * 406 connections = 20,300 gallons per day. Adding the residential wastewater estimate and the RV/campsite estimate produces the total wastewater volume projection, which is used to design the system. For the examples given, 121,420 gallons/day from households + 20,300 gallons/day from RV/campsites = 141,720 gallons per day. This volume is rounded up as shown in Table 6. Table 6 shows projections for wastewater generation for the service regions. Treatment facilities for each alternative were designed to meet wastewater projections for 2020, as required by the TCEQ Standard Chapter 317.

Table 6. Projection of Wastewater Generation Per Day (1,000 gallons)

Study Region	2003	2010	2020	2030	2040	2050
TX1	117	131	142	151	159	167
TX2	716	803	868	923	973	1,023
TX3	139	156	169	179	189	199
TX4	382	429	463	493	519	546
Totals	1,354	1,519	1,641	1,746	1,840	1,934

CONCEPT DESIGN

The concept designs developed for this report provide alternatives to regionalize wastewater treatment by expanding existing facilities (Option D) and/or creating new wastewater treatment systems (Option F). The Phase I report analysis indicated that a regionalized system was most likely to satisfy the majority of the concerns expressed by State and local interests. Three alternatives were developed to concept design level. Each alternative would provide regionalized wastewater treatment for the study area. The alternatives are described later in the report.

COLLECTION

The collection system consists of a primary collection system and a secondary collection system. For this study, the primary collection system is defined as the system of force mains, 3 inches in diameter and larger, and the lift stations that connect the secondary collection systems and the treatment facilities. The secondary collection system is defined as the gravity mains, force mains, and lift stations that collect the waste from existing structures and transport the waste to the primary collection system. This study includes a concept design of the primary collection system. The study scope does not include design of the secondary collection system. Design specifications for the primary collection system are located in Appendix 2.

Concept level costs were developed for the primary collection system on each of the three alternatives. The cost for the secondary collection system was estimated from costs developed for the Grand Lake Water Association in the Grand Lake Regional Sewer System Study completed in May 2000. More detailed cost information is provided in Appendix 3.

DESCRIPTION OF ALTERNATIVES

Three alternatives were developed which would meet the projected needs for wastewater treatment in the study area. The alternatives include various combinations of treatment options. The Cost Analysis Section explains the estimated monthly cost per user for each alternative.

Effluent requirements for the alternatives were taken from TCEQ Standard Chapter 309, Domestic Wastewater Effluent Limitations. Since Lake Texoma is a source for public drinking water, Effluent Set 2 is the minimum that must be achieved. Effluent Set 2 requirements are a 30-day average biological oxygen demand (BOD) of 10 and total suspended solids (TSS) of 15.

The existing treatment plant at Pottsboro is an extended aeration plant with a capacity of 0.35 million gallons per day. The treated effluent is discharged to Mineral Creek. This plant is currently treating waste from the Tanglewood and Summer Cove areas, in addition to Pottsboro.

The new treatment plants proposed in the alternatives would be sequential batch reactors. The sequential batch reactor treatment process is an activated sludge system in which mixing, aeration, and clarification occur in one basin instead of several separate units. Advantages of this process include decreased capital costs, more easily tolerated loads, higher overall aeration efficiency, and reduced operator demands. Sequential batch reactors can be installed underground, which eliminates odor and allows them to be installed in residential areas. Sequential batch reactors can be easily expanded to meet increased wastewater volume. A standard system includes the following elements: influent lift station, bar screen, flow measurement, sequential batch reactor treatment, aerobic sludge digester and thickening basin, chlorination equipment, and contact chamber.

Constructed wetlands are shallow pools with saturated substrates, emergent and submergent vegetation, and animal life that simulate natural wetlands. There are two types of constructed wetlands: submerged flow and free water surface systems. The free water surface (FWS) type was chosen for this study. Constructed wetlands treatment systems are inundated or saturated by wastewater flows at a frequency and duration sufficient to support flora and fauna typically adapted for life in saturated or inundated soil conditions. In accordance with TCEQ Standard Chapter 317, the constructed wetlands must be preceded by primary treatment. A partially aerated lagoon was chosen as the primary treatment. A partially aerated lagoon was chosen over a facultative lagoon to reduce odors. The lagoon is designed for a 50% reduction in BOD. Chapter 317 requires the constructed wetlands to the sized for a 15-day detention time to meet the Effluent Set 2 requirements when the influent is 50% reduced BOD.

Chapter 317 requirements for FWS type constructed wetlands include: average depth no greater than 18 inches, plug flow design (length to width ratio of at least 3:1), minimal impact from prevailing wind (long side oriented north and south with inlet on windward side), minimum slope along the bottom of 0.075% for complete drainage, and multiple units sized so that total capacity is adequate with largest unit out of service. Appendix 2 contains the design details and calculations.

ALTERNATIVE 1

For Alternative 1, each region would have its own treatment plant. The existing treatment plant located north of Pottsboro would be expanded to serve all of TX2. The existing facility is an extended aeration plant with a capacity of 0.35 million gallons per day (mgd), which would be expanded to 1.28 mgd. New sequential batch reactor treatment plants would be constructed for TX1, TX3, and TX4. The new TX1 plant would have a capacity of 0.142 mgd. The new TX3 plant would have a capacity of 0.169 mgd. The new TX4 plant would have a capacity of 0.463 mgd. The location plan for Alternative 1 is shown on Figure 7. For more detail, see Appendix 2 drawings G1 and M1 through M4. Treated wastewater would be discharged from the constructed wetlands directly to the lake or to a stream near the treatment plant.

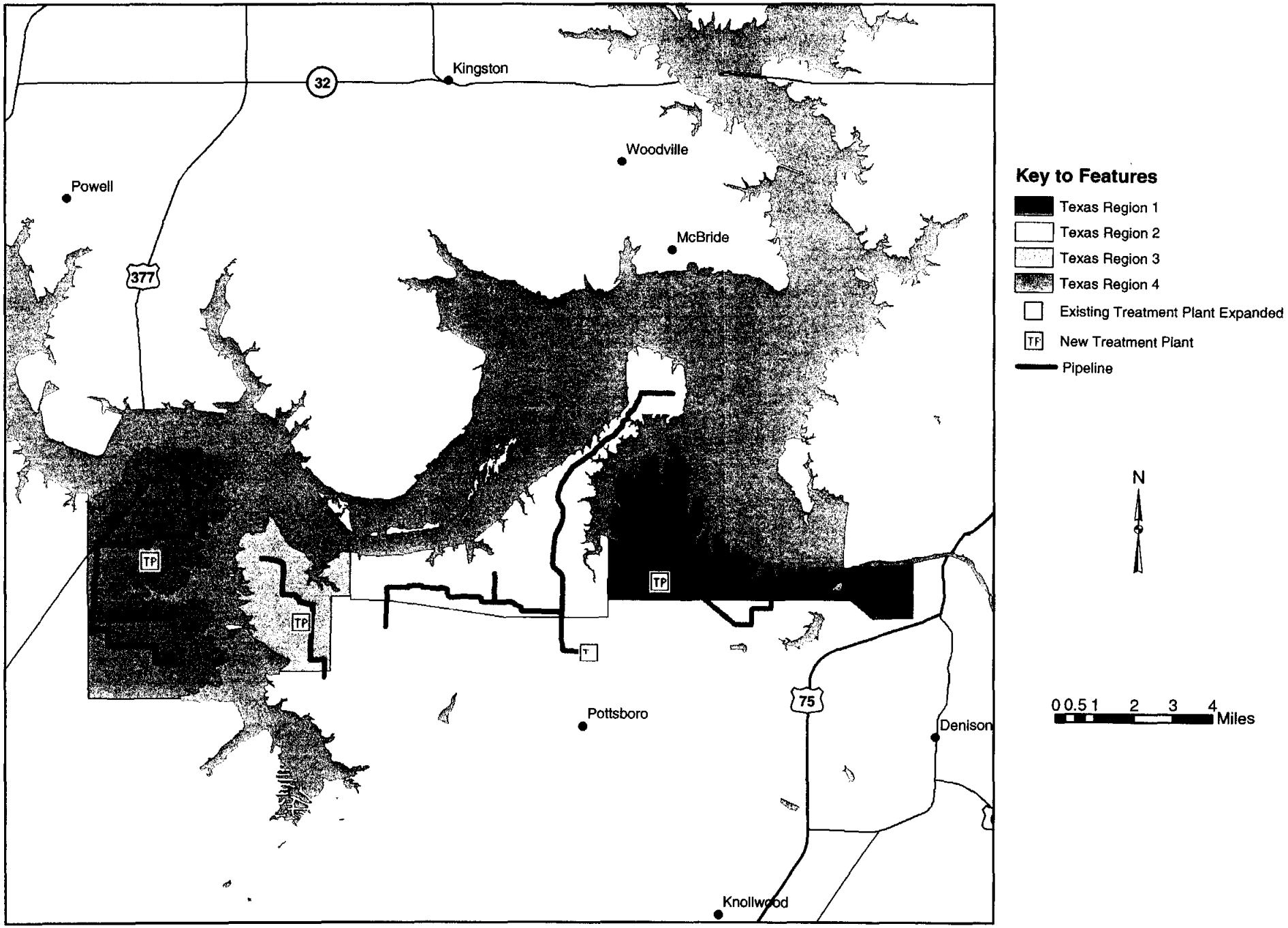


Figure 7
Alternative 1
Multiple Treatment Plants Location Plan

ALTERNATIVE 2

For Alternative 2, the existing Pottsboro treatment plant would be expanded to serve TX1, TX2, and TX3. The existing plant at Pottsboro is an extended aeration plant with a capacity of 0.35 million gallons per day. It would require expansion to treat 1.529 mgd. A new sequential batch reactor with 0.463 mgd capacity would serve TX4. Figure 8 shows the plan location for Alternative 2. For more detail, refer to Appendix 2 drawings G2 and M5 through M7. Treated wastewater would be discharged directly to the lake or to a stream near the treatment plant.

ALTERNATIVE 3

For Alternative 3, each region would have separate treatment facilities. TX1 would have a new sequential batch reactor with 0.142 mgd capacity as in Alternative 1. TX2 would be served by the expanded Pottsboro facility, as in Alternative 1. TX3 would be served by a constructed wetlands preceded by a partially aerated lagoon. A new sequential batch reactor with 0.463 mgd capacity would serve TX4, as in Alternative 1. Figure 9 shows the plan location for Alternative 3. For more detail, refer to Appendix 2, drawings G3 and M8. Treated wastewater would be discharged from the constructed wetlands directly to the lake or to a nearby stream.

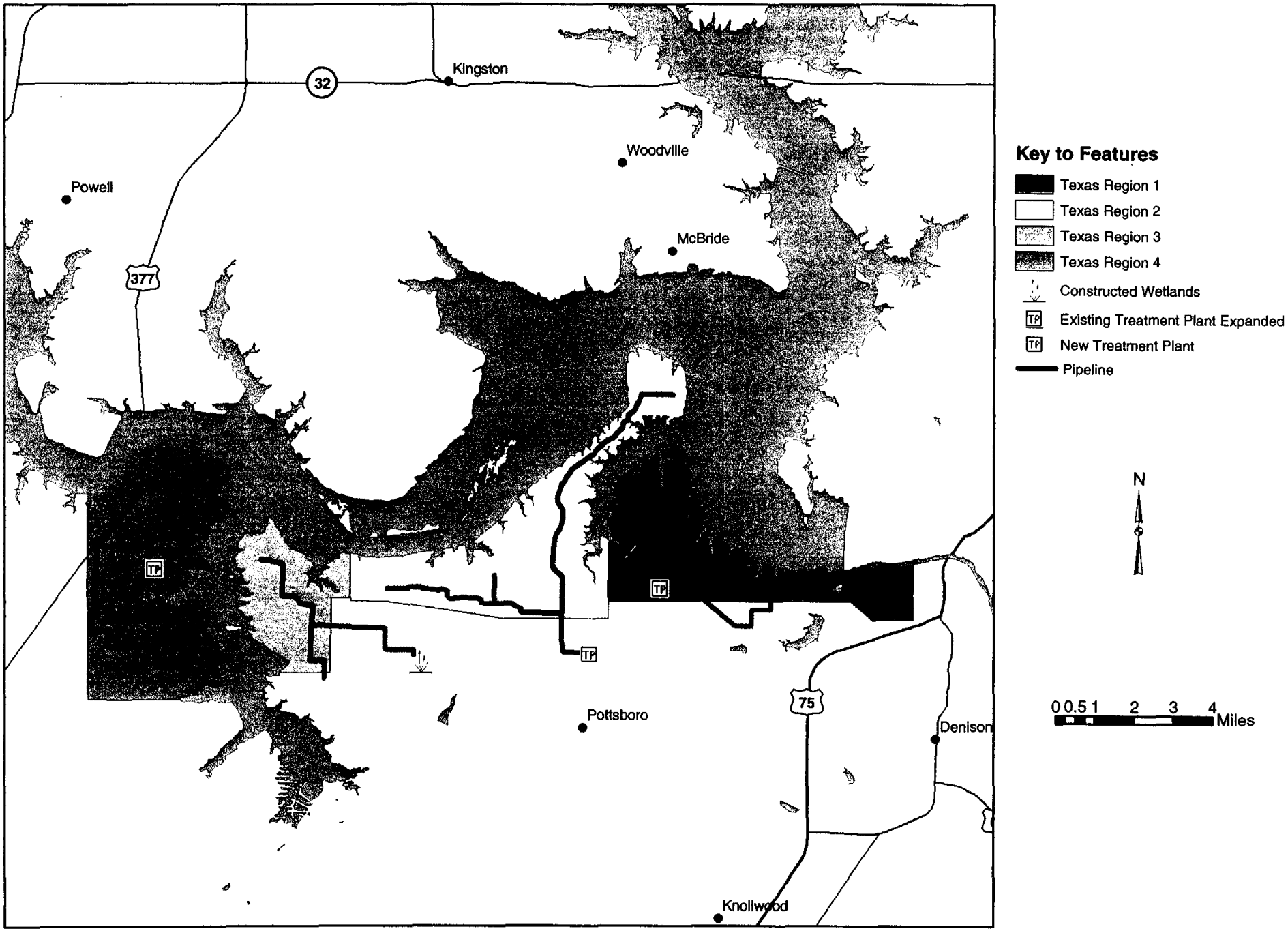


Figure 9
Alternative 3
Constructed Wetlands Location Plan

REAL ESTATE

A number of assumptions were used to develop the real estate cost estimate for this study.

- Pipelines will use existing rights of way, at no cost.
- Property owners will donate easements needed for the secondary collection system.
- All private lands would be acquired by negotiation or condemnation in excess of the current fair market value.
- No utility or facility relocations would be required to implement this project, and no homes or other significant improvements would be adversely impacted

Real estate for the primary collection system consists of easements for pipeline and lift stations, fee purchase of lands for treatment facilities, and administrative costs. It was assumed that pipeline easements along public roads would be acquired from the state at no cost. Table 7 summarizes the real estate costs for the primary collection system of each alternative. Contingencies represent the risks of negotiation and condemnation.

Table 7. Real Estate Costs for Primary Collection System

	Alternative 1	Alternative 2	Alternative 3
Land for Treatment Facilities	40 Acres	35 Acres	70 Acres
Lands & Damages	$216,000	$189,000	$294,000
Relocation Assistance	$0	$0	$0
Minerals	$0	$0	$0
Contingencies	$ 54,000	$ 47,250	$ 73,500
Administrative	$ 85,000	$ 51,000	$102,000
Total:	$355,000	$287,250	$469,500

For this study, it was assumed that owners would donate easements for the secondary collection systems and that the administration cost for obtaining the easements would bee $500 per owner. Easements will be required from about half of the owners for

the secondary collection system, for a total of 2,730 easements. Therefore, the cost for obtaining easements for the secondary collection system will be about $1,365,000.

The real estate valuation study is included as Appendix 5.

COST ANALYSIS

The study sponsor has indicated that the Regional Sewer System would be financed entirely with revenue bonds with terms of 20 years at 4% interest. All system components were assumed to have a life of at least 20 years.

The total initial cost of the system includes construction cost, engineering and construction management, and real estate. The fee for engineering and construction management is estimated to be 12% of the construction cost. Estimates for costs associated with endangered species and/or cultural resources investigations that may be required were beyond the scope of this study and are not included in the cost analysis.

The initial cost would be financed by the sale of revenue bonds, which include a 3-1/2% charge for legal fees and commissions. The annual capital cost is calculated using a capital recovery factor, based on bond terms of 20 years at 4% interest. The average annual cost is calculated using the annual capital cost and estimated annual operation and maintenance costs. Operation and maintenance costs include energy costs, labor, sludge disposal, and chemicals for waste treatment. Tables 8, 9 and 10 show a cost summary for each alternative. Costs are in June 2003 dollars.

Table 8. Alternative 1 Cost Summary					
	TX Region 1	**TX Region 2**	**TX Region 3**	**TX Region 4**	**Total Study Area**
Construction Cost	$1,650,000	$8,936,000	$1,775,000	$4,680,000	$17,050,000
Engineering & Management	$198,000	$1,072,000	$213,000	$562,000	$2,046,000
Real Estate Costs	$147,000	$898,000	$180,000	$494,750	$1,720,000
Total First Costs	$1,995,000	$10,906,000	$2,168,500	$5,736,750	$20,816,000
Average Annual Costs	$201,500	$1,099,080	$218,250	$577,400	$2,096,500
Monthly Cost per Sewer Connection	$44	$31	$35	$31	$32

Table 9. Alternative 2 Cost Summary					
	TX Region 1	**TX Region 2**	**TX Region 3**	**TX Region 4**	**Total Study Area**
Construction Cost	$1,639,000	$9,044,000	$1,749,000	$4,680,000	$17,120,000
Engineering & Management	$197,000	$1,085,000	$210,000	$562,000	$2,054,000
Real Estate Costs	$114,650	$888,350	$154,550	$494,750	$1,652,250
Total First Costs	$1,950,650	$11,017,350	$2,113,550	$5,736,750	$20,826,250
Average Annual Costs	$198,170	$1,110,320	$213,470	$577,400	$2,099,600
Monthly Cost per Sewer Connection	$43	$31	$34	$31	$32

Table 10. Alternative 3 Cost Summary					
	TX Region 1	**TX Region 2**	**TX Region 3**	**TX Region 4**	**Total Study Area**
Construction Cost	$1,650,000	$8,936,000	$1,658,000	$4,680,000	$16,930,000
Engineering & Management	$198,000	$1,072,000	$199,000	$562,000	$2,032,000
Real Estate Costs	$147,000	$898,000	$295,000	$494,750	$1,834,500
Total First Costs	$1,995,000	$10,906,000	$2,152,000	$5,736,750	$20,796,500
Average Annual Costs	$201,500	$1,099,080	$213,740	$577,400	$2,091,900
Monthly Cost per Sewer Connection	$44	$31	$34	$31	$32

ENVIRONMENTAL CONSIDERATIONS

INTRODUCTION

Existing environmental conditions were investigated to identify potential problem areas such as endangered species, cultural resources, wetlands, and water quality. The scope of this investigation does not include documentation consistent with the National Environmental Policy Act of 1969, but does identify significant environmental issues that would need to be addressed prior to any construction. Please refer to Appendix 4 for the complete Environmental Report.

ENVIRONMENTAL SETTING

The proposed project area lies within the central lowlands located in the Prairie Division, Prairie Parkland Province, Cross timbers and Southern Tallgrass Prairie Section (Bailey 1980). The region is gently rolling to flat plains. Over 50% of the area is gently sloping. Average annual rainfall varies from 35 to 40 inches per year and falls mainly during the 235-day growing season (April-October). The average annual temperature is 55° to 63° Fahrenheit.

The vegetation is characterized as cross timbers and oak-hickory forest. The area is dominated by various short and medium to tall grasses, along with a few hardy tree species. Forest cover consists of post, live, and blackjack oaks; and pignut and mockernut hickories. Post oak and blackjack oak dominate the cross timbers region. Grasses are the dominant plants on the prairies. The most prevalent type is bluestem prairie. Other dominant grasses are indiangrass, and switchgrass. Soil is a key factor in local distribution. Fine, heavy soils generally support grassland vegetation, and coarse, lighter soils are covered with stands of savanna.

Land use is varied consisting of developed, recreational, residential, agricultural, and pasturelands, all of which are heavily influenced by recreational activities associated with Lake Texoma.

ENDANGERED SPECIES

A number of Federally listed threatened and/or endangered species are present in the project area. There is no designated critical habitat for listed species in Grayson County. Federally listed threatened bald eagles (Haliaeetus leucocephalus) winter and may be spring residents at Lake Texoma and along the Red River. They utilize the lakeshore for perching and secluded areas for roosting. They also use the river area downstream of the dam for feeding and perching. The threatened piping plover (Charadrius melodus) and potentially threatened mountain plover (Charadrius montanus) are migrants within the project area. The endangered interior least tern (Sterna antillarum) nests along the Red River, and a nesting colony has been documented using areas around Lake Texoma at Hagerman National Wildlife Refuge in recent years. Protocol for dealing with Federally listed species (if found to exist) is contained in a letter from the U.S. Fish and Wildlife Service (USFWS) dated February 4, 2003, and is included in Appendix 4.

CULTURAL RESOURCES

Archaeological sites representative of the Early Archaic Period through the Middle and Late Archaic, Woodland, Caddoan, and Historic Periods are known in the larger vicinity of Lake Texoma in northern Texas. This culture-historical sequence falls generally within the overall sequence that has been established for northern Texas and southern Oklahoma. Many sites in this area have undisturbed, deeply-buried deposits; many are comprised of multi-component prehistoric and/or historic occupations. A number of cultural resources investigations, including survey and excavation, were conducted incident to the construction of Lake Texoma. While archaeological reconnaissance efforts undertaken in the area by the Army Corps of Engineers resulted in

identification of hundreds of archaeological sites, none of these investigations occurred within the proposed project areas/alignments, which remain largely uninvestigated. In the larger regional area, however, there are hundreds of archaeological sites and historic standing structures on record with the Texas Historical Commission (THC).

Any of the proposed Texoma Regional Sewer System alternatives has the potential to impact cultural resources. Sections 106 and 110 of the National Historic Preservation Act (NHPA) of 1966 (as amended) require agencies to evaluate the impacts of Federal undertakings on historic properties, which include prehistoric and historic archaeological sites and historic standing structures. Section 106 requires the identification of all historic properties, which emphasizes an evaluation of eligibility for listing on the National Register of Historic Places (NRHP). Agencies must then determine which historic properties (those eligible for listing on the NRHP) will be adversely impacted. Sections 106 and 110 require that agencies resolve adverse effects to these properties. Plans for resolving adverse effects will be determined through consultation with the Texas Historical Commission, potentially the Advisory Council on Historic Preservation (ACHP), and appropriate and interested Native American tribes and other interested parties.

To fulfill the requirements outlined in Sections 106 and 110 of the NHPA, archaeological reconnaissance investigations, to include archival research, will be necessary to identify archaeological sites and standing structures that exist within the proposed project area. Each site and structure will require National Register evaluation; some will require subsurface evaluation, detailed archival research, or architectural documentation. NRHP-eligible sites and structures that will be adversely impacted by the undertaking will require mitigation, which will be determined through formal consultation with the THC, and potentially the ACHP.

WATER QUALITY

Moderate to high levels of salinity characterizes general water quality in Lake Texoma with a predominance of sodium and calcium salts of chloride and sulfate (Leifeste et al. 1971). In terms of productivity, the lake has been classified as mesotrophic based on chlorophyll a concentrations (Ground and Groeger 1994).

WETLANDS

Wetlands and deepwater habitats are essential for many species of fish and wildlife. In addition to providing habitat for fish and wildlife, they also perform important roles and function in controlling floods and pollution abatement. The USFWS developed and adopted a classification system to be used for classifying wetlands and conducted a national inventory of wetland habitats (National Wetland Inventory Maps [NWI]). The four service regions were evaluated for the presence of wetlands based on the NWI maps. Numerous wetland types were found to be present in the delineated project area and are listed in Appendix 4.

A large number of the wetlands appear to be small farm ponds or impoundments. All sewage collection facilities and pipelines should be carefully evaluated to avoid wetland habitats and adverse impacts associated with construction in wetlands.

SECTION 404, CLEAN WATER ACT

The proposed project would be subject to Section 10 of the River and Harbors Act of 1899 as well as Section 404 of the Clean Water Act. The construction and placement of outfall structures, intake structures, and sewer lines would be subject to Section 10 and Section 404 permitting activities. The construction of an intake structure should fall within the scope of a Nationwide permit or a General permit. Construction of wastewater processing facilities could require a determination of status regarding jurisdictional waters of the United States. The placement of sewage collection lines and lift stations

should fall within the scope of Nationwide Permit No. 12, Utility Line Discharges. Prior to construction, a Section 404 (Clean Water Act) determination should be requested from the Tulsa District, COE (Regulatory Branch) to assure compliance with Federal law.

NATIONAL FORESTS AND OTHER PUBLIC USE AREAS

The proposed project area is not located within any National Forests, National Parks, or National Monuments. However, the Hagerman National Wildlife Refuge is located on the Big Mineral Arm of Lake Texoma, just south of the proposed project area that encompasses Flowing Wells Camp and Big Mineral Camp. These two parks are adjacent to the northern boundary of the wildlife refuge. The 11,320-acre refuge was established in 1946 and includes 3,000 acres of marsh and water and 8,000 acres of upland and farmland.

Numerous public recreation sites within the project plan exist around Lake Texoma on COE owned lands or immediately adjacent.

NATIONAL ENVIRONMENTAL POLLICY ACT (NEPA)

Should Federal funds be expended for construction of any part of the proposed alternatives and/or should the proposed facilities be constructed on Federal property, NEPA coordination would be required. Documentation required by NEPA would consist of either an Environmental Assessment and signed Finding of No Significant Impact or an Environmental Impact Statement and signed Record of Decision.

CONCLUSION

Concept designs and cost estimates were developed for three alternatives, which would provide wastewater treatment to the four Texas service regions at Lake Texoma. Alternatives include expansion of existing treatment plants and construction of new

facilities. Table 11 shows the cost per connection for each alternative in each service region.

Table 11. Summary of Cost Per Connection			
Region	**Cost per Connection Alternative 1**	**Cost per Connection Alternative 2**	**Cost per Connection Alternative 3**
TX1	$44	$43	$44
TX2	$31	$31	$31
TX3	$35	$34	$34
TX4	$31	$31	$31
Average Cost	$32	$32	$32

The three alternatives vary little in cost per connection. Decisions will have to be based on considerations other than cost. Without action, aging septic systems will continue to be a potential contributor to ground and surface water contamination. Users have few direct economic incentives to ensure that the outflow of their septic systems does not degrade water quality for the basin. Even with a regional treatment system in place, development will occur in areas where sewer lines will not reach. The new and existing septic systems will pose potential water quality problems in the future if the systems are not monitored, maintained, and operated correctly.

Construction of any of the alternatives for a regional sewer treatment system would have a positive impact on water quality at Lake Texoma. Construction of such a project could have potential adverse impacts to cultural resources, wetlands, and possibly listed endangered species in the Lake Texoma area. However, with proper planning and coordination with resource agencies including the U.S. Fish and Wildlife Service, Texas Historical Commission, Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, and U.S. Army Corps of Engineers Regulatory Branch, any possible impacts can be avoided or mitigated.

The alternatives developed for this report are a start towards solving water quality problems in the Lake Texoma area. Residents, State and local leaders and developers

must understand and appreciate their roles in improving water quality for Lake Texoma. All groups will share in the cost of any alternative chosen and so each group must understand how they will benefit. Local officials and community leaders are central to any institutional arrangement to help solve wastewater issues in the Lake Texoma area. These leaders must ensure that all groups understand the benefits of moving ahead with a regional wastewater treatment system. Any institutional plan to deal with wastewater and water quality issues will require close coordination and cooperation between all groups.

APPENDIX 1

LETTER AGREEMENT

LETTER AGREEMENT
PLANNING ASSISTANCE TO STATES

Lake Texoma Regional Sewer System Study, Phase II
Lake Texoma Area, Texas

THIS AGREEMENT, entered into this 24th day of June, 2002, by and between the United States of America (hereinafter called the "Government"), represented by the District Engineer for the Tulsa District, U.S. Army Corps of Engineers, and the Greater Texoma Utility Authority (GTUA) (hereinafter called the "Sponsor"),

WITNESS THAT:

WHEREAS, Section 22 of the Water Resources Development Act of 1974 (Public Law 93-251), as amended, authorizes the Secretary of the Army, acting through the Chief of Engineers, to assist the states in preparation of comprehensive plans for the development, utilization and conservation of water and related land resources; and

WHEREAS, Section 319 of the Water Resources Development Act of 1990 (Public Law 101-640) authorizes the Secretary of the Army to collect from non-Federal entities fees for the purpose of recovering 50 percent of the cost of the program established by Section 22; and

WHEREAS, the Sponsor has reviewed the State's comprehensive water plans and identified the need for planning assistance as described in the Scope of Studies incorporated into this agreement; and

WHEREAS, the Sponsor has the authority and capability to furnish the cooperation hereinafter set forth and is willing to participate in the study cost-sharing and financing in accordance with the terms of this Agreement;

NOW THEREFORE, the parties agree to the following:

1. The Government, using funds contributed by the Sponsor and appropriated by the Congress shall expeditiously prosecute and complete the Study, currently estimated to be completed within a twelve (12) month study period (not to exceed 12 months), substantially in compliance with the Scope of Study attached as Appendix A and in conformity with applicable Federal laws and regulations and mutually acceptable standards of engineering practice.

2. The Government shall contribute in cash **fifty (50) percent**, and the Sponsor shall contribute in cash **fifty (50) percent** of the total study cost which is currently estimated to be **$68,500**; provided, that the Government shall not obligate any cash contribution toward Study costs until such cash contribution has actually been made available to it by the Sponsor. The Sponsor agrees to provide funds in the amount of **$34,250**, which shall be made payable to the Finance and Accounting Officer, Tulsa District, 1645 South 101 East Avenue, Tulsa, Oklahoma 74128-4609.

3. No Federal funds may be used to meet the local Sponsor's share of study costs under this Agreement unless the expenditure of such funds is expressly authorized by statute as verified by the granting agency.

4. Before any Party to this Agreement may bring suit in any court concerning any issues relating to this Agreement, such Party must first seek in good faith to resolve the issue through negotiation or other form of nonbinding alternative dispute resolution mutually acceptable to the Parties.

5. This Agreement shall terminate on June 30, 2003, or upon the completion of the Study, whichever occurs earlier; provided, that, prior to such time and upon thirty days written notice, either party may terminate or suspend this Agreement without penalty. It is further understood and agreed that if the Study is not completed by June 30, 2003, or cannot be completed within the total study cost of $68,500, this Agreement may be renewed or amended by the mutual written agreement of the parties.

6. Within ninety days upon termination of this Agreement, the Government shall prepare a final accounting of the Study costs, which shall display (1) cash contributions by the Federal Government, (2) cash contributions by the Sponsor, and (3) disbursements by the Government of all funds. Subject to the availability of funds, within thirty days after the final accounting, the Government shall reimburse the Sponsor for non-Federal cash contributions that exceed the Sponsor's required share of the total study costs. Within thirty days after the final accounting, the Sponsor shall provide the Government any cash contributions required to meet the Sponsor's required share of the total study costs.

7. In the event that any (one or more) of the provisions of this Agreement is found to be invalid, illegal, or unenforceable, by a court of competent jurisdiction, the validity of the remaining provisions shall not in any way be affected or impaired and shall continue in effect until the Agreement is completed.

8. This Agreement shall become effective upon the signatures of both Parties.

FOR THE SPONSOR:

By: David Wright
David Wright
President
Greater Texoma Utility Authority

Date: 5/20/02

Attest:
Jerry Chapman, General Manager

Date: 5/20/02

(Seal)

FOR THE GOVERNMENT:

By:
Robert L. Suthard, Jr.
Colonel, Corps of Engineers
District Engineer
Tulsa District

Date: 6/24/2002

APPENDIX A

SCOPE OF STUDY
PLANNING ASSISTANCE TO STATES

LAKE TEXOMA REGIONAL SEWER SYSTEM STUDY, PHASE II
(Conceptual Designs and Cost Estimates - Lake Texoma Area, Texas)

I. GENERAL.

The Tulsa District will provide preliminary design and cost estimates for constructing regional sewer systems in the Lake Texoma, Texas, area under authority of Section 22 of the Water Resources Development Act of 1974, also known as the Planning Assistance to States Program.

II. WORK TO BE PERFORMED.

a. PLAN FORMULATION. The Corps will work with the Sponsor to develop a plan for each of the four study regions identified in the Phase 1 report to provide sewer service for the current and projected future population in each region.

b. PRELIMINARY DESIGNS. The Corps will provide reconnaissance-level preliminary designs for the plans developed in each study region. The designs will include selection of sites for the sewage treatment plants, location and sizing of required pump stations, layout of main sewage lines, sewage plant type and size, disposal of treated sewage, and preliminary cost estimates. The design will also include an economic analysis that will consider all costs associated with the regional sewage system to determine an estimated monthly cost per sewage connection for each of the four regions.

Aerial photography will be utilized for sizing and locating main sewage lines and lift stations. The most recent aerial photographs obtained by the Texoma Project Office will be used.

The most economical form of acceptable treated sewage disposal will be determined through coordination with the Oklahoma Department of Environmental Quality and the Texas Natural Resource Conservation Commission.

c. **ENVIRONMENTAL STUDIES.**

(1) Endangered Species coordination. The Corps will coordinate the study with the United States Fish and Wildlife Service and the Oklahoma Department of Wildlife Conservation to learn the impacts, if any, on any listed endangered species. If endangered species are found in the project area, the Corps will recommend the Sponsor conduct a biological assessment and possibly formal consultation.

(2) NEPA and other environmental requirements. The Corps will discuss, in narrative format, National Environmental Policy Act (NEPA) and other environmental requirements the Sponsor will need for the detailed study. The Corps will also prepare discussion concerning coordination with Federal, State, and local agencies having legislative and administrative responsibilities for environmental protection.

d. **REAL ESTATE STUDIES.**

(1) Real estate activities necessary for the project consist of all tasks related to identifying and providing real estate cost estimates, determining real estate requirements, and coordinating the acquisition of lands with the Sponsor.

(2) The Corps will conduct a gross appraisal of each alternative to decide the estimated real estate costs and estates purchase requirements, i.e., fee or type of easement. The Corps will obtain maps of the study area that contain sufficient detail, to identify the types of land and improvements that the proposed project would affect. The Corps will research the local real estate market to gather data concerning recent sales of improved and unimproved properties comparable to the right-of-way required. The research will involve searching deed records and contacting local appraisers, brokers, attorneys, central appraisal district, and others knowledgeable of the local real estate market. The Corps will use the market information as a basis for the values of the various types of properties within the proposed project.

(3) After all fieldwork is completed, the Corps will prepare the real estate text for the main report. The valuation portion of the report will include the following: land values (surface and minerals), severance damage, improvement value, contingencies, acquisition costs, and a total of the estimated real estate cost.

e. **COST ESTIMATES.** Cost estimates will be provided that include preliminary designs and real estate costs. The Corps will use the Microcomputer-Aided Cost Estimating System (MCACES) Gold computer program for all study-related cost estimates.

III. STUDY MANAGEMENT.

This work item will include scheduling and organizing of the study; regular periodic meetings with technical elements to review progress; preparing budget documentation; monitoring and managing all funds being obligated and expended; preparing project-related correspondence; coordinating with Federal, State, and local agencies; and providing guidance and support as required to ensure that all study-related questions have been answered, and all study-related problems have been solved. This task will be performed for the duration of the study.

IV. REPORT PREPARATION.

(1) Report preparation will consist of preparing a draft report, duplicating and distributing the draft report, reviewing and editing the draft report to final form, and then duplicating and distributing the final report. The report will be direct, concise, and written in a style that is easy to understand. The report will also include the study findings and recommendations.

(2) The Corps will document the study results in report form. The Corps will base the report on all studies and investigations conducted and on published reports applicable to the study area. The Corps will prepare report originals on 8-1/2 inches by 11 inches plain white bond paper, one side only. Plates will be 8-1/2 inches by 11 inches or 11 inches high and folded to conform with the 8-1/2 inches width of the main document. The Corps will submit draft and final reports to the Sponsor in one and one-half spaced text. Five copies each of the draft and final report will be provided to the Sponsor. One compact disc with a printable version of the report, in PDF format, will be provided to the Sponsor with the submission of the draft and final reports.

V. DELIVERY AND SCHEDULE.

a. DRAFT DOCUMENT. The Corps will provide a draft copy of the report to the Sponsor. The report will include discussion concerning methodology, data sources, findings, and other appropriate data for review and approval. It will be one and one-half spaced, unbound, with all pages consecutively numbered. The report will identify all data sources and references.

b. FINAL DOCUMENT. Upon the Sponsor's approval and return of the edited draft to the Corps, the Corps will type the document in one and one-half spaced format, with corrections made as noted on the first draft. The Corps will furnish the final original document to the Sponsor, unbound, with pages numbered.

c. MEETINGS AND CONFERENCES. The Corps and the Sponsor will hold monthly meetings, either face-to-face or through telephone

conference calls. The corps or the Sponsor will request other meetings as needed for discussion of questions and problems relating to work.

d. SCHEDULE. The Corps will submit the above items according to the following schedule.

Item	Schedule
Draft Document	392 calendar days after the date of the signed agreement and receipt of Federal funds.
Sponsor Review	42 calendar days after submittal of the draft document.
Final Document	28 calendar days after receipt of Sponsor's comments on the draft document.

VI. STUDY MANAGER.

The Government manager for this contract will be Mr. Phillip A. Cline, Project Manager, Planning Assistance to States Program, Civil Works Branch, Programs and Project Management Division, Tulsa District, Corps of Engineers. Questions or problems that may arise during the performance of the work specified in this Agreement should be discussed with Mr. Cline. The Sponsor should coordinate entry clearance with Mr. Cline before planning site or office visits. The Sponsor should appoint a project coordinator to serve as a single point of contact or liaison with the Corps of Engineers. The name of the individual so designated will be furnished in writing to the Corps. The project coordinator will be responsible for complete coordination of the work.

APPENDIX B

TIME AND COST ESTIMATE
PLANNING ASSISTANCE TO STATES

LAKE TEXOMA REGIONAL SEWER SYSTEM STUDY, PHASE II
(CONCEPTUAL DESIGNS AND COST ESTIMATES LAKE TEXOMA AREA, TEXAS)

Study Item	Duration (Workdays)	Cost ($)
1. Plan Formulation	30	4,000
2. Preliminary Designs	110	27,500
3. Environmental Studies		
a. Endangered Species Coordination	30	2,500
b. NEPA and Other Requirements	30	2,500
4. Real Estate Studies	90	8,000
5. Cost Estimates	20	2,500
6. Data Processing and Report Prep.	50	9,000
7. Study Management/Meetings	330	12,500
TOTAL STUDY COST		**$68,500**

APPENDIX 2

CONCEPT DESIGN

TEXOMA REGIONAL SEWER SYSTEM STUDY

CONCEPT DESIGN

June 2003

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF DRAWINGS

TEXOMA REGIONAL SEWER SYSTEM STUDY

CONCEPT DESIGN

INTRODUCTION

This design includes collection, treatment, and disposal for regional sanitary sewer systems in the Lake Texoma area. The eastern portion of the Texas side of Lake Texoma has been divided into four geographic regions, Texas regions 1 through 4. These regions are shown on Drawing G1. The purpose of the regional systems is to replace individual septic systems and small private systems that are contributing to the pollution of Lake Texoma.

Three alternatives have been analyzed. The alternatives are explained in the "Treatment" portion of this report. Calculations for force mains and lift stations are included with the drawings. See attached drawings for locations and sizes of piping and other system components.

According to data provided by Grayson County, there are currently 5,460 housing units served by septic systems and small private systems in the geographic study area. Population estimates developed for the Phase I report show that there are 2.6 people per housing unit for regions 1 and 3, 2.4 people per housing unit for region 2, and 2.3 people per housing unit for region 4. Projections developed during the Phase I study indicate that there will be 21.2% growth by 2020 and 42.9% growth by 2050. Based on these growth rates, the total number of housing units will be 6,618 in 2020 and 7,802 in 2050. As indicated in the Texas Commission on Environmental Quality (TCEQ) Standard Chapter 317, Design Criteria for Sewerage Systems, the collection facilities have been designed for 2050. The treatment facilities have been designed for 2020.

Wastewater generation is based on 100 gallons per capita per day and 50 gallons per day for RV's or campsites as indicated in TCEQ Standard Chapter 317. See attached tables for wastewater generation projections.

TABLE 1

WASTEWATER PROJECTIONS

	Projections of Numbers of Household Sewer Connections						
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**	
TX1	385	432	467	496	523	550	
TX2	2,983	3,347	3,615	3,846	4,054	4,620	
TX3	519	582	629	669	705	741	
TX4	1,573	1,765	1,906	2,028	2,138	2,247	
Totals	5,460	6,126	6,616	7,040	7,420	7,798	
Projections of Numbers of RV Sites/Campsites							
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**	
TX1	335	376	406	432	455	478	
TX2	0	0	3,615	0	0	0	
TX3	84	94	629	108	114	120	
TX4	407	457	1,906	525	553	581	
Totals	826	927	6,616	1,065	1,122	1,180	
Projections of Total Sewer Connections							
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**	
TX1	720	808	872	928	978	1,028	
TX2	2,983	3,347	3,615	3,846	4,054	4,620	
TX3	603	677	731	777	819	861	
TX4	1,980	2,222	2,399	2,553	2,691	2,828	
Totals	6,286	7,053	7,617	8,105	8,542	8,978	
	Modified Decennial Growth Rates						
Study Region	**2003-2010**	**2010-2020**	**2020-2030**	**2030-2040**	**2040-2050**		
TX1,2,3,4	0.122	0.08	0.064	0.054	0.061		
Projection of Wastewater Generation Per Day (1,000 gallons)(assume 100 gal/person/day)							
Study Region	**2003**	**2010**	**2020**	**2030**	**2040**	**2050**	**People per Connection**
TX1	117	131	142	151	159	167	2.6
TX2	716	803	868	923	973	1,023	2.4
TX3	139	156	169	179	189	199	2.6
TX4	382	429	463	493	519	546	2.3
Totals	1,354	1,519	1,641	1,746	1,840	1,934	

COLLECTION

For this study, the collection system has been divided into the primary collection system and the secondary collection system. The primary collection system is defined as the system of force mains, 3 inches in diameter and larger, and the lift stations which connect the secondary collection systems and the treatment facilities. The secondary collection system is defined as the gravity mains, force mains, and lift stations which collect the waste from existing structures and transports the waste to the primary collection system. This study includes a concept design of the primary collection system. The secondary collection system design is not included. See the attached tables for design specifics of the primary collection system.

The cost for the secondary collection system was estimated from costs developed for the Grand Lake Water Association in the Grand Lake Regional Sewer System Study completed in May 2000. The cost per structure for the secondary collection system was multiplied by the total number of structures served by the proposed regional sewer systems to determine the secondary collection system cost.

The force main piping for this project will be PVC pipe conforming to AWWA C900, working pressure not less than 150 psi. Polyethylene piping conforming to ASTM D 3350 and ASTM D 3035 may also be used for force main piping, especially the smaller sizes. Gravity main piping will be PVC pipe conforming to ASTM D 3034 type PSM with a maximum SDR of 35.

Large lift stations will be duplex with each pump capable of pumping the extreme peak flow rate. Lift stations serving single structures will contain a single grinder pump and will be similar to those manufactured by E/One Sewer Systems.

Force mains and lift stations have been sized based on sewage flows of 100 gallons per capita per day and 50 gallons per day for RV's or campsites as indicated in TCEQ Standard Chapter 317.

TREATMENT

Three alternatives have been analyzed for treatment of sewage. For alternative 1, each region will have its own treatment plant. The existing treatment plant located north of Pottsboro will be expanded to serve all of region 2. New treatment plants will be constructed for all other areas. New treatment plants will be sequential batch reactors. Locations of existing and new treatment plants are shown on Drawings G1 and M1 through M4. Alternative 2 includes expanding the existing Pottsboro treatment plant to serve regions 1, 2, and 3. Refer to Drawings G2 and M5 through M7. Treatment for region 4 is the same as alternative 1. Alternative 3 is the same as alternative 1 except region 3 will be served by constructed wetlands preceded by a partially aerated lagoon. See Drawings G3 and M8 for alternative 3.

Treatment options include expanding the existing treatment plant located north of Pottsboro, sequential batch reactors, and constructed wetlands preceded by a partially aerated lagoon. Effluent requirements are taken from TCEQ Standard Chapter 309, Domestic Wastewater Effluent Limitations. Since Lake Texoma is a source for public drinking water, Effluent Set 2 is the minimum that must be achieved. Effluent Set 2 requirements are a 30-day average BOD of 10 and TSS of 15.

The existing plant at Pottsboro is an extended aeration plant with a capacity of 0.35 mgd. The treated effluent is discharged to Mineral Creek. This plant is currently treating waste from the Tanglewood and Summer Cove areas.

The sequential batch reactor treatment process is an activated sludge system in which mixing, aeration, and clarification occur in one basin instead of several separate units. Advantages of the proposed process include decreased capital costs, more easily tolerated hydraulic and organic "shock" loads, higher overall aeration efficiency, and reduced operator demands. A standard system includes the following elements: influent lift station, bar screen, flow measurement, sequential batch reactor treatment, aerobic sludge digester and thickening basin, chlorination equipment, and contact chamber.

Constructed wetlands are designed and man-made complexes of saturated substrates, emergent and submergent vegetation, animal life, and water that simulates natural wetlands. Constructed wetlands consist of two varieties: submerged flow and free water surface systems. The free water surface (FWS) type was chosen for this study. Constructed wetlands are constructed treatment systems that are inundated or saturated by wastewater flows at a frequency and duration sufficient to support a prevalence of flora and fauna typically adapted for life in saturated or inundated soil conditions. In accordance with TCEQ Standard Chapter 317, the constructed wetlands must be preceded by primary treatment. A partially aerated lagoon was chosen as the primary treatment. A partially aerated lagoon was chosen over a facultative lagoon to reduce odors.

The lagoon is designed for a 50% reduction in BOD. Chapter 317 requires the constructed wetlands to the sized for a 15-day detention time to meet the Effluent Set 2 requirements when the influent is 50% reduced BOD.

Chapter 317 requirements for FWS type constructed wetlands include average depth no greater than 18 inches, plug flow design (length to width ratio of at least 3:1), minimized effects of prevailing wind (long side oriented north and south with inlet on windward side), minimum slope along the bottom of 0.075% for complete drainage, multiple units sized so that total capacity is adequate with largest unit out of service. See computations attached.

DISPOSAL

Treated wastewater will be discharged directly to the lake or to a stream near the treatment plant.

TABLE 2

ALTERNATIVE 1

CALCULATIONS

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 1
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	3,300	54	2.1		75	0.002275	16	24
F2	3.230	10,300	62	2.4	43	77	0.002884	42	72
F3	4.266	10,300	165	3.7	233	184	0.004621	-3	45
F31	4.266	8,200	165	3.7	233	184	0.004621	30	68
F4	4.266	6,800	141	3.2	102	176	0.003458	17	40
F5	4.266	5,000	159	3.6	102	201	0.00432	22	44
F6	6.134	2.600	325	3.5	335	385	0.002748	-13	-6

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 2
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	3,400	96	3.8		144	0.006558	7	30
F2	6.134	3,600	397	4.3		596	0.003995	-4	10
F3	8.044	8,500	449	2.8	38	665	0.001336	0	11
F4	8.044	4,400	618	3.9	38	919	0.002415	35	46
F5	9.866	4,200	1033	4.3	38	1542	0.002313	-23	-14
F6	9.866	3,600	1125	4.7	38	1680	0.002709	-8	2
F7	9.866	10,700	1303	5.5	38	1946	0.003551	12	50
F8	9.866	5,800	1409	5.9	38	2105	0.004104	0	24
F9	4.266	4,400	55	1.2		82	0.000597	-17	-15
F10	6.134	7,800	243	2.6		365	0.001613	28	41
F11	6.134	3,500	342	3.7		513	0.003027	-2	8
F12	6.134	8,600	585	6.4		878	0.008180	-29	41
F13	11.734	8,800	1994	5.9	38	2983	0.003355	-14	15

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 3
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	8,900	64	2.5		89	0.003122	3	31
F2	4.266	5,400	204	4.6	11	280	0.006808	0	37
F3	6.134	1,000	387	4.2	84	519	0.003796	6	10

TABLE 1 (Continued)

TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION 1 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	62	72
L2	165	45
L3	165	62
L4	141	40
L5	159	38
TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION2 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	96	30
L2	449	74
L3	169	34
L4	1303	89
L5	106	39
L6	243	41
L7	585	57
TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION 3 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	64	31
L2	204	47
L3	53	29
TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION 4 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	342	60
L2	671	52

TABLE 3

ALTERNATIVE 2

CALCULATIONS

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 1
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	3,300	54	2.1		75	0.002275	16	24
F2	3.230	10,300	62	2.4	43	77	0.002884	42	72
F3	4.266	10,300	165	3.7	233	184	0.004621	-3	45
F31	4.266	8,200	165	3.7	233	184	0.004621	30	68
F4	4.266	6,800	141	3.2	102	176	0.003458	17	40
F5	4.266	5,000	159	3.6	102	201	0.00432	22	44
F6	6.134	19,100	325	3.5	335	385	0.002748	-43	9

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 2
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	3,400	96	3.8		144	0.006558	7	30
F2	6.134	3,600	397	4.3		596	0.003995	-4	10
F3	8.044	8,500	449	2.8	38	665	0.001336	0	11
F4	8.044	4,400	618	3.9	38	919	0.002415	35	46
F5	9.866	4,200	1033	4.3	38	1542	0.002313	-23	-14
F6	9.866	3,600	1125	4.7	38	1680	0.002709	-8	2
F7	9.866	10,700	1303	5.5	38	1946	0.003551	12	50
F8	9.866	5,800	1409	5.9	38	2105	0.004104	0	24
F9	6.134	4,400	442	4.8		82	0.004858	-17	4
F10	8.044	7,800	630	4.0		365	0.002506	28	48
F11	6.134	3,500	342	3.7		513	0.003027	-2	8
F12	8.044	8,600	972	6.1		878	0.005587	-29	19
F13	11.734	8,800	2381	7.1	38	2983	0.004658	-14	27

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 3
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	8,900	64	2.5		89	0.003122	3	31
F2	4.266	5,400	204	4.6	11	280	0.006808	0	37
F3	6.134	4,600	387	4.2	84	519	0.003796	0	18
F4	3.230	8,800	53	2.1	23	69	0.002187	0	19
F5	6.134	12,000	387	4.2	84	519	0.003796	23	69

TABLE 3 (Continued)

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 4
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	4.266	3,200	342	7.7	70	520	0.017741	-12	45
F2	6.134	3,300	635	6.9	70	978	0.009498	-16	15
F3	8.044	8,000	671	4.2	85	1032	0.002814	23	45
F4	8.044	1,800	1063	6.7	407	1575	0.006586	-5	7
F5	6.134	6,000	314	3.4	112	467	0.002583	-9	7
F6	3.230	4,200	95	3.7	5	148	0.006463	-14	13
F7	6.134	4,700	219	2.4	107	319	0.001323	20	27
F8	4.266	6,700	178	4.0	107	256	0.005325	-22	14
F9	4.266	3,900	124	2.8	107	171	0.002721	1	11
F10	4.266	10,200	108	2.4	107	146	0.002109	19	41

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 5
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	4.266	3,200	342	7.7	70	520	0.017741	-12	45
F2	6.134	3,300	635	6.9	70	978	0.009498	-16	15
F3	8.044	8,000	671	4.2	85	1032	0.002814	23	45
F4	8.044	1,800	1063	6.7	407	1575	0.006586	-5	7
F5	6.134	6,000	314	3.4	112	467	0.002583	-9	7
F6	3.230	4,200	95	3.7	5	148	0.006463	-14	13
F7	6.134	4,700	219	2.4	107	319	0.001323	20	27
F8	4.266	6,700	178	4.0	107	256	0.005325	-22	14
F9	4.266	3,900	124	2.8	107	171	0.002721	1	11
F10	4.266	10,200	108	2.4	107	146	0.002109	19	41

TABLE 3 (Continued)

TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION 1 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	62	72
L2	165	45
L3	165	77
L4	141	40
L5	159	53

TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION2 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	96	30
L2	449	74
L3	169	34
L4	1303	101
L5	106	51
L6	630	48
L7	972	46

TEXOMA REGIONAL SANITARY SEWER SYSTEM TEXAS REGION 3 DUPLEX LIFT STATIONS		
Mark	**Flow in GPM (each pump)**	**Head psi**
L1	64	31
L2	204	55
L3	53	37
L4	387	69

TABLE 4

ALTERNATIVE 3

CALCULATIONS

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 3
FORCE MAINS

Mark	Diameter (inches)	Length (feet)	Flow (gpm)	Velocity (feet/sec)	No. of Campsites	No. of Connections	Friction (psi/feet)	Static psi	Total psi
F1	3.230	8,900	342	7.7	70	520	0.017741	-12	45
F2	4.266	5,400	635	6.9	70	978	0.009498	-16	15
F3	6.134	4,600	671	4.2	85	1032	0.002814	23	45
F4	3.230	8,800	1063	6.7	407	1575	0.006586	-5	7
F5	6.134	7,500	314	3.4	112	467	0.002583	-9	7

TEXOMA REGIONAL SANITARY SEWER SYSTEM
TEXAS REGION 3
DUPLEX LIFT STATIONS

Mark	Flow in GPM (each pump)	Head psi
L1	64	31
L2	204	55
L3	53	37
L4	387	32

Figure 1. Computation Sheet

COMPUTATION SHEET

PROJECT	PAGE	COMPUTED BY	DATE
Texoma Regional Sewer System	1 of 3	K. Lehman	Dec 2002
SUBJECT		CHECKED BY	DATE
Constructed Wetlands Computations – Alternative 3			

Reference TCEQ Standard Chapter 317

Free water surface type
Maximum Depth – 18 inches
Detention time with 50% BOD remaining is 15 days

Calculate area required for 1.0 mgd (million gallons per day) sewage flow
Assume average depth of 18 inches

15 days x 1 mgd = 15 million gallons (volume)

$$\frac{\text{15 million gallons}}{\text{1.5 ft (depth) x 325,900 (gallons per acre)}} = 31 \text{ acres}$$

Constructed wetlands for Texas Region 3

Sewage generated in area 3 in the year 2020 is 0.169 mgd

Area required is 0.169 mgd x 31 acres/mgd = 5 acres

Chapter 317 requires multiple units, assume largest unit is out of service

Select 4 units, 1-2/3 acre each

1-2/3 acres x 43,560 sq ft/acre = 72,600 sq ft

select length to width ratio of 4:1

Width = 135 ft Length = 540 ft

COMPUTATION SHEET

PROJECT	PAGE	COMPUTED BY	DATE
Texoma Regional Sewer System	2 of 3	K. Lehman	Dec 2002
SUBJECT		CHECKED BY	DATE
Partially Mixed Aerated Lagoon – Alternative 3			

Partially Mixed Aerated Lagoon (surface aeration)

$$E = \frac{1}{1 + K(V/Q)}$$

From Chapter 317
E = fraction BOD remaining
K = BOD removal rate constant
Use 0.28 per chapter 317
V = volume of lagoon
Q = influent flow rate
V/Q = t = detention time

For Q = 1 mgd and pond depth of 8 feet and a detention time of 4 days
E = 47%

Pond Area

V = t x Q = 4 days x 1 mgd = 4 million gallons

$$\text{Area} = \frac{4 \text{ million gallons}}{8 \text{ feet} \times 7.48 \text{ gals/cu ft} \times 43{,}560 \text{ sq ft/acre}}$$

= 1.5 acres = 65,000 sq ft

Use 4:1 length to width ratio (chapter 317)

Partially Mixed Aerated Lagoon for Region 3

1.0 mgd requires 1.5 acres, 8 feet deep
0.169 mgd x 1.5 acres = 0.25 acres
select 0.5 acres
Use 4:1 length to width ratio (chapter 317)
L = 296 ft, W = 74 ft

COMPUTATION SHEET

PROJECT	PAGE	COMPUTED BY	DATE
Texoma Regional Sewer System	3 of 3	K. Lehman	Dec 2002
SUBJECT		CHECKED BY	DATE
Partially Mixed Aerated Lagoon – Region 3			

Oxygen Requirements

1.6 lbs of oxygen per lb of BOD applied (chapter 317)

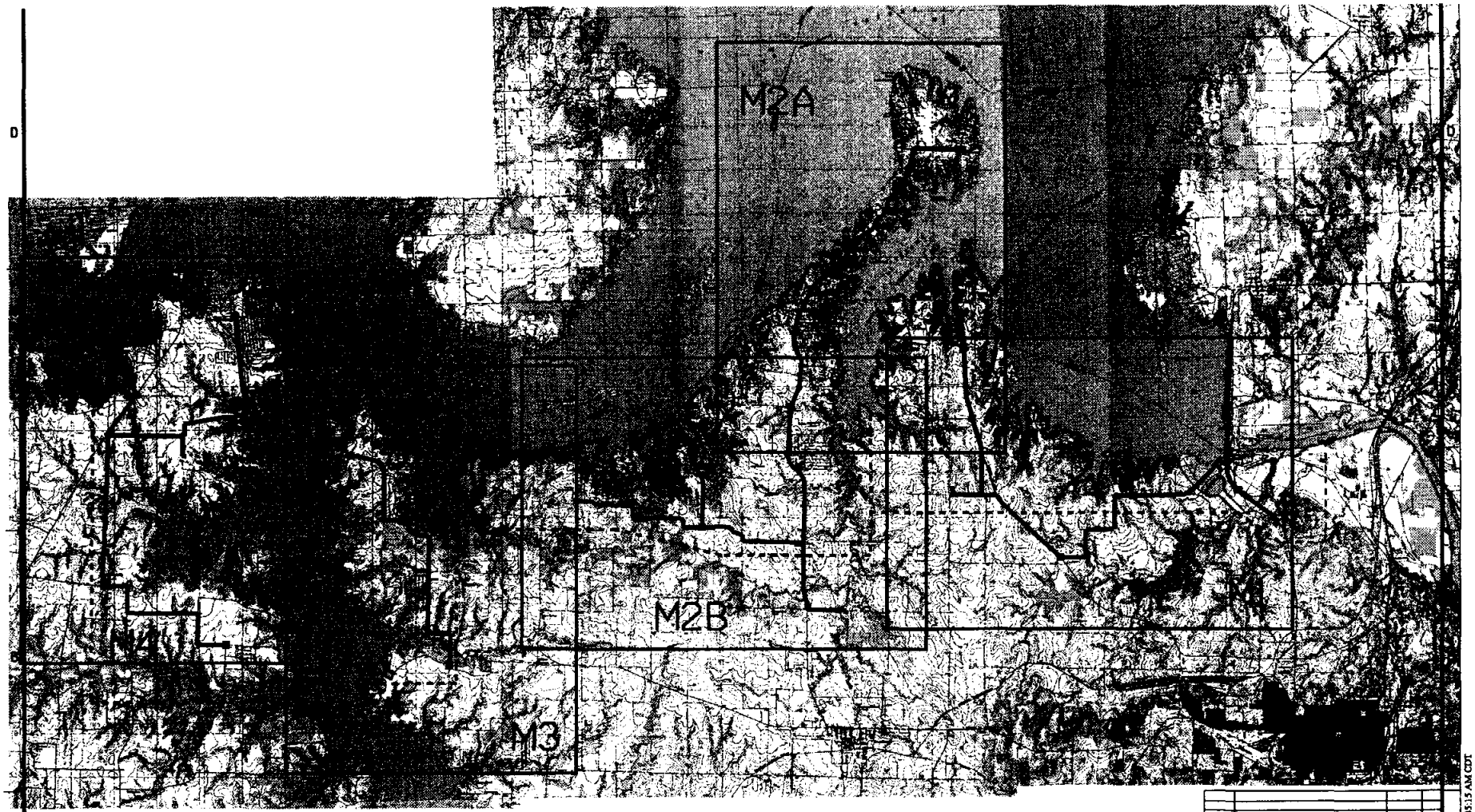
1.6 lbs x 1 mgd x 200 mg/l x 8.34 (lb/million gal x mg/l)

= 2670 lbs of oxygen per day

Assume typical aerator will transfer
2 lbs oxygen per hp hour = 48 lbs oxygen per hp day

$$\frac{\text{2670 lbs per day}}{\text{48 lbs per hp day}} = 56 \text{ hp}$$

DRAWINGS



LEGEND

REGION BOUNDARY ----------

PIPELINE ——————

INDEX

DRAWING	TITLE
M1	ALTERNATIVE 1, MULTIPLE TREATMENT PLANTS, TEXAS REGION 1
M2A	ALTERNATIVE 1, MULTIPLE TREATMENT PLANTS, TEXAS REGION 2
M2B	ALTERNATIVE 1, MULTIPLE TREATMENT PLANTS, TEXAS REGION 2
M3	ALTERNATIVE 1, MULTIPLE TREATMENT PLANTS, TEXAS REGION 3
M4	ALTERNATIVE 1, MULTIPLE TREATMENT PLANTS, TEXAS REGION 4

N

SYMBOL	DESCRIPTION	DATE	APPR

Tulsa District, Tulsa, Oklahoma — US Army Corps of Engineers

DESIGNED BY: E. LEHMAN
DRAWN BY:
E. LEHMAN
REVIEWED BY:
SUBMITTED BY: LARRY BEARDEN, CHIEF, CIVIL SECTION

RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS

PDC: FY: 02
TEXOMA REGIONAL SEWER SYSTEM STUDY

ALTERNATIVE 1
MULTIPLE TREATMENT PLANTS
LOCATION PLAN

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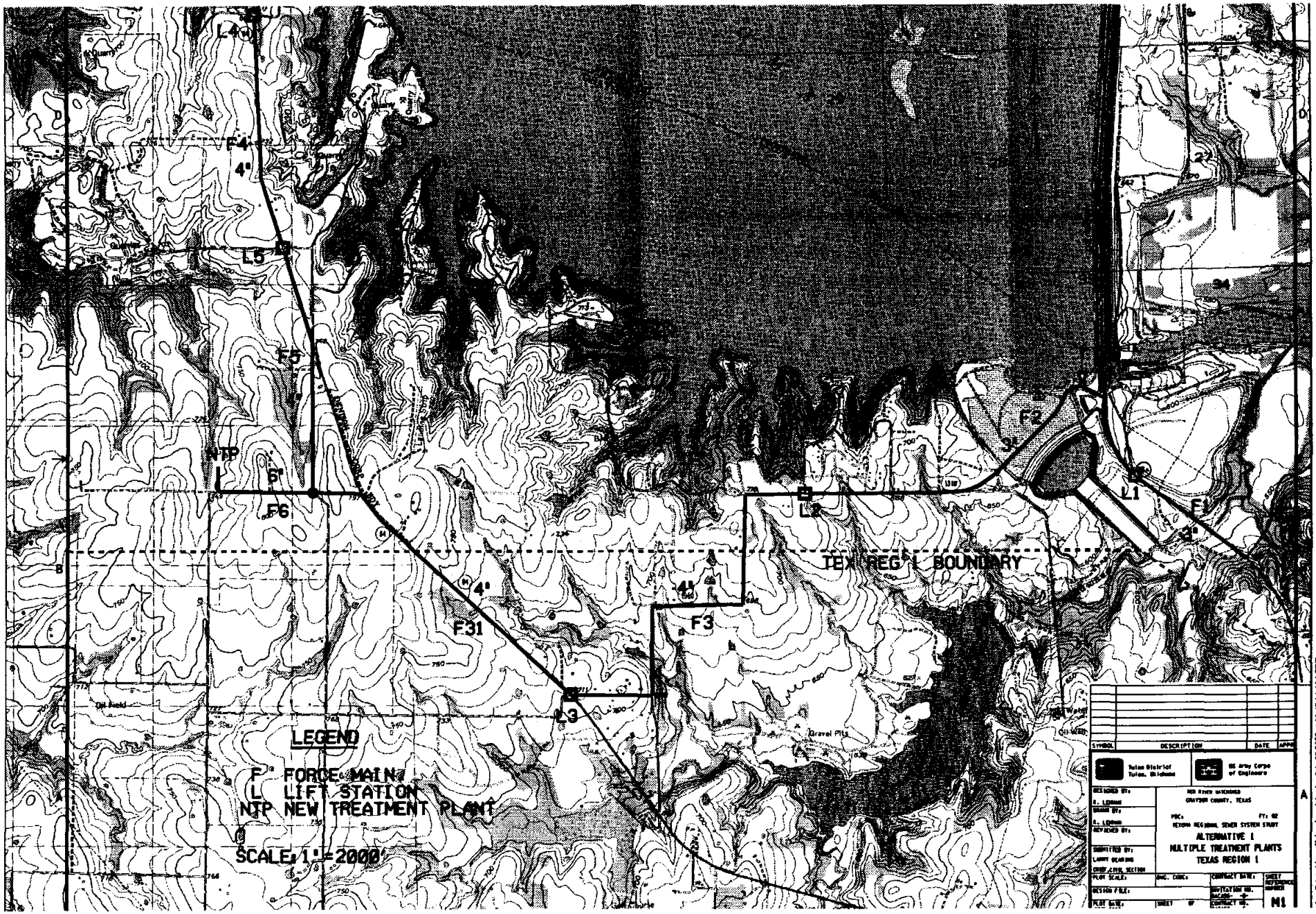
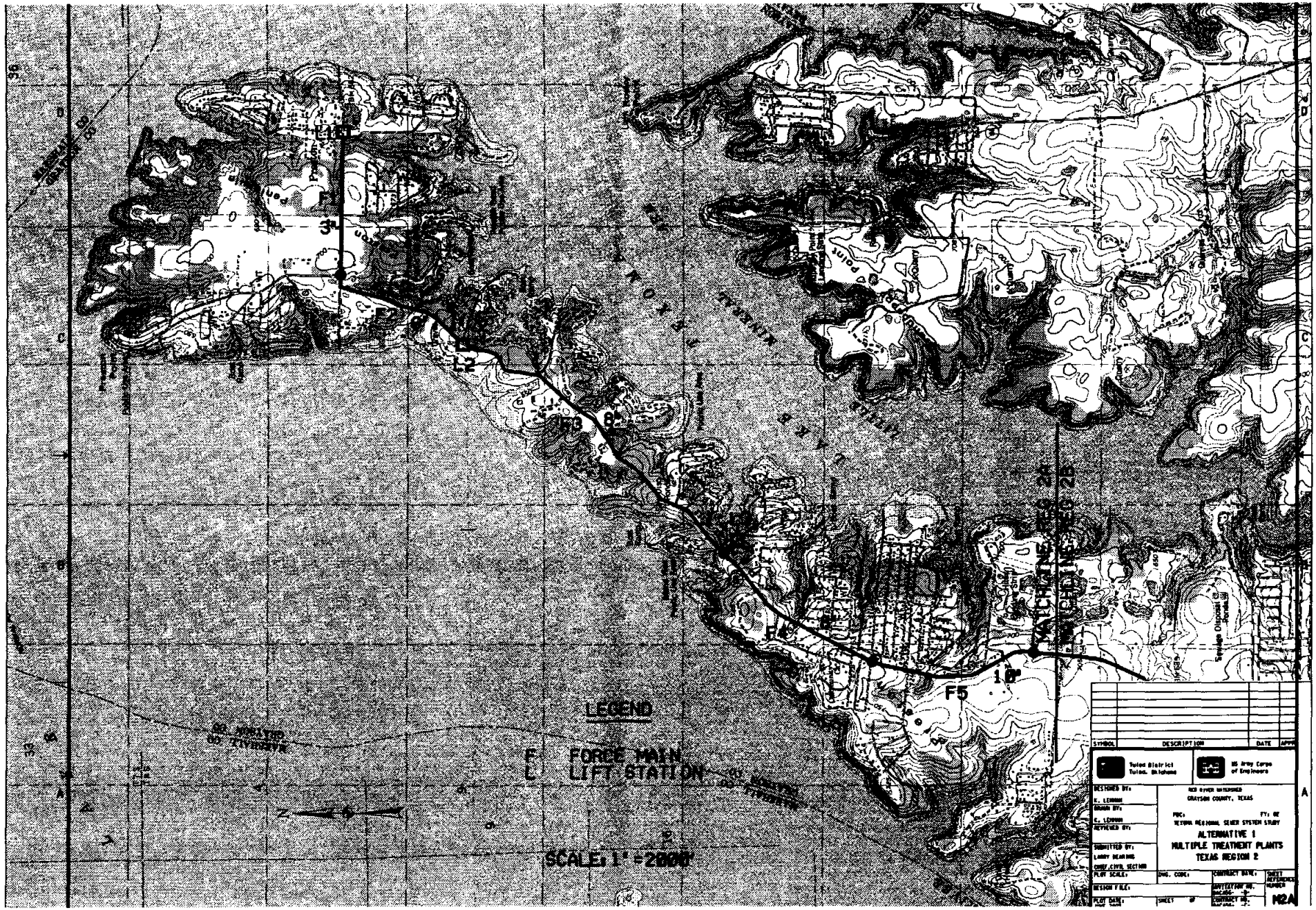
PLOT DATE: | SHEET OF

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L LIFT STATION
SCALE: 1" = 2000'
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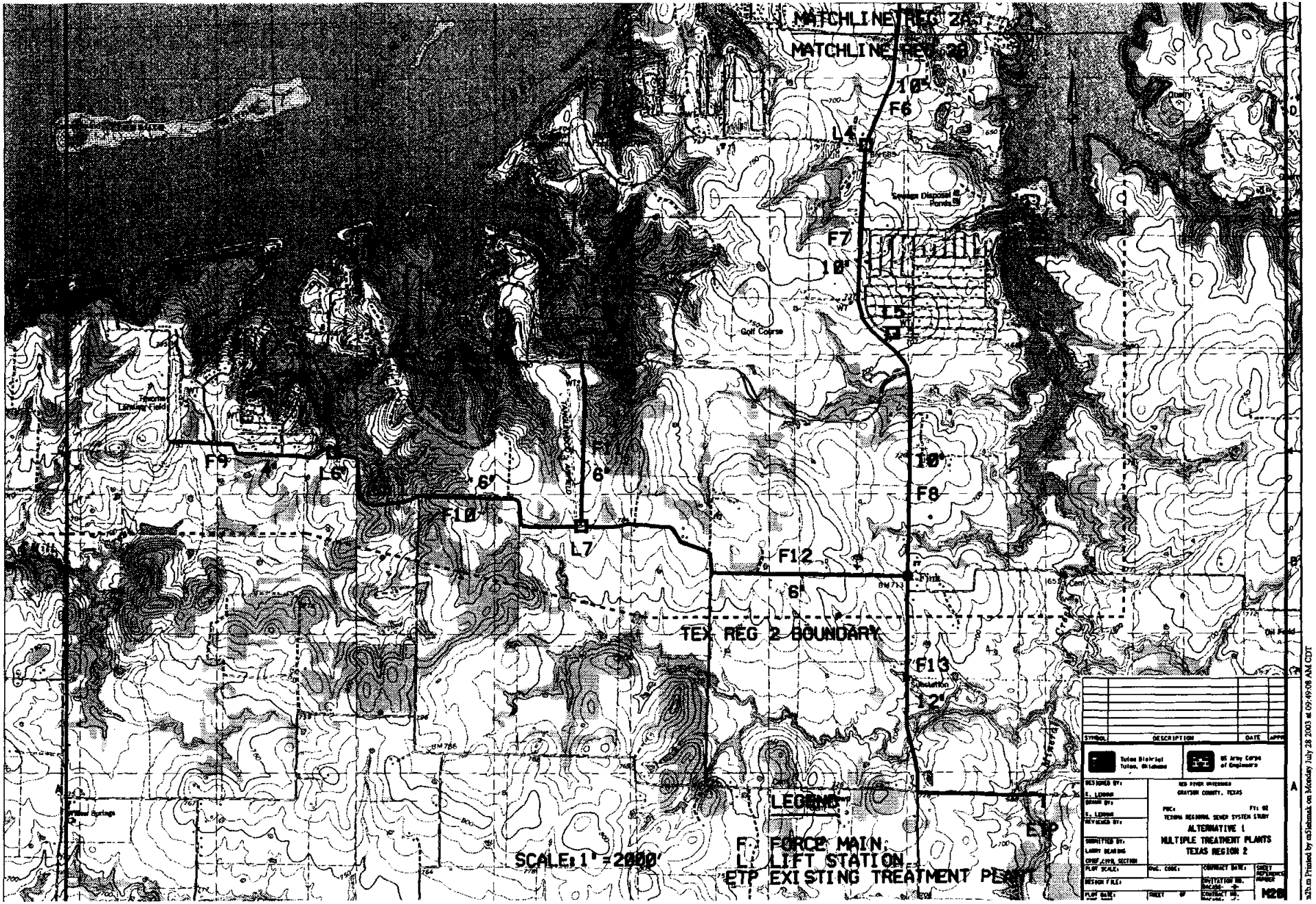
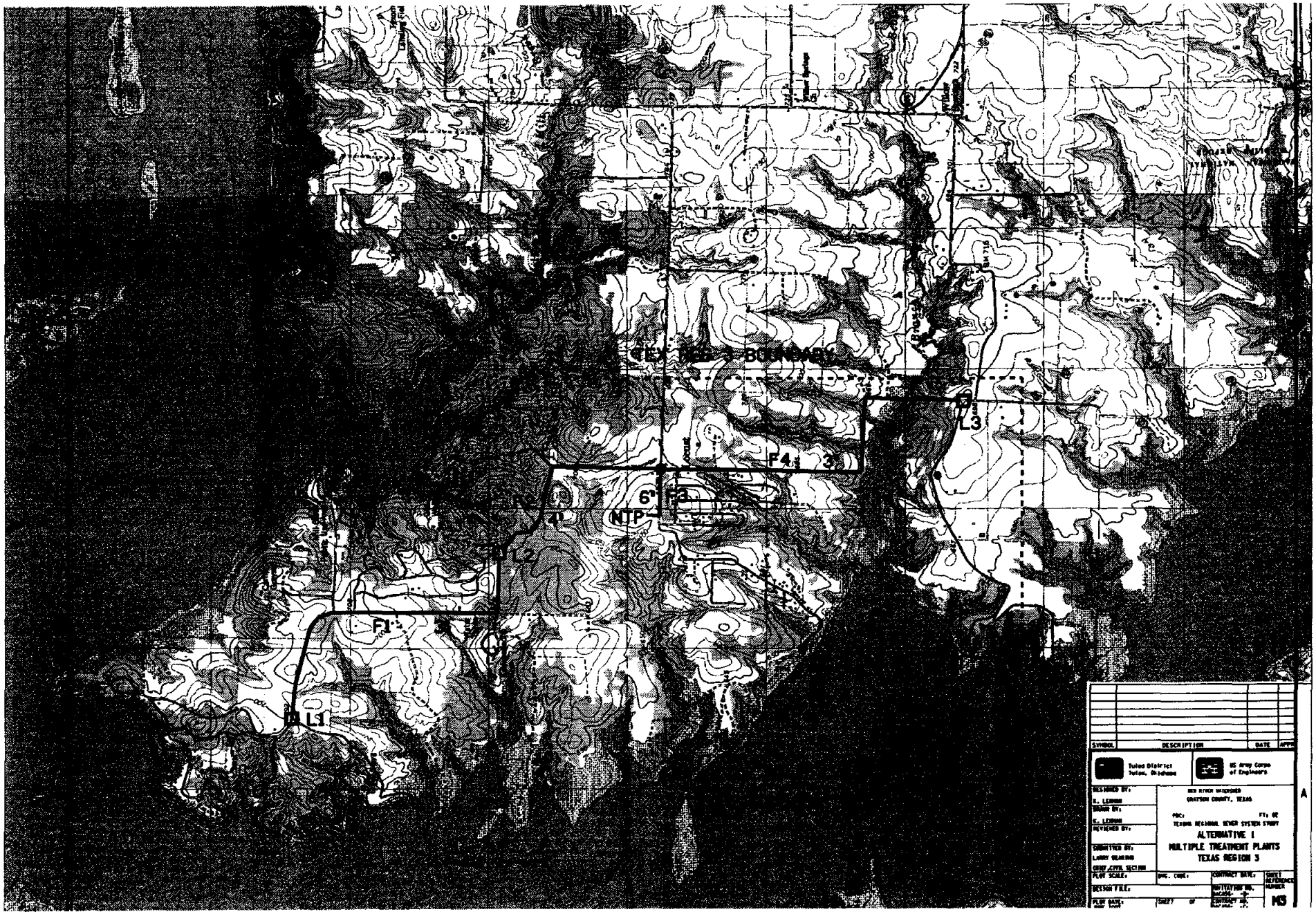
F2
F3
F4
F5
L1
L2
3P
8P
10P
SYMBOL
DESCRIPTION
DATE
Tulsa District
Tulsa, Oklahoma
US Army Corps of Engineers
DESIGNED BY:
K. LEMMON
DRAWN BY:
C. LOWDEN
REVIEWED BY:
SUBMITTED BY:
LARRY DEARING
CHIEF, CIVIL SECTION
PLAN SCALE:
DESIGN FILE:
PLOT DATE:
SHEET OF
ENG. CODE:
CONTRACT NAME:
CONTRACT NO.
SHEET REFERENCE NUMBER
M2A
RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS
FOR:
TEXOMA REGIONAL SEWER SYSTEM STUDY
ALTERNATIVE 1
MULTIPLE TREATMENT PLANTS
TEXAS REGION 2

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Tulsa, Oklahoma
US Army Corps
of Engineers
RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS
TEXOMA REGIONAL SEWER SYSTEM STUDY
ALTERNATIVE I
MULTIPLE TREATMENT PLANTS
TEXAS REGION 3
DESIGNED BY:
K. LEHMAN
DRAWN BY:
K. LEHMAN
REVIEWED BY:
SUBMITTED BY:
LARRY BEARDS
CHIEF, CIVIL SECTION
PLOT SCALE:
DESIGN F.B.C.
PLOT DATE:
SHEET OF
CONTRACT DATE:
CONTRACT NO.
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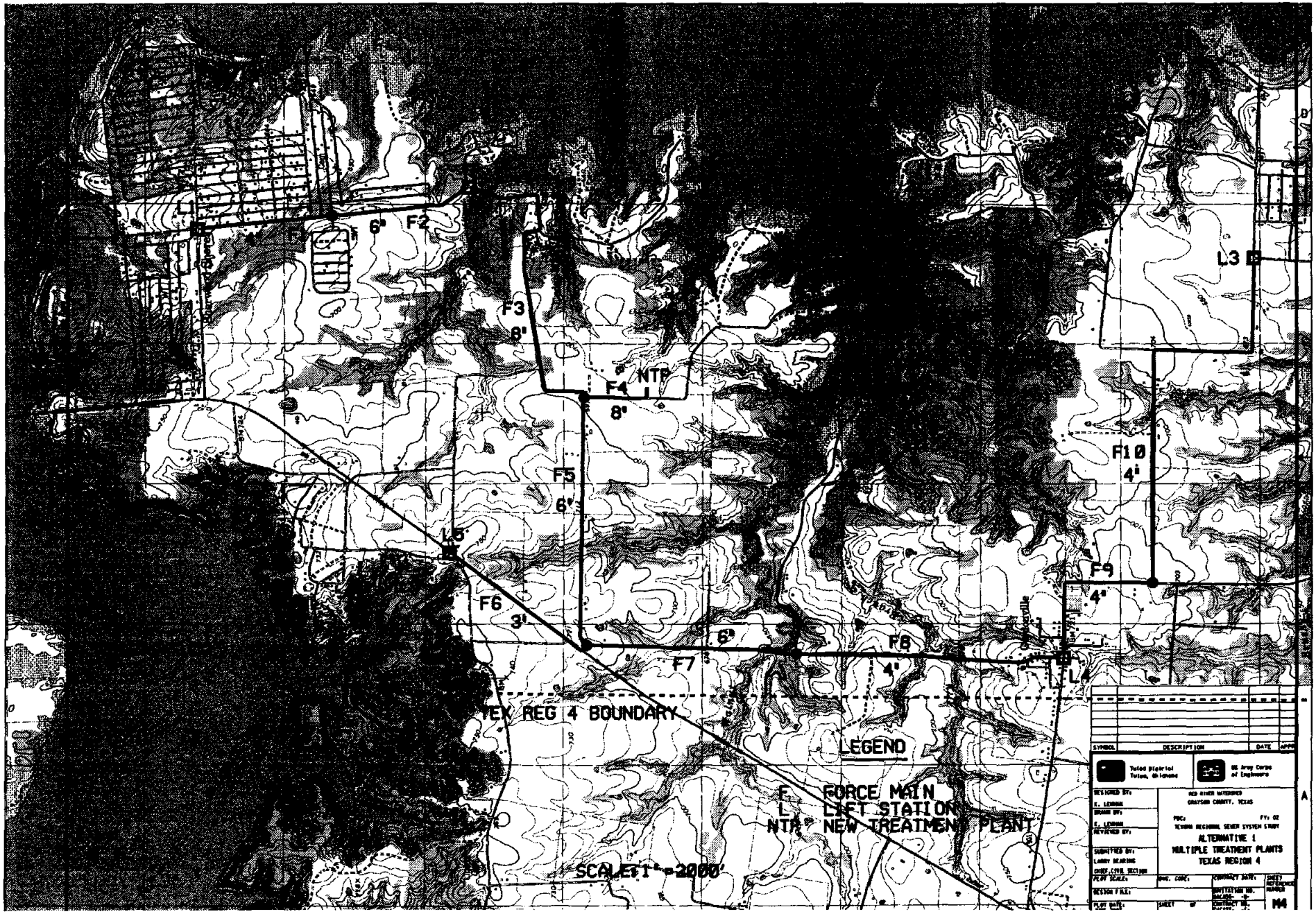
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F10
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3"
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F8
4"
F7
L4
TEX REG 4 BOUNDARY
LEGEND
F FORCE MAIN
L LIFT STATION
NTP NEW TREATMENT PLANT
SCALE 1"=2000'
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DATE
Texas Pipeline Tulsa, Oklahoma
US Army Corps of Engineers
DESIGNED BY: E. LEHMAN
DRAWN BY: E. LEHMAN
REVIEWED BY:
SUBMITTED BY: LARRY BEARING
CHIEF, CIVIL SECTION
PLAN SCALE:
DESIGN FILE:
PLOT DATE:
RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS
PROJ. FY: 02
REGIONAL SEWER SYSTEM STUDY
ALTERNATIVE 1
MULTIPLE TREATMENT PLANTS
TEXAS REGION 4
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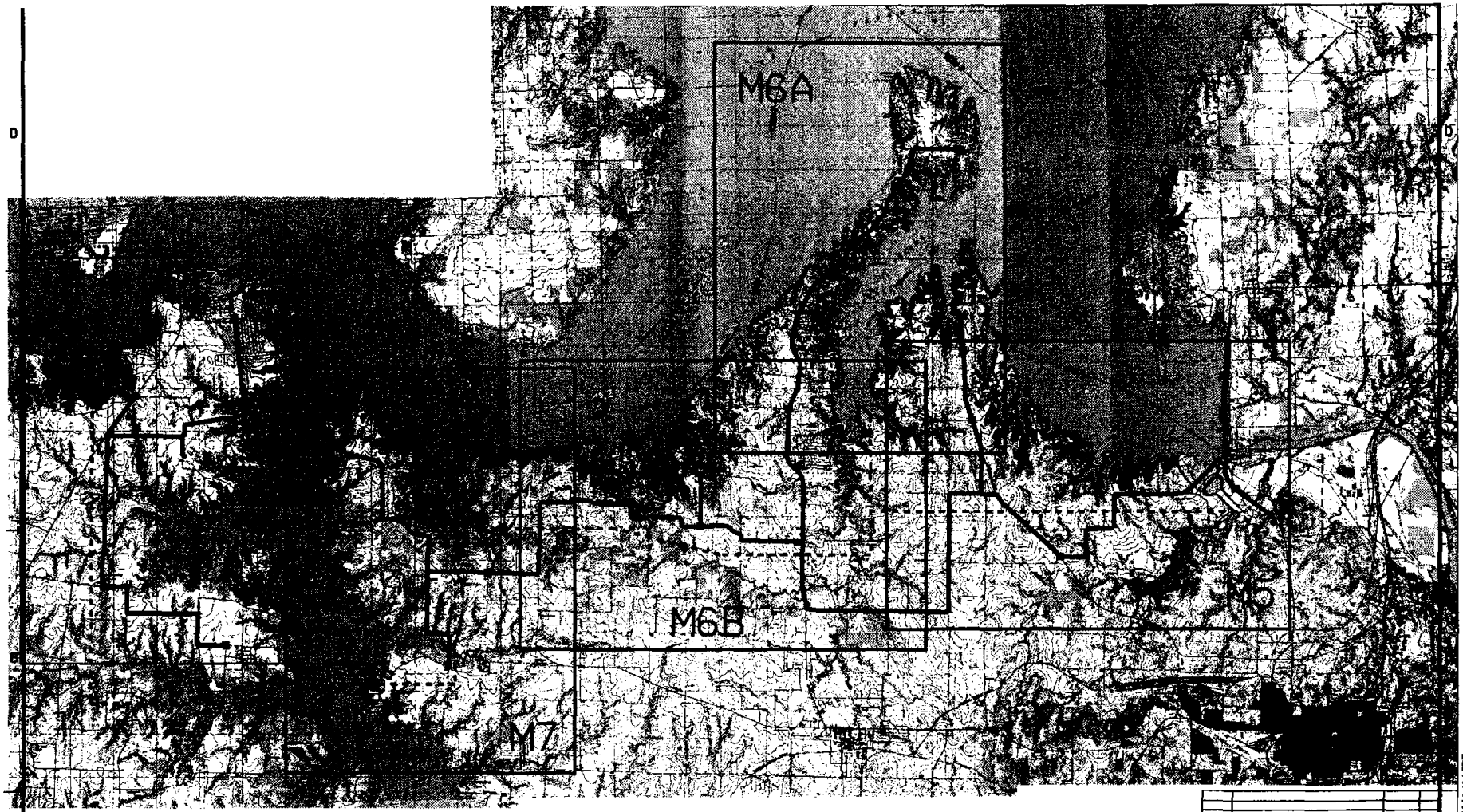

LEGEND

REGION BOUNDARY

PIPELINE

INDEX

DRAWING	TITLE
M5	ALTERNATIVE 2, COMBINE REGIONS 1, 2, & 3, TEXAS REGION 1
M6A	ALTERNATIVE 2, COMBINE REGIONS 1, 2, & 3, TEXAS REGION 2
M6B	ALTERNATIVE 2, COMBINE REGIONS 1, 2, & 3, TEXAS REGION 2
M7	ALTERNATIVE 2, COMBINE REGIONS 1, 2, & 3, TEXAS REGION 3

N

SYMBOL	DESCRIPTION	DATE	APPD

Tulsa District, Tulsa, Oklahoma

US Army Corps of Engineers

DESIGNED BY: E. LEHMAN
DRAWN BY: E. LEHMAN
REVIEWED BY:
SUBMITTED BY: LARRY BEARING
CHIEF, CIVIL SECTION
PLOT SCALE:
DESIGN FILE:
PLOT DATE:

RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS

PDC: FY: 02
TEXOMA REGIONAL SEWER SYSTEM STUDY

ALTERNATIVE 2
COMBINE REGIONS 1,2,& 3
LOCATION PLAN

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INITIATING ORGANIZATION:
CONTRACT NO.
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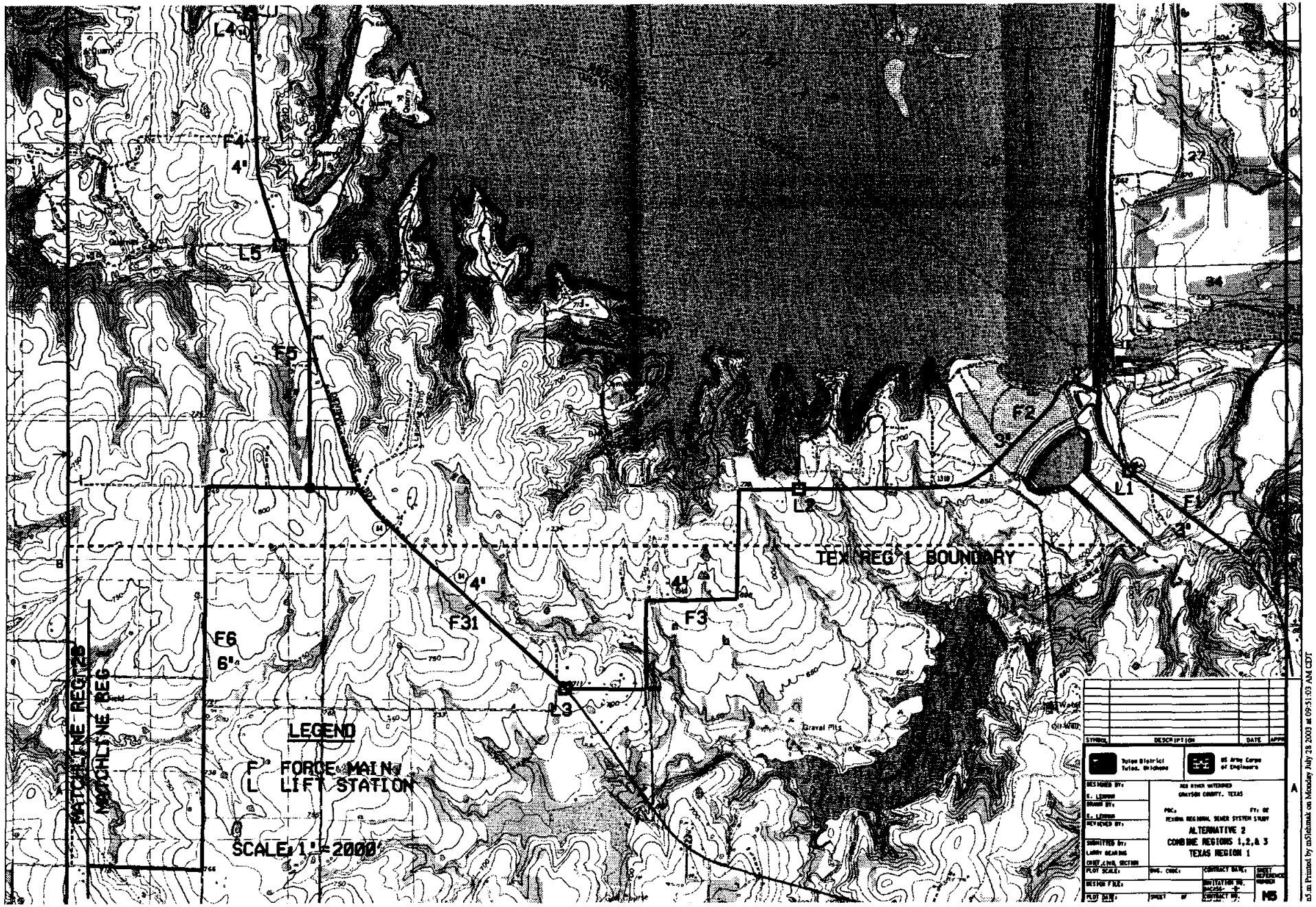

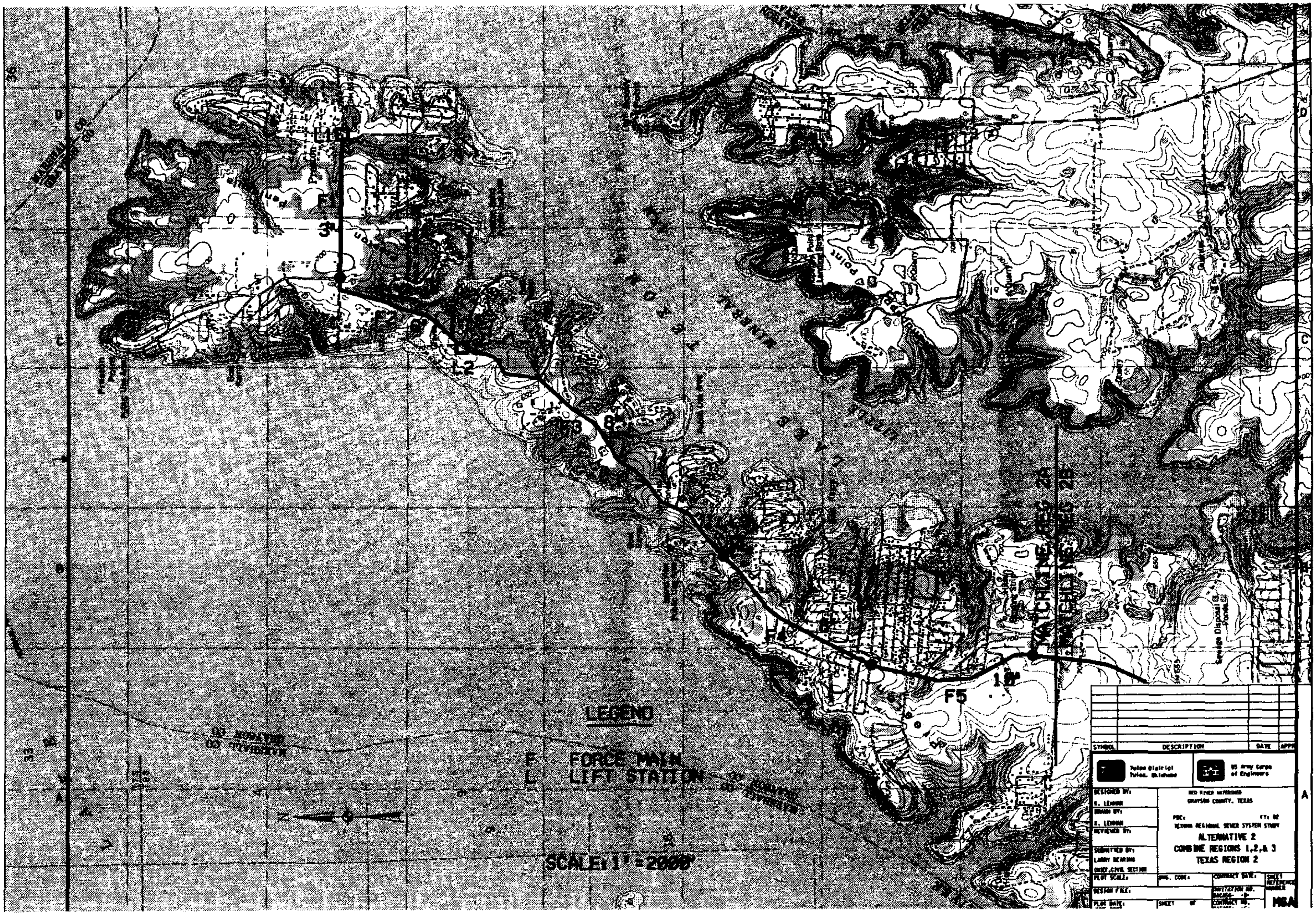
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Tulsa, Oklahoma
US Army Corps
of Engineers
DESIGNED BY:
DRAWN BY:
REVIEWED BY:
SUBMITTED BY:
LARRY BEARING
CHIEF, CIVIL SECTION
RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS
REGIONAL SEWER SYSTEM STUDY
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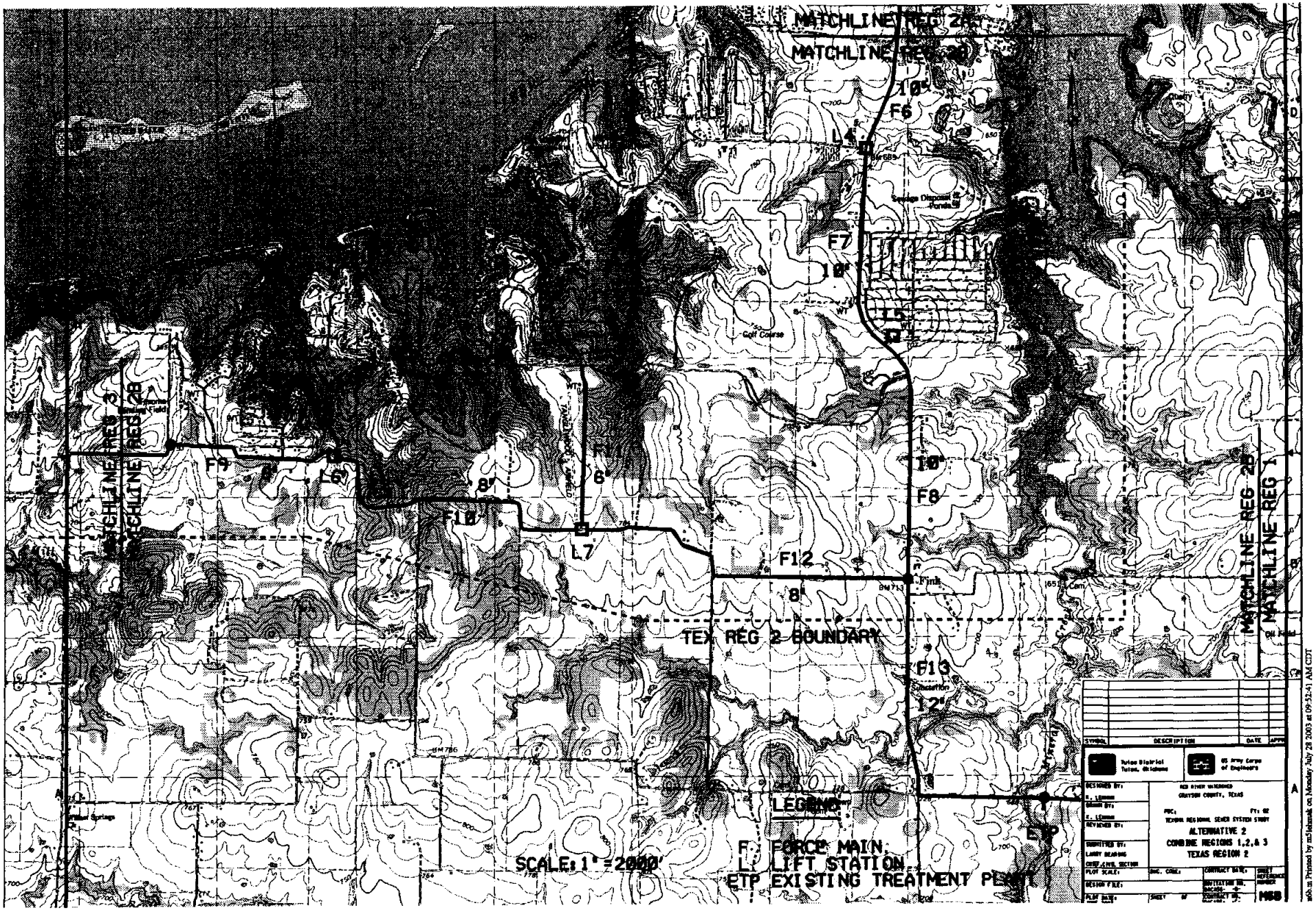

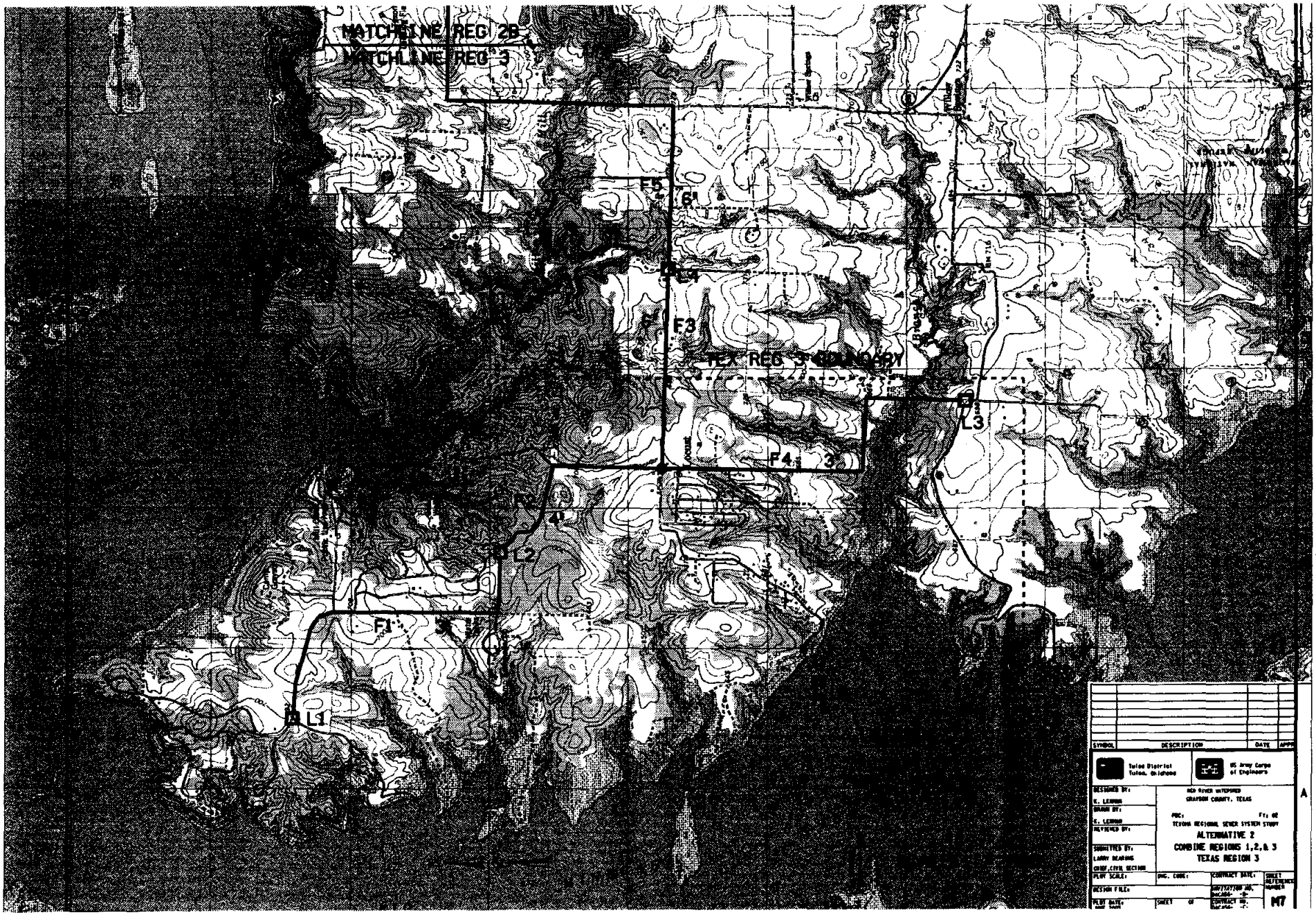
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SYMBOL
DESCRIPTION
DATE
APP'D
Tulsa District
Tulsa, Oklahoma
US Army Corps
of Engineers
DESIGNED BY:
E. LEHMAN
DRAWN BY:
E. LEHMAN
REVIEWED BY:
SUBMITTED BY:
LARRY BEARING
CHIEF, CIVIL SECTION
RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS
PDC:
FY: 02
TEXOMA REGIONAL SEWER SYSTEM STUDY
ALTERNATIVE 2
COMBINE REGIONS 1,2,& 3
TEXAS REGION 3
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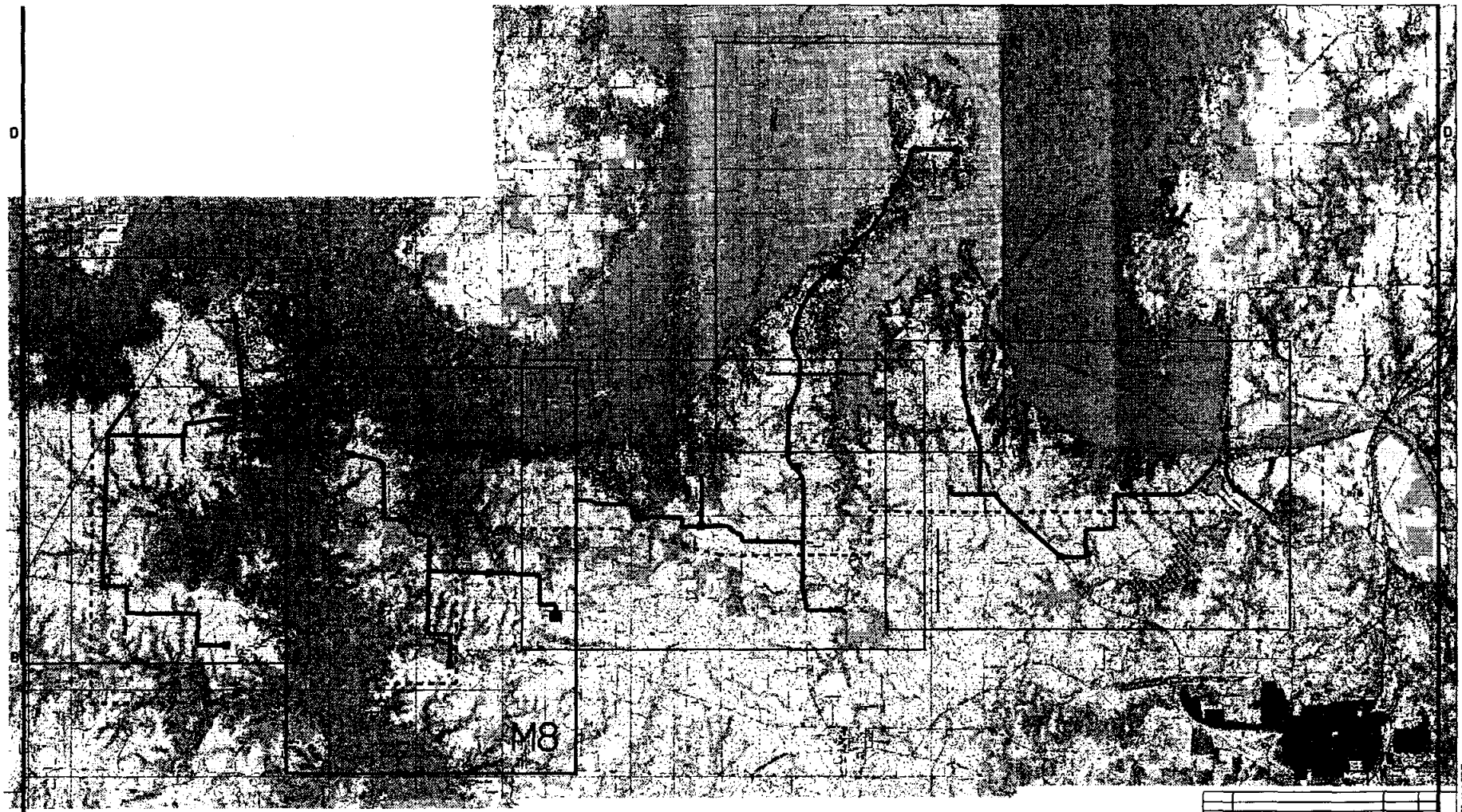

LEGEND

REGION BOUNDARY

PIPELINE

INDEX

DRAWING	TITLE
M8	ALTERNATIVE 3, CONSTRUCTED WETLANDS, TEXAS REGION 3

N

SYMBOL	DESCRIPTION	DATE	APPD

TULSA DISTRICT
TULSA, OKLAHOMA

US ARMY CORPS
OF ENGINEERS

RED RIVER WATERSHED
GRAYSON COUNTY, TEXAS

DESIGNED BY: K. LEHMAN
DRAWN BY: K. LEHMAN
REVIEWED BY:
SUBMITTED BY: LARRY DEARSON
CHIEF, CIVIL SECTION
PLOT SCALE:
DESIGN FILE:
PLOT DATE:

PROJ: FY= 02
TEXOMA REGIONAL SEWER SYSTEM STUDY

ALTERNATIVE 3
CONSTRUCTED WETLANDS
LOCATION PLAN

ORIG. CODE:
CONTRACT DATE:
CONTRACT NO.
SHEET
M3

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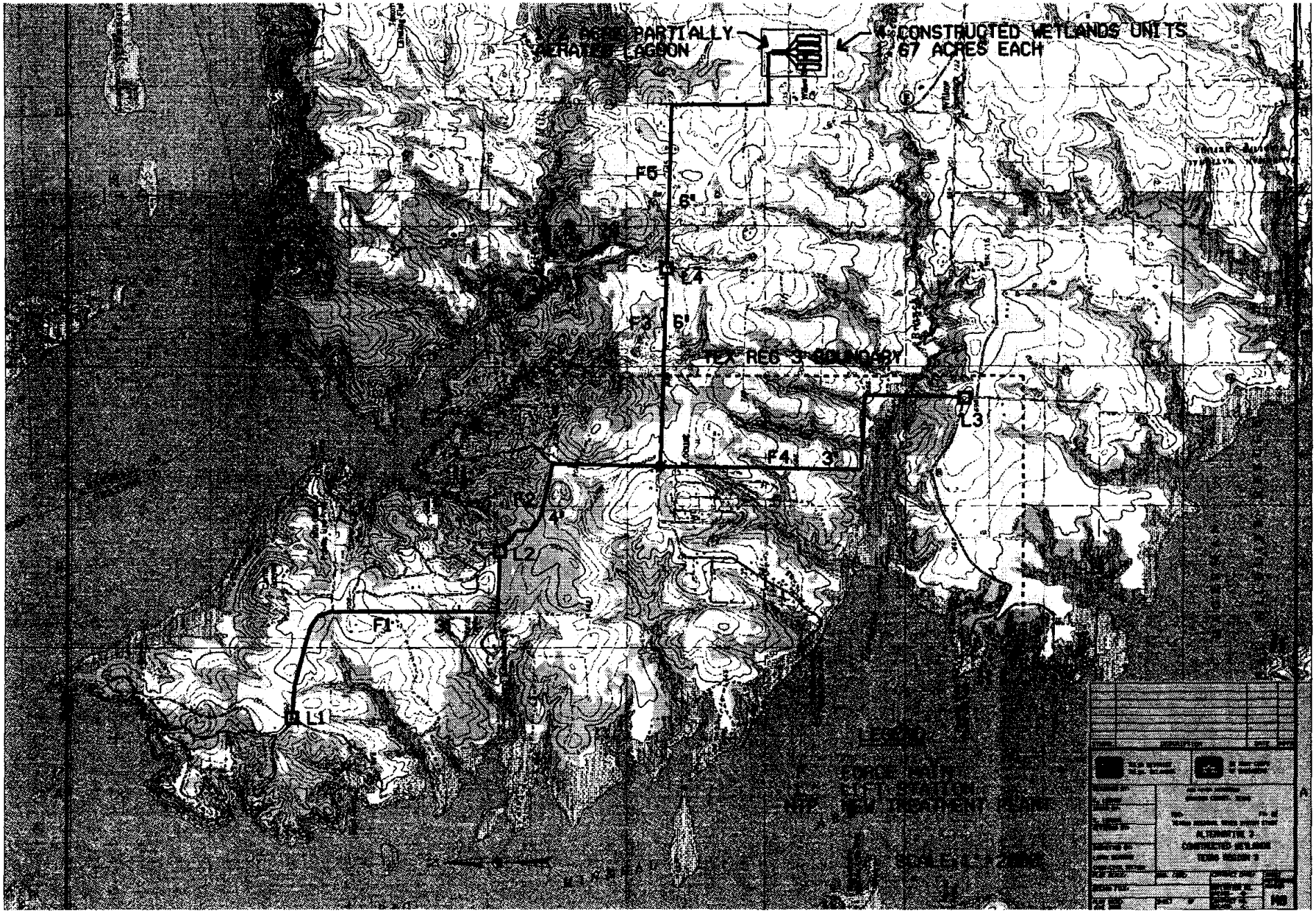
CONSTRUCTED WETLANDS UNITS
67 ACRES EACH
F5
6"
L4
F3
6"
REG 3 BOUNDARY
L3
F4
3"
F2
4"
L2
F1
3"
L1

APPENDIX 3

COST ANALYSIS

TEXOMA REGIONAL SEWER SYSTEM STUDY

COST ANALYSIS

June 2003

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TEXOMA REGIONAL SEWER SYSTEM STUDY

COST ANALYSIS

INTRODUCTION

It is assumed that the Regional Sewer System will be financed entirely with revenue bonds. The Texas Water Development Board indicates that the terms for the bonds will be 20 years at 4% interest. All system components were assumed to have a life of at least 20 years. All costs are in today's dollars.

The total initial cost of the system includes construction cost, engineering and construction management, and real estate. The fee for engineering and construction management is assumed to be 12% of the construction cost.

The initial cost will be financed by the sale of revenue bonds, which includes a 3-1/2% charge for legal fees and commissions. Using a capital recovery factor, based on bond terms of 20 years at 4% interest, an annual capital cost is calculated.

Included in the total annual cost is the annual capital cost and costs for operations and maintenance. Included in the operations and maintenance costs are energy costs, labor, sludge disposal, and chemicals for waste treatment.

The following tables show costs associated with each alternative.

TABLE 1

ALTERNATIVE 1

Texoma Lake Regional sanitary Sewer System Alternative 1 Total Cost	
Construction Cost ($)	17,041,000
Engineering and Construction Management (12% of construction cost)	2,045,000
Real Estate Cost ($)	1,720,000
Total Initial Cost ($)	20,806,000
Bond Legal Fees and Commissions (3-1/2%)	728,000
Total Bond Amount ($)	21,534,000
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	1,584,000
Annual Operations and Maintenance Cost ($)	511,230
Total Annual Cost ($)	2,095,230
Number of Septic Systems Connected	5,460
Annual Cost Per Connection ($)	384
Monthly Cost Per Connection ($)	32

TABLE 2

ALTERNATIVE 2

Texoma Lake Regional Sanitary Sewer System Alternative 2, Texas Region 1 Total Cost	
Construction Cost ($)	1,639,000
Engineering and Construction Management (12% of construction cost)	197,000
Real Estate Cost ($)	114,650
Total Initial Cost ($)	1,950,650
Bond Legal Fees and Commissions (3-1/2%)	68,000
Total Bond Amount ($)	2,018,650
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	149,000
Annual Operations and Maintenance Cost ($)	49,170
Total Annual Cost ($)	198,170
Number of Septic Systems Connected	385
Annual Cost Per Connection ($)	515
Monthly Cost Per Connection ($)	43

Texoma Lake Regional Sanitary Sewer System Alternative 2, Texas Region 2 Total Cost	
Construction Cost ($)	9,044,000
Engineering and Construction Management (12% of construction cost)	1,085,000
Real Estate Cost ($)	888,350
Total Initial Cost ($)	11,017,350
Bond Legal Fees and Commissions (3-1/2%)	386,000
Total Bond Amount ($)	11,403,350
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	839,000
Annual Operations and Maintenance Cost ($)	271,320
Total Annual Cost ($)	1,110,320
Number of Septic Systems Connected	2,983
Annual Cost Per Connection ($)	372
Monthly Cost Per Connection ($)	31

TABLE 2 (Continued)

Texoma Lake Regional Sanitary Sewer System Alternative 2, Texas Region 3 Total Cost	
Construction Cost ($)	1,749,000
Engineering and Construction Management (12% of construction cost)	210,000
Real Estate Cost ($)	154,550
Total Initial Cost ($)	2,113,550
Bond Legal Fees and Commissions (3-1/2%)	74,000
Total Bond Amount ($)	2,187,550
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	161,000
Annual Operations and Maintenance Cost ($)	52,470
Total Annual Cost ($)	213,470
Number of Septic Systems Connected	519
Annual Cost Per Connection ($)	411
Monthly Cost Per Connection ($)	34

Texoma Lake Regional Sanitary Sewer System Alternative 2, Texas Region 4 Total Cost	
Construction Cost ($)	4,680,000
Engineering and Construction Management (12% of construction cost)	562,000
Real Estate Cost ($)	494,750
Total Initial Cost ($)	5,736,750
Bond Legal Fees and Commissions (3-1/2%)	201,000
Total Bond Amount ($)	5,937,750
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	437,000
Annual Operations and Maintenance Cost ($)	140,400
Total Annual Cost ($)	577,400
Number of Septic Systems Connected	1,573
Annual Cost Per Connection ($)	367
Monthly Cost Per Connection ($)	31

TABLE 2 (Continued)

Texoma Lake Regional Sanitary Sewer System Alternative 2 Total Cost	
Construction Cost ($)	17,112,000
Engineering and Construction Management (12% of construction cost)	2,053,000
Real Estate Cost ($)	1,652,300
Total Initial Cost ($)	20,817,300
Bond Legal Fees and Commissions (3-1/2%)	729,000
Total Bond Amount ($)	21,546,300
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	1,585,000
Annual Operations and Maintenance Cost ($)	513,360
Total Annual Cost ($)	2,098,360
Number of Septic Systems Connected	5,460
Annual Cost Per Connection ($)	384
Monthly Cost Per Connection ($)	32

TABLE 3 (Continued)

Texoma Lake Regional Sanitary Sewer System Alternative 3, Texas Region 3 Total Cost	
Construction Cost ($)	1,658,000
Engineering and Construction Management (12% of construction cost)	199,000
Real Estate Cost ($)	295,000
Total Initial Cost ($)	2,152,000
Bond Legal Fees and Commissions (3-1/2%)	75,000
Total Bond Amount ($)	2,227,000
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	164,000
Annual Operations and Maintenance Cost ($)	49,740
Total Annual Cost ($)	213,740
Number of Septic Systems Connected	519
Annual Cost Per Connection ($)	412
Monthly Cost Per Connection ($)	34

Texoma Lake Regional sanitary Sewer System Alternative 3, Texas Region 4 Total Cost	
Construction Cost ($)	4,680,000
Engineering and Construction Management (12% of construction cost)	562,000
Real Estate Cost ($)	494,750
Total Initial Cost ($)	5,736,750
Bond Legal Fees and Commissions (3-1/2%)	201,000
Total Bond Amount ($)	5,937,750
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	437,000
Annual Operations and Maintenance Cost ($)	140,400
Total Annual Cost ($)	577,400
Number of Septic Systems Connected	1,573
Annual Cost Per Connection ($)	367
Monthly Cost Per Connection ($)	31

TABLE 3 (Continued)

Texoma Lake Regional sanitary Sewer System Alternative 3 Total Cost	
Construction Cost ($)	16,924,000
Engineering and Construction Management (12% of construction cost)	2,031,000
Real Estate Cost ($)	1,834,750
Total Initial Cost ($)	20,789,750
Bond Legal Fees and Commissions (3-1/2%)	728,000
Total Bond Amount ($)	21,517,750
Capital Recovery Factor (20 years at 4%)	0.07358
Annual Capital Cost ($)	1,583,000
Annual Operations and Maintenance Cost ($)	507,720
Total Annual Cost ($)	2,090,720
Number of Septic Systems Connected	5,460
Annual Cost Per Connection ($)	383
Monthly Cost Per Connection ($)	32

CONSTRUCTION COST

For a detailed cost estimate, refer to the cost estimate performed by Cost Engineering Branch. The estimate is located at then end of this appendix.

REAL ESTATE COST

For details of real estate costs, refer to Appendix 5. Easement costs for the primary collection system are as follows: Alternative 1, $355,000; Alternative 2, $287,250; Alternative 3, $469,500.

It has been assumed that easements for the secondary collection system will be donated by the owner. The administration cost for obtaining the easements is assumed to be $500 per owner. Easements will be required from about one-half of the owners for the secondary collection system, for a total of 2,730 easements. Therefore, the cost for obtaining easements for

the secondary collection system will be about $1,365,000. The following table shows the estimated real estate needed for each alternative.

TABLE 4

ALTERNATIVES 1-3

ALTERNATIVE 1
TEXOMA REGIONAL SANITARY SEWER SYSTEM
TREATMENT PLANTS

Region	Treatment Plant Type	Plant Capacity (mgd)	Land Area (acres)	Primary Collection System Real Estate Cost
TX1	Sequential Batch Reactor	0.142	5	$ 50,750
TX2	Existing Mechanical Aeration	Expand from 0.35 to 1.218	20	$152,000
TX3	Sequential Batch Reactor	0.169	5	$ 50,750
TX4	Sequential Batch Reactor	0.463	10	$101,500
		Totals	40	$355,000

ALTERNATIVE 2
TEXOMA REGIONAL SANITARY SEWER SYSTEM
TREATMENT PLANTS

Region	Treatment Plant Type	Plant Capacity (mgd)	Land Area (acres)	Primary Collection System Real Estate Cost
TX1	To Region TX2		0	$ 0
TX2	Existing Mechanical Aeration	Expand from 0.35 to 1.429	25	$185,750
TX3	To Region TX2		0	$ 0
TX4	Sequential Batch Reactor	0.463	10	$101,500
		Totals	35	$287,250

ALTERNATIVE 3
TEXOMA REGIONAL SANITARY SEWER SYSTEM
TREATMENT PLANTS

Region	Treatment Plant Type	Plant Capacity (mgd)	Land Area (acres)	Primary Collection System Real Estate Cost
TX1	Sequential Batch Reactor	0.142	5	$ 50,750
TX2	Existing Mechanical Aeration	Expand from 0.35 to 1.218	20	$152,000
TX3	Constructed wetland (four units/1.67 acres each) preceded by partially aerated lagoon (0.5 acre)	0.169	35	$165,250
TX4	Sequential Batch Reactor	0.463	10	$101,500
		Totals	70	$469,500

Texoma Regional Sewer System
Texoma Lake, Grayson Co., Texas
Concept Design Study

Designed By: Tulsa District
Estimated By: Tom Skelton

Prepared By: Corps of Engineers

Preparation Date: 02/14/03
Effective Date of Pricing: 02/14/03

Sales Tax: 7.50%

This estimate is for three alternative plans, for the primary and secondary collection sewage systems, as well as the treatment facilities for an area on the south side of Lake Texoma. The costs shown here are intended to show probable construction contract costs. They do not include the non contract costs, such as design costs, or government supervision and administration costs. The costs for items that are not designed yet, such as lift stations, was based on past similar projects. The cost for the secondary collection system was based on an existing design used at Grand Lake. A ratio of the quantities of pipelines, manholes & lift stations etc. was based on the number of connections at each location. The cost for the sewage treatment facilities was based on costs from RS Means Building Cost Data and from past projects.

** PROJECT INDIRECT SUMMARY - Facility **

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01 Alternative No. 1									
01.01 Region No. 1			839,030	62,927	45,098	94,706	10,418	1,052,178	
01.02 Region No. 2			3,393,752	254,531	182,414	383,070	42,138	4,255,905	
01.03 Region No. 3			769,208	57,691	41,345	86,824	9,551	964,618	
01.04 Region No. 4			1,761,050	132,079	94,656	198,779	21,866	2,208,429	
01.05 Secondary Collection System			6,833,306	512,498	367,290	771,309	84,844	8,569,248	
TOTAL Alternative No. 1			13,596,346	1019726	730,804	1534688	168,816	17,050,379	
02 Alternative No. 2									
02.01 Region No. 1			448,204	33,615	24,091	50,591	5,565	562,066	
02.02 Region No. 2			4,313,898	323,542	231,872	486,931	53,562	5,409,806	
02.03 Region No. 3			295,972	22,198	15,908	33,408	3,675	371,161	
02.04 Region No. 4			1,761,050	132,079	94,656	198,779	21,866	2,208,429	
02.05 Secondary Collection System			6,833,306	512,498	367,290	771,309	84,844	8,569,248	
TOTAL Alternative No. 2			13,652,430	1023932	733,818	1541018	169,512	17,120,710	
03 Alternative No. 3									
03.01 Region No. 1			839,030	62,927	45,098	94,706	10,418	1,052,178	
03.02 Region No. 2			3,393,752	254,531	182,414	383,070	42,138	4,255,905	
03.03 Region No. 3			676,595	50,745	36,367	76,371	8,401	848,478	
03.04 Region No. 4			1,761,050	132,079	94,656	198,779	21,866	2,208,429	
03.05 Secondary Collection System			6,833,306	512,498	367,290	771,309	84,844	8,569,248	
TOTAL Alternative No. 3			13,503,734	1012780	725,826	1524234	167,666	16,934,239	

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01	Alternative No. 1									
01.01	Region No. 1									
01.01.01	Primary Collection System Piping									
01.01.01.01	3" Force Main (F-1)	3300.00	LF	15,665	1,175	842	1,768	195	19,645	5.95
01.01.01.02	3" Force Main (F-2)	10300.00	LF	48,889	3,667	2,628	5,518	607	61,309	5.95
01.01.01.03	4" Force Main (F-3)	10300.00	LF	56,115	4,209	3,016	6,334	697	70,371	6.83
01.01.01.04	4" Force Main (F-4)	6800.00	LF	37,057	2,779	1,992	4,183	460	46,471	6.83
01.01.01.05	4" Force Main (F-5)	5000.00	LF	27,242	2,043	1,464	3,075	338	34,162	6.83
01.01.01.06	6" Force Main (F-6)	2600.00	LF	19,858	1,489	1,067	2,241	247	24,903	9.58
01.01.01.31	4" Force Main (F-31)	8200.00	LF	44,672	3,350	2,401	5,042	555	56,021	6.83
	TOTAL Primary Collection System Piping			249,499	18,712	13,411	28,162	3,098	312,883	
01.01.02	Lift Stations for Primary System									
01.01.02.L1	62 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
01.01.02.L2	165 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
01.01.02.L3	165 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
01.01.02.L4	141 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
01.01.02.L5	159 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
	TOTAL Lift Stations for Primary System			72,651	5,449	3,905	8,200	902	91,107	
01.01.04	Seweage Treatment Plant									
01.01.04.01	0.142 MGD Sequential Batch React			516,880	38,766	27,782	58,343	6,418	648,189	
	TOTAL Seweage Treatment Plant			516,880	38,766	27,782	58,343	6,418	648,189	
	TOTAL Region No. 1			839,030	62,927	45,098	94,706	10,418	1,052,178	
01.02	Region No. 2									
01.02.01	Primary Collection System									
01.02.01.01	3" Force Main (F-1)	3400.00	LF	16,142	1,211	868	1,822	200	20,243	5.95
01.02.01.02	6" Force Main (F-2)	3600.00	LF	27,502	2,063	1,478	3,104	341	34,488	9.58
01.02.01.03	8" Force Main (F-3)	8500.00	LF	91,825	6,887	4,936	10,365	1,140	115,153	13.55
01.02.01.04	8" Force Main (F-4)	4400.00	LF	47,529	3,565	2,555	5,365	590	59,604	13.55
01.02.01.05	10" Force Main (F-5)	4200.00	LF	63,719	4,779	3,425	7,192	791	79,906	19.03
01.02.01.06	10" Force Main (F-6)	3600.00	LF	54,616	4,096	2,936	6,165	678	68,491	19.03
01.02.01.07	10" Force Main (F-7)	10700.00	LF	162,333	12,175	8,725	18,323	2,016	203,573	19.03
01.02.01.08	10" Force Main (F-8)	5800.00	LF	87,993	6,599	4,730	9,932	1,093	110,347	19.03
01.02.01.09	4" Force Main (F-9)	4400.00	LF	23,973	1,798	1,289	2,706	298	30,063	6.83

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01.02.01.10	6" Force Main (F-10)	7600.00	LF	59,589	4,469	3,203	6,726	740	74,728	9.83
01.02.01.11	6" Force Main (F-11)	3500.00	LF	26,745	2,006	1,438	3,019	332	33,540	9.58
01.02.01.12	6" Force Main (F-12)	8600.00	LF	65,695	4,927	3,531	7,415	816	82,385	9.58
01.02.01.13	12" Force Main (F-13)	8800.00	LF	179,440	13,458	9,645	20,254	2,228	225,025	25.57
	TOTAL Primary Collection System			907,103	68,033	48,757	102,389	11,263	1,137,545	
01.02.02	Lift Stations for Primary System									
01.02.02.L1	96 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
01.02.02.L2	449 GPM Duplex Lift Station	1.00	EA	24,933	1,870	1,340	2,814	310	31,267	31267
01.02.02.L3	169 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
01.02.02.L4	1303 GPM Duplex Lift Station	1.00	EA	48,050	3,604	2,583	5,424	597	60,257	60257
01.02.02.L5	106 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
01.02.02.L6	243 GPM Duplex Lift Station	1.00	EA	18,392	1,379	989	2,076	228	23,064	23064
01.02.02.L7	585 GPM Duplex Lift Station	1.00	EA	29,925	2,244	1,608	3,378	372	37,528	37528
	TOTAL Lift Stations for Primary System			160,409	12,031	8,622	18,106	1,992	201,159	
01.02.04	Expand Seweage Treatment Plant									
01.02.04.01	Expand 0.36 MGD to 1.018 MGD			2,326,240	174,468	125,035	262,574	28,883	2,917,201	
	TOTAL Expand Seweage Treatment Plant			2,326,240	174,468	125,035	262,574	28,883	2,917,201	
	TOTAL Region No. 2			3,393,752	254,531	182,414	383,070	42,138	4,255,905	
01.03	Region No. 3									
01.03.01	Primary Collection System									
01.03.01.01	3" Force Main (F-1)	8900.00	LF	42,244	3,168	2,271	4,768	525	52,976	5.95
01.03.01.02	4" Force Main (F-2)	5400.00	LF	29,423	2,207	1,581	3,321	365	36,898	6.83
01.03.01.03	6" Force Main (F-3)	1000.00	LF	7,641	573	411	862	95	9,582	9.58
01.03.01.04	8" Force Main (F-4)	8800.00	LF	41,777	3,133	2,246	4,716	519	52,390	5.95
	TOTAL Primary Collection System			121,085	9,081	6,508	13,667	1,503	151,846	
01.03.02	Lift Stations for Primary System									
01.03.02.L1	64 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
01.03.02.L2	204 GPM Duplex Lift Station	1.00	EA	18,392	1,379	989	2,076	228	23,064	23064
01.03.02.L3	53 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
	TOTAL Lift Stations for Primary System			32,963	2,472	1,772	3,721	409	41,337	

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01.03.04 Sewage Treatment Plant									
01.03.04.01 0.169 MGD Sequential Batch React			615,160	46,137	33,065	69,436	7,638	771,436	
TOTAL Sewage Treatment Plant			615,160	46,137	33,065	69,436	7,638	771,436	
TOTAL Region No. 3			769,208	57,691	41,345	86,824	9,551	964,618	
01.04 Region No. 4									
01.04.01 Primary Collection System									
01.04.01.01 4" Force Main (F-1)	3200.00	LF	17,430	1,307	937	1,967	216	21,859	6.83
01.04.01.02 6" Force Main (F-2)	3300.00	LF	25,210	1,891	1,355	2,846	313	31,615	9.58
01.04.01.03 8" Force Main (F-3)	8000.00	LF	86,415	6,481	4,645	9,754	1,073	108,367	13.55
01.04.01.04 8" Force Main (F-4)	1800.00	LF	19,445	1,458	1,045	2,195	241	24,385	13.55
01.04.01.05 6" Force Main (F-5)	6000.00	LF	45,837	3,438	2,464	5,174	569	57,482	9.58
01.04.01.06 3" Force Main (F-6)	4200.00	LF	19,927	1,495	1,071	2,249	247	24,989	5.95
01.04.01.07 6" Force Main (F-7)	4700.00	LF	35,905	2,693	1,930	4,053	446	45,026	9.58
01.04.01.08 4" Force Main (F-8)	6700.00	LF	36,507	2,738	1,962	4,121	453	45,782	6.83
01.04.01.09 4" Force Main (F-9)	3900.00	LF	21,249	1,594	1,142	2,398	264	26,647	6.83
01.04.01.10 4" Force Main (F-10)	10200.00	LF	55,565	4,167	2,987	6,272	690	69,681	6.83
TOTAL Primary Collection System			363,492	27,262	19,538	41,029	4,513	455,833	
01.04.02 Lift Stations for Primary System									
01.04.02.L1 342 GPM Duplex Lift Station	1.00	EA	22,755	1,707	1,223	2,568	283	28,535	28535
01.04.02.L2 671 GPM Duplex Lift Station	1.00	EA	34,666	2,600	1,863	3,913	430	43,472	43472
01.04.02.L3 108 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
01.04.02.L4 178 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
01.04.02.L5 108 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
TOTAL Lift Stations for Primary System			96,528	7,240	5,188	10,896	1,199	121,051	
01.04.04 Sewage Treatment Plant									
01.04.04.01 0.463 MGD Sequential Batch React			1,301,030	97,577	69,930	146,854	16,154	1,631,545	
TOTAL Sewage Treatment Plant			1,301,030	97,577	69,930	146,854	16,154	1,631,545	
TOTAL Region No. 4			1,761,050	132,079	94,656	198,779	21,866	2,208,429	
01.05 Secondary Collection System									
01.05.01 Secondary Collection Sys/Unit									

		QUANTITY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
01.05.01.01	4" Force Mains	71717.00 LF	544,626	40,862	29,284	61,497	6,765	683,234	9.53
01.05.01.02	6" Force Mains	30160.00 LF	299,983	22,499	16,124	33,861	3,725	376,191	12.47
01.05.01.03	8" Gravity Sewer Mains	122460 LF	1,886,619	141,496	101,406	212,952	23,425	2,365,899	19.32
01.05.01.04	House Connections, 3" Gravity	390000 LF	2,115,854	158,689	113,727	238,827	26,271	2,653,368	6.80
01.05.01.05	Manholes	719.00 EA	990,643	74,298	53,247	111,819	12,300	1,242,307	1728
01.05.01.07	Lift Stations		995,382	74,654	53,502	112,354	12,359	1,248,250	
	TOTAL Secondary Collection Sys/Unit	5460.00 EA	6,833,306	512,498	367,290	771,309	84,844	8,569,248	1569
	TOTAL Secondary Collection System		6,833,306	512,498	367,290	771,309	84,844	8,569,248	
	TOTAL Alternative No. 1		13,596,346	1019726	730,804	1534668	168,816	17,050,379	
02	Alternative No. 2								
02.01	Region No. 1								
02.01.01	Primary Collection System								
02.01.01.01	3" Force Main (F-1)	3300.00 LF	15,665	1,175	842	1,768	195	19,645	5.95
02.01.01.02	3" Force Main (F-2)	10300.00 LF	48,889	3,667	2,628	5,518	607	61,309	5.95
02.01.01.03	4" Force Main (F-3)	10300.00 LF	56,115	4,209	3,016	6,334	697	70,371	6.83
02.01.01.04	4" Force Main (F-4)	6800.00 LF	37,057	2,779	1,992	4,183	460	46,471	6.83
02.01.01.05	4" Force Main (F-5)	5000.00 LF	27,242	2,043	1,464	3,075	338	34,162	6.83
02.01.01.06	6" Force Main (F-6)	19100.00 LF	145,912	10,943	7,843	16,470	1,812	182,979	9.58
02.01.01.31	4" Force Main (F-31)	8200.00 LF	44,672	3,350	2,401	5,042	555	56,021	6.83
	TOTAL Primary Collection System		375,553	28,166	20,186	42,391	4,663	470,959	
02.01.02	Lift Stations for Primary System								
02.01.02.L1	62 GPM Duplex Lift Station	1.00 EA	7,285	546	392	822	90	9,136	9136
02.01.02.L2	165 GPM Duplex Lift Station	1.00 EA	16,341	1,226	878	1,845	203	20,493	20493
02.01.02.L3	165 GPM Duplex Lift Station	1.00 EA	16,341	1,226	878	1,845	203	20,493	20493
02.01.02.L4	141 GPM Duplex Lift Station	1.00 EA	16,341	1,226	878	1,845	203	20,493	20493
02.01.02.L5	159 GPM Duplex Lift Station	1.00 EA	16,341	1,226	878	1,845	203	20,493	20493
	TOTAL Lift Stations for Primary System		72,651	5,449	3,905	8,200	902	91,107	
	TOTAL Region No. 1		448,204	33,615	24,091	50,591	5,565	562,066	
02.02	Region No. 2								
02.02.01	Primary Collection System								
02.02.01.01	3" Force Main (F-1)	3400.00 LF	16,142	1,211	868	1,822	200	20,243	5.95
02.02.01.02	6" Force Main (F-2)	3600.00 LF	27,502	2,063	1,478	3,104	341	34,488	9.58
02.02.01.03	8" Force Main (F-3)	8500.00 LF	91,825	6,887	4,936	10,365	1,140	115,153	13.55

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
02.02.01.04	8" Force Main (F-4)	4400.00	LF	47,529	3,565	2,555	5,365	590	59,604	13.55
02.02.01.05	10" Force Main (F-5)	4200.00	LF	63,719	4,779	3,425	7,192	791	79,906	19.03
02.02.01.06	10" Force Main (F-6)	3600.00	LF	54,616	4,096	2,936	6,165	678	68,491	19.02
02.02.01.07	10" Force Main (F-7)	10700.00	LF	162,333	12,175	8,725	18,323	2,016	203,573	19.03
02.02.01.08	10" Force Main (F-8)	5800.00	LF	87,993	6,599	4,730	9,932	1,093	110,347	19.03
02.02.01.09	6" Force Main (F-9)	4400.00	LF	33,613	2,521	1,807	3,794	417	42,152	9.58
02.02.01.10	8" Force Main (F-10)	7800.00	LF	84,259	6,319	4,529	9,511	1,046	105,665	13.55
02.02.01.11	6" Force Main (F-11)	3600.00	LF	26,746	2,006	1,438	3,019	332	33,540	9.32
02.02.01.12	8" Force Main (F-12)	8600.00	LF	92,895	6,967	4,993	10,486	1,153	116,495	13.55
02.02.01.13	12" Force Main (F-13)	8800.00	LF	179,440	13,458	9,645	20,254	2,228	225,025	25.57
	TOTAL Primary Collection System			968,613	72,646	52,063	109,332	12,027	1,214,681	
02.02.02	Lift Stations for Primary System									
02.02.02.L1	96 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
02.02.02.L2	449 GPM Duplex Lift Station	1.00	EA	24,933	1,870	1,340	2,814	310	31,267	31267
02.02.02.L3	169 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
02.02.02.L4	1303 GPM Duplex Lift Station	1.00	EA	48,050	3,604	2,583	5,424	597	60,257	60257
02.02.02.L5	106 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
02.02.02.L6	671 GPM Duplex Lift Station	1.00	EA	34,666	2,600	1,863	3,913	430	43,472	43472
02.02.02.L7	972 GPM Duplex Lift Station	1.00	EA	38,807	2,911	2,086	4,380	482	48,666	48666
	TOTAL Lift Stations for Primary System			185,565	13,917	9,974	20,946	2,304	232,706	
02.02.04	Expand Seweage Treatment Plant									
02.02.04.01	Expand 0.35 MGD to 1.529 MGD			3,159,720	236,979	169,835	356,653	39,232	3,962,419	
	TOTAL Expand Seweage Treatment Plant			3,159,720	236,979	169,835	356,653	39,232	3,962,419	
	TOTAL Region No. 2			4,313,898	323,542	231,872	486,931	53,562	5,409,806	
02.03	Region No. 3									
02.03.01	Primary Collection System									
02.03.01.01	3" Force Main (F-1)	8900.00	LF	42,244	3,168	2,271	4,768	525	52,976	5.95
02.03.01.02	4" Force Main (F-2)	5400.00	LF	29,423	2,207	1,581	3,321	365	36,898	6.83
02.03.01.03	6" Force Main (F-3)	4600.00	LF	35,136	2,635	1,889	3,966	436	44,062	9.58
02.03.01.04	3" Force Main (F-4)	8800.00	LF	41,777	3,133	2,246	4,716	519	52,390	5.95
02.03.01.05	6" Force Main (F-5)	12000.00	LF	91,675	6,876	4,928	10,348	1,138	114,964	9.58
	TOTAL Primary Collection System			240,255	18,019	12,914	27,119	2,983	301,289	
02.03.02	Lift Stations for Primary System									

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
02.03.02.L1	64 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
02.03.02.L2	204 GPM Duplex Lift Station	1.00	EA	18,392	1,379	989	2,076	228	23,064	23064
02.03.02.L3	53 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
02.03.02.L4	387 GPM Duplex Lift Station	1.00	EA	22,755	1,707	1,223	2,568	283	28,535	28535
	TOTAL Lift Stations for Primary System			55,717	4,179	2,995	6,289	692	69,872	
	TOTAL Region No. 3			295,972	22,198	15,906	33,408	3,675	371,161	
02.04	Region No. 4									
02.04.01	Primary Collection System									
02.04.01.01	4" Force Main (F-1)	3200.00	LF	17,430	1,307	937	1,967	216	21,859	6.83
02.04.01.02	6" Force Main (F-2)	3300.00	LF	25,210	1,891	1,355	2,846	313	31,615	9.58
02.04.01.03	8" Force Main (F-3)	8000.00	LF	86,415	6,481	4,645	9,754	1,073	108,367	13.55
02.04.01.04	8" Force Main (F-4)	1800.00	LF	19,445	1,458	1,045	2,195	241	24,385	13.55
02.04.01.05	6" Force Main (F-5)	6000.00	LF	45,837	3,438	2,464	5,174	569	57,482	9.58
02.04.01.06	3" Force Main (F-6)	4200.00	LF	19,927	1,495	1,071	2,249	247	24,989	5.95
02.04.01.07	6" Force Main (F-7)	4700.00	LF	35,905	2,693	1,930	4,053	446	45,026	9.58
02.04.01.08	4" Force Main (F-8)	6700.00	LF	36,507	2,738	1,962	4,121	453	45,782	6.83
02.04.01.09	4" Force Main (F-9)	3900.00	LF	21,249	1,594	1,142	2,398	264	26,647	6.83
02.04.01.10	4" Force Main (F-10)	10200.00	LF	55,565	4,167	2,987	6,272	690	69,681	6.83
	TOTAL Primary Collection System			363,492	27,262	19,538	41,029	4,513	455,833	
02.04.02	Lift Stations for Primary System									
02.04.02.L1	342 GPM Duplex Lift Station	1.00	EA	22,755	1,707	1,223	2,568	283	28,535	28535
02.04.02.L2	671 GPM Duplex Lift Station	1.00	EA	34,666	2,600	1,863	3,913	430	43,472	43472
02.04.02.L3	108 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
02.04.02.L4	178 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
02.04.02.L5	108 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
	TOTAL Lift Stations for Primary System			96,528	7,240	5,188	10,896	1,199	121,051	
02.04.04	Seweage Treatment Plant									
02.04.04.01	0.463 MGD Sequential Batch React			1,301,030	97,577	69,930	146,854	16,154	1,631,545	
	TOTAL Seweage Treatment Plant			1,301,030	97,577	69,930	146,854	16,154	1,631,545	
	TOTAL Region No. 4			1,761,050	132,079	94,656	198,779	21,866	2,208,429	
02.05	Secondary Collection System									
02.05.01	Secondary Collection Sys/Unit									

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
02.05.01.01	4" Force Mains	71717.00	LF	544,826	40,862	29,284	61,497	6,765	683,234	9.53
02.05.01.02	6" Force Mains	30160.00	LF	299,983	22,499	16,124	33,861	3,725	376,191	12.47
02.05.01.03	8" Gravity Sewer Mains	122460	LF	1,886,619	141,496	101,406	212,952	23,425	2,365,899	19.32
02.05.01.04	House Connections, 3" Gravity	390000	LF	2,115,854	158,689	113,727	238,827	26,271	2,653,368	6.80
02.05.01.05	Manholes	719.00	EA	990,643	74,298	53,247	111,819	12,300	1,242,307	1728
02.05.01.07	Lift Stations			995,382	74,654	53,502	112,354	12,359	1,248,250	
	TOTAL Secondary Collection Sys/Unit	5460.00	EA	6,833,306	512,498	367,290	771,309	84,844	8,569,248	1569
	TOTAL Secondary Collection System			6,833,306	512,498	367,290	771,309	84,844	8,569,248	
	TOTAL Alternative No. 2			13,652,430	1023932	733,618	1541018	169,512	17,120,710	
03	Alternative No. 3									
03.01	Region No. 1									
03.01.01	Primary Collection System Piping									
03.01.01.01	3" Force Main (F-1)	3300.00	LF	15,665	1,175	842	1,768	195	19,645	5.95
03.01.01.02	3" Force Main (F-2)	10300.00	LF	48,889	3,667	2,628	5,518	607	61,309	5.95
03.01.01.03	4" Force Main (F-3)	10300.00	LF	56,115	4,209	3,016	6,334	697	70,371	6.83
03.01.01.04	4" Force Main (F-4)	6800.00	LF	37,057	2,779	1,992	4,183	460	46,471	6.83
03.01.01.05	4" Force Main (F-5)	5000.00	LF	27,242	2,043	1,464	3,075	338	34,162	6.83
03.01.01.06	6" Force Main (F-6)	2600.00	LF	19,858	1,489	1,067	2,241	247	24,903	9.58
03.01.01.31	4" Force Main (F-31)	8200.00	LF	44,672	3,350	2,401	5,042	555	56,021	6.83
	TOTAL Primary Collection System Piping			249,499	18,712	13,411	28,162	3,098	312,883	
03.01.02	Lift Stations for Primary System									
03.01.02.L1	62 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
03.01.02.L2	165 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
03.01.02.L3	165 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
03.01.02.L4	141 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
03.01.02.L5	159 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
	TOTAL Lift Stations for Primary System			72,651	5,449	3,905	8,200	902	91,107	
03.01.04	Seweage Treatment Plant									
03.01.04.01	0.142 MGD Sequential Batch React			516,880	38,766	27,782	58,343	6,418	648,189	
	TOTAL Seweage Treatment Plant			516,880	38,766	27,782	58,343	6,418	648,189	
	TOTAL Region No. 1			839,030	62,927	45,098	94,706	10,418	1,052,178	

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
03.02	Region No. 2									
03.02.01	Primary Collection System									
03.02.01.01	3" Force Main (F-1)	3400.00	LF	16,142	1,211	868	1,822	200	20,243	5.95
03.02.01.02	6" Force Main (F-2)	3600.00	LF	27,502	2,063	1,478	3,104	341	34,488	9.58
03.02.01.03	8" Force Main (F-3)	8500.00	LF	91,825	6,887	4,936	10,365	1,140	115,153	13.55
03.02.01.04	8" Force Main (F-4)	4400.00	LF	47,529	3,565	2,555	5,365	590	59,604	13.55
03.02.01.05	10" Force Main (F-5)	4200.00	LF	63,719	4,779	3,425	7,192	791	79,906	19.03
03.02.01.06	10" Force Main (F-6)	3600.00	LF	54,616	4,096	2,936	6,165	678	68,491	19.03
03 02.01.07	10" Force Main (F-7)	10700.00	LF	162,333	12,175	8,725	18,323	2,016	203,573	19.03
03.02.01.08	10" Force Main (F-8)	5800.00	LF	87,993	6,599	4,730	9,932	1,093	110,347	19.03
03.02.01.09	4" Force Main (F-9)	4400.00	LF	23,973	1,798	1,289	2,706	298	30,063	6.83
03.02.01.10	6" Force Main (F-10)	7800.00	LF	59,589	4,469	3,203	6,726	740	74,728	9.58
03.02.01.11	6" Force Main (F-11)	3500.00	LF	26,745	2,006	1,438	3,019	332	33,540	9.58
03.02.01.12	6" Force Main (F-12)	8600.00	LF	65,695	4,927	3,531	7,415	816	82,385	9.58
03.02.01.13	12" Force Main (F-13)	8800.00	LF	179,440	13,458	9,645	20,254	2,228	225,025	25.57
	TOTAL Primary Collection System			907,103	68,033	48,757	102,389	11,263	1,137,545	
03.02.02	Lift Stations for Primary System									
03.02.02.L1	96 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
03.02.02.L2	449 GPM Duplex Lift Station	1.00	EA	24,933	1,870	1,340	2,814	310	31,267	31267
03.02.02.L3	169 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
03.02.02.L4	1303 GPM Duplex Lift Station	1.00	EA	48,050	3,604	2,583	5,424	597	60,257	60257
03.02.02.L5	106 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
03.02.02.L6	243 GPM Duplex Lift Station	1.00	EA	18,392	1,379	989	2,076	228	23,064	23064
03.02.02.L7	585 GPM Duplex Lift Station	1.00	EA	29,925	2,244	1,608	3,378	372	37,528	37528
	TOTAL Lift Stations for Primary System			160,409	12,031	8,622	18,106	1,992	201,159	
03.02.04	Expand Seweage Treatment Plant									
03.02.04.01	Expand 0.35 MGD to 1.218 MGD			2,326,240	174,468	125,035	262,574	28,883	2,917,201	
	TOTAL Expand Seweage Treatment Plant			2,326,240	174,468	125,035	262,574	28,883	2,917,201	
	TOTAL Region No. 2			3,393,752	254,531	182,414	383,070	42,138	4,255,905	
03.03	Region No. 3									
03.03.01	Primary Collection System									
03.03.01.01	3" Force Main (F-1)	8900.00	LF	42,244	3,168	2,271	4,768	525	52,976	5.95
03.03.01.02	4" Force Main (F-2)	5400.00	LF	29,423	2,207	1,581	3,321	365	36,898	6.83
03.03.01.03	6" Force Main (F-3)	4600.00	LF	35,136	2,635	1,889	3,966	436	44,062	9.58
03.03.01.04	3" Force Main (F-4)	8800.00	LF	41,777	3,133	2,246	4,716	519	52,390	5.95

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
03.03.01.05	6" Force Main (F-5)	7500.00	LF	57,298	4,297	3,080	6,467	711	71,854	9.58
	TOTAL Primary Collection System			205,878	15,441	11,066	23,238	2,556	258,179	
03.03.02	Lift Stations for Primary System									
03.03.02.L1	64 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
03.03.02.L2	204 GPM Duplex Lift Station	1.00	EA	18,392	1,379	989	2,076	228	23,064	23064
03.03.02.L3	53 GPM Duplex Lift Station	1.00	EA	7,285	546	392	822	90	9,136	9136
03.03.02.L4	387 GPM Duplex Lift Station	1.00	EA	22,755	1,707	1,223	2,568	283	28,535	28535
	TOTAL Lift Stations for Primary System			55,717	4,179	2,995	6,289	692	69,872	
03.03.04	Seweage Treatment Plant									
03.03.04.01	Constructed Wetlands, 0.169 MGD			415,000	31,125	22,306	46,843	5,153	520,427	
	TOTAL Seweage Treatment Plant			415,000	31,125	22,306	46,843	5,153	520,427	
	TOTAL Region No. 3			676,595	50,745	36,367	76,371	8,401	848,478	
03.04	Region No. 4									
03.04.01	Primary Collection System									
03.04.01.01	4" Force Main (F-1)	3200.00	LF	17,430	1,307	937	1,967	216	21,859	6.83
03.04.01.02	6" Force Main (F-2)	3300.00	LF	25,210	1,891	1,355	2,846	313	31,615	9.58
03.04.01.03	8" Force Main (F-3)	8000.00	LF	86,415	6,481	4,645	9,754	1,073	108,367	13.55
03.04.01.04	8" Force Main (F-4)	1800.00	LF	19,445	1,458	1,045	2,195	241	24,385	13.55
03.04.01.05	6" Force Main (F-5)	6000.00	LF	45,837	3,438	2,464	5,174	569	57,482	9.58
03.04.01.06	3" Force Main (F-6)	4200.00	LF	19,927	1,495	1,071	2,249	247	24,989	5.95
03.04.01.07	6" Force Main (F-7)	4700.00	LF	35,905	2,693	1,930	4,053	446	45,026	9.58
03.04.01.08	4" Force Main (F-8)	6700.00	LF	36,507	2,738	1,962	4,121	453	45,782	6.83
03.04.01.09	4" Force Main (F-9)	3900.00	LF	21,249	1,594	1,142	2,398	264	26,647	6.83
03.04.01.10	4" Force Main (F-10)	10200.00	LF	55,565	4,167	2,987	6,272	690	69,681	6.83
	TOTAL Primary Collection System			363,492	27,262	19,538	41,029	4,513	455,833	
03.04.02	Lift Stations for Primary System									
03.04.02.L1	342 GPM Duplex Lift Station	1.00	EA	22,755	1,707	1,223	2,568	283	28,535	28535
03.04.02.L2	671 GPM Duplex Lift Station	1.00	EA	34,666	2,600	1,863	3,913	430	43,472	43472
03.04.02.L3	108 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
03.04.02.L4	178 GPM Duplex Lift Station	1.00	EA	16,341	1,226	878	1,845	203	20,493	20493
03.04.02.L5	108 GPM Duplex Lift Station	1.00	EA	11,383	854	612	1,285	141	14,275	14275
	TOTAL Lift Stations for Primary System			96,528	7,240	5,188	10,896	1,199	121,051	

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
03.04.04	Sewage Treatment Plant									
03.04.04.01	0.463 MGD Sequential Batch React			1,301,030	97,577	69,930	146,854	16,154	1,631,545	
	TOTAL Sewage Treatment Plant			1,301,030	97,577	69,930	146,854	16,154	1,631,545	
	TOTAL Region No. 4			1,761,050	132,079	94,656	198,779	21,866	2,208,429	
03.05	Secondary Collection System									
03.05.01	Secondary Collection Sys/Unit									
03.05.01.01	4" Force Mains	72717.00	LF	544,826	40,862	29,284	61,497	6,765	683,234	9.53
03.05.01.02	6" Force Mains	30160.00	LF	299,983	22,499	16,124	33,861	3,725	376,191	12.47
03.05.01.03	8" Gravity Sewer Mains	122460	LF	1,886,619	141,496	101,406	212,952	23,425	2,365,899	19.32
03.05.01.04	House Connections, 3" Gravity	390000	LF	2,115,854	158,689	113,727	238,827	26,271	2,653,368	6.80
03.05.01.05	Manholes	719.00	EA	990,643	74,298	53,247	111,819	12,300	1,242,307	1728
03.05.01.07	Lift Stations			995,382	74,654	53,502	112,354	12,359	1,248,250	
	TOTAL Secondary Collection Sys/Unit	5460.00	EA	6,833,306	512,498	367,290	771,309	84,844	8,569,248	1569
	TOTAL Secondary Collection System			6,833,306	512,498	367,290	771,309	84,844	8,569,248	
	TOTAL Alternative No. 3			13,503,734	1012780	725,826	1524234	167,606	16,934,239	

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
AA Prime (Mechanical)											
OVERHEAD	P	7.50									
HOME OFC	P	5.00									
PROFIT	P	10.00									
BOND	P	1.00									
EL Electrical											
OVERHEAD	P	15.00									
HOME OFC	P	0.00									
PROFIT	P	10.00									
BOND	P	0.00									
PL Lift Station											
OVERHEAD	P	15.00									
HOME OFC	P	0.00									
PROFIT	P	10.00									
BOND	P	0.00									

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	DEFAULT	**** TOTAL **** HOURS
01. Alternative No. 1												
MIL	B-ELECTRN	Electricians	18.25	0.0%	39.0%	4.59	0.00	29.96	HR	01/17/02	23.41	1570
MIL	B-EQOPRCRN	Eq Oper, Crane/Shovl	18.70	0.0%	41.0%	5.90	0.00	32.27	HR	01/17/02	21.34	547
MIL	B-EQOPRLT	Eq Oper, Light	15.45	0.0%	41.6%	5.90	0.00	27.78	HR	01/17/02	10.42	19
MIL	B-EQOPRMED	Eq Oper, Medium	17.45	0.0%	41.6%	5.90	0.00	30.61	HR	01/17/02	14.16	9753
MIL	B-EQOPROIL	Eq Oper, Oilers	14.45	0.0%	41.6%	5.90	0.00	26.36	HR	01/17/02	14.16	537
MIL	B-LABORER	Laborer (Semi-Skilled)	9.00	0.0%	38.0%	1.31	0.00	13.73	HR	01/17/02	10.00	49934
MIL	B-PLUMBER	Plumbers	21.45	0.0%	38.6%	6.67	0.00	36.40	HR	01/17/02	28.80	13161
MIL	B-POWDERMN	Powderman	19.59	0.0%	57.9%	6.21	0.00	37.14	HR	01/17/02	13.42	272
MIL	B-SKILLWKR	Skilled Worker	9.00	0.0%	41.6%	1.31	0.00	14.05	HR	01/17/02	13.02	21
MIL	B-STRSTEEL	Struct Stl Workers	18.20	0.0%	66.6%	7.87	0.00	38.19	HR	01/17/02	24.98	1
MIL	X-EQOPRMED	Outside Equip. Op. Medium	17.45	0.0%	41.6%	5.90	0.00	30.61	HR	01/17/02	11.89	6048
MIL	X-LABORER	Outside Laborer (Semi-Skilled)	15.00	0.0%	41.6%	1.31	0.00	22.55	HR	02/10/03	8.43	27189
MIL	X-PLUMBER	Outside Plumber	21.45	0.0%	38.0%	6.67	0.00	36.27	HR	01/17/02	29.36	22978
02. Alternative No. 2												
MIL	B-ELECTRN	Electricians	18.25	0.0%	39.0%	4.59	0.00	29.96	HR	01/17/02	23.41	1581
MIL	B-EQOPRCRN	Eq Oper, Crane/Shovl	18.70	0.0%	41.0%	5.90	0.00	32.27	HR	01/17/02	21.34	632
MIL	B-EQOPRLT	Eq Oper, Light	15.45	0.0%	41.6%	5.90	0.00	27.78	HR	01/17/02	10.42	19
MIL	B-EQOPRMED	Eq Oper, Medium	17.45	0.0%	41.6%	5.90	0.00	30.61	HR	01/17/02	14.16	9969
MIL	B-EQOPROIL	Eq Oper, Oilers	14.45	0.0%	41.6%	5.90	0.00	26.36	HR	01/17/02	14.16	621
MIL	B-LABORER	Laborer (Semi-Skilled)	9.00	0.0%	38.0%	1.31	0.00	13.73	HR	01/17/02	10.00	52404
MIL	B-PLUMBER	Plumbers	21.45	0.0%	38.6%	6.67	0.00	36.40	HR	01/17/02	28.80	15097
MIL	B-POWDERMN	Powderman	19.59	0.0%	57.9%	6.21	0.00	37.14	HR	01/17/02	13.42	272
MIL	B-SKILLWKR	Skilled Worker	9.00	0.0%	41.6%	1.31	0.00	14.05	HR	01/17/02	13.02	22
MIL	B-STRSTEEL	Struct Stl Workers	18.20	0.0%	66.6%	7.87	0.00	38.19	HR	01/17/02	24.98	2
MIL	X-EQOPRMED	Outside Equip. Op. Medium	17.45	0.0%	41.6%	5.90	0.00	30.61	HR	01/17/02	11.89	6048
MIL	X-LABORER	Outside Laborer (Semi-Skilled)	15.00	0.0%	41.6%	1.31	0.00	22.55	HR	02/10/03	8.43	27189
MIL	X-PLUMBER	Outside Plumber	21.45	0.0%	38.0%	6.67	0.00	36.27	HR	01/17/02	29.36	22978
03. Alternative No. 3												
MIL	B-ELECTRN	Electricians	18.25	0.0%	39.0%	4.59	0.00	29.96	HR	01/17/02	23.41	1581
MIL	B-EQOPRCRN	Eq Oper, Crane/Shovl	18.70	0.0%	41.0%	5.90	0.00	32.27	HR	01/17/02	21.34	577
MIL	B-EQOPRLT	Eq Oper, Light	15.45	0.0%	41.6%	5.90	0.00	27.78	HR	01/17/02	10.42	20
MIL	B-EQOPRMED	Eq Oper, Medium	17.45	0.0%	41.6%	5.90	0.00	30.61	HR	01/17/02	14.16	9828
MIL	B-EQOPROIL	Eq Oper, Oilers	14.45	0.0%	41.6%	5.90	0.00	26.36	HR	01/17/02	14.16	566
MIL	B-LABORER	Laborer (Semi-Skilled)	9.00	0.0%	38.0%	1.31	0.00	13.73	HR	01/17/02	10.00	50727
MIL	B-PLUMBER	Plumbers	21.45	0.0%	38.6%	6.67	0.00	36.40	HR	01/17/02	28.80	13779
MIL	B-POWDERMN	Powderman	19.59	0.0%	57.9%	6.21	0.00	37.14	HR	01/17/02	13.42	272
MIL	B-SKILLWKR	Skilled Worker	9.00	0.0%	41.6%	1.31	0.00	14.05	HR	01/17/02	13.02	22
MIL	B-STRSTEEL	Struct Stl Workers	18.20	0.0%	66.6%	7.87	0.00	38.19	HR	01/17/02	24.98	1
MIL	X-EQOPRMED	Outside Equip. Op. Medium	17.45	0.0%	41.6%	5.90	0.00	30.61	HR	01/17/02	11.89	6048
MIL	X-LABORER	Outside Laborer (Semi-Skilled)	15.00	0.0%	41.6%	1.31	0.00	22.55	HR	02/10/03	8.43	27189
MIL	X-PLUMBER	Outside Plumber	21.45	0.0%	38.0%	6.67	0.00	36.27	HR	01/17/02	29.36	22978

APPENDIX 4

ENVIRONMENTAL ANALYSIS

DRAFT
ENVIRONMENTAL REPORT
TEXOMA REGIONAL SEWER SYSTEM STUDY
PLANNING ASSISTANCE TO STATES

June 2003

TABLE OF CONTENTS

LIST OF FIGURES

DRAFT
ENVIRONMENTAL REPORT
TEXOMA REGIONAL SEWER SYSTEM STUDY
PLANNING ASSISTANCE TO STATES

Existing environmental conditions were determined from investigations to identify potential problem areas, such as endangered species, cultural resources, wetlands, and water quality. The scope of this investigation does not include documentation consistent with the National Environmental Policy Act of 1969, but does identify significant environmental issues that would need to be addressed prior to any construction.

INTRODUCTION

The proposed project is located on the southeast end of Texoma Lake in extreme northern Texas in Grayson County. Texoma Lake was constructed by the U.S. Army Corps of Engineers and impounds 89,000 surface acres at normal pool. The lake has two primary arms, the Red and Washita rivers. Lake Texoma is approximately 5 miles northwest of Denison, Texas, and 15 miles southwest of Durant, Oklahoma, and became operational in 1944.

ENVIRONMENTAL SETTING

The proposed project area lies within the central lowlands located in the Prairie Division, Prairie Parkland Province, Cross Timbers and Southern Tallgrass Prairie Section (Bailey 1980). The region is gently rolling to flat plains. Over 50% of the area is gently sloping. Average annual rainfall varies from 35 to 40 inches per year and falls mainly during the 235-day growing season (April-October). The average annual temperature is 55° to 63° Fahrenheit.

The vegetation is characterized as cross timbers and oak-hickory forest. The area is dominated by various short and medium to tall grasses, along with a few hardy tree species. Forest cover consists of post, live, and blackjack oaks and pignut and mockernut hickories. Post oak and blackjack oak dominate the cross timbers region. Grasses are the dominant plants on the

prairies. The most prevalent type is bluestem prairie. Other dominant grasses are indiangrass and switchgrass. Soil is a key factor in local distribution. Fine, heavy soils generally support grassland vegetation, and coarse, lighter soils are covered with stands of savanna.

Land use is varied consisting of developed, recreational, residential, agricultural, and pasturelands, all of which are heavily influenced by recreational activities associated with Texoma Lake.

ENDANGERED SPECIES

A number of Federally listed threatened and/or endangered species are present in the project area. There is no designated critical habitat for listed species in Grayson County. Federally listed threatened bald eagles *(Haliaeetus leucocephalus)* winter and may be spring residents at Lake Texoma and along the Red River. They utilize the lakeshore for perching and secluded areas for roosting. They also use the river area downstream of the dam for feeding and perching. The threatened piping plover *(Charadrius melodus)* and potentially threatened mountain plover *(Charadrius montanus)* are migrants within the project area. The endangered interior least tern *(Sterna antillarum)* nests along the Red River, and a nesting colony has been documented using areas around Lake Texoma at Hagerman National Wildlife Refuge in recent years. Protocol for dealing with Federally listed species (if found to exist) is contained in a letter from the USFWS dated February 4, 2003, and is included at the end of this appendix.

CULTURAL RESOURCES

Cultural Resources Overview

Archaeological sites representative of the Early Archaic Period through the Middle and Late Archaic, Woodland, Caddoan, and Historic Periods are known in the larger vicinity of Lake Texoma in northern Texas. This culture-historical sequence falls generally within the overall sequence that has been established for northern Texas and southern Oklahoma. Many sites in this area have undisturbed, deeply buried deposits; many are comprised of multi-component prehistoric and/or

historic occupations. A number of cultural resources investigations, including survey and excavation, were conducted incident to the construction of Lake Texoma. While archaeological reconnaissance efforts undertaken in the area by the U.S. Army Corps of Engineers resulted in the identification of hundreds of archaeological sites, none of these investigations occurred within the proposed project areas/alignments, which remain largely uninvestigated. In the larger regional area, however, there are hundreds of archaeological sites and historic standing structures on record with the Texas Historical Commission (THC).

Cultural Resources (Impacts)

Any of the proposed Texoma Regional Sewer System alternatives/alignments has the potential to impact cultural resources. Sections 106 and 110 of the National Historic Preservation Act (NHPA) of 1966 (as amended) require agencies to evaluate the impacts of Federal undertakings on historic properties, which include prehistoric and historic archaeological sites and historic standing structures. Section 106 requires the identification of all historic properties, which emphasizes an evaluation of eligibility for listing on the National Register of Historic Places (NRHP). Agencies must then determine which historic properties (those eligible for listing on the NRHP) will be adversely impacted. Sections 106 and 110 require that agencies resolve adverse effects to these properties. Plans for resolving adverse effects will be determined through consultation with the Texas Historical Commission (THC), potentially the Advisory Council on Historic Preservation (ACHP), and appropriate and interested Native American tribes and other interested parties.

To fulfill the requirements outlined in Sections 106 and 110 of the NHPA, archaeological reconnaissance investigations, to include archival research, will be necessary to identify archaeological sites and standing structures that exist within the proposed project area. Each site and structure will require National Register evaluation; some will require sub-surface evaluation, detailed archival research, or architectural documentation. NRHP-eligible sites and structures that will be adversely impacted by the undertaking will require mitigation, which will be determined through formal consultation with the THC, and potentially the ACHP.

WATER QUALITY

General water quality in Lake Texoma is characterized by moderate to high levels of salinity with a predominance of sodium and calcium salts of chloride and sulfate (Leifeste et al. 1971). Chloride and sodium are the most abundant ions in Lake Texoma. In terms of productivity, the lake has been classified as mesotrophic based on chlorophyll a concentrations (Ground and Groeger 1994). Based on chlorophyll a concentrations for the Main Lake Zone (near dam) from Atkinson et al. (1999) during the summer months, trophic status ranged from mesotrophic to hypereutrophic with a mean trophic classification of slightly eutrophic.

In a report by Atkinson et al. (1996), selected water quality data from Lake Texoma were reviewed. Historical data relating to chloride and sulfate concentrations throughout the lake defined four zones: the Upper Red River Arm (lotic zone), the Red River Transition Zone, the Main Body (lacustrine zone), and the Washita Arm (lotic zone). Chloride and sulfate concentrations are highest in the Upper Red River Zone and are more variable than in other zones. The Red River Transition Zone shows decreasing concentrations from west to east and is influenced by loadings from Big Mineral Creek. The Main Lake Zone is relatively homogenous in surface layers in terms of chlorides and sulfates and shows much less variability than the other zones.

The Oklahoma Conservation Commission listed Texoma Lake in the Oklahoma Nonpoint Source Pollution Program's 2001 Annual Report as having several non-point source pollution problems. Sources for these pollutants included non-irrigated and irrigated crop production, animal holding/management, and unknown sources.

WETLANDS

Wetlands and deepwater habitats are essential for many species of fish and wildlife. In addition to providing habitat for fish and wildlife, they also perform important roles and function in controlling floods and pollution abatement. The USFWS developed and adopted a classification system to be used for classifying wetlands and conducted a national inventory of wetland habitats (National Wetland Inventory Maps [NWI]). The four regions were evaluated for the presence of

wetlands based on the NWI maps. Numerous wetland types were found to be present in the delineated project area and are summarized as follows:

Texas Region 1. A majority of wetlands within this project component are farm ponds characterized as Palustrine Open Water Permanently Flooded Diked/Impounded (POWHh). Other wetlands identified are classified as Palustrine Emergent Persistent Seasonally Flooded (PEM1C), Palustrine Emergent Persistent Semi-Permanently Flooded (PEMIF), Riverine Intermittent Streambed Seasonally Flooded (R4SBC), and Riverine Lower Perennial Open Water Permanently Flooded (R2OWH).

Texas Region 2. Wetlands within this project component are sparse. The majority of wetlands are farm ponds characterized as Palustrine Open water Permanently Flooded Diked/Impounded (POWHh). Other wetlands identified are Palustrine Emergent Persistent Semi-Permanently Flooded (PEM1F) and Riverine Intermittent Streambed Seasonally Flooded (R4SBC).

Texas Region 3. Wetlands identified in this project component are sparse as well. It includes farm ponds characterized as Palustrine Open Water Permanently Flooded Diked/Impounded (POWHh), Palustrine Forested Broad Leaved Deciduous Temporarily Flooded (PFO1A), and Riverine Intermittent Streambed Seasonally Flooded (R4SBC).

Texas Region 4. Wetlands identified include Palustrine, Lacustrine, and Riverine wetland types. Specific wetland types present in the area include Palustrine Open Water Permanently Flooded Diked/Impounded (POWHh), Riverine Intermittent Streambed Seasonally Flooded (R4SBC), and Palustrine Scrub-Shrub Broad-Leaved Deciduous Seasonally Flooded Diked/Impounded (PSS 1 Ch)

A large number of the wetlands appear to be small farm ponds or impoundments. All sewage collection facilities and pipelines should be carefully evaluated to avoid wetland habitats and associated adverse impacts associated with construction in wetlands.

SECTION 404, CLEAN WATER ACT

The proposed project would be subject to Section 10 of the River and Harbors Act of 1899 as well as Section 404 of the Clean Water Act. The construction and placement of outfall structures, intake structures, and sewer lines would be subject to Section 10 and Section 404 permitting activities. The construction of an intake structure should fall within the scope of a Nationwide permit or a General permit. Construction of wastewater processing facilities could require a determination of status regarding jurisdictional waters of the United States. The placement of sewage collection lines and lift stations should fall within the scope of Nationwide Permit No. 12, Utility Line Discharges. Prior to construction, a Section 404 (Clean Water Act) determination should be requested from the Tulsa District, Corps of Engineers (Regulatory Branch) to assure compliance with Federal law.

NATIONAL FORESTS AND OTHER PUBLIC USE AREAS

The proposed project area is not located within any National Forests, National Parks, or National Monuments. However, the Hagerman National Wildlife Refuge is located on the Big Mineral Arm of Lake Texoma, just south of the proposed project area that encompasses Flowing Wells Camp and Big Mineral Camp. These two parks are adjacent to the northern boundary of the wildlife refuge. The 11,320-acre refuge was established in 1946 and includes 3,000 acres of marsh and water and 8,000 acres of upland and farmland.

Numerous public recreation sites within the project plan exist around the Lake Texoma on Corps of Engineers owned lands. Park and recreation areas operated by various public entities immediately adjacent to or within Corps of Engineers boundaries include the spillway, overlook, Denison power plant and Texoma Area Office, Island View, Straight Arrow Clubs and Camps, Inc., Texas Baptist Bible Fellowship, Austin College, Preston Point, Episcopal Recreation Center, Preston Bend Resort, Sherman-McKinney District of Methodist Church, Presbytery of Trinity, United Presbyterian Church, Boles Orphans Home, Preston Fishing Camp, and Cedar Mills Resort. Other park and recreation areas in the project area include Highport Resort, Paradise Cove, Flowing Wells Camp, Juniper Point, Walnut Creek Resort, Future Farmers of America, Texas State College for

Women, Big Mineral, Mill Creek, Grandpappy Point, and Big Mineral Camp. Eisenhower State Park, operated by the State of Texas, is also located in the area.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

Should Federal funds be expended for construction of any part of the proposed alternatives and/or should the proposed facilities be constructed on Federal property, NEPA coordination would be required. Documentation required by NEPA would consist of either an Environmental Assessment and signed Finding of No Significant Impact or an Environmental Impact Statement and signed Record of Decision.

Public involvement is an important component to the NEPA process. It requires full disclosure of project purpose(s), design, alternatives, and environmental impacts. The public should be given an opportunity to comment on the proposed action early in the planning process through a "Scoping Process," which includes public meetings or workshops. If warranted, an additional public meeting(s) could be required at the time the NEPA documentation is released for public review and comments. The public should be given at least 2 weeks' notice prior to all public meetings or workshops, which should be held at a time of convenience to the public (Monday-Friday). Notification should be made by purchasing an advertisement in local newspapers, and through the use of public service announcements on local radio and television stations. Since the project is regional in scope, several community newspapers should be used for notification purposes.

CONCLUSIONS

Preliminary conceptual designs and cost estimates have been developed for the treatment and disposal of wastewater for four geographic regions on the eastern portion of the Texas side of Texoma Lake. The plans and costs identified the resources required to replace individual septic systems and small private systems, which are contributing to the pollution of Lake Texoma. The expansion of existing wastewater treatment facilities, sequential batch reactors, and constructed wetlands preceded by a partially aerated lagoon were considered. The report identified four facilities (Texas Regions 1 through 4) to be expanded or constructed.

Construction of this project would have a positive impact on the water quality of Texoma Lake and associated benefits to the aquatic ecosystem and recreation. Construction of the project would not be expected to adversely impact Federally listed threatened and endangered species. Construction of the project could have potential adverse impacts on wetlands; however, with proper planning and coordination with the U.S. Fish and Wildlife Service and Tulsa District Regulatory Branch these impacts can be avoided or mitigated.

REFERENCES

Bailey, Robert G. 1980. Description of Ecoregions of the United States. United States Department of Agriculture Forest Service Miscellaneous Publication No. 1391, 77 pp.

Atkinson, S. F., K. L. Dickson, J. L. Franks, D. C. Garrett, B. A. Hunter, W. T. Waller, and S. L. Burks. 1996. An evaluation of U.S. Army Corps of Engineers Provided Historical Water Quality Data from Lake Texoma: Implications for Water Quality Monitoring Program. University of North Texas, Denton, TX.

Atkinson, S. F., K. L. Dickson, W. T. Waller, L. Ammann, J. Franks, T. Clyde, J. Gibbs, D. Rolbiecki. 1999. A Chemical, Physical and Biological Water Quality Survey of Lake Texoma: August 1996-September 1997 Final Report, Institute of Applied Science, University of North Texas, Denton, TX.

Ground, T. A. and A. W. Groeger. 1994. Chemical classification and trophic characteristics of Texas Reservoirs. Lake and Reservoir Management, 10:189-201.

Leifeste, D. K., J. F. Blakey, and L. S. Hughes. 1971. Reconnaissance of the chemical quality of surface waters of the Red River Basin, Texas. Report No. 126, Texas Water Development Board, Austin, TX.

Matthews, W. J. and L. G. Hill. 1988. Physical and chemical profiles in Lake Texoma (Oklahoma-Texas) in the summer of 1982 and 1983. Proceedings of the Oklahoma Academy of Sciences 68:33-38.

Perry, W., J. A. Stanford, and C. Rafferty. 1979. Water quality study, Lake Texoma, Texas and Oklahoma: December 1977 - November 1978. Institute of Applied Sciences. North Texas State University, Denton, TX.

Stanford, J. A., L. C. Fitzpatrick, and S. Zimmerman. 1977. Water quality study, Lake Texoma, Texas and Oklahoma: December 1975 - November 1976. Institute of Applied Sciences, North Texas State University, Denton, TX.

Stanford, J. A. and S. Zimmerman. 1978. Water quality study, Lake Texoma, Texas-Oklahoma: December 1976 - November 1977. Institute of Applied Sciences, North Texas State University, Denton, TX.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

2-12-03-I-158

February 4, 2003

Mr. Larry Hogue
Department of the Army
Corps of Engineers, Tulsa District
1645 South 101st East Avenue
Tulsa, Oklahoma 74128-4609

Dear Mr. Hogue:

This responds to your January 22, 2003, letter requesting information on federally listed threatened and endangered species with regard to the Lake Texoma Regional Sewer System Study in Grayson County, Texas.

Our records indicate that the following threatened (T), endangered (E), and proposed threatened (PT) species have been documented, or are known to occur in Grayson County:

interior least tern (*Sterna antillarum*) - E
bald eagle (*Haliaeetus leucocephalus*) - T
piping plover (*Charadrius melodus*) - T
mountain plover (*Charadrius montanus*) - PT

There is no designated critical habitat for listed species in Grayson County. The piping plover and mountain plover are migrants within the project area. Bald eagles are winter and possible spring residents at Lake Texoma and along the Red River. The interior least tern nests along the Red River and a nesting colony has been documented using areas around Lake Texoma at Hagerman National Wildlife Refuge in recent years.

A qualified biologist should use the most current information available to evaluate the project site and adjacent areas for the presence of suitable habitat for the listed or proposed listed species occurring in the county. If, after an assessment has been conducted using appropriate biological expertise, the assessment indicates there is the potential for the proposed action to affect listed or proposed listed species (i.e., suitable habitat for listed species is present within or adjacent to the action area), you should contact this office for further evaluation. Otherwise, no further coordination with this office would be necessary regarding threatened or endangered species.

The clearing of vegetation from riparian areas associated with the construction of linear utility right-of-way can result in significant impacts to fish and wildlife habitat. These impacts can include direct habitat loss, habitat fragmentation, soil erosion, increased sedimentation, and alteration of the hydrology of the impacted area. For these reasons, we have enclosed general guidelines for linear utility construction that should be considered during the alternatives analysis, project planning and implementation.

Thank you for the opportunity to provide information on the proposed project. If you have any questions, please contact Jacob Lewis of my staff at (817) 277-1100.

Sincerely,

Tom Cloud

Thomas J. Cloud, Jr.
Field Supervisor

enclosure

General Recommendations for Avoiding and/or Minimizing Environmental Impacts from Utility Pipeline Construction

The U.S. Fish and Wildlife Service places a high priority on the conservation of wetlands and riparian corridors due to the inherent value and significant level of benefits these areas provide to a multitude of fish and wildlife species. In addition to the food, shelter, and habitat they provide to fish and wildlife, these areas also furnish invaluable ecological services to the watershed and the community. They act as a buffer zone for pollutants and sediment entering the stream via storm water runoff. They also prevent erosion, and provide a pervious surface to facilitate the percolation of storm water to prevent flooding.

The best method of avoiding and/or minimizing environmental impacts caused by linear utility construction is to utilize existing right-of-way (transmission line, highway, pipeline, etc.) for the new route. This often eliminates or greatly reduces the need to clear wildlife habitat for construction. The following additional recommendations for avoiding and/or minimizing construction related impacts commonly associated with utility pipeline projects should also be considered, especially when using existing right-of-way is not possible. These are only general recommendations; details for avoiding and minimizing all potential impacts should take into account specific project and site descriptions at each sensitive area. The development of specific mitigating measures for anticipated environmental impacts should focus on protecting the integrity of stream banks, riparian zones, and wetlands.

- **Route alignment should be adjusted where necessary to avoid wetland impacts and to avoid losses of moderate-aged to mature-aged trees.** Utilizing existing right-of-ways reduces environmental impacts usually associated with utility pipeline construction. However, where proposed routes would require new right-of-way, minor adjustments in route alignment could minimize impacts to fish and wildlife habitat. Route modification should include avoiding wetlands and crossing creeks and streams where the riparian corridor is at its minimum width.

- **Directional drilling should be used at all wetlands, perennial streams, and other waterbodies.** The process of boring under waterbodies greatly reduces impacts to wetlands, streams, or other sensitive areas that usually occur with the open-cut or trenching method of utility pipeline installation. When construction must occur during the rainy season, directional drilling also reduces sedimentation and erosion resulting from construction activity. Because this method often avoids or reduces impacts to wetlands and waters of the U.S., potential project mitigation required under section 404 of the Clean Water Act would also be minimized.

- **Temporary workspaces at stream crossings should be placed outside of the riparian zone of the respective stream.** Temporary workspaces are often needed where pipeline routes cross creeks, streams, roads, railways, or other linear obstacles and construction requires an alternate method such as directional drilling. Should temporary workspaces be necessary for directional drilling or other method of installation, they should not be located within the riparian zone of creeks, streams, or other waterbodies. They should also not be located within wetlands.

- **Temporary right-of-ways within or adjacent to riparian areas should be hand cleared.** Clearing of permanent right-of-way and the construction and installation of pipeline requires the use of heavy machinery. In riparian and other wooded areas, the use of heavy machinery and

other equipment is often detrimental to the underground root system of adjacent trees not intended for removal. Oaks are particularly sensitive to ground disturbance caused by heavy equipment and often die when their roots are damaged. Temporary areas cleared by machinery may also reduce subsequent revegetation by native hardwoods due to the damaged root mat from which new saplings originate. Therefore, we recommend temporary workspaces and right-of-ways within or adjacent to riparian corridors be cleared with chainsaws to avoid additional tree loss and encourage new hardwood growth following construction.

- **Trenching of creeks, streams, and other wetland areas should be conducted during a dry period.** Trenching or open-cut methods of pipeline installation may be necessary if directional drilling of waterbodies is not possible or practical. To reduce the potential for soil erosion, creek sedimentation, and impacts to aquatic species, trenches and open-cut methods should be conducted during the dry season, preferably mid to late summer.

- **All temporary right-of-ways and workspaces should be revegetated immediately following construction with native vegetation appropriate to habitat type.** It is important that disturbed areas be revegetated following construction activities to prevent erosion, reduce sedimentation, and decrease the chance of non-native, invasive plant species from becoming established. We would be glad to provide information on appropriate native grasses, shrubs, and trees for replanting in the project area.

- **Right-of-way width should be reduced to the minimum amount necessary to allow pipe installation at riparian areas.** New right-of-way for pipeline projects usually includes a temporary right-of-way for allowing access for equipment and workspace for construction. The environmental consequences of using temporary right-of-ways may be minimal, especially when they are located adjacent to roads or occur in pastures and agricultural areas. However, at stream crossings, temporary right-of-ways may remove valuable wildlife habitat. For these areas, additional workspace should be placed outside of the riparian corridor and every effort be made to avoid clearing more vegetation than is necessary to install the pipeline.

- **Unavoidable wetland impacts should be mitigated through in-kind creation or restoration of wetland areas that establish similar functions and values of the affected wetlands.** Federal policy provides that wetland losses be mitigated to restore lost habitat values of equal or greater value to fish and wildlife resources. This includes restoring or creating areas that retain the primary hydrological characteristics of the affected wetlands and revegetating the disturbed land with native plant species appropriate to habitat type.

We also recommend all areas that would be avoided using these or other measures (e.g., mature trees, riparian areas) be marked with orange guard fence or flagged prior to construction to prevent accidental clearing by work crews. All mitigation measure developed for a specific project should be incorporated into the Environmental Assessment for the proposed project as well the project plans to ensure implementation by the contractor. Additionally, if impacts to wetlands, creeks, streams, or other water bodies are anticipated, you should contact the appropriate U.S. Army Corps of Engineers office to determine if a permit is required by that Agency prior to commencement of construction activities.

APPENDIX 5

REAL ESTATE

RECONNAISSANCE LEVEL
REAL ESTATE ACQUISITION STUDY
FOR THE
TEXOMA REGIONAL SEWER SYSTEM STUDY
PHASE 2
GRAYSON COUNTY, TEXAS

April 2003

TABLE OF CONTENTS

Page

RECONNAISSANCE LEVEL
REAL ESTATE ACQUISITION STUDY
FOR THE
TEXOMA REGIONAL SEWER SYSTEM STUDY
PHASE 2
GRAYSON COUNTY, TEXAS

PURPOSE OF RECONNAISSANCE VALUATION STUDY

The purpose of this reconnaissance level valuation study is to estimate the market values and acquisition costs of the real estate interests that would be required to implement the Texoma Regional Sewer System Study, Phase 2, Grayson County, Texas. The study area encompasses the communities along the south side of Lake Texoma. The Corps of Engineers is preparing this study for the Greater Texoma Utility Authority, the project sponsor, under the authority of Section 22 of the Water Resource Development Act of 1974, the Planning Assistance to States program. The sponsor will use the information to decide the feasibility of a regional sewer system within Grayson County.

DATE OF VALUATION STUDY

The fieldwork for the land values was completed in March 2003.

REAL ESTATE COST ESTIMATE SUMMARY

	Alternative 1	Alternative 2	Alternative 3
Lands and Damages	$216,000	$189,000	$294,000
Relocation Assistance	$ 0	$ 0	$ 0
Minerals	$ 0	$ 0	$ 0
Contingencies	$ 54,000	$ 47,250	$ 73,500
Administrative	$ 85,000	$ 51,000	$102,000
Total	$355,000	$287,250	$469,500

ESTIMATE OF VALUE

The estimated acquisition cost for the required interests in real estate for the three alternatives are $355,000, $287,250, and $102,000, respectively. Contingencies represent the risks of negotiation and condemnation.

The estimated value for the real estate interests and damages is based upon an assumption that county road rights-of-way will provide adequate spacing, and will always be available at no cost and used. In addition, it is assumed that all private lands would be acquired by negotiation or condemnation in excess of the current fair market value.

The study information on the design of the regional sewer systems only addressed the primary distribution system consisting of lift stations, treatment plants, and related facilities. No secondary system elements were evaluated.

PROPERTY ESTATES FOR THE PROJECT

The estate for the pipeline and lift stations would be a perpetual right-of-way easement. A fee estate would be appropriate for the treatment plant and facilities. The language of a standard utility and/or pipeline easement is as follows:

> 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 and patrol of (overhead) (underground) (specifically name type of utility or pipeline); 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 hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

ESTIMATED NUMBER OF OWNERSHIPS

Alternative 1. For this alternative, real estate interests would be required from 4 private, 1 State and 1 Federal ownerships.

Alternative 2. For this alternative, there are 2 private, 1 State, and 1 Federal ownerships.

Alternative 3. For this alternative, there are 5 private, 1 State, and 1 Federal ownerships.

It is assumed that no utility or facility relocations would be required to implement this project and no homes or other significant improvements would be adversely impacted. There is no evidence at this time that any relocation assistance costs would be incurred.

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