JUL 0 5 1989

CITY OF GATESVILLE

REGIONAL WASTEWATER PLANNING

STUDY

DRAFT

Prepared by:

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ENGINEERS • PLANNERS • SURVEYORS
• WATER/WASTEWATER • ENVIRONMENTAL • STREETS/DRAINAGE • BUILDING DESIGN
• MECHANICAL • ELECTRICAL • STRUCTURAL • CADD
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EXECUTIVE SUMMARY

A variety of locations were evaluated as potential sites for additional wastewater treatment facilities in the Gatesville Regional Planning Study. Initially, four potential sites were considered, and of these, three were selected for further consideration. The three sites chosen for analysis were:

> The City of Gatesville existing wastewater facility located along the Leon River south of State Highway 84;
>
> Along the Leon River north of the confluence of Stillhouse Branch Creek with the Leon River, upstream from the existing WWTP; and
>
> Along the Leon River near State Highway 36, north of North Fort Hood.

Many factors were taken into account in making the final site recommendations. As with any wastewater treatment facility, the impact of discharges into receiving streams had to be considered, and treatment levels necessary to achieve standards specified by the TWC for Segment 1221 had to be determined. Other factors that were considered during the course of the study included additional biological considerations and the costs associated with scenarios that met the requisite criteria.

The expected water quality downstream of the outfall of a variety of wastewater treatment plants at various treatment levels was determined. Several scenarios were constructed in order to determine the combination of plants that would give a total treatment capacity of 5.2 MGD while maintaining water quality levels in the receiving stream above the minimum DO level of 5 mg/l. The following conclusions were drawn from the Streeter-Phelps modeling of Segment 1221:

> The City of Gatesville could discharge up to approximately 3.2 MGD from the existing facility with a treatment level upgrade to 10/2/5. The minimum DO, under summer critical low flow conditions, resulting from this discharge would be 5.2 mg/l. It is not likely that the City of Gatesville's treatment facility could be expanded beyond 3.2 MGD without requiring a treatment level of 5/2/5.
>
> Without upgrading the Gatesville facility to a treatment level of 10/3/5, the discharges resulting from an upstream WWTP at 10/3/5 and a downstream WWTP at 10/3/5 would violate the 5.0 mg/l minimum DO criterion. The minimum predicted DO concentration is 3.5 mg/l.
>
> With the City of Gatesville facility upgraded to a treatment level of 10/3/5, both an upstream 2.2 MGD WWTP and a downstream 2.0 MGD WWTP could discharge at 10/3/5 resulting in a minimum predicted DO concentration of 4.9 mg/l.
>
> A 5.2 MGD facility located along the Leon River near S.H. 84 discharging at 5/2/4 would violate state criterion. The minimum predicted DO would be 4.2 mg/l.

A 5.2 MGD facility located along the Leon River near S.H. 36 discharging at 5/2/5 would not violate state criterion. The minimum predicted DO would be 5.1 mg/l.

Water quality modeling of selected combinations of sites at various treatment levels was used to select the following scenarios for economic evaluation:

1) A single, 5.2 MGD facility at State Highway 36 below the City of Fort Gates with a treatment level of 5/2/5.

2) A two plant scenario with the existing treatment plant at 3.2 MGD upgraded to 10/3/5 and a 2.0 MGD WWTP located at State Highway 36 below the City of Fort Gates, also discharging at 10/3/5.

3) A three plant scenario with the existing treatment plant discharging 1.0 MGD at 10/3/5, a 2.2 MGD WWTP located near Stillhouse Branch Creek discharging at 10/3/5, and a 2.0 MGD WWTP at State Highway 36 below the City of Fort Gates, also discharging at 10/3/5.

It is assumed that each of these scenarios meets the TWC criteria for maintaining minimum DO concentrations, as specified by the TWC, for Segment 1221 of the Leon River. Thus, further narrowing down of the alternatives is likely to rely heavily on growth, flexibility, location relative to the flood plain, land availability, and economic considerations. Cost estimates were derived for each of these scenarios in 1990 assuming a 20-year amortization period and a 10 percent interest rate. Because the total cost of the interceptors was driven by the cost of the interceptor required in 1990, the interceptor costs were compared in 1990 dollars.

A comparison of the three scenarios considered shows that the least expensive alternative is the three plant scenario. The most expensive alternative is the one plant scenario. Two factors contribute to the heavy costs associated with this option. First, the existing treatment plant is abandoned, resulting in the immediate construction of a 5.2 MGD WWTP simultaneously requiring construction of several thousand linear feet of large interceptors as compared with the other scenarios. The other reason is the fact that water quality modeling shows that the construction of a single, large facility, discharging a total of 5.2 MGD, would have to have a treatment level of 5/2/5 in order to meet minimum DO concentrations, as specified by the TWC, for Segment 1221 of the Leon River.

The two plant scenario, although only moderately more expensive than the three plant scenario, also involves the abandonment of the existing WWTP, larger interceptors paralleling existing interceptors which lead to the existing WWTP, and expansion of the WWTP in the flood plain.

Based on these considerations, the following development schedule is recommended:

Immediately construct a 2.2 MGD WWTP near the confluence of Stillhouse Branch Creek with the Leon River to handle the wastestreams of the prisons, diverting a portion of the load on the City of Gatesville WWTP.

Upgrading the existing City of Gatesville WWTP to 10/15/3/5 concurrently with its next permit renewal.

As growth occurs, construct a separate WWTP to handle the wastes of the City of Fort Gates and North Fort Hood.

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I. INTRODUCTION

I.A Authorization

As a result of projected growth in the Gatesville area, the City of Gatesville and the City of Fort Gates, in cooperation with North Fort Hood, have agreed to participate in a feasibility study for the development of regional wastewater collection and treatment facilities. The region is served by a regional potable water supply system which is managed and operated by the City of Gatesville. Members of the regional potable water supply are as follows:

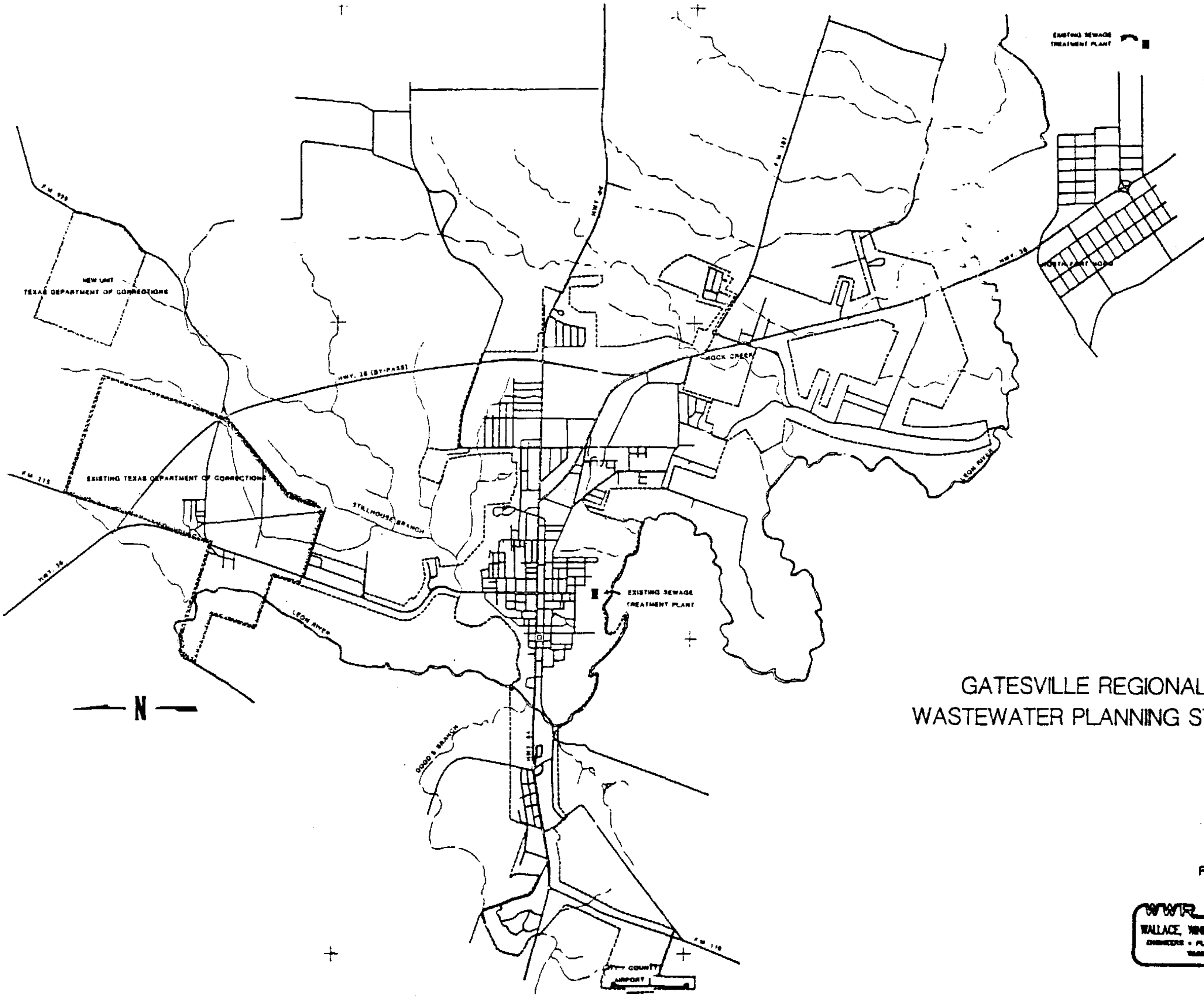
- City of Gatesville
- Texas Department of Corrections
- North Fort Hood
- City of Fort Gates
- Mountain Water Supply Corporation
- Coryell City Water District
- Flat Water Supply Corporation
- Grove Water Supply Corporation

Mountain Water Supply Corporation, Coryell City Water District, Flat Water Supply Corporation, and Grove Water Supply Corporation are rural water systems and customers are on septic tanks. The City of Gatesville presently treats wastewater from all local Texas Department of Corrections units.

The regional wastewater study, financed in part by the Texas Water Development Board (TWDB), was initiated as a result of House Bill 2 and House Joint Resolution 6, passed by the 65th Texas Legislature in 1985, in order to encourage cost-effective regional water and wastewater facility planning and development. Accordingly, the City of Gatesville contracted with Wallace, Winkler and Rice, Inc. to undertake a study of the adequacy of existing wastewater facilities in the Gatesville area, and to evaluate the nature, timing, and costs associated with alternative scenarios for facility improvements required to meet the projected demand by the year 2030.

I.B Scope and Objectives of Study

The study area considered for the Gatesville Regional Wastewater Planning Study was the area defined by Figure I.1. This area includes the city limits of the Cities of Gatesville and Fort Gates



GATESVILLE REGIONAL WASTEWATER PLANNING STUDY

FIGURE I.1

WWR WALLACE, WINKLER & RICE, INC. ENGINEERS • PLANNERS • SURVEYORS WACO • TEMPLE and their extra-territorial jurisdictions as well as North Fort Hood. The planning area lies wholly within the Leon River basin, including several small watersheds which lead to or are a part of existing development in the area.

Growth in this area is directly influenced and driven by the Texas Department of Corrections and proximity to North Fort Hood. The objective of the study was to determine the adequacy of existing wastewater treatment facilities given the population growth projections and the fact that the TDC flows from the new 2250 bed prison would eventually exceed the rated plant capacity. Given that additional treatment plant capacity will be required, cost estimates were determined for various alternative development scenarios. In developing these scenarios, consideration was given to the fact that the new Texas Department of Corrections Alfred Hughes Unit, scheduled to open in the fall of 1989, is currently under construction in the City of Gatesville.

I.C Contents of Report

This report focuses on the problem of providing adequate wastewater treatment facilities in the Gatesville area, given these assumptions:

1. the existing city wastewater treatment plant is approaching capacity;
2. considerable growth is projected in the Gatesville area, particularly south of the TDC facilities, currently not served by centralized treatment facilities;
3. the new TDC facility will require increased wastewater treatment capacity.

The scope of the study includes an assessment of existing wastewater treatment facilities and a determination of future demand for the years 1990, 2000, 2010, 2020, and 2030. These estimates have been derived from a combination of population projection scenarios together with predicted land use patterns. In determining these estimates, an attempt has been made to assign future wastewater flows to specific drainage basins within the study area, in order to locate areas most in need of facility expansion. Suitable wastewater collection and treatment alternatives have been identified and evaluated relative to these growth areas. Assessments, environmental constraints, water quality impacts, project feasibility, and permitting requirements are presented for a variety of alternative scenarios. Recommendations are made for wastewater treatment plants and major collection line locations and sizing, phasing of different projects, potential financing mechanisms, and institutional considerations. Given the uncertainties associated with growth projections, a major consideration was to maintain flexibility and allow for incremental expansion of the various wastewater treatment facilities.

Computer modeling, using the Streeter-Phelps Water Quality Simulation Model, was used to determine water quality constraints associated with various plant size and location scenarios. Cost estimates were derived from the known cost of wastewater treatment plant construction, land prices, interceptor costs, and the need for pumping stations based on the topography of the area. Throughout the course of the study, public meetings were held in order to address the concerns of the study participants and affected public entities, as well as private land owners.

II. EXISTING CONDITIONS

II.A DESCRIPTION OF STUDY AREA

II.A.1 POPULATION DISTRIBUTION AND LAND USE PATTERNS

Formerly, the City of Gatesville was an agriculturally oriented community. However, with an increasing population the City of Gatesville has experienced a shift toward industrialization and urbanization. The overall economic base of Gatesville is strengthening as indicated by Texas Employment Commission data concerning gains in employment and payrolls for manufacturing. These gains in non-manufacturing are largely attributable to the City of Gatesville's proximity to North Fort Hood and the Texas Department of Corrections.

Presently, the majority of land use is rural residential, with concentrated areas of industrial and commercial uses along State Highway 36 and U.S. Highway 84. The residential population of approximately 8,800 persons is dispersed behind and along these highways, with the greatest population density occurring at the intersection of U.S. Highway 84 and State Highway 36.

In order to continue effective land use planning and control, the City of Gatesville adopted a Comprehensive Plan through which subdivision and zoning ordinances have been developed and approved. The current zoning categories include single family, single family/four unit apartments, combination single family/ multi-family, local retail, community facility, general industrial, general business, agricultural homesteads, planned development, mobile home park, and outdoor commercial.

The City of Fort Gates residential population follows these same trends with access to Highway 36 directing the growth. The population of Fort Gates currently stands at approximately 1,100 persons.

II.A.2 DEVELOPMENT CONSTRAINTS

II.A.2.a FLOOD PLAINS

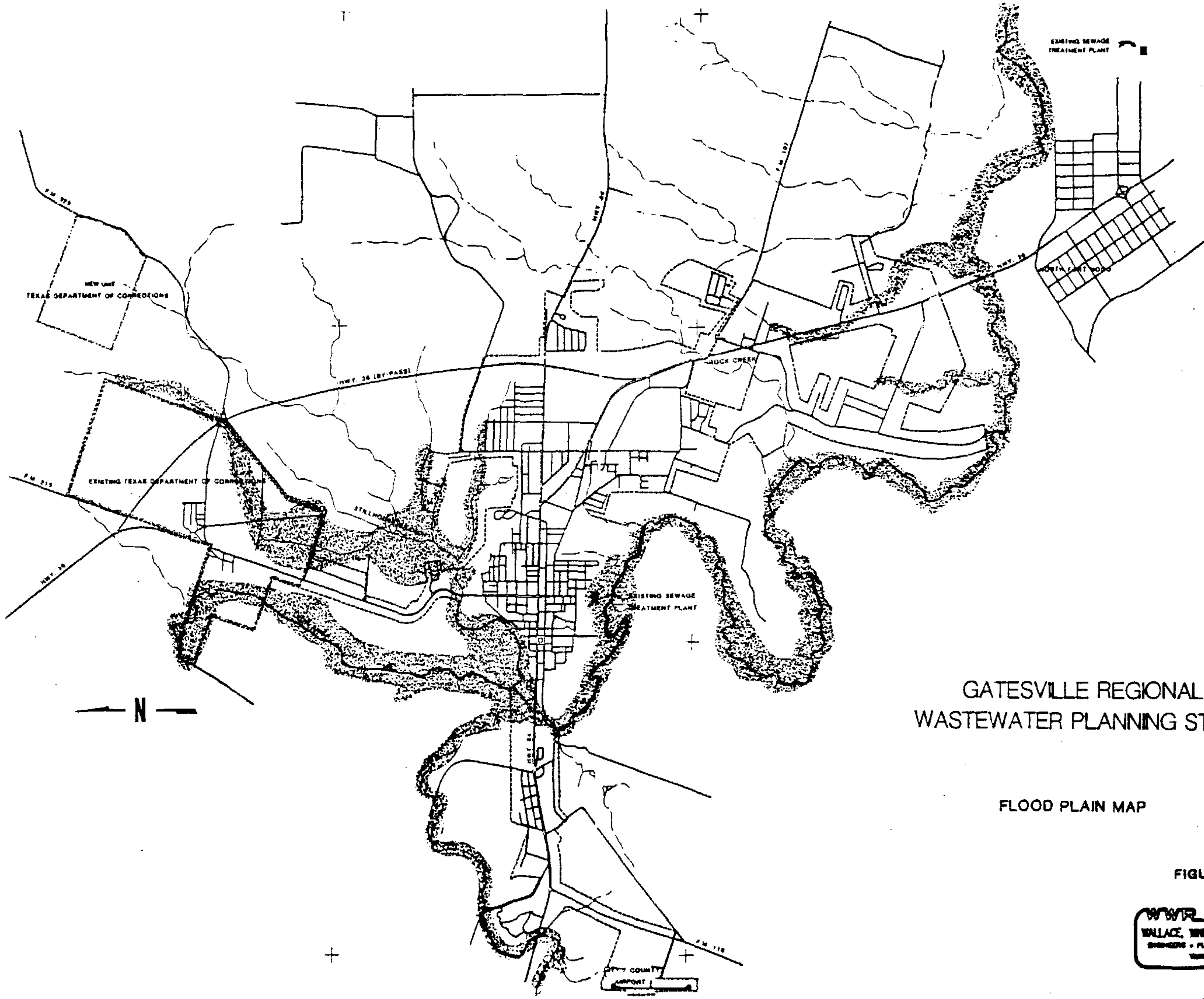
Approximately 1240 acres of the planning area rests in the 100 year flood plain region. The flood plain region is delineated on Figure II.1. These areas are subject to flooding during heavy rainfalls and run-offs, and therefore, development has been restricted or not permitted. Areas in close proximity to these flood plains are subject to infrequent flooding; however, development has been permitted in these areas because flood insurance has been made available to the City of Gatesville and Coryell County.

II.A.2.b TEXAS DEPARTMENT OF CORRECTIONS (TDC) FACILITIES

To the north of Gatesville lies the existing Texas Department of Corrections facility. Development on this property is for the TDC to decide and is beyond the jurisdiction of the City of Gatesville. The new TDC Hughes Unit will lie directly northeast of the present facility, thus blocking any development in that direction except for the land laying directly south of each of these facilities. Figure II.2 locates these facilities and displays their proximity to the Cities of Gatesville and Fort Gates.

II.A.2.c TOPOGRAPHY

Most of the land in the study area is gently sloped except for a few regions where the slopes are considered hilly. In these areas, development is difficult to impossible due to the impracticalities involved with servicing these areas with either water or sanitary sewer lines. Figure II.2 displays the regions where development is constrained because of topography.



GATESVILLE REGIONAL
WASTEWATER PLANNING STUDY

FLOOD PLAIN MAP

FIGURE II.1

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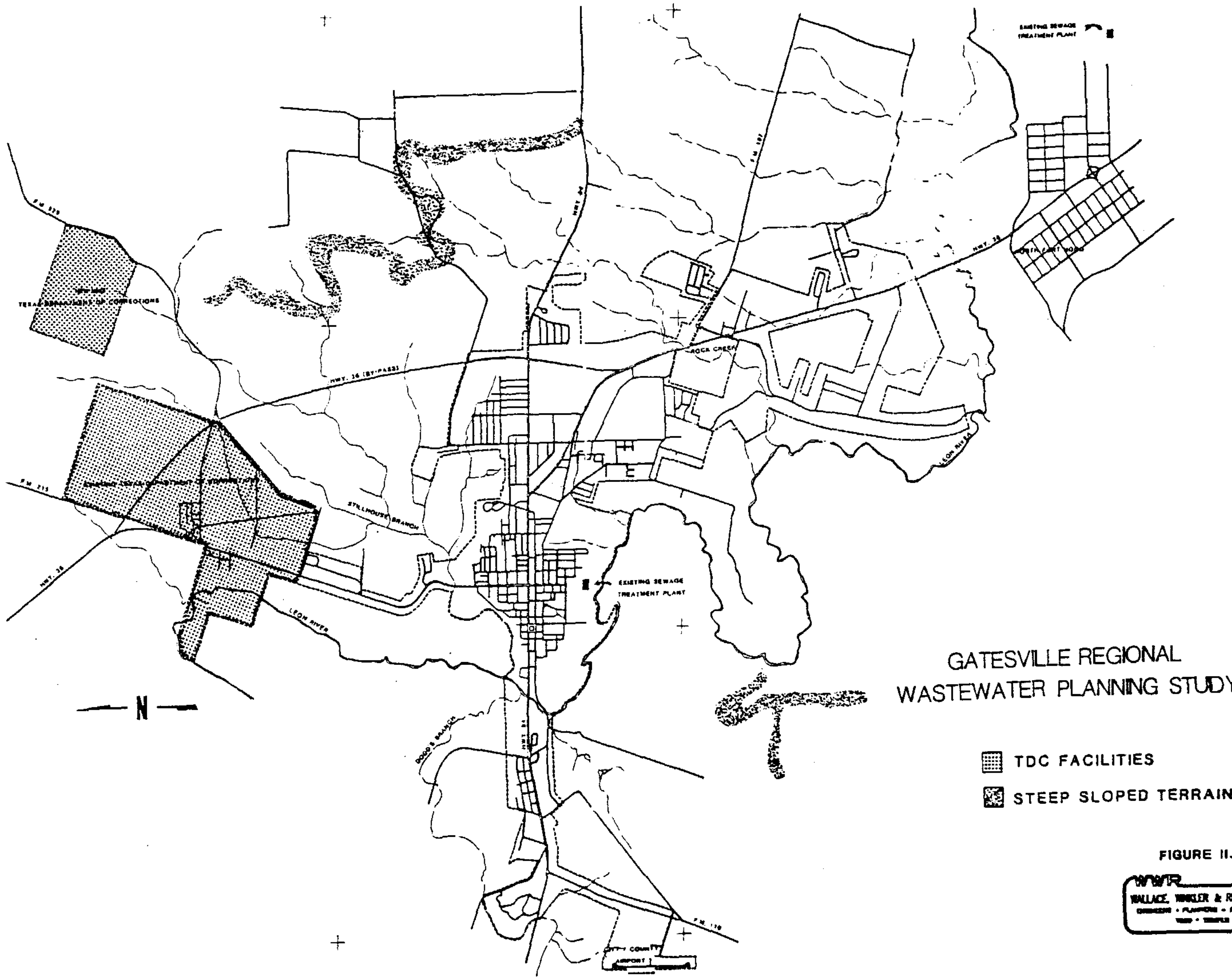

FIGURE II.2

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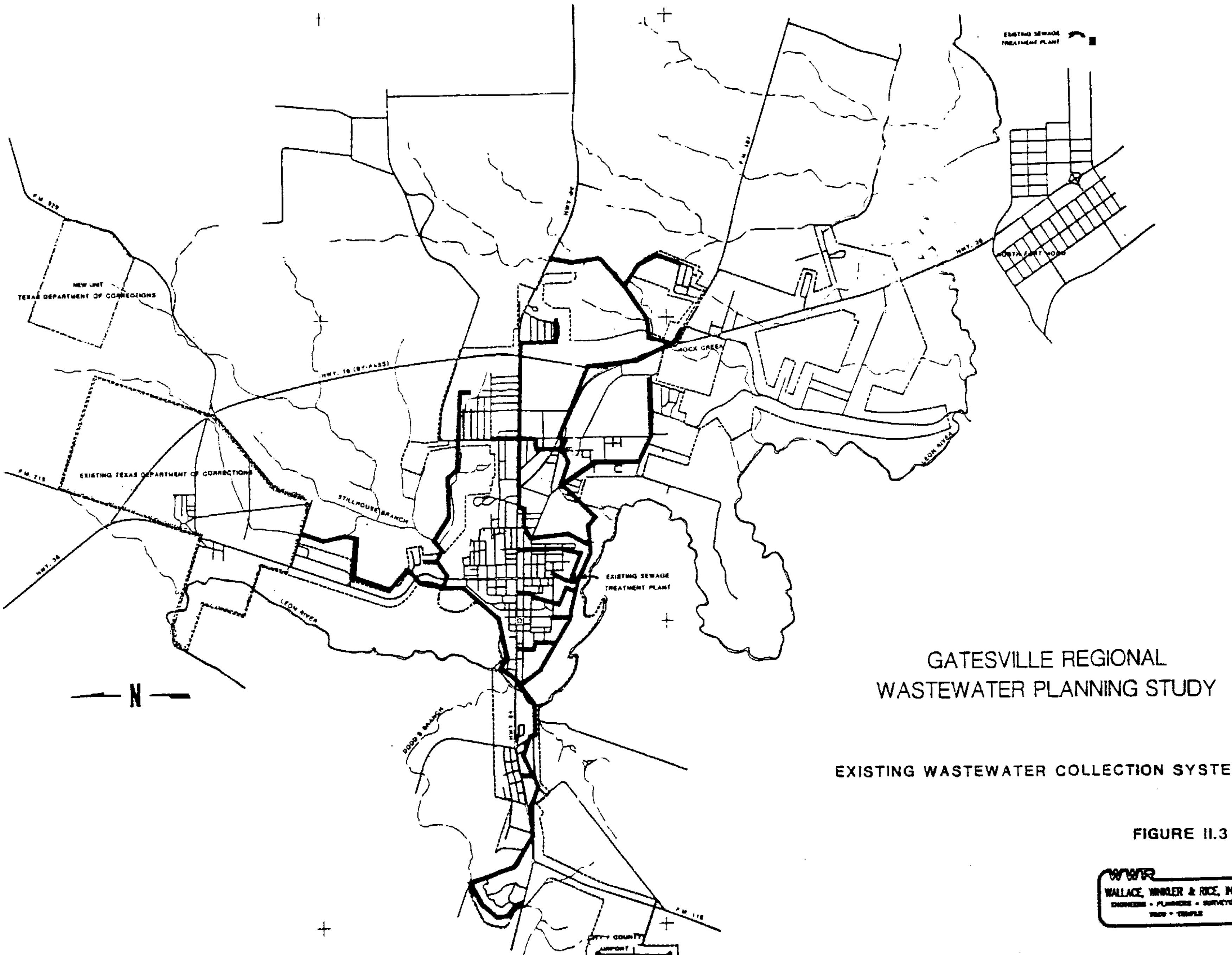

GATESVILLE REGIONAL
WASTEWATER PLANNING STUDY

EXISTING WASTEWATER COLLECTION SYSTEM

FIGURE II.3

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II.A.3.c SEWAGE TREATMENT FACILITIES

II.A.3.c.1 IMHOFF SYSTEM

This portion of the existing facility was constructed in 1963 making the major units approximately twenty-five years old. The major components of this system are a screen chamber and Parshall flume, a primary settling structure, a trickling filter, a final settling structure, a chlorine detention tank, and sludge drying beds. A layout of this facility is included as Figure II.4. In 1977, this part of the plant was known to exceed its permit limitations and was hydraulically and biologically overloaded. Table II.1 provides the capacities of the major units in the Imhoff system.

II.A.3.c.2 CONTACT STABILIZATION

In 1977, plans were made to expand the existing wastewater treatment facility, which resulted in the construction of a contact stabilization package plant in 1983. Figure II.5 shows the layout of this half of the treatment facility. The expansion required modifications to the existing screen chamber and Parshall flume, the final settling tank, sludge drying beds, and chlorine facilities to achieve maximum treatment efficiency and accomplish the required secondary treatment. Table II.2 provides the capacities of the contact stabilization unit and the overall capacity of the facilities. In 1983, several improvements were made to the collection system as well. These improvements included two lift stations and approximately 46,000 feet of sanitary sewer lines and some force mains.

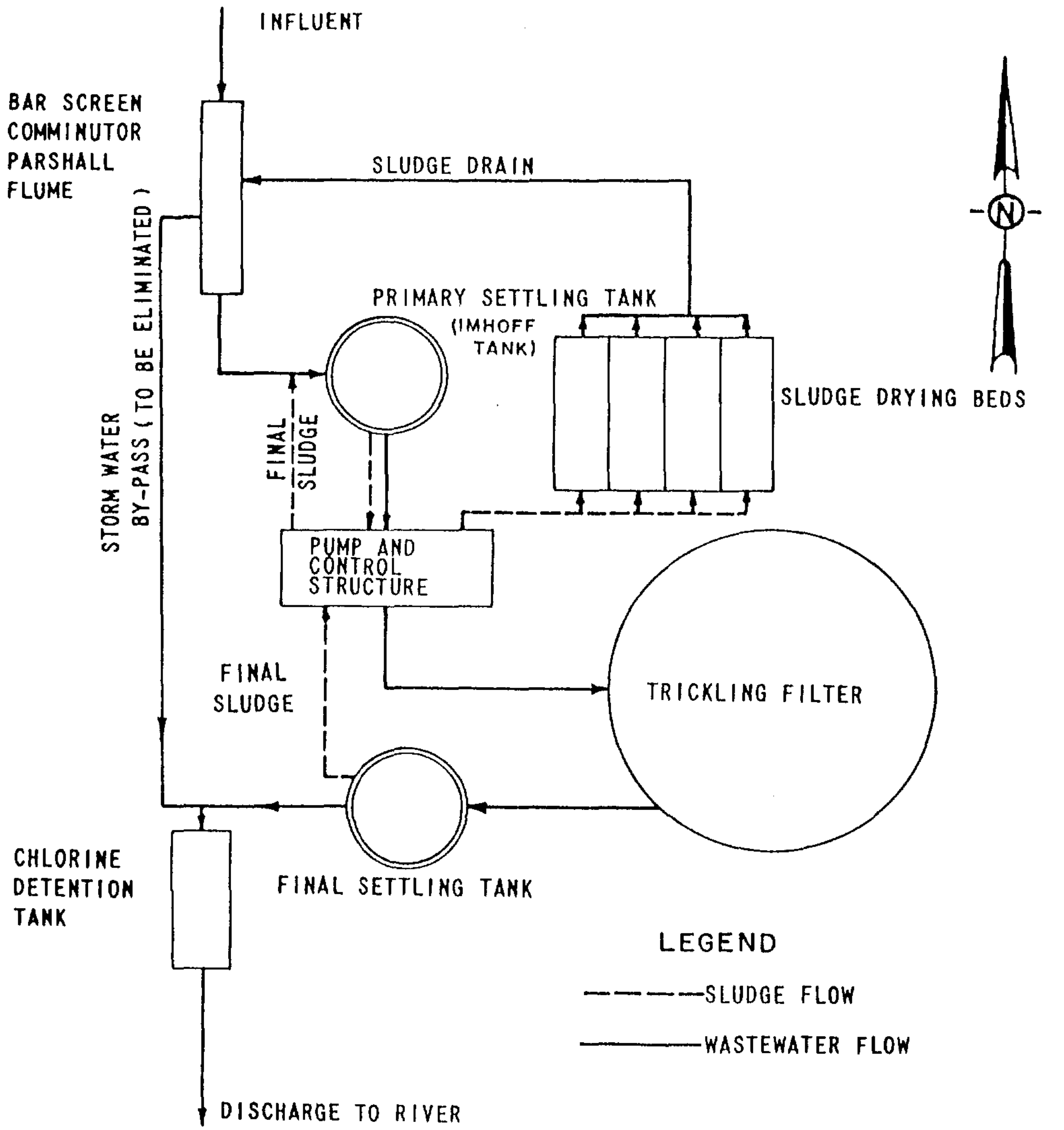
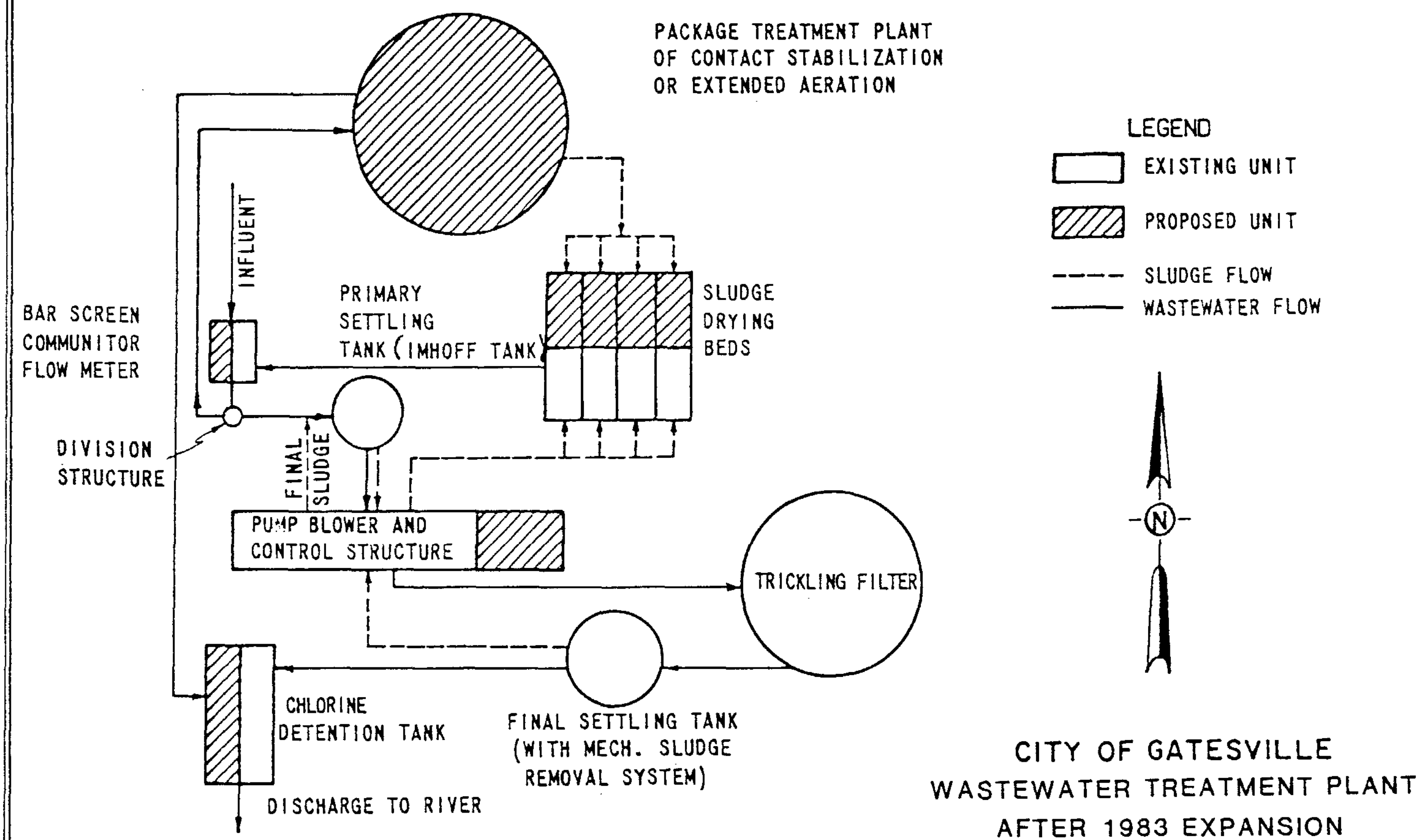


DIAGRAM OF 1963 WASTEWATER TREATMENT PLANT

CITY OF GATESVILLE

FIGURE II.4



CITY OF GATESVILLE
WASTEWATER TREATMENT PLANT
AFTER 1983 EXPANSION

FIGURE II.5

Table II.1

SUMMARY OF 1963 EXISTING COMPONENT CAPACITIES

Process Unit	Corresponding Capacity (MGD)
Screen Chamber and Parshall Flume	1.50
Primary Settling Structure	1.00 (Peak Flow)
Trickling Filter	0.50
Final Settling Structure	1.00 (Peak Flow)
Chlorine Detention Tank	0.46
Sludge Drying Beds	0.38

TABLE II.2

SUMMARY OF ALL EXISTING COMPONENT CAPACITIES

Process Unit	Corresponding Capacity (MGD)
Screen Chamber and Parshall Flume	2.00
Primary Settling Structure	2.00 (Peak Flow)
Trickling Filter	0.50
Contact Stabilization	0.50
Final Settling Structure	2.00 (Peak Flow)
Chlorine Detention Tank	2.00
Sludge Drying Beds	1.14

* Source: Rady and Associates, Inc. Facility Plan Report, July 1977

II.A.4 EXISTING WASTEWATER FLOWS

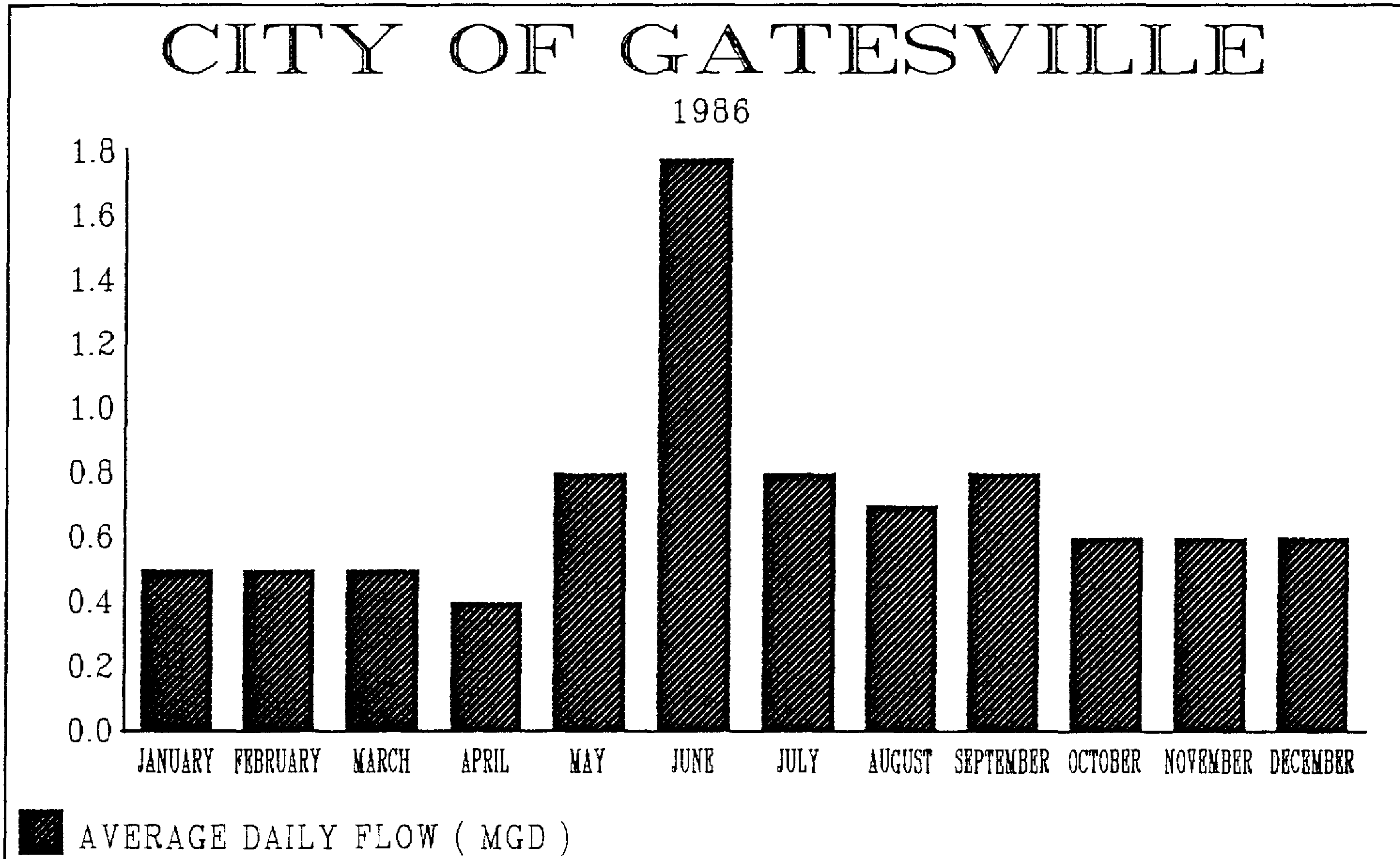
Records over the past two years indicate an average daily flow of 0.8 MGD for the existing sewage treatment plant. As indicated by Table II.2, the combined capacity of the treatment facilities is 1.0 MGD average daily flow and 2.0 MGD peak hourly flow.

These same records show some variation in the loading of the treatment facilities; however, the water quality of these flows is typically within the permitted levels; these being 20 mg/l Five-Day Biological Oxygen Demand (BOD_5) and 20 mg/l Total Suspended Solids.

The collection system is basically in sound condition, although some infiltration/inflow does occur in the system. Because the City of Gatesville has an on-going line maintenance an replacement program, sources of I/I are continually being identified and line deteriorations repaired to reduce the flow into the existing wastewater treatment plant.

The wastewater treatment plant at North Fort Hood, permitted at 0.625 MGD, is subject to even greater variation due to the changing military staff and operations on a seasonal basis.

Figures II.6 and II.7 show the average monthly flows for the years 1986 and 1987 for the existing wastewater treatment facility in Gatesville as reported to the TWC by the City of Gatesville. Wastewater flows as reported by Fort Hood officials from the North Fort Hood treatment plant are shown on Figure II.8.



BASED ON SELF-REPORTING DATA SUBMITTED TO THE TWC

FIGURE II. 6

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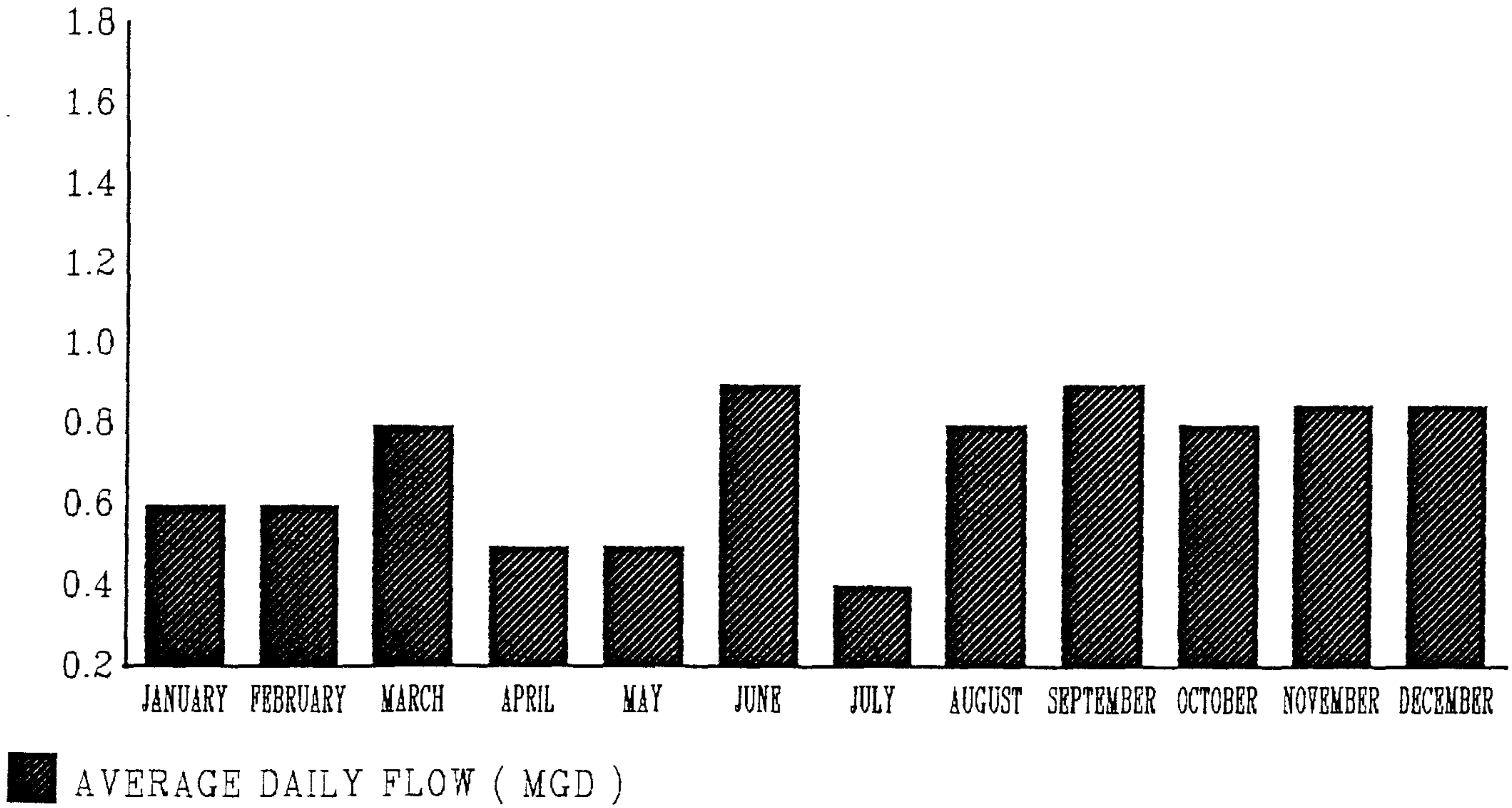
CITY OF GATESVILLE

1987



BASED ON SELF-REPORTING DATA SUBMITTED TO THE TWC

FIGURE II.7

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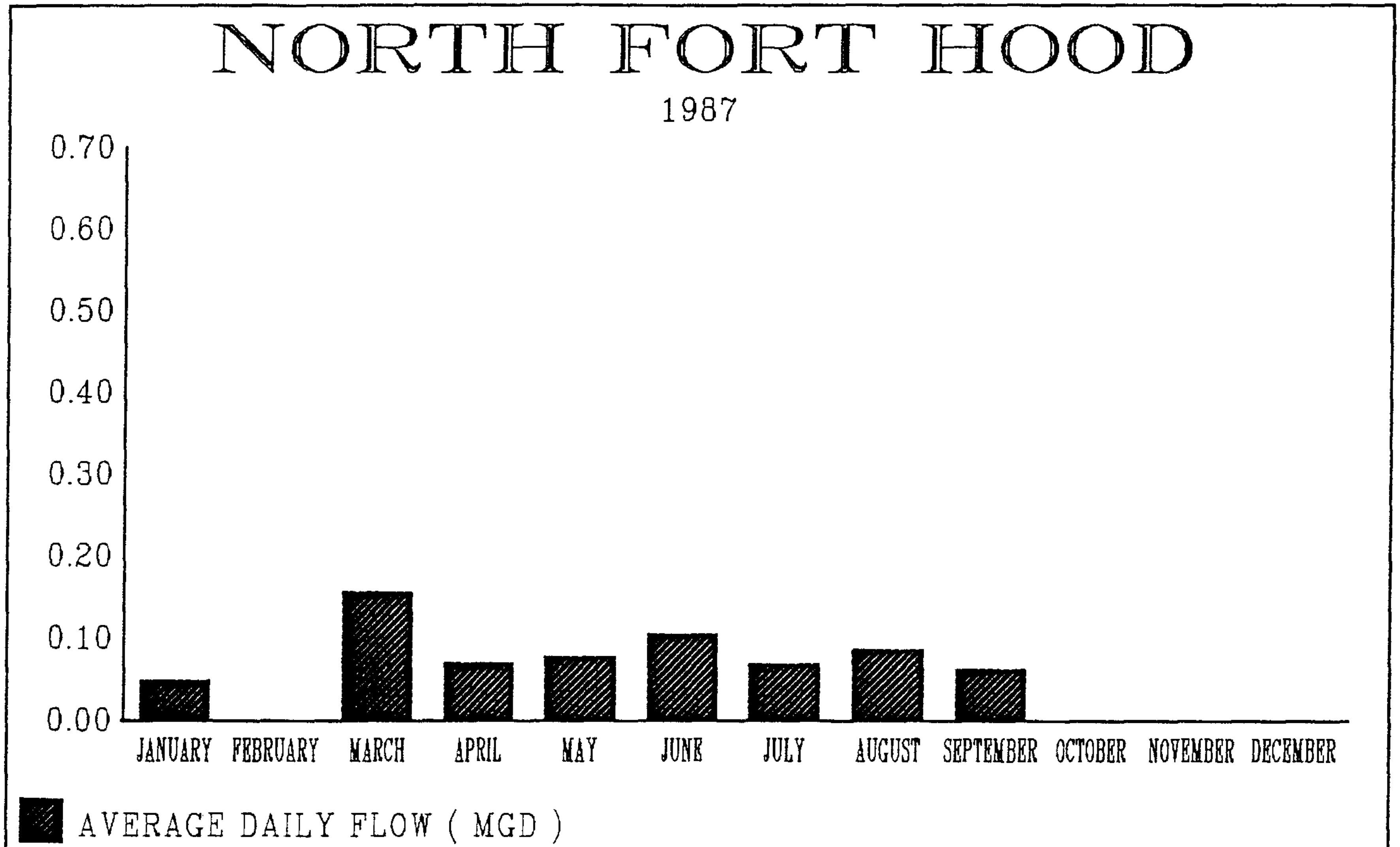

FIGURE II. 8

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II.B GROWTH SCENARIOS AND PREDICTED LAND USE

II.B.1 GROWTH SCENARIOS

Although growth rates in the state of Texas have been sluggish due to the economic downturn, slow but steady growth can be expected in the Gatesville area due to the Texas Department of Corrections facilities. In addition to the new prison facility, some small subdivisions have been planned in the area, thus promoting growth. Population projections for the City of Gatesville and the surrounding area reflect this slow and steady growth.

II.B.1.a City of Gatesville

In the past, the City of Gatesville has developed around the major highways. With the opening of the Highway 36 bypass, growth in the north and northeast portions of town can be expected, particularly on the land immediately surrounding the bypass. Land is available in the northern expanse and along the western and southwestern edges of the City. If development follows previously set patterns, the northern areas will develop focusing on rural residential uses. However, land closer to the correctional facilities will be less likely to develop as residential, but rather commercial/retail. Industrial areas will become focused on the western section of Highway 84 as well as toward the southwest around the Anchor Industries and Medical Plastics location, which is located on F.M 116. This urbanization and industrialization would be encouraged by additional wastewater capacity at a regional treatment facility. Although a treatment plant cannot generate population increases and development, the extra capacity does increase the potential for these types of growth.

II.B.1.b City of Fort Gates

The City of Fort Gates is a residential area, with growth here limited by the lack of municipal wastewater facilities. However, a small portion of north Fort Gates is provided with capacity in the existing Gatesville treatment plant. In the future, a sewage treatment plant could be constructed to serve the entire area. However, this action is not feasible until the population achieves that number to which the current septic tank system is either inadequate or is endangering the ground water or the surrounding rivers and streams. As mentioned for the Gatesville area, a sewage treatment plant increases the potential for growth and development but cannot actually generate population increases.

II.B.2 CRITERIA FOR FUTURE LAND USE

This growth scenario evolved from the criteria for future land use. These criteria include population projections, examination of previous development trends in each drainage basin or sub-basin, zoning regulations, and the availability of land. Each of these criteria were considered for the cities of Gatesville and Fort Gates.

Population projections were developed for the planning area using water system meter connections over the past several years and projecting these connections to the year 2030. A ratio of 2.3 people per connect, knowing the 1980 population and number of system connects, was used for both cities. These projections closely follow the September 1988 draft TWDB projections (Figure II.9). The population can be expected to approximate actual conditions fairly closely having been developed from previous trends for the Cities. Looking at foregoing land use maps and the existing density of development, the obvious trend in the planning area is to develop along the highways and at major intersections. Concerning the City of Gatesville's zoning regulations, these can be changed, but ordinarily, the basic intent of a city's comprehensive plan is followed with variations not far from the originally intended use. Also, zoning and subdivision regulations are strictly enforced so that the City in question can continue to receive state and federal assistance. With regard to land availability in the Gatesville and Fort Gates areas, a great quantity of land is open to growth and development, particularly in the northern city limits of Gatesville.

II.C POPULATION AND LAND USE - BASE CONDITIONS: 1990

II.C.1 POPULATION

According to WWR population projections, the area population of Gatesville and Fort Gates will total 10,048 persons by the year 1990. Approximately 1248 persons will reside in Fort Gates, with the remaining 8,800 persons living in Gatesville. The underlying assumption is that the study areas growth will be primarily residential in nature. This residential growth could in turn, support additional commercial and industrial development. However, the area as a whole is expected to remain essentially residential in character. Table II.3 represents a tabulation of the population in the study area.

TABLE II.3

POPULATION PROJECTIONS*

YEAR	WWR\CITY OF GATESVILLE	TWDB HIGH SERIES	TWDB LOW SERIES	WWR\CITY OF FORT GATES
1980	6,620	6,620	6,620	777
1986	6,884			1,016
1990	8,800	8,228	8,097	1,248
2000	9,766	9,341	8,530	1,788
2010	11,632	11,155	9,867	2,328
2020	13,616	13,009	10,788	3,036
2030	16,801	15,170	11,957	3,960

* Population Projections do not include TDC inmates at 3 existing prisons, the new Alfred Hughes Unit, or North Fort Hood.

II.C.2 LAND USE

II.C.2.a City of Gatesville

As the City of Gatesville continues to turn toward a service based economy, land uses in the area will change. Small industrial parks are expected to develop near the western city limits and along the far west portion of Highway 84. The newly constructed Highway 36 bypass will create an area of retail and commercial establishments extending toward the TDC facilities, as well as residential neighborhoods on either side of the Bypass, approximately 500 feet beyond the right-of-way.

II.C.2.b City of Fort Gates

The City of Fort Gates will remain primarily a residential area, with limited retail/commercial development along Highway 36, due in part to the aforementioned lack of adequate municipal wastewater facilities. In the event that treatment and collection facilities are constructed, the City of Fort Gates could experience an increase in commercial and light industrial development. Figure II.8 exhibits these anticipated land uses.

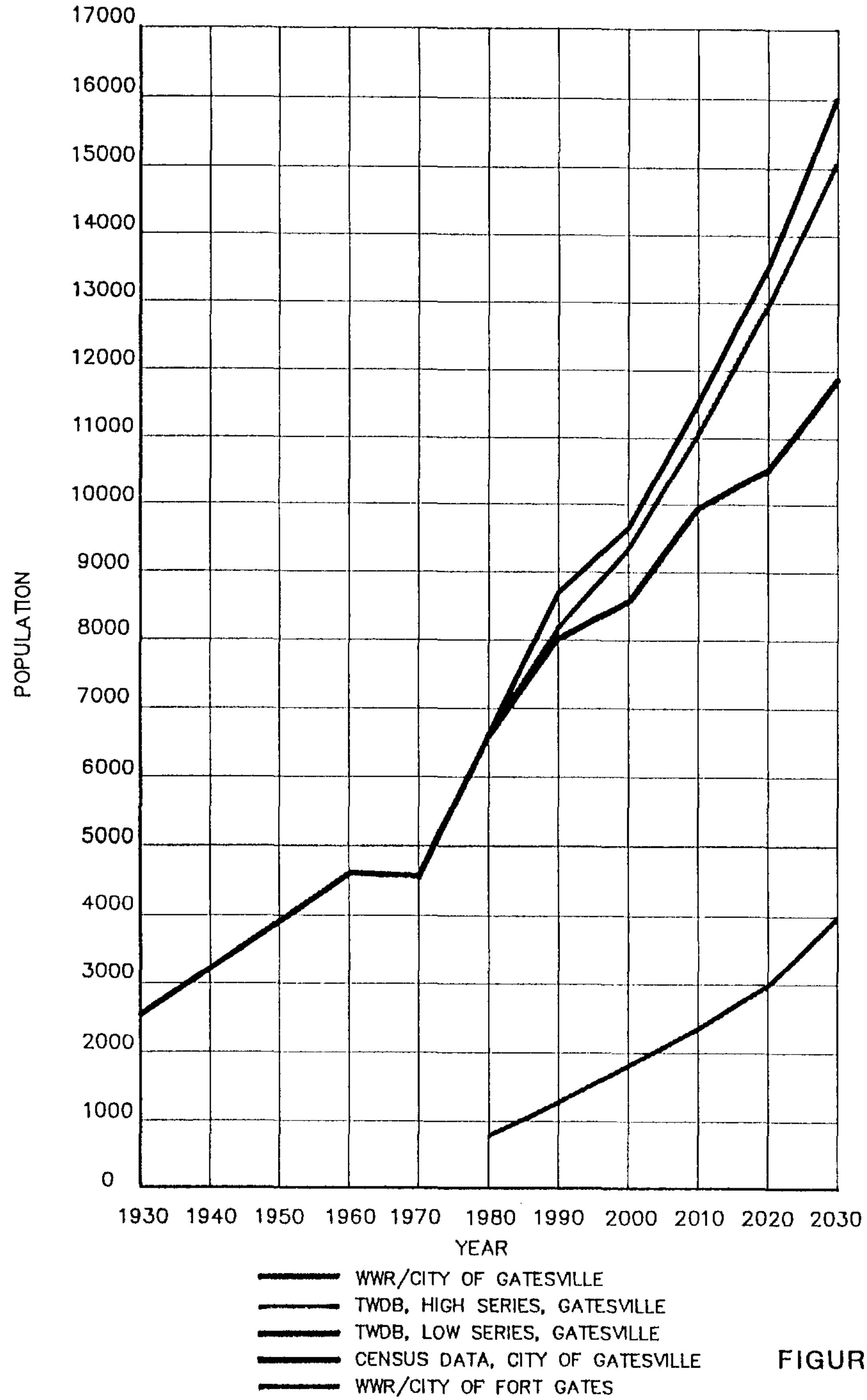
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
POPULATION
1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030
YEAR
WWR/CITY OF GATESVILLE
TWDB, HIGH SERIES, GATESVILLE
TWDB, LOW SERIES, GATESVILLE
CENSUS DATA, CITY OF GATESVILLE
WWR/CITY OF FORT GATES

FIGURE II.9

II.D ENVIRONMENTAL CONDITIONS

II.D.1 SOILS

Deposits of sand, gravel and stone occur at various locations throughout Coryell County, of which Gatesville is the County seat. Coryell County ranks low compared to other counties in Texas with respect to natural resources. Neither oil nor other currently valuable minerals have been discovered within the County. Other types of minerals which could be used as a basis for the development of a resource-based industrial complex do not exist.

In the project area, no evidence of fossils has been detected. The geological formations within the project area contain no known faults or synclines.

The general soil map provided by the Soil Conservation Service shows that the Gatesville area is comprised of two major soil types. The first type is sandy loam to loamy sand surface soils overlying sandy clay or sandy clay loam subsoils. These types of soils are found in that area east of the Leon River and are of the Travis and Bastrop series which are characteristically moderately permeable and well-drained. The slopes of the soil are gently sloping to sloping and range from 1 to 6 percent. The second type lies in the western section of Gatesville and has dark brown to grayish brown calcareous clay surface soils overlying limestone bedrock of the Tarrant and Brackett series. These soils are characteristically moderately permeable and well-drained. The slopes of the soil are gently sloping to hilly and range from 1 to 30 percent.

Coryell County lies in the Grand Prairie physiographical sub-region of Texas which comprises a limestone plain on which in many sloping sections the soil has been removed by erosion.

The Trinity Group Aquifer underlies Coryell County and is a confined sand sandwiched between two shale stratas. The Trinity group is divided into the Travis Peak Formation, Glen Rose Limestone, and Paluxy Sand. The maximum thickness of the Paluxy Sand is approximately 190 feet in northwestern Erath County to extinction in Southern Hill, McLennan and Coryell Counties. The Trinity Aquifer once supplied potable water to Coryell County and much of Central Texas. Due to rapidly receding water levels and a degradation of water quality, most of the county has obtained surface water sources. The Aquifer is predicted to be in continual decline into the foreseeable future.

II.D.2 Climatic Elements

The climate of the area in which the study area is located is temperate and sub-humid. The summers are long and the winters are comparatively short and mild. The average January temperature is 49 degrees and the average July temperature is 84 degrees. The usual winter weather consists of cool, mainly clear weather with westerly winds of moderate strength, followed by a period of warmer weather with moderately or strong southerly winds. Such a period may end suddenly by a shift of the wind to the northwest, with a sudden sharp drop in temperature. This "norther" lasts from two to four days and is followed by gradually rising temperature and decreasing wind. The spring weather is pleasant, although there are strong southerly winds. Summers are warm with some hot days. The area has a growing season of 241 days with an average annual rainfall of 32.8 inches. The first killing frost is in the fall toward the end of November, and the last on in the spring toward the end of March.

II.D.3 Zoological Elements

Mammals found in the Gatesville area include the following: nutria, jack rabbit, cottontail, white tailed deer, barbary sheep, armadillo, plains pocket gopher, beaver, various species of mice, raccoon, long-tailed weasel, mink, spotted skunk, striped skunk, red fox, gray fox, coyote, bobcat, eastern gray squirrel, fox squirrel, eastern flying squirrel, opossum, eastern mole, cave bat, red bat, and guano bat.

Reptiles found in the area around Gatesville include the following: plain water snake, brown snake, garter snake, lined snake, earth snakes, southern copperhead, northern copperhead, broad-banded copperhead, cottonmouth, western diamond-back rattlesnake, canebrake rattlesnake, Texas coral snake, whip snake, racer snake, green snake, Texas patch-nosed snake, corn snake, ratsnake, bull snake, king snake, ground snake, and slender blind snake.

Insects common to the Gatesville area include: flies, dragonflies, termites, black widow spiders, ticks, grasshoppers, silverfish, wasps, fleas, and daddy long legs.

Birds found in the Gatesville area include: Canada goose, mallard duck, pied-billed grebe, double-crested cormorant, great blue heron, little heron, gadwell, pintail, american widgeon ring neck duck, lesser scoup, turkey vulture, black vulture, sparrow hawk, bobwhite, sandhill crane, american coot, Killdeer, common snipe, upland plover, Franklin's gull, dove roadrunner, barn owl, screech owl, great horned owl, mockingbird, robin, ruby-crowned kinglet, cedar waxwing, loggerhead shrike, starling, myrtle warbler, house sparrow, eastern meadowlark, red-winged blackheaded cowbird, cardinal, dicklissel, american goldfinch, lark sparrow, white-throated hummingbird, blackchinned hummingbird, kingfisher, yellow-shafted flicker, redbelted woodpecker, red-headed woodpecker, western kingbird, scissor-tailed flycatcher, eastern phoebe, horned lark, cliff swallow, purple martin, blue jay, common crow, carolina chickadee, tufted titmouse, brown creeper, Bewick's wren, and carolina wren.

Principal fish species found in the area are catfish, bass, and sunperch.

Shellfish, macrofauna, breeding areas, and endangered species are not known to exist in the Gatesville area; however, eleven endangered, threatened, or peripheral vertebrate species have potential occurrence near the City of Gatesville. These species are the white-faced ibis, roseate spoonbill, fulvous whistling duck, bald eagle, golden eagle, osprey, peregrine falcon, prairie falcon, merlin, golden-cheeked warbler, and mountain lion. Of these, only five have been sighted in the Gatesville area in recent years: white-faced ibis, mountain lion, osprey, peregrine falcon, and golden-cheeked warbler.

II.D.4 Botanical Elements

The study area is located in an area which follows the Cross Timbers and Prairies vegetation zones. Vegetation includes the following: mistletoe, buttercup, dewberry, mesquite, bull nettle, prickly pear, purple thistle, wild dill, bluebell, milkweed, morning-glory, paint-brush, broomweed, daisy-yellow, daisy-white, mex hat, black-eyed susan, ragweed, sunflower, Indian blanket, squaw weed, periwinkle, green milkweed, poccoon, venus looking glass, honeysuckle, bird-eye bush, mouse ear, chickweed, spiderwort, Texas thistle, rabbit tobacco, Engelmann daisy, firewheel, wild cauliflower, Lindheimer daisy, false dandelion, ragwort, tansy mustard, draba, bladder pod, pecan, cottonwood, birch, postoak, american elm Texas walnut, cedar elm, white ash, chinese elm, eastern redcedar, green ash, hackberry, liveoak, white oak, slippery elm sassafras, witch-hazel, and silver maple. The existence of any microflora, unique species, unique plant communities, or mature stands of forest in the study area could not be detected.

II.E WASTEWATER FLOWS

II.E.1 CRITERIA FOR PROJECTIONS

Based on values supplied in Wastewater Treatment Design by Metcalf and Eddy, flows per acre per day (gallon per acre per day) were assigned to the existing system. The total resulting flow was then calibrated to match recorded flows into the sewage treatment plant. The total useable land (total land acreage minus the flood plain region and undeveloped area) was assigned a population density to match the amount of land developed at the design year considered. The average daily flows were calculated by the following equation:

Flow = (gpad) * (total useable land) * (% maximum development)

where percent maximum development equals the calibrated estimate of flow divided by the design flow. Appendix A includes the total flow per basin for each decade to the year 2030 used for design calculations.

II.E.2 PROJECTED FLOWS

Table II.4 represents the projected populations for the City of Gatesville and the City of Fort Gates. Corresponding wastewater flows expected from this population for the design years 1990, 2000, 2010, 2020, and 2030 are also indicated. Wastewater flows from the TDC facilities are included in Table II.4; however, the inmate population is not indicated because these flows are not necessarily proportional to the inmate population.

North Fort Hood wastewater flows are dependent upon military operations that occur. Because this information is not public knowledge and is somewhat seasonal in nature, predicting wastewater flows for North Fort hood is precluded. For design purposes, projections from the Brazos River Authority Leon River Study are used. For North Fort Hood, inclusive of the decades 1990 through 2030, these flows are 0.25, 0.33, 0.44, 0.59, and 0.79 respectively.

TABLE II.4

PROJECTED WASTEWATER FLOWS

CITY OF GATESVILLE

DESIGN YEAR	POPULATION	FLOW (MGD)
1990	8,800	0.83
2000	9,766	0.92
2010	11,632	1.10
2020	13,616	1.30
2030	16,801	1.60

CITY OF FORT GATES

DESIGN YEAR	POPULATION	FLOW(MGD)
1990	1,248	0.14
2000	1,788	0.20
2010	2,328	0.26
2020	3,036	0.33
2030	3,960	0.44

TDC

DESIGN YEAR	FLOW(MGD)
1990	0.93
2000	1.10
2010	1.40
2020	1.50
2030	1.70

II.E.3 PROPOSED WASTEWATER TREATMENT SYSTEMS

II.E.3.a CONTACT STABILIZATION

A contact stabilization system using an aeration unit, re-aeration, primary and secondary settling, chlorination, dechlorination, and sludge drying was considered and rejected. The short detention time in the aeration basin does not lend itself readily to shock loadings and nitrification. The City currently has difficulty meeting permit, even on flows less than design, with the existing system, This alternative was rejected.

II.E.3.b AERATED LAGOON

An aeration lagoon system using mechanically aerated lagoons, secondary settling, chlorination, dechlorination, and sludge drying was considered. The process is subject to significant seasonal variations in effluent quality due to temperature changes and the formation of algae. The ability to meet the permit requirements were questioned and this alternative was rejected.

II.E.3.c TRICKLING FILTER

A trickling filter system using primary and secondary settling, trickling filter units in series, chlorination, dechlorination and sludge drying was considered. Changes in quality vary with seasonal temperature changes and the filters are non-compliant with permit requirements when backwashed. Furthermore, the trickling filter system does not lend itself to nitrification. This alternative was rejected.

II.E.3.d EXTENDED AERATION WASTEWATER TREATMENT PLANTS

Many treatment processes are available and were considered prior to final recommended design of a regional facilities. In this study, a Carrousel extended aeration wastewater treatment plant is assumed for the purposes of alternative evaluation. Extended aeration is a process which compares favorably to other options in a wide range of conditions. Advantages of this type facility, besides requiring less land, include relatively low capital costs and simplicity in operation and maintenance, due in part to the type of mixing and flow configuration. This facility also has a moderately low susceptibility to process upsets, and is capable of producing a very high quality effluent which should be satisfactory for current and future discharge permitting purposes. One particular advantage of this type process is the ease of adding additional processes such as phosphorus and nitrogen removal.

Other benefits particular to Carrousel activated sludge plant include good sludge flocculation characteristics and considerable settling and clarification in the final clarifier if used in the plug flow mode. Furthermore, extended aeration produces an extremely stable sludge making the waste sludge is suitable for direct land disposal for agricultural purposes. Also, the flow pattern prevents short circuiting and buffers like a complete mix system. In addition, tremendous dilution is provided as the influent combines with the mixed liquor recirculating through the channels.

The principal disadvantages of this process are the relatively high power costs and higher operation and maintenance costs compared to other similar treatment processes. So that minimum dissolved oxygen requirements are met, it is assumed that the effluent will undergo cascade aeration prior to discharge. Figure II.11 represents a typical layout for this wastewater treatment plant.

II.E.3.e SEPTIC/EVAPOTRANSPIRATION

In the Fort Gates area, septic/evapotranspiration systems are expected to be used until the population can support a treatment facility. A common, single home septic system is illustrated by Figure II.12. In some areas, the percolation rate is too slow for subsurface disposal, and an evapotranspiration bed must be used to dissipate the septic tank effluent. This method, which uses plant transpiration and surface evaporation, may also be used in relatively permeable soils by adding an impermeable liner below the bed to prevent seepage and /or groundwater contamination.

II.E.3.f CLUSTERED SEPTIC SYSTEMS

In certain situations, it may be feasible to collect wastewater from a few nearby residences for a common disposal. Such a system could take the overflow from individual septic tanks. or could collect raw sewage into a common tank. The resulting effluent could be disposed of by a large drainfield or evapotranspiration bed.

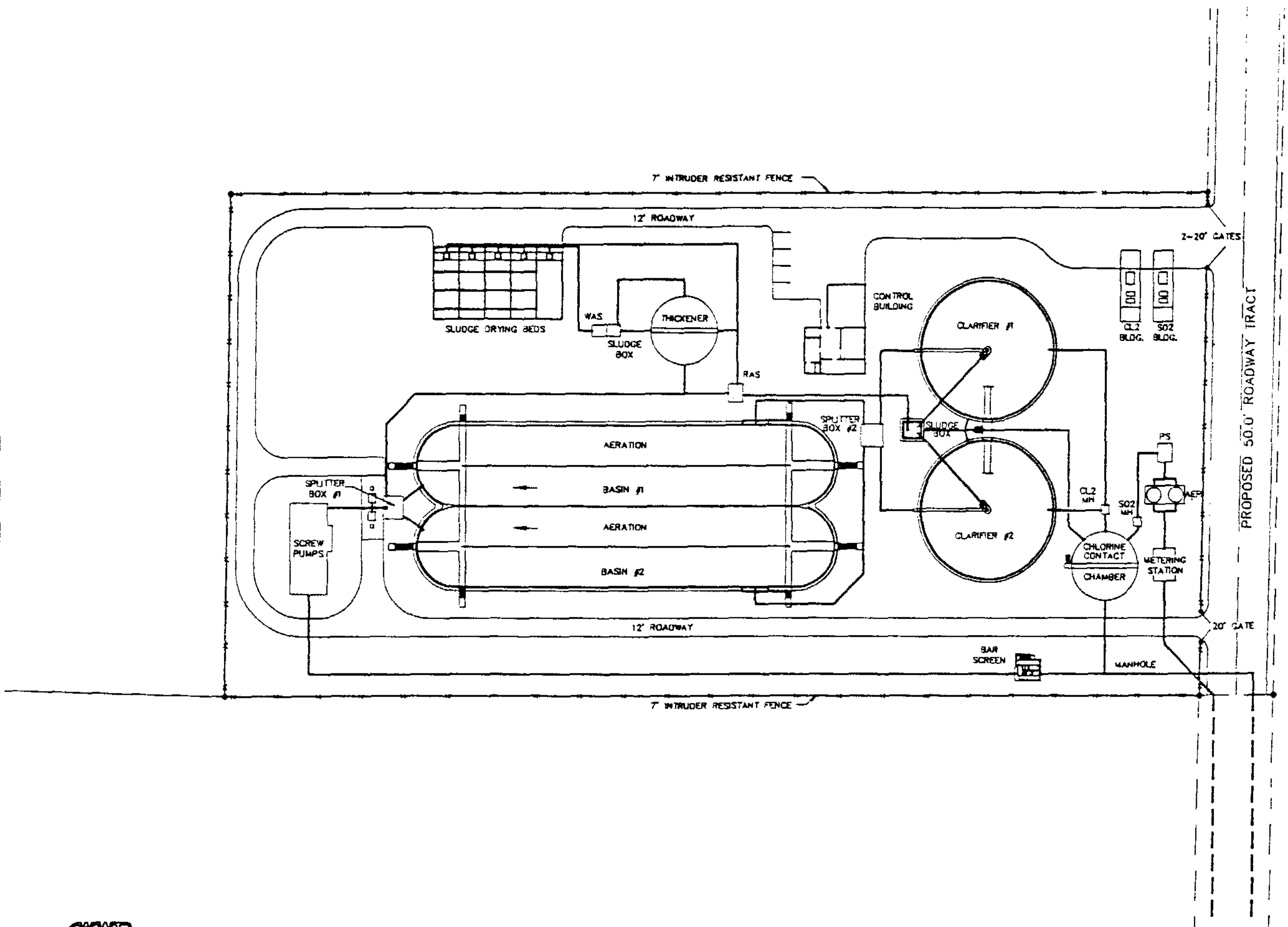

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FIGURE II.11

TYPICAL PLANT LAYOUT

TYPICAL LAYOUT

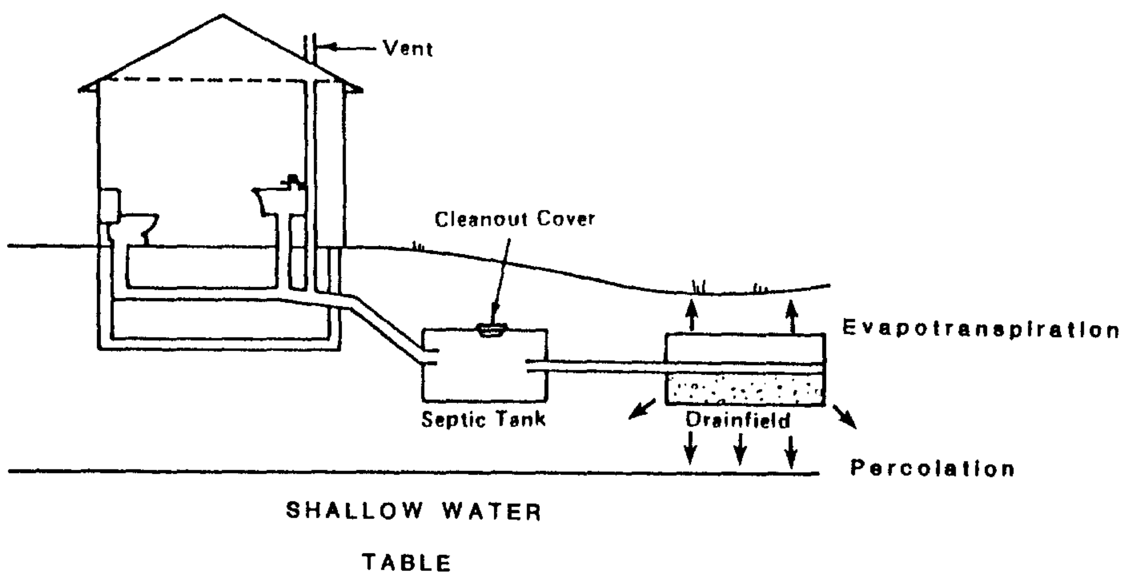

FIGURE II.12

CONVENTIONAL SUBSURFACE DISPOSAL

WWR
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III. SUMMARIZE ALTERNATIVES

III.A GENERAL OVERVIEW

Treatment plant alternatives for this study range from a single regional plant to as many as three local or sub-regional plants. A regional wastewater treatment plant is conceptually the simplest method of providing regional wastewater management. With the exception of rural areas outside the city limits of Fort Gates, all wastewater would be collected and transported to a central location for treatment and discharge. An extensive system of gravity collection lines, lift stations, and force mains is required to transport wastewater from the scattered developments within the study area.

Local or sub-regional treatment plants provide a viable component of a regional wastewater plan. The use of small plants reduces the cost of transporting wastewater by treating flows closer to their source. This would also allow greater flexibility in phasing improvements to coincide with growth.

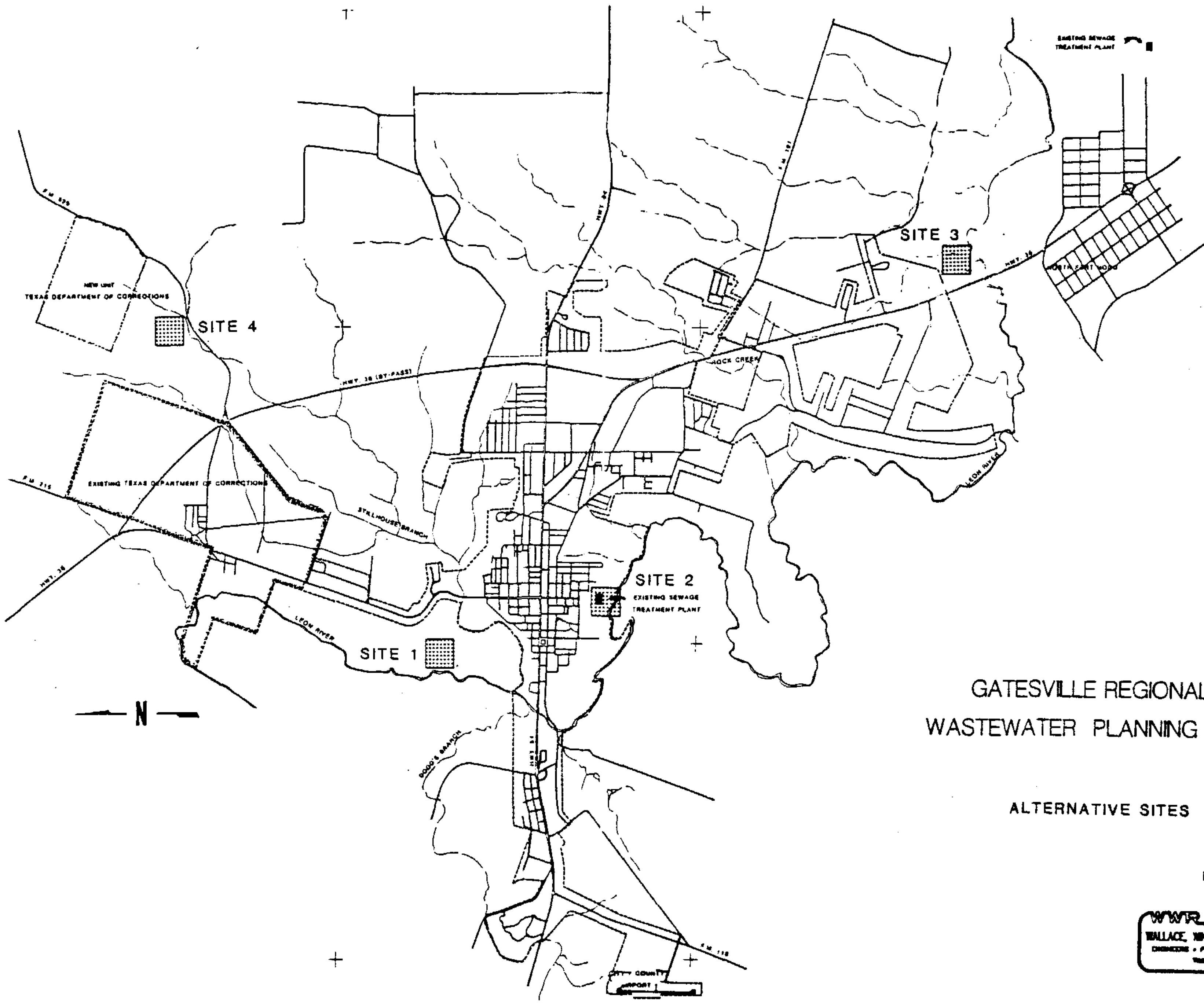
In the initial evaluation, several treatment plant sites were considered. These sites were as follows: (1) location upstream of the existing facility, (2) expand existing location, (3) a downstream location, and (4) location adjacent to the new Alfred Hughes Texas Department of Corrections Unit. These alternative sites are shown on Figure III.1.

II.B ALTERNATIVE A

The first alternative, the upstream location, was considered because this location could serve the Texas Department of Corrections Facilities including the new Hughes Unit plus collecting from the existing population north of Highway 84 and the expected growth along the Highway 36 Bypass east of the existing sewage treatment plant. This alternative includes several thousand feet of interceptors; however, because these collectors are proposed, a phasing and implementation plan could be developed in order to control the costs of the entire system.

III.C ALTERNATIVE B

Expanding the existing treatment plant location south of the City of Gatesville, the second alternative mentioned above, was considered in order to address all economical alternatives. Since this site is



GATESVILLE REGIONAL
WASTEWATER PLANNING STUDY

ALTERNATIVE SITES

FIGURE III.1

WWR
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located in the flood plain, expansion to the necessary size and acquisition of land is nearly impossible. Additional treatment facilities of the required size would be very costly because of flood plain design considerations.

In addition to flood plain problems, the location would require several more thousand lineal feet of interceptors, and the existing facilities would need to be replaced with new facilities in order to meet the new effluent and stream standards outlined in the State Regulations by the Texas Water Commission.

III.D ALTERNATIVE C

The third alternative, that being a downstream location, was considered as a regional facility with collection and treatment capabilities for the Cities of Gatesville and Fort Gates, and easily expanded to include North Fort Hood. This location is still a viable alternative for a regional or sub-regional facility. However, because of the cost of the additional collection system, the time frame surrounding the Alfred Hughes Correctional Facility, and the stringent treatment levels associated with a regional facility, this alternative was investigated as an ultimate phase of the regional facility system to be implemented at a later date rather than as a response to the immediate situation.

Constructing a sub-regional wastewater treatment facility with a reduced capacity will reduce the initial cost of the system and can be implemented on a more timely basis.

III.E ALTERNATIVE D

With the Texas Department of Corrections Facility expected to be fully operational in November of 1989, this fourth alternative was analyzed to consider the "quick fix" alternative. However, the City of Gatesville itself is currently operating their existing sewage treatment plant at near capacity, thus a treatment plant at this location would mostly benefit the Texas Department of Corrections, with any benefits to the City of Gatesville requiring an extensive force main/lift station system. For this reason, this alternative was rejected early in the decision making process.

III.F NO ACTION ALTERNATIVE

Customarily, the "do nothing" alternative is explored when examining the benefits of a proposed improvement. This alternative, subjective by nature, examines the projected conditions in the study area without a regional wastewater plan.

Obviously, if no additional wastewater treatment facilities are constructed, the current sewage treatment facility would have to treat all incoming wastewater flows. This 1.0 MGD plant is currently operating near capacity, and will soon be overloaded. The existing plant could be expanded, but obtaining the necessary land and achieving the necessary effluent quality would be difficult with the facilities available to the City of Gatesville.

Without expanding the existing wastewater treatment plant, the plant will eventually become overloaded, leading to the degradation of water quality in the Leon River by dropping the dissolved oxygen level to unacceptable levels. This action would also be a violation of the existing plant's permit, which could lead to legal action by the Texas Water Commission or the Environmental Protection Agency.

Later, with the Alfred Hughes Correctional Facility becoming fully operational, the existing plant would be overloaded to the point that the high aquatic habitat in the Leon River would be degraded, with the wastewater treatment plant being incapable of handling the amount of wastewater to be treated. Fish kills in the Leon River and odor problems would be associated with excessive untreated wastewater flows.

The lack of adequate treatment facilities for the City of Gatesville and the Texas Department of Corrections Facilities would affect the City of Fort Gates in that the water quality through the Leon River would be degraded as semi-treated water traveled downstream. Also, Lake Belton would be degraded, as the sewage would aggregate in the lake increasing the rate of eutrophication.

IV. EVALUATION OF TREATMENT ALTERNATIVES

Treatment plant alternatives for this study range from a single regional plant to as many as three local or sub-regional plants. A regional wastewater treatment plant is conceptually the simplest method of providing regional wastewater management. With the exception of rural areas outside the city limits of Fort Gates, all wastewater could be collected and transported to a central location for treatment and discharge. An extensive system of gravity collection lines, lift stations, and force mains is required to transport wastewater from the scattered developments within the study area.

Local or sub-regional treatment plants provide a viable component of a regional wastewater plan. The use of small plants reduces the cost of transporting wastewater by treating flows closer to their source. This would also allow greater flexibility in phasing improvements to coincide with growth.

IV.A WATER QUALITY EVALUATION

IV.A.1 INTRODUCTION

IV.A.1.a Regional Wastewater Treatment Study Dissolved Oxygen Modeling Description and Scope

The purpose of dissolved oxygen modeling is to perform a wasteload evaluation (WLE) of the Leon River. The WLE method involves taking the anticipated wastewater discharge loads and locations and determining the levels of treatment necessary to comply with the State water quality standards set for Texas Designated Segment 1221 (the Leon River - upper reaches of Lake Belton to the Procter Lake Dam). Dissolved oxygen levels of the Leon River are simulated using the Texas Water Commission (TWC) version of the widely accepted Streeter-Phelps Model and the WWTP effluents from each of the proposed development scenarios. Iterative application of the model results in the evaluation of numerous possible effluent data sets for each of the scenarios and ensures that the prescribed dissolved oxygen levels for the Leon River are not violated. The result of the WLE is the least restrictive treatment levels for each development scenario that will achieve the stated goals, maintain the current uses of the stream, and not violate accepted water quality criteria.

IV.A.1.b Area Description and Development Scenarios

Segment 1221 is a relatively unpopulated stretch of the Leon River Basin with the Cities of Gatesville and Fort Gates representing the concentrated growth centers on this reach. The segment begins in southwestern Coryell County at the upper reaches of Lake Belton, proceeds in a northwesterly direction through central Hamilton County, and terminates at the Procter Dam in Northeastern Comanche County. The region is predominantly agricultural/ranching with broad expanses of the Texas Hill Country. Fort Hood dominates much of the regional map.

The Leon River is a relatively new river basin as characterized by a strong meander pattern and relatively defined channel. In several places, low relief adjacent to the stream results in a broad and extensive flood plain. Lake Belton serves as a major water supply reservoir for much of central Texas and is currently considered to be a relatively pristine system. There are three moderately large cities (Hamilton, Comanche, and Gatesville) and several small communities that discharge to Segment 1221; however, TWC water quality records indicate that the system does not suffer form any major water quality problems.

The region of interest for this study lies principally in Coryell County between the upper reaches of Lake Belton, State Highway 36, to approximately five kilometers upstream from the City of Gatesville. This region is expected to undergo a relatively rapid expansion in the near future with the relocation of a number of U.S. military operations at Fort Hood and construction of a new Texas Department of Corrections (TDC) prison at Gatesville. To accommodate this growth, a number of development scenarios have been selected for detailed examination.. The location and size of the wastewater treatment facilities planned for each of the development scenarios are as follows:

ALTERNATIVE A - The new TDC prison, which needs immediate treatment capacity, and portions of the existing prison will be handled by a new 2.2 MGD WWTP to be located on the Leon River near the old railroad bridge north of Gatesville. Under this scenario, the existing City of Gatesville plant will remain at 1.0 MGD. The City plant, the load having been reduced by diversion of a portion of the existing TDC waste, will accommodate anticipated increases in the Gatesville population. The City of Fort Gates and North Fort Hood will contribute waste to a new 2.0 MGD treatment facility to be located on the Leon River upstream of the State Highway 36 bridge.

ALTERNATIVE B - The new TDC prison, the old prison, and the City of Gatesville will be treated by a single 3.2 MGD WWTP located at the site of the existing Gatesville facility. The City of Fort Gates and North Fort Hood will contribute waste to a new 2.0 MGD treatment facility to be located on the Leon River just upstream from the State Highway 36 bridge.

ALTERNATIVE C - The new and existing prisons, the cities of Gatesville and Fort Gates, and North Fort Hood will be served by an single 5.2 MGD WWTP located just upstream of the State Highway 36 bridge.

IV.A.1.c Segment Waste Quantification and Characterization

There are currently eight permitted wastewater dischargers to Segment 1221 (Table IV.1). The majority of the dischargers are relatively small and cause little concern. Also, a number of these dischargers are sufficiently upstream of Gatesville to result in little impact to regional WWTP treatment levels.

TABLE IV.1

PERMITTED DISCHARGERS

	OWNER OF PERMIT	PERMIT NUMBER	MAXIMUM DISCHARGE		BOD_5 (mg/l)
1)	U.S. NAVY	02335-001	0.15	MGD	30
2)	GATEVILLE	10176-001	1.0	MGD	20
3)	DUBLIN	10405-001	0.25	MGD	30
4)	HAMILTON	10492-002	0.25	MGD	20
5)	COMANCHE	10719-001	0.73	MGD	20
6)	GUSTINE	10841-001	0.082	MGD	20
7)	OGLESBY	10914-001	0.025	MGD	20
8)	U.S. ARMY DOMESTIC OUTFALL	12096-001	0.25	MGD	30

IV.B MODEL DESCRIPTION

IV.B.1 General Description

The Streeter-Phelps Dissolved Oxygen Sag Model has become widely recognized as a useful tool in predicting the magnitude and duration of the dissolved oxygen sag that typically appears downstream of wastewater discharges. Because the treatment process does not generally render complete decomposition to the organic portion of the waste, there is a residual of organic oxygen demanding material (expressed as a biochemical oxygen demand, BOD) that is discharged to the receiving stream. The biodecomposition of this residual organic material continues in the receiving stream resulting in a reduction of the dissolved oxygen levels downstream of the wastewater treatment plant outfall.

The Streeter-Phelps Model performs an oxygen-balance around the residual organic oxygen demanding material discharged to the receiving stream. The amount of oxygen required to biodegrade the carbon based (carbonaceous) and nitrogen based (nitrogenous) portions of the residual organic material discharged are well established and documented.

IV.B.2 Model Structure

IV.B.2.a Governing Equations

A simplified version of the Streeter-Phelps Model developed by the Water Quality Division of the Texas Water Commission was selected for application to this discharge because of its wide-spread use and acceptance by both practicing engineers and the TWC. The model is designed around six equations that perform the mass-balance and material dynamics calculations necessary to predict downstream oxygen levels.

1. $$D_x = D_o e^{\frac{-K_2}{u} x} + B_o \frac{K_d}{K_2 - K_r} \left(e^{\frac{-K_1}{u} x} - e^{\frac{-K_2}{u} x} \right) + N_o \frac{K_n}{K_2 - n} \left(e^{\frac{-K_n}{u} x} - e^{\frac{-K_2}{u} x} \right)$$

where, D_x = oxygen deficit at distance x downstream, mg/L,

D_o	=	initial oxygen deficit, mg/L,
u	=	stream velocity, ft/sec,
x	=	distance downstream, ft,

K_2 = reaeration rate, 1/day,

B_o = initial ultimate carbonaceous BOD concentration, mg/L,

K_d = BOD deoxygenation rate, 1/day,

K_r = BOD removal rate, 1/day,

N_o = initial nitrogenous BOD concentration, mg/L, and

K_n = ammonia decay rate, 1/day.

2. $B_x = B_o e^{\frac{-K_r}{u}x}$

where, B_x = ultimate BOD concentration at distance x downstream, mg/L

3. $N_x = N_o e^{\frac{-K_n}{u}x}$

where, N_x = ultimate BOD concentration at distance x downstream, mg/L

4. $C_x = C_s - D_x$

where, C_x = dissolved oxygen at distance x downstream, mg/L and

C_s = dissolved oxygen saturation concentration, mg/L.

5. $K_r = K_d - K_s$

where, K_r = BOD settling rate, 1/day.

6. $K_t = K_{20}\, Ø^{T\text{-}20}$

where, K_t = rate at °F, 1/day, and

K_{20}= rate at 68 °F, 1/day.

IV.B.2.b Model Assumptions

There are three main simplifying assumptions that govern the Streeter-Phelps Model.

1. All of the residual oxygen demanding material discharged from the treatment facility are biodegradable, i.e., biochemically oxygen demanding material as opposed to chemical oxygen demanding material.
2. There is a negligible oxygen demand resulting from deposited sedimentary material.
3. There are no inputs or oxygen demand parameters resulting from algal or macrophyte

communities that may develop downstream of the outfall.

IV.B.3 Model Application

IV.B.3.a Application Assumptions

The Streeter-Phelps Model is applied to the system in the following manner:

1. The receiving stream is segmented longitudinally into reaches of uniform cross-section and hydraulic characteristics.
2. For each reach the velocity and depth of flow is determined by either inputs derived from measured or calculated data, or calculated using standard equations internal to the model code.
3. The kinetics (reaction rates) must be input using known reaction rates or rates determined appropriate for that area from literature review.
4. There are no other significant sources of either oxygen demanding material or oxygen sources within each reach.
5. An appropriate reaeration equation must be selected from the four options coded into the Streeter-Phelps model
   * Conner-Dobins,
   * Owen-Gibbs,
   * Texas Equation, or
   * input constants for the standard velocity/depth reaeration equation

$$K_2 = \frac{aV^b}{D^c}$$

where

K_2 = reaeration rate, 1/day,

V = stream velocity, feet/sec,

D = stream depth, feet, and

a, b, c = constants.

IV.B.3.b Required Input Data

The following input data are required for application of the Streeter-Phelps Model:

* Segment description data (depth and velocity if not calculated internally).
* Flow rate.
* Waste characteristics (temperature, ultimate BOD concentration [BOD_u], NH_3 concentration, and effluent DO concentration).
* Appropriate temperature rate correction factor (Ø), BOD decay and settling rates (K_d and K_r), and nitrogen decay rate (K_n) determined from the literature.
* Appropriate reaeration equation.

IV.B.3.c Output Data

Output from the Streeter-Phelps Model Consists of:

* Tabularized printout of
  - Distance downstream,
  - DO concentration,
  - BOD_5
  - NH_3, and
  - Flow.
* Plotted print out (if requested) of DO and BOD_5 as a function of distance downstream.

IV.C MODEL APPLICATION TO THE LEON RIVER AND GATESVILLE DISCHARGES

IV.C.1 Simulation Scenario Description

The purpose of dissolved oxygen modeling is to establish minimum treatment levels (effluent BOD_5, NH_3-N , and DO concentrations) necessary to satisfy the State and federal water quality criteria and antidegradation statutes applicable to that segment. The approach is iterative in that WWTP development scenarios and treatment levels are assumed, simulation performed, and criteria tested. Adjustments are then made to the development scenarios and/or treatment levels (adjustments can be either up or down depending on predicted downstream DO levels) until the criteria are satisfied with the least restrictive, and usually most cost effective, treatment level.

Three development scenarios were selected for simulation with the Streeter-Phelps Model. All three simulation scenarios were run under both winter and summer temperature conditions. All simulation scenarios assume the following:

- The old and new prison, the Cities of Gatesville and Fort Gates, and North Fort Hood will be sewered and all effluent will be treated and all discharges will be to the Leon River;
- The combined discharges of the portions of the existing and all of the new prisons to be treated by a separate facility upstream of the existing Gatesville WWTP will be 2.2 MGD;
- The City of Gatesville discharge will be 1.0 MGD; and
- The combined discharges of Fort Gates and North Fort Hood will be 2.0 MGD.

IV.C.1.a Alternative A - Proposed Prison @ 2.0 MGD and Gatesville @ 1.0 MGD

The first scenario (Alternative A) assumes that a separate treatment facility will be built to accommodate the waste streams of the new prison and portions of the existing prisons and surrounding areas. The plant is expected to treat approximately 2.2 MGD at full capacity and would be located on the east side of the Leon River north of Gatesville near the old railroad crossing (Figure IV.1). This location is approximately 79.5 kilometers upstream of State Highway 36 which serves as the lower boundary of the Leon River Segment 1221 and the upper boundary of the Lake Belton Segment 1220. This site is approximately 4.5 kilometers upstream of the existing Gatesville WWTP. Alternative A assumes that the Gatesville WWTP will be upgraded to accommodate 1.0 MGD at the specified treatment level. It also assumes that the combined wastes of Fort Gates and North Fort Hood will be combined and treated in a single 2.0 MGD facility to be located just upstream of U.S. Highway 36, approximately 60.5 kilometers upstream of the Lake Belton headwaters.

IV.C.1.b Alternative B - Proposed Prison Plus Gatesville @ 3.2 MGD

The second scenario (B) assumes that a single plant will be constructed at the location of the existing Gatesville WWTP (approximately 75 km upstream from the Lake Belton headwaters). This plant will accommodate both the old and new prisons and the City of Gatesville (Figure IV.2). The facility will treat approximately 3.2 MGD, at full utilization, and discharge directly to the Leon River. Scenario B also assumes that the combined wastes of Fort Gates and North Fort Hood will be combined and treated in a single 2.0 MGD facility to be located just downstream of U.S. Highway 36, approximately 60.5 km upstream of U.S. Highway 236.

IV.C.1.c Alternative C - Proposed prison, Gatesville, Fort Gates, and North Fort Hood @ 5.2 MGD

The third scenario (C) assumes that a large regional facility will be built to accommodate the existing and proposed prisons, the Cities of Gatesville and Fort Gates, and sections of North Fort Hood. Under this scenario, the existing Gatesville WWTP would be abandoned and flows routed through the new plant. The location of this facility would most likely be where State Highway 36 crosses the Leon River, approximately 62 km upstream of the headwaters of Lake Belton (Figure IV.3). The capacity of this plant would be approximately 5.2 MGD at full loading.

IV.C.2 Model Assumptions and Input Data

IV.C.2.a Model Segmentation

Model segmentation is a user supplied function. The upstream boundary corresponds to the point of initial condition insertion: the downstream boundary is generally selected far enough downstream to ensure reasonable recovery from the dissolved oxygen sag. In these simulations, the upstream boundary is approximately 5 km upstream of the farthest upstream discharge location (dependent on the simulation scenario). The downstream boundary was selected as the Lake Belton Dam. However, full recovery of DO levels occurs far upstream of the Lake Belton Headwaters.

- Total number of segments = 85.0 for Scenario A,
  = 80.0 for Scenario B, and

= 67.0 for Scenario C.

- Segment length = 0.5 km

IV.C.2.b Hydraulic Characterization

There are several options for the characterization of the system to be modeled. The more physical data available, the more precise the hydraulics of the system can be characterized. The Streeter-Phelps Model contains a default equation to be used when precise cross-sectional and flow data are not available.

Because there were no measured cross-section data available, MSA decided to use the velocity and depth relationships included in the Streeter-Phelps Model code; $V = aQ^b$ and $D = cQ^d$. The TWC default coefficients are a = 0.161, b = 0.5, c = 0.632, and d = 0.4.

- Hydraulics calculated by: $V = 0.161\ Q^{0.5}$ $D = 0.632\ Q^{0.4}$

IV.C.2.c Reaeration Rate Equation

As stated in Section 2.3.1, the TWC version of the Streeter-Phelps contains four options for calculation of the reaeration coefficient. The Texas Equation has gained the highest level of use and acceptance in recent years. Reaeration rate studies were not conducted in conjunction with this investigation; therefore, the Texas equation was selected for use in all scenario simulations.

- Reaeration calculation using the Texas Equation $K_2 = \dfrac{4.022\ V^{0.273}}{D^{0.894}}$

IV.C.2.d Other Rate Coefficients and Conversion Factors

- Reaction rates calculated by: for K_d $\emptyset = 1.047$,

  for K_s $\emptyset = 1.024$,

  for K_n $\emptyset = 1.083$, and

  for K_2 $\emptyset = \left(\dfrac{9.07}{C_s}\right)^{\frac{1}{T-20}}$

- Conversion from BOD_5 to BOD_U: = $BOD_5 \cdot 2.30$.

IV.C.2.e Flows

The wasteload evaluation process is predicated on the lowest flow conditions which would persist for seven days and occur approximately every two years. When sufficient hydrologic data is available, this seven-day two-year low flow (7Q2) can be calculated directly. The TWC has performed this task for most designated segments. The TWC specified 7Q2 for Segment 1221.0100 is 0.05664 cms (2.0 cfs). Generally, a separate 7Q2 is computed for winger and summer simulations. However, examination of the USGS historical flow records for the Leon River at Gatesville (USGS #08100400) indicates occasional periods of very low flow during the winter months. Therefore, 2.0 cfs was used as a baseflow for both summer and winter simulations.

IV.C.2.f Temperatures

The Texas Water Commission - Statewide Monitoring Network (SMN) water quality data for station 1221.0100 (Leon River: Belton Reservoir headwater to Proctor Dam -- corresponds to USGS Gauge 008100.500) were examined. The period of record is 9/8/68 through 8/17/87. Temperature data were divided into two seasons. Summer was defined as May through October; Winter was defined as November through April.

A total of 23 summer and 33 winter recorded temperatures were examined. The highest recorded temperature, 31.0°C, was on 7/24/69 and again on 7/23/74; the second highest was 30.0°C on 7/16/70. The lowest recorded temperature, 6.7°C, was on 1/7/74; the second lowest was 7.0° on 1/6/69. Statistical analyses were performed on the data. The mean summer water temperature was 26.5°C with a standard deviation of 2.7°C; the mean winter water temperature was 12.7°C with a standard deviation of 3.5°C. Therefore, the upper end of the normal range of summer temperatures could be considered 29.2°C and the upper end of the normal range of winter temperatures could be considered to be 16.2°C.

The 7Q2 conditions prescribed for wasteload evaluations are designed around the extreme end of normal conditions. Therefore, in the interest of conservatism, 30°C (equal to the second highest recorded temperature) was used as the water temperatures for all summer simulations.

IV.C.2.g Waste Strength

Influent characteristics to the wastewater treatment facility to serve the proposed prison will be somewhat higher than that normally encountered with typical municipal domestic sewage. The effluent from this plant is not, however, expected to be significantly different from typical municipal WWTP effluent.

Effluent sets are characterized as a/b/c/d/ where "a" refers to the 5-day biochemical oxygen demand (BOD5) concentration, "b" is the total suspended solids (TSS) concentration, "c" is the ammonia concentration measured as nitrogen (NH_3-N), and "d" is the dissolved oxygen (DO) concentration in the effluent at the point of discharge. Unless specific design measures are included, the effluent from the typical 20/20 plant is assumed to have a NH_3-N = 15.0 mg/L and DO = 3.0 mg/L and the typical 10/15 is assumed to have a NH_3-N = 10.0 mg/L and DO = 4.0 mg/L.

IV.C.2.h Initial Conditions

The TWC-SMN water quality data for Segment 1221 were used to determine initial conditions for BOD_5, NH_3-N, and DO Mean values for summer (June, July, and August) were used to characterized the initial conditions (see Table 2):

BOD_5 = 2.50 mg/L,

NH_3 = ≤0.10 mg/L, and

DO = 6.7 mg/L

IV.D SIMULATION RESULTS

IV.D.1 Alternative A

Under summer temperature and flow conditions, it appears that all three WWTPs would have to achieve significant levels of nitrification to protect the 5 mg/l DO standard specified for Segment 1221 of the

Leon River (Figure IV.4). The proposed 2.2 MGD prison facility and the City of Gatesville facility would, in addition, required some level of effluent post aeration. The Fort Gates/North Fort Hood WWTP would require only the standard advanced waste treatment with nitrification, 10/15/3/4, effluent set to maintain compliance with the DO standard.

Under winter temperature and flow conditions, it appears that all three facilities would need to achieve only minimal nitrification to protect the Segment 1221 DO standard (Figure IV.5). Effluent NH_3 levels of less than or equal to 12 mg/l should be easily maintained by a facility designed to provide NH_3 levels less than ore equal to 3 mg/l under summer temperature conditions.

IV.D.2 Alternative B

Under summer temperature and flow conditions, it appears that both WWTPs would have to achieve significant levels of nitrification to protect the 5 mg/l DO standard specified for Segment 1221 of the Leon River (Figure IV.6). The proposed 3.2 MGD facility serving the City of Gatesville and both prisons would need to nitrify to NH_3 levels of less than or equal to 2 mg/l and would, in addition, require effluent post aeration. The Fort Gates/North Fort Hood WWTP would require only the standard advanced waste treatment with nitrification to NH_3 less than or equal to 3 mg/l.

Under winter temperature and flow conditions, it appears that both facilities would need to achieve only minimal nitrification to protect the Segment 1221 DO standard (Figure IV.7). Effluent NH_3 levels of less than or equal to 12 mg/l should be easily maintained by a facility designed to provide NH_3 levels less than or equal to 3 mg/l under summer temperature conditions.

IV.D.3 Alternative C

A regional facility treating 5.2 MGD, located near Fort Hood, may require tertiary treatment (5/5/2/4); however, the increase in DO levels over a 10/15/3/6 effluent data set are marginal (Figure IV.8). In either case the 5.0 mg/l DO standard is violated. It may be that the additional costs associated with a tertiary treatment plant may not be justified in view of the marginal gains. Similar results were achieved for the winter simulations (Figure IV.9).

ALTERNATIVE A

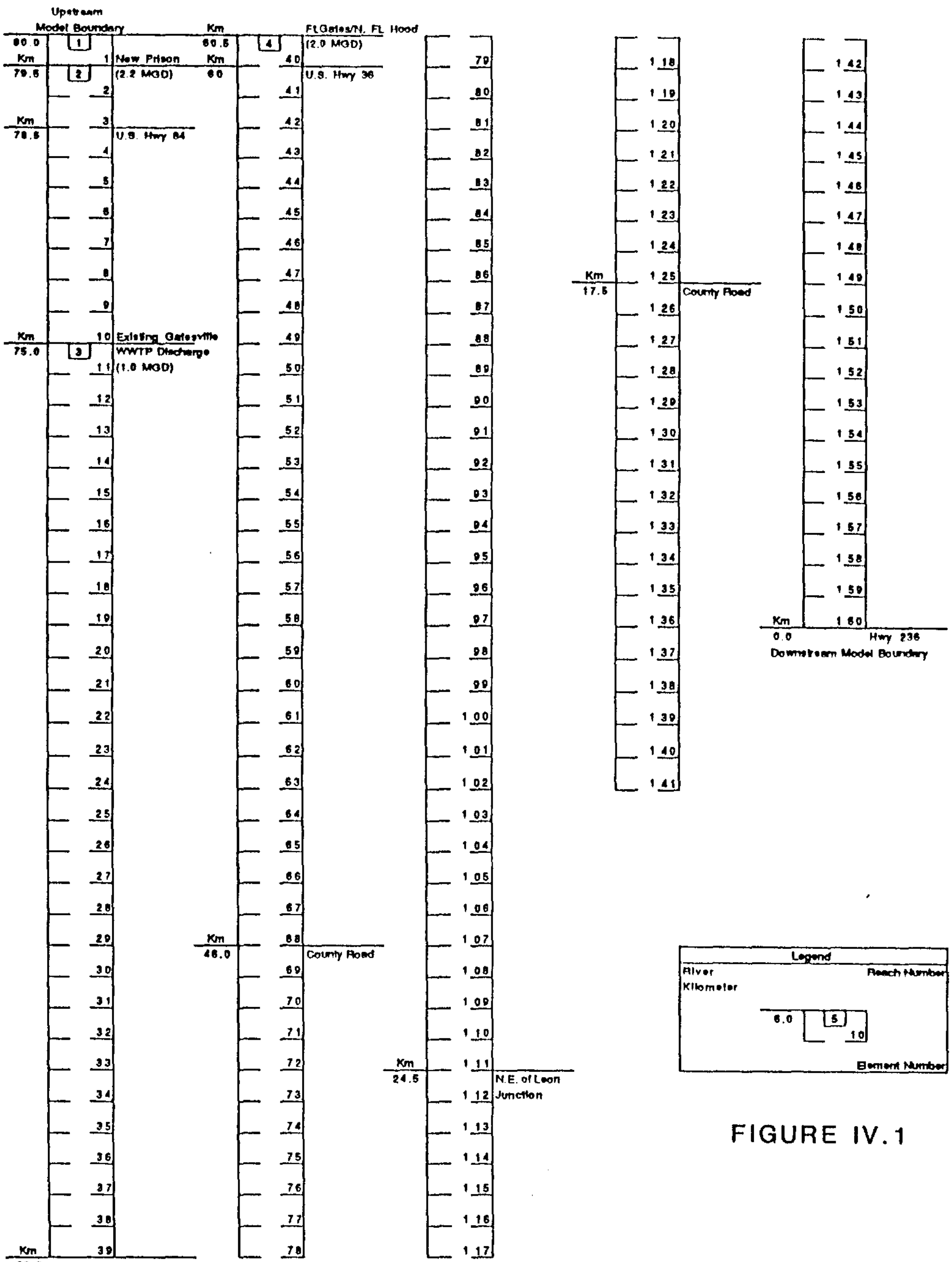


FIGURE IV.1

ALTERNATIVE B

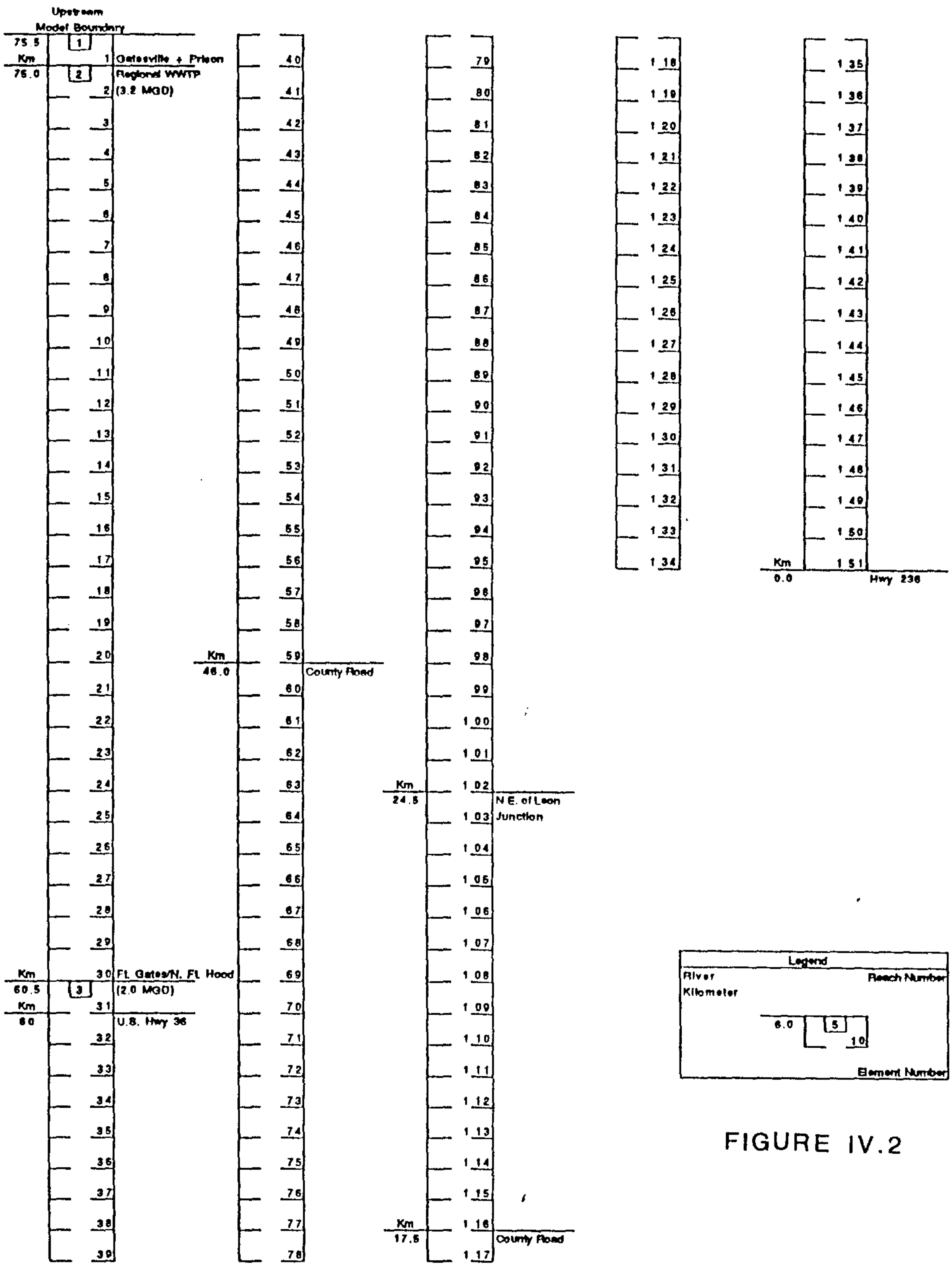


FIGURE IV.2

ALTERNATIVE C

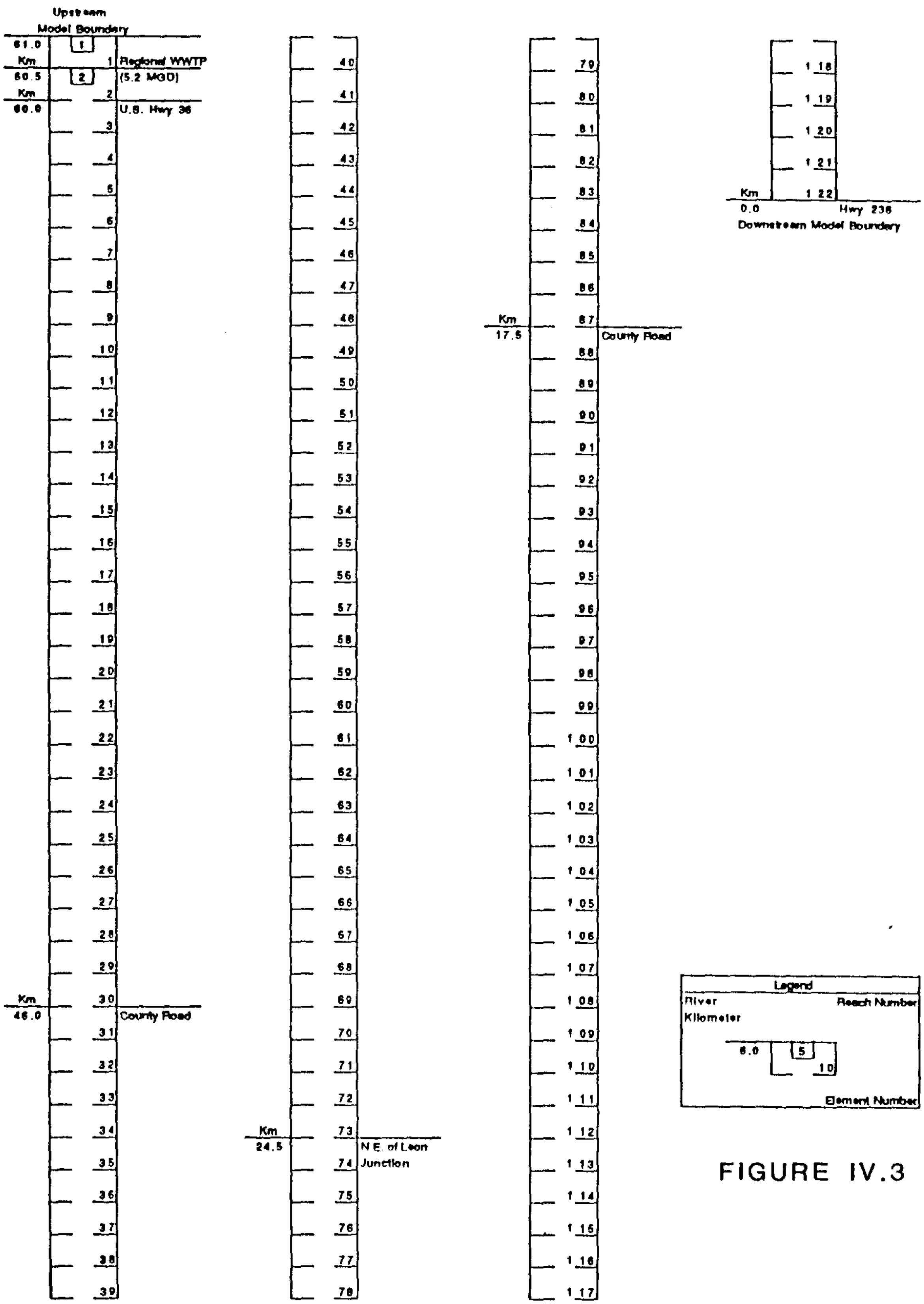


FIGURE IV.3

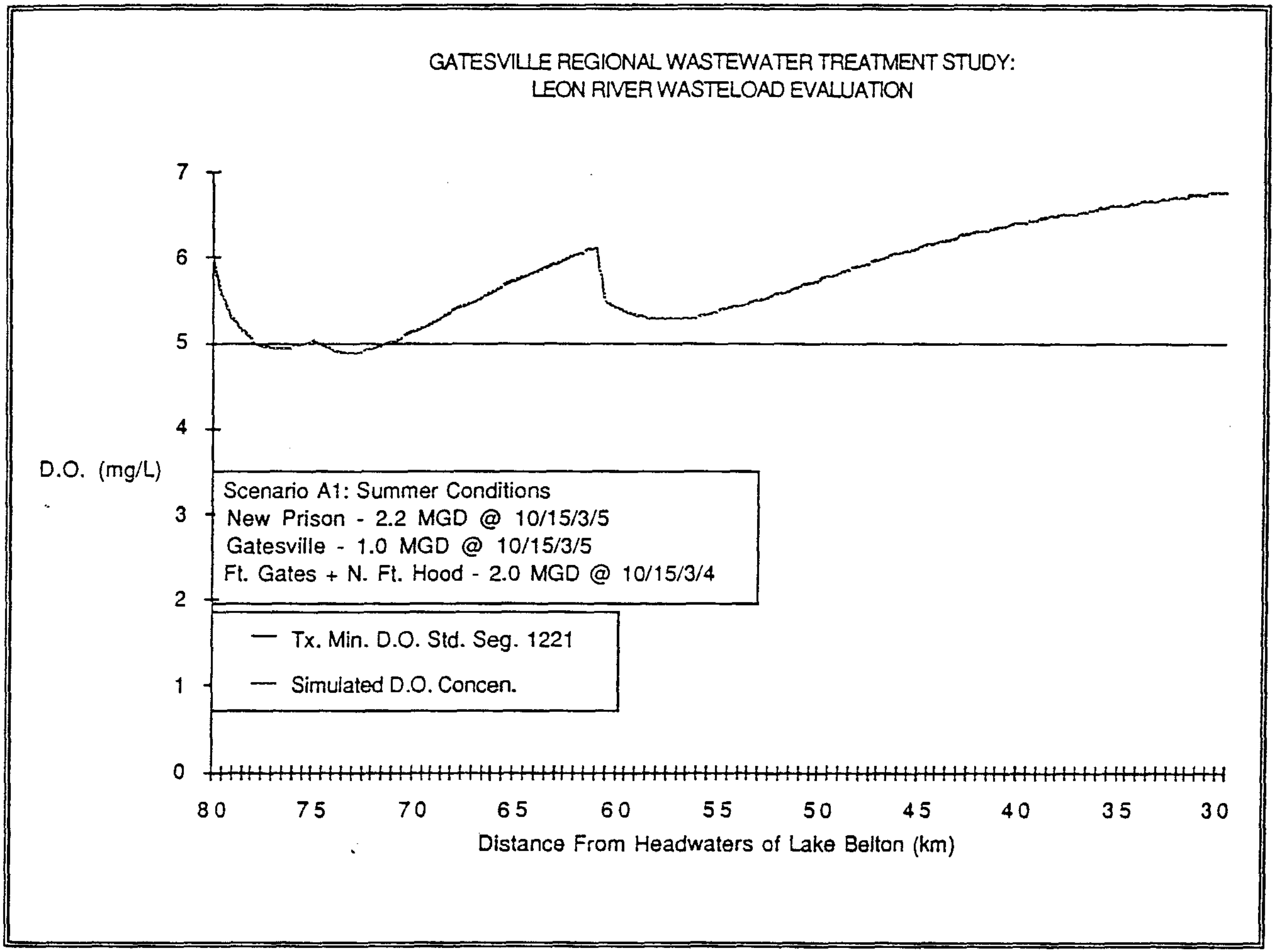

GATESVILLE REGIONAL WASTEWATER TREATMENT STUDY:
LEON RIVER WASTELOAD EVALUATION
D.O. (mg/L)
7
6
5
4
3
2
1
0
Scenario A1: Summer Conditions
New Prison - 2.2 MGD @ 10/15/3/5
Gatesville - 1.0 MGD @ 10/15/3/5
Ft. Gates + N. Ft. Hood - 2.0 MGD @ 10/15/3/4
Tx. Min. D.O. Std. Seg. 1221
Simulated D.O. Concen.
80
75
70
65
60
55
50
45
40
35
30
Distance From Headwaters of Lake Belton (km)

FIGURE IV.4

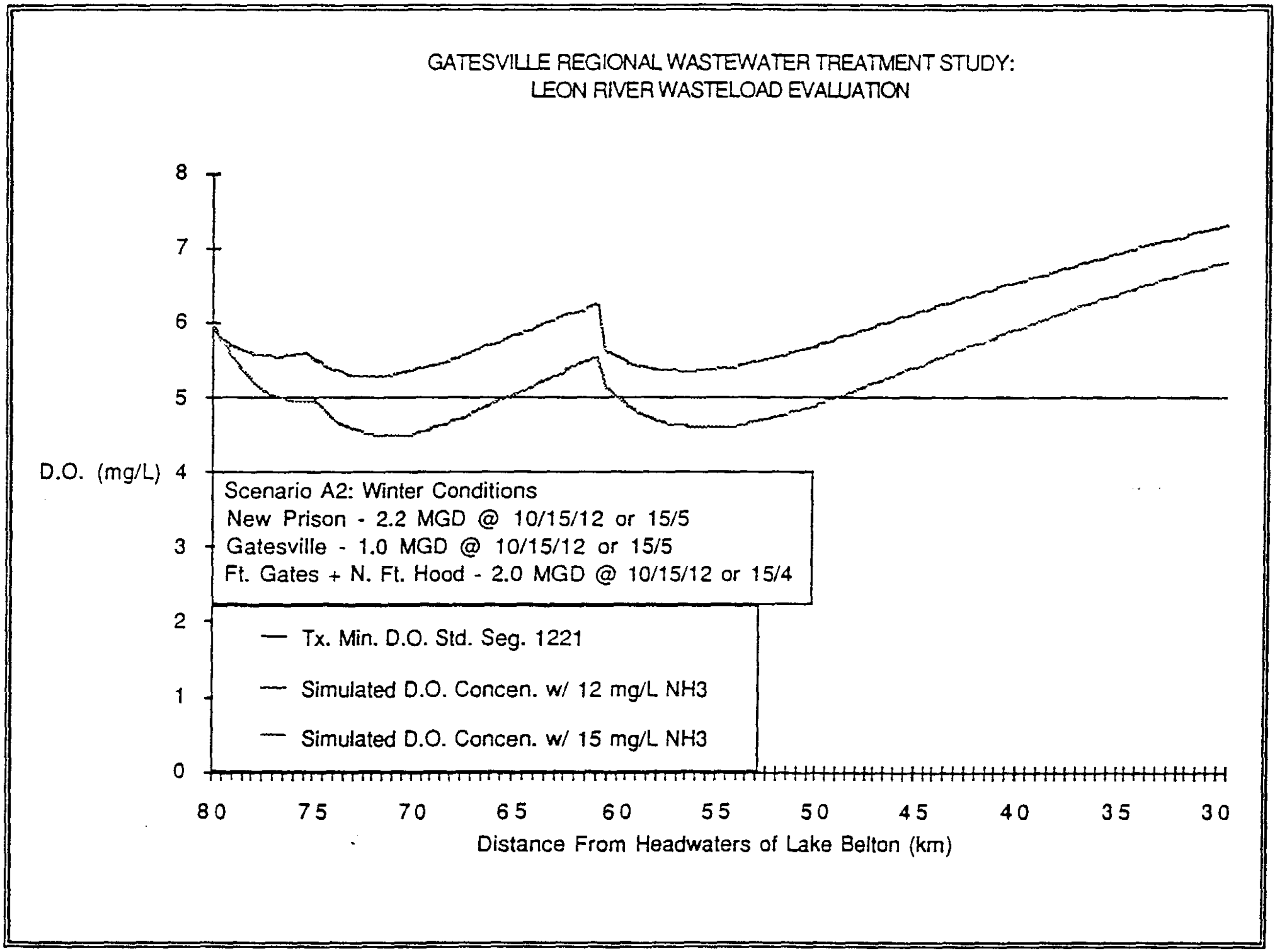

GATESVILLE REGIONAL WASTEWATER TREATMENT STUDY:
LEON RIVER WASTELOAD EVALUATION
D.O. (mg/L)
8
7
6
5
4
3
2
1
0
Scenario A2: Winter Conditions
New Prison - 2.2 MGD @ 10/15/12 or 15/5
Gatesville - 1.0 MGD @ 10/15/12 or 15/5
Ft. Gates + N. Ft. Hood - 2.0 MGD @ 10/15/12 or 15/4
Tx. Min. D.O. Std. Seg. 1221
Simulated D.O. Concen. w/ 12 mg/L NH3
Simulated D.O. Concen. w/ 15 mg/L NH3
80
75
70
65
60
55
50
45
40
35
30
Distance From Headwaters of Lake Belton (km)

FIGURE IV.5

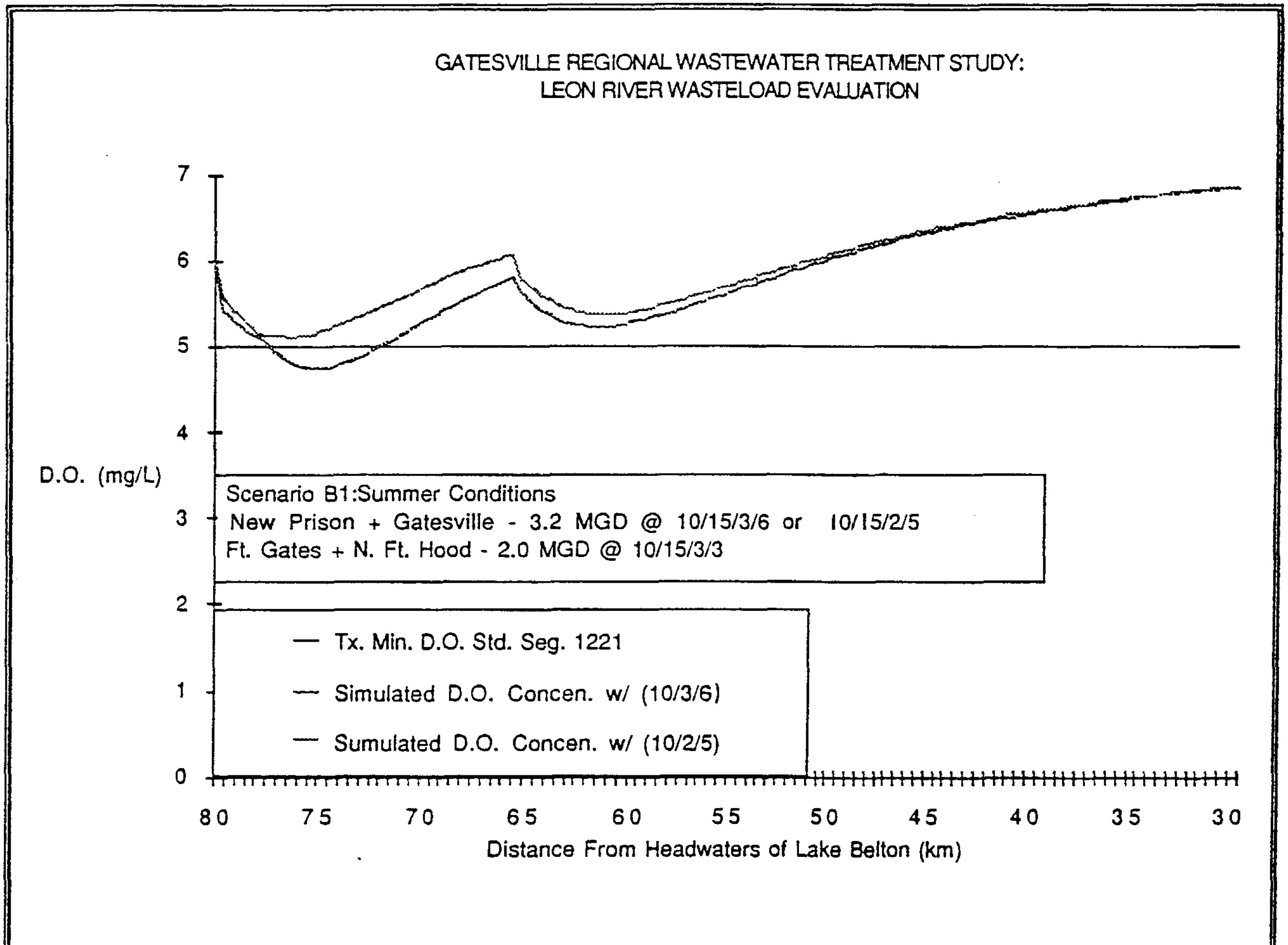
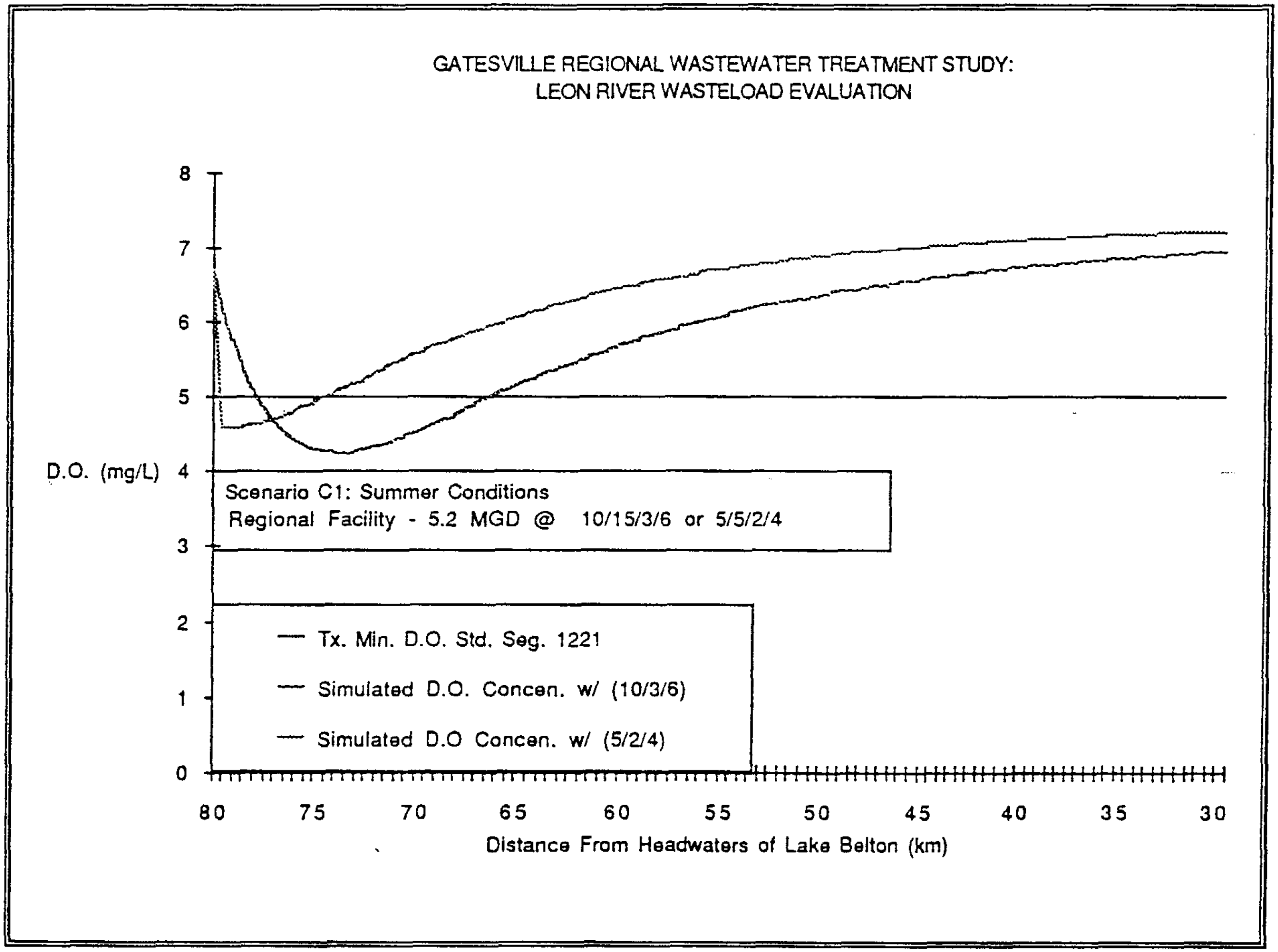

GATESVILLE REGIONAL WASTEWATER TREATMENT STUDY:
LEON RIVER WASTELOAD EVALUATION
D.O. (mg/L)
7
6
5
4
3
2
1
0
Scenario B1:Summer Conditions
New Prison + Gatesville - 3.2 MGD @ 10/15/3/6 or 10/15/2/5
Ft. Gates + N. Ft. Hood - 2.0 MGD @ 10/15/3/3
Tx. Min. D.O. Std. Seg. 1221
Simulated D.O. Concen. w/ (10/3/6)
Sumulated D.O. Concen. w/ (10/2/5)
80
75
70
65
60
55
50
45
40
35
30
Distance From Headwaters of Lake Belton (km)

FIGURE IV.6



GATESVILLE REGIONAL WASTEWATER TREATMENT STUDY:
LEON RIVER WASTELOAD EVALUATION
D.O. (mg/L)
8
7
6
5
4
3
2
1
0
Scenario C1: Summer Conditions
Regional Facility - 5.2 MGD @ 10/15/3/6 or 5/5/2/4
Tx. Min. D.O. Std. Seg. 1221
Simulated D.O. Concen. w/ (10/3/6)
Simulated D.O Concen. w/ (5/2/4)
80
75
70
65
60
55
50
45
40
35
30
Distance From Headwaters of Lake Belton (km)

FIGURE IV.8

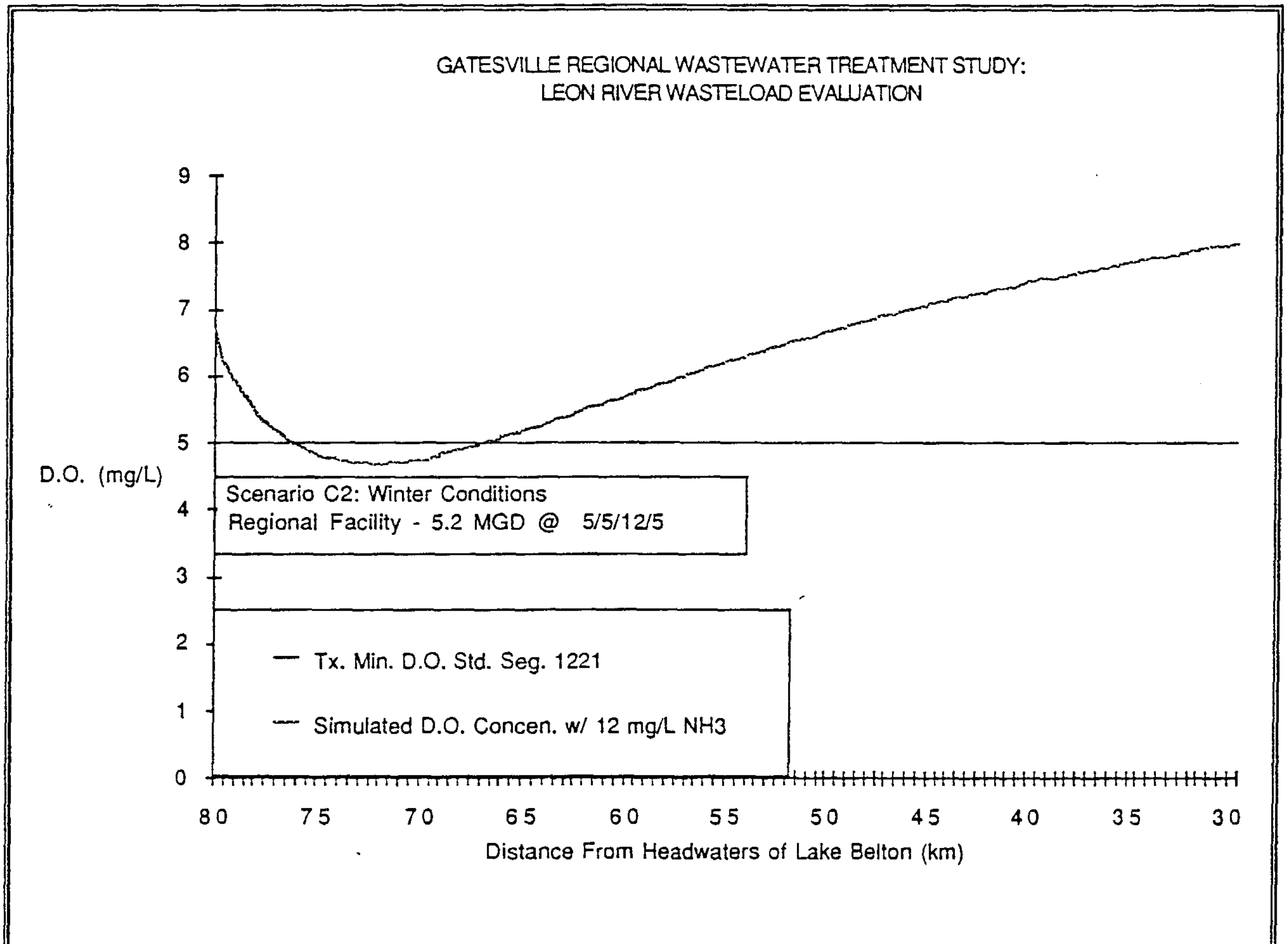

GATESVILLE REGIONAL WASTEWATER TREATMENT STUDY:
LEON RIVER WASTELOAD EVALUATION
D.O. (mg/L)
9
8
7
6
5
4
3
2
1
0
Scenario C2: Winter Conditions
Regional Facility - 5.2 MGD @ 5/5/12/5
Tx. Min. D.O. Std. Seg. 1221
Simulated D.O. Concen. w/ 12 mg/L NH3
80
75
70
65
60
55
50
45
40
35
30
Distance From Headwaters of Lake Belton (km)

FIGURE IV.9

IV.E. BRAZOS RIVER AUTHORITY STUDY AND RESULTS

Modeling results obtained for the detailed scenarios are similar to the results of a study performed by the Brazos River Authority ("Authority") on the Leon River. The "Authority's" model was used to simulate the water quality of the Leon river with estimated effluent flows for the years 1990, 2000, 2010, 2020, and 2030. The combined flows for the Cities of Gatesville and Fort Gates projected by the "Authority" range from 1.14 MGD for the year 1990 to 3.62 MGD for the year 2030. These flows are comparable to those predicted by WWR which range from 0.97 MGD in 1990 to 2.04 MGD in the year 2030. The disparity in total flow could be a result of estimated wastewater flows generated by the TDC facilities. In addition, the majority of wastewater generated by the City of Fort Gates is not treated by the existing plant.

Conclusions of this study demonstrate that advanced secondary treatment with nitrification resulted in dissolved oxygen levels above 5.0 mg/l which is the stream standard set for this segment by the Texas Water Commission. Figures IV.10 and IV.11 show the results obtained by the "Authority" for the years 1990 and 2000 using secondary treatment, advanced secondary treatment, and advanced secondary treatment with nitrification for the effluent flows in the Leon River. Similar results are achieved with the modeling performed and described in the previous section.

B R A. CALCULATED DISSOLVED OXYGEN

FOR 1990 EFFLUENT FLOWS IN THE LEON

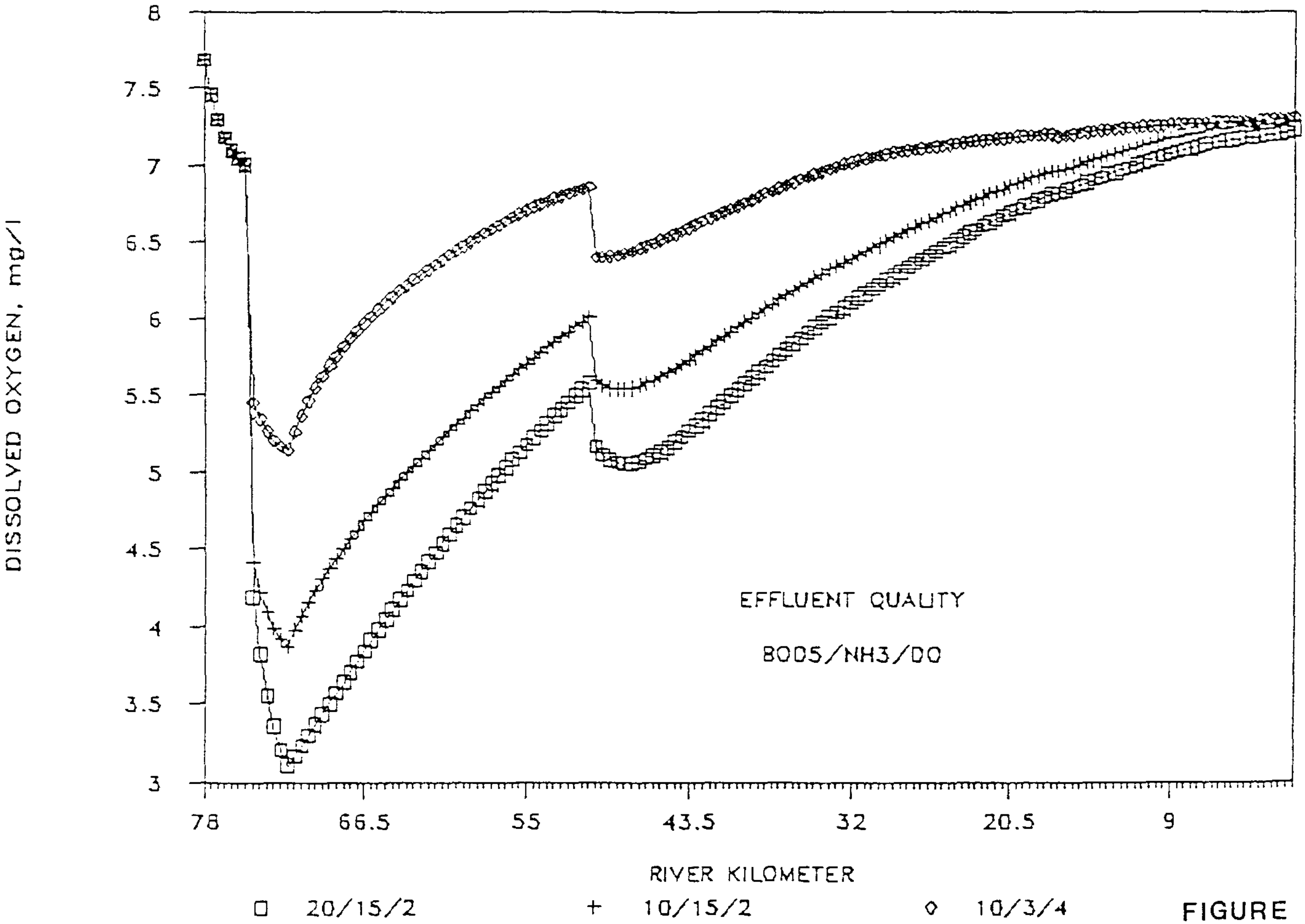
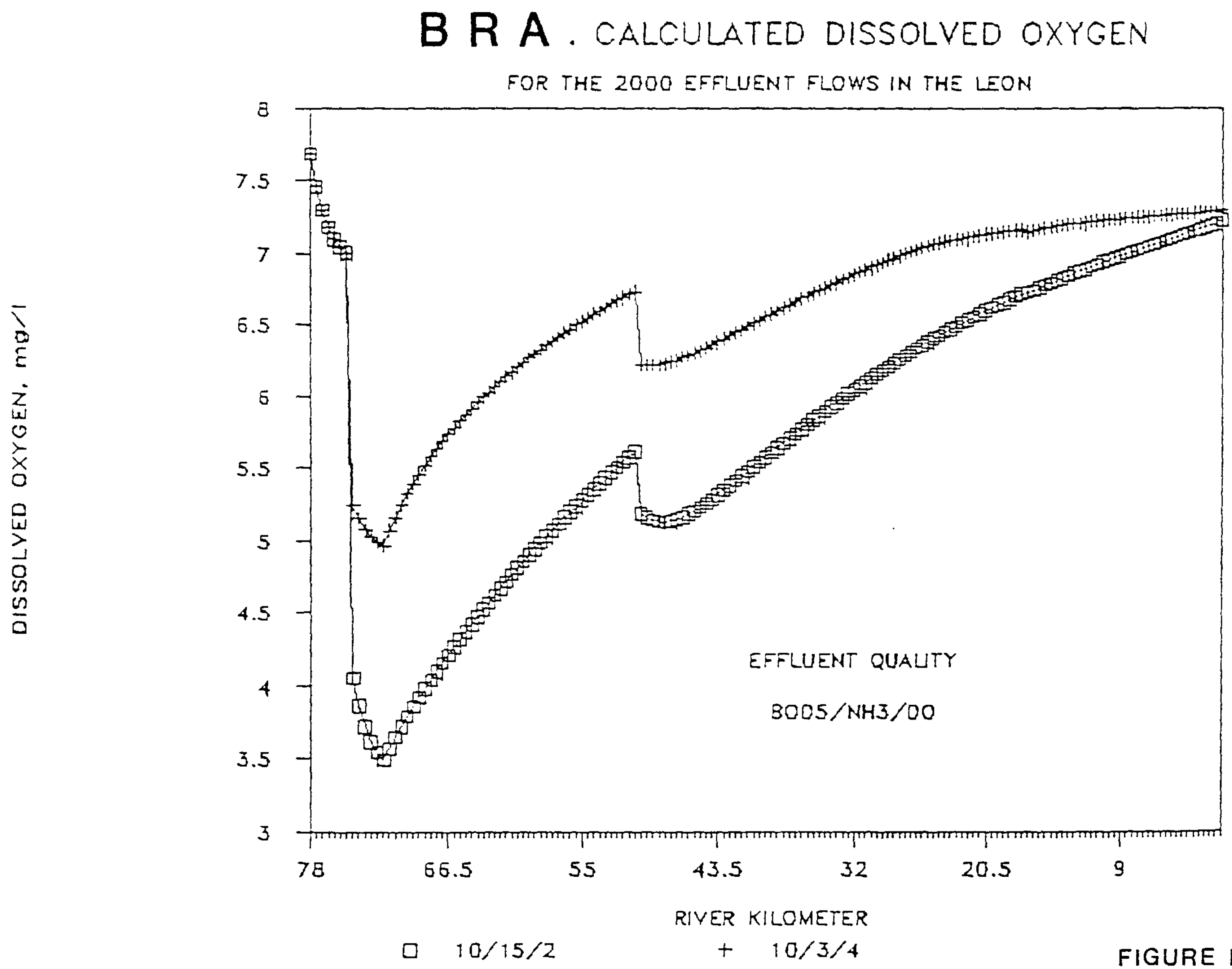


FIGURE IV.10



B R A . CALCULATED DISSOLVED OXYGEN
FOR THE 2000 EFFLUENT FLOWS IN THE LEON
DISSOLVED OXYGEN, mg/l
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
78
66.5
55
43.5
32
20.5
9
RIVER KILOMETER
EFFLUENT QUALITY
BOD5/NH3/DO
□ 10/15/2
+ 10/3/4

FIGURE IV.11

V. EVALUATION OF WASTEWATER COLLECTION SYSTEMS

V.A EVALUATION - SIZING/CAPACITY, HYDRAULIC SLOPE

V.A.1 GRAVITY SEWERS

To utilize existing topographical conditions and to minimize operation and maintenance costs for the overall system, gravity sewer collection lines were used wherever possible. Gravity lines are normally implemented if sufficient slope is available to provide the correct flow characteristics for the projected flows.

In some instances the slope required to attain these characteristics is achieved through deep installation. Occasionally, no actual capital cost savings over pressurized lines is realized due to the depths required to attain the correct line slopes.

V.A.2 LIFT STATIONS/FORCE MAINS

Force mains are normally required to convey flows from lift stations to the required point of delivery. In general, they are much smaller than gravity lines and are installed at shallow depths. Therefore, the cost of a force main can often be approximately the same or less that the cost of a gravity line. Lift stations are sewage pump stations that usually receive flows from gravity collection lines, lift them to a higher elevation and deliver them to a specific point of processing, such as a wastewater treatment plant. In a few cases lift stations are required to surmount existing physical obstructions such as mountains. In other cases, they are required to convey flows from one collection system component to another, particularly if convenience dictates a particular alignment that precludes gravity flow.

Force mains are normally required to convey flows from lift stations to the required point of delivery. Normally these are much smaller than gravity lines and are installed at shallow depths. therefore, the cost of a force main can often be approximately the same or less than the cost of a gravity line. The only significant difference in cost between a lift station and a force main lies in the capital and operations and maintenance cost of the lift station. This difference is due to increased energy consumption and equipment maintenance of lift stations.

V.A.3 DRAINAGE BASINS AND WASTEWATER FLOWS

The drainage basin boundaries were determined from naturally occurring ridgelines in the study area. For the City of Gatesville, these basins were further divided by service areas of the existing collection system. The City of Fort Gates outer boundaries were developed to include that area expected to be populated by the year 2030. These drainage basins are labeled according to the major interceptor to which they connect and contribute flows. The four major interceptors are labeled A, B, C, and D, with A including the northernmost area of the study area leading to the existing wastewater treatment plant. Interceptor B includes the basins west of the existing wastewater treatment plant, and the interceptor C includes that area south and east of the existing plant. Interceptor D collects wastewater from the City of Fort Gates.

For each alternative, cumulative flows were determined from the calculated flows per basin (see Appendix A). For the system collectors in the Cities of Gatesville and Fort Gates, an eighty-five percent of maximum development was used to avoid small interceptors in large drainage basins. The system collector sizes are the same for all three alternatives. Appendix B contains information pertaining to how these flows are accumulated through the system, and includes the line sizes required for these flows.

V.A.4 SIZING OF LINES

Sanitary sewers are designed as open channels, with wastewater flowing downstream in the pipe under the force of gravity. Assuming a uniform, steady, open channel flow, Manning's equation applies. Manning's equation is as follows:

$$Q = 1.486/n \times A \times S^{1/2} \times R^{2/3} \qquad [V-1]$$

where:
- Q = quantity of flow in cubic feet per second
- n = coefficient of roughness (commonly adopted value for sewer design is 0.013)
- A = cross-sectional area of flow in square feet
- S = slope of the hydraulic gradient in feet per foot
- R = hydraulic radius in feet (cross-sectional area divided by the wetted perimeter)

Given the hydraulic slope and calculating the design flows, the line is sized accordingly using Manning's equation and solving for the diameter (D).

$$D = (2.159 \times Q \times n / S^{1/2})^{3/8} \qquad [V-2]$$

The hydraulic gradient slopes for the proposed lines were calculated based on topographic information taken from U.S. Geological Survey maps. For calculation purposes, the pipes were assumed to be flowing full with Manning's n values equal to 0.013, typical for the clay material used for sanitary sewer collection lines.

V.B PROPOSED INTERCEPTOR ROUTES

V.B.1 ALTERNATIVE A

V.B.1.a City of Gatesville

The primary interceptor in this area is referenced on Figure V.1 as line "A", which is the interceptor from the Alfred Hughes Unit that follows along the Highway 36 Bypass until it reaches the southern branch of Stillhouse Hollow Creek. This line will carry the majority of all new development in the area previously described.

Any amount of development that will occur east of the Highway 36 Bypass will be carried by the lines "A7" and "A8", which will be carried to the new sewage treatment plant by line "A". These two lines follow the two major draws in the area, making gravity flow possible. West of the Bypass, more development is expected, with lines "A2b" in addition to lines "A5" and "A6" proposed to serve this area. Line "A2b" will be added to an existing 15" line which serves the existing Texas Department of Corrections facility. Lines "A5" and "A6" will be carried to the new sewage treatment plant by line "A" by gravity flow.

West of the existing sewage treatment plant, development is limited to those areas south of Highway 84 and Dodd's Branch Creek. For this area, an extension of the existing 8" line and proposed lines "B5" and "B6" are suggested to carry the expected flows from industrial development in this area. With the moderate to gentle slopes in this area, gravity flow is expected on these proposed lines which lead to the existing sewage treatment plant.

The only lift station suggested for the City of Gatesville is found at the end of the proposed line "C4". This station would enable the wastewater from this area to be treated by the existing sewage treatment plant on the Leon River. This action is recommended after the existing plant is permitted at 10/15/3.

V.B.1.b City of Fort Gates

For the City of Fort Gates, we propose a collection system as delineated by Figure V.1, inclusive of several lift stations due to the topography of City and the indicated wastewater treatment plant. The collection system and the lift stations associated with the system can be constructed as the City experiences its projected growth.

The City of Fort Gates, currently served by septic tank systems, will eventually need to develop its own collection system and sewage treatment plant due in part to the soils limiting septic tank capacity with the density of population expected. The interceptors planned for this area follow that same pattern as the City of Gatesville, with a primary interceptor through town collecting flows from other major interceptors. Referenced on Figure V.1 as line "D", this interceptor represents the primary interceptor for the City of Fort Gates. All other major interceptors lead to it or directly to the proposed sewage treatment plant. With the slopes and elevations in this area, gravity flow is limited to very few areas of the city with force mains in conjunction with lift stations serving a majority of the city. Figure V.1 indicates the interceptors required for servicing the study area under this scenario.

V.B.1.c NORTH FORT HOOD

The current level of activity at Fort Hood is expected to remain constant over the next few decades, having already reached the limits of their facilities levels of activity on a seasonal basis. When and if expansion occurs within the life span of the sewage treatment plant and more capacity is needed for the North Fort Hood, collection facilities can be planned in conjunction with the City of Fort Gates.

V.B.1.d Total Cost of Interceptors

For the three plant scenario, Alternative A, the total build out on the collection system will cost, in 1990 dollars, approximately $ 3.0 M. The interceptor A represents a significant amount of the cost at approximately $ 1.0 M. The Fort Gates collection system and interceptor D represents approximately $ 780,000 in 1990 dollars. Approximately $ 1.3 M is for improvements to be made in the Gatesville collection system as development occurs. In the cost comparison, interceptor A is labeled as the TDC interceptor, with the Cities of Gatesville and Fort Gates labeled as separate systems (Figure V.4). Appendix C contains the detailed cost estimates for each of the three alternatives.

V.B.2 ALTERNATIVE B

V.B.2.a City of Gatesville

For the City of Gatesville under this two plant scenario, the collection system will remain the same except for the interceptor parallel to the Leon River after Dodd's Branch. This interceptor would be added to or replace the existing 18 inch line which leads to the existing plant.

V.B.2.b City of Fort Gates

For Alternative B, the City of Fort Gates has the same collection system as delineated for Alternative A. Figure V.2 represents the collection system required for this scenario.

V.B.1.c Total Cost of Interceptors

Total build out on the two plant scenario is somewhat higher than the three plant scenario due to the extra outfall leading to the existing wastewater treatment plant. Here the total cost in 1990 dollars would be approximately $ 3.4 M, with the TDC interceptor A taking $ 1.3 M and the Gatesville improvements at $ 1.2 M. The remaining $ 780,00 is for the collection system in the City of Fort Gates (Figure V.4).

V.B.3 ALTERNATIVE C

V.B.3.a City of Gatesville

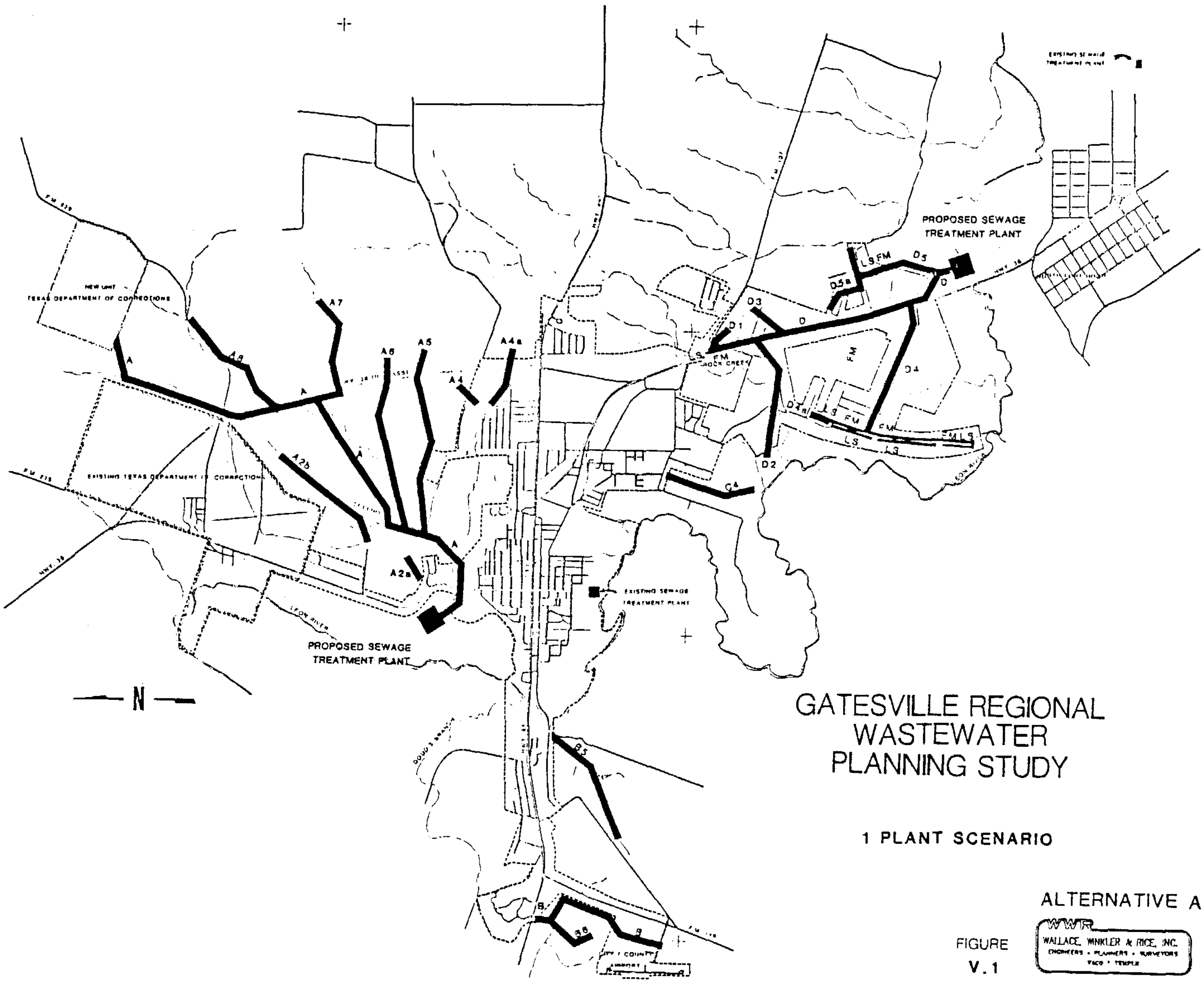
Under the one plant scenario, Alternative C, the collection system will be that delineated by Figure V.3. This collection is similar to that of Alternative B, however, the existing wastewater treatment plant is bypassed, and a combination of gravity lines and lift station/force mains would carry the flow from the prisons and the City of Gatesville to the main interceptor "D" down S.H. 36 in Fort Gates.

V.B.3.b City of Fort Gates

The only interceptor affected by the City of Gatesville and TDC flows is the primary interceptor "D". This interceptor is sized accordingly to handle these flows.

V.B.3.c Total Cost of Interceptors

For Alternative C, the TDC interceptor leading to the treatment plant south of the City of Fort Gates will cost approximately $ 2.5 M out of a total of $ 4.4 M. The City of Fort Gates collection system would tie onto this main interceptor at a cost of approximately $ 0.63 M. Improvements made to the City of Gatesville collection system would remain around $ 1.3 M (Figure V.4).

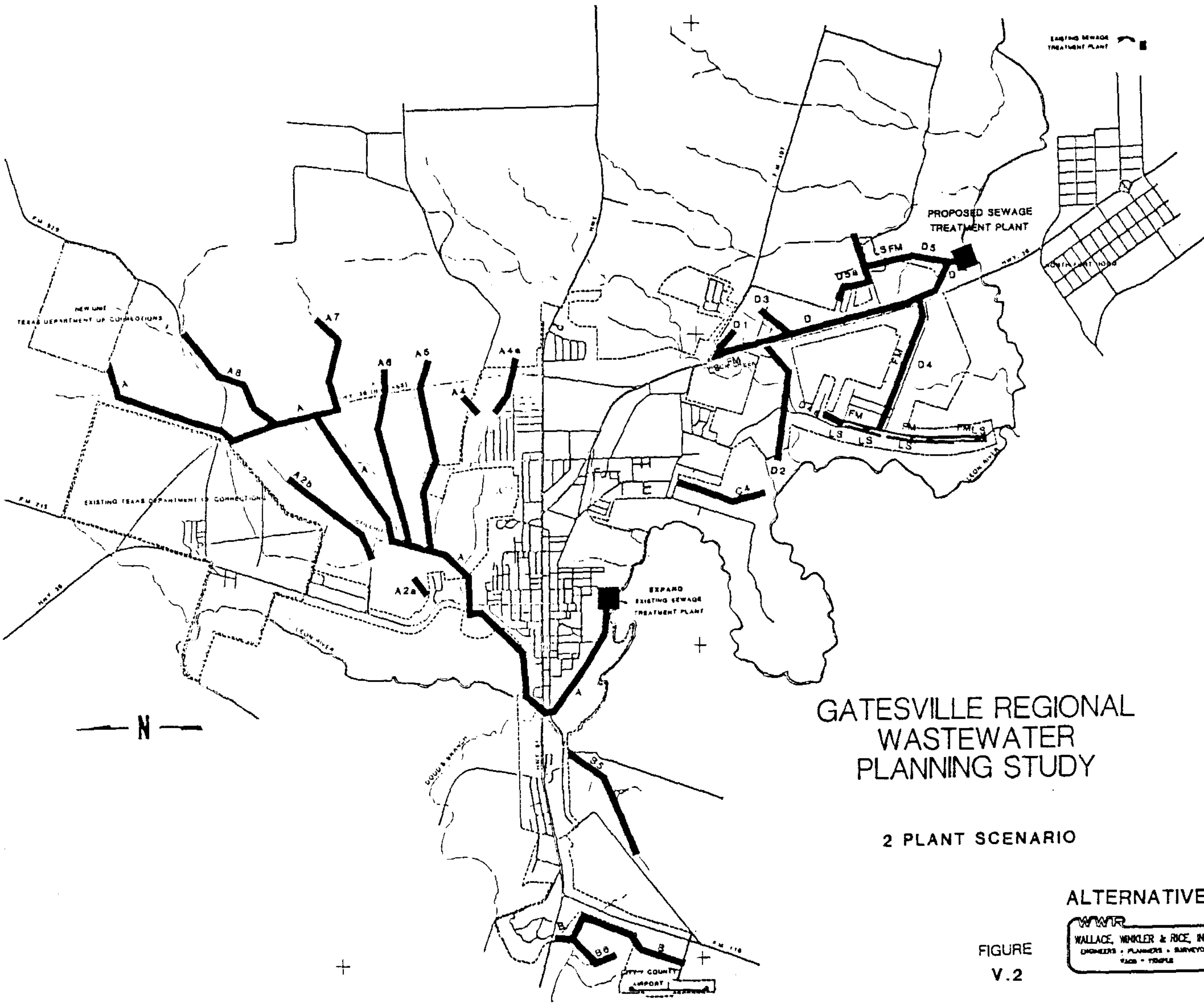


GATESVILLE REGIONAL WASTEWATER PLANNING STUDY

1 PLANT SCENARIO

ALTERNATIVE A

FIGURE V.1



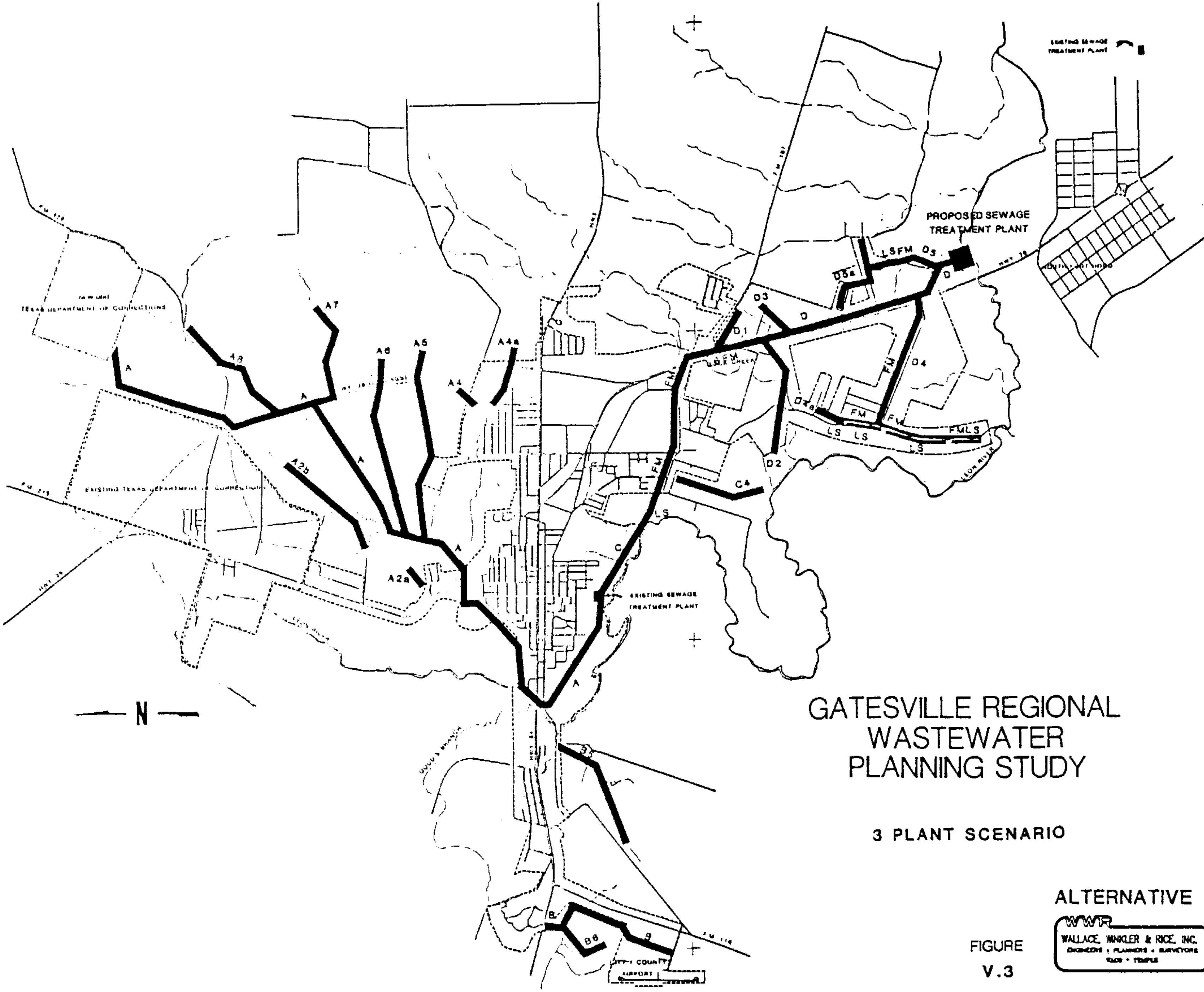
GATESVILLE REGIONAL WASTEWATER PLANNING STUDY

2 PLANT SCENARIO

ALTERNATIVE B

WWR
WALLACE, WINKLER & RICE, INC.

FIGURE
V.2



GATESVILLE REGIONAL WASTEWATER PLANNING STUDY

3 PLANT SCENARIO

ALTERNATIVE C

WWR
WALLACE, WINKLER & RICE, INC.

FIGURE
V.3

TOTAL INTERCEPTOR COSTS

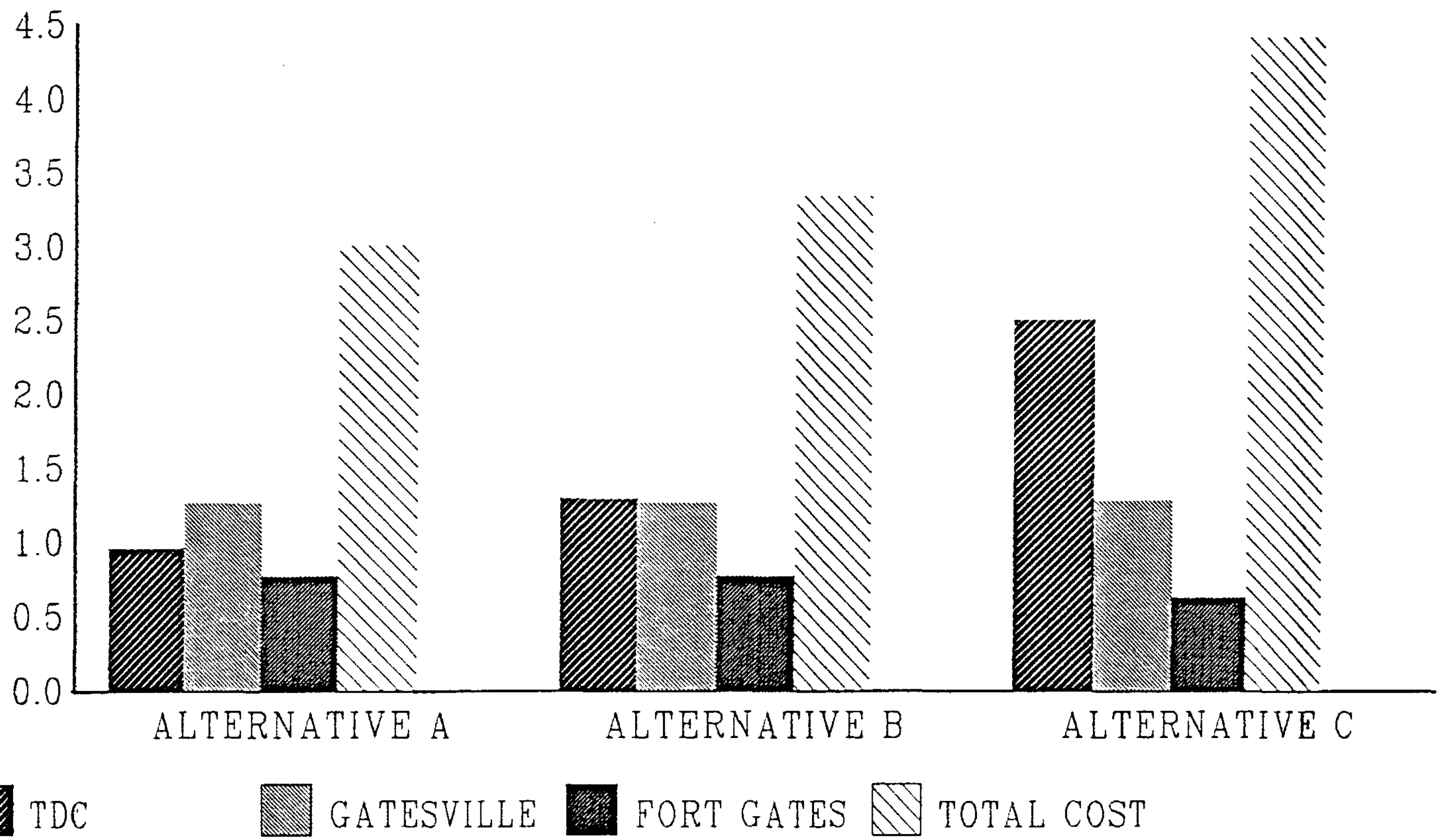


FIGURE V.4

WWR
WALLACE, WINKLER & RICE, INC.

VI. RECOMMEND ALTERNATIVE

VI.A CONCLUSIONS

VI.A.1 Treatment Plants

With the addition of the Alfred Hughes Unit and development in the region increasing, additional WWTP capacity is required. The existing Gatesville WWTP, 1.0 MGD @ 20/20 cannot meet State receiving stream water quality standards; thus, under either development Alternative A or B, this WWTP must be upgraded to an effluent level of at least 10/15/3/5. If a new plant is built to solely accommodate the existing and new prisons, the treatment levels of both the new plant and the Gatesville plant would need to be 10/15/3/5 to maintain a minimum DO level greater than or equal to 5.0 mg/L in the Leon River. Under development Alternative B, with the wastestreams of the prisons and the City of Gatesville combined, a treatment level of 10/15/2/5 would be necessary to maintain a minimum DO level greater than or equal to 5.0 mg/L in the Leon River. If a regional WWTP to serve the prisons, the Cities of Gatesville and Fort Gates, and North Fort Hood is constructed at Highway 36, development Alternative C, a treatment level of 5/5/2/5 would be necessary to maintain a minimum DO level greater than or equal to 5.0 mg/L in the Leon River.

VI.A.2 Interceptor Routing

The TDC interceptor, which must be constructed immediately for the Alfred Hughes Unit, represents the most significant change in total costs in comparing each of the development Alternatives. Alternative A requires the least amount of total expenditures for new interceptors, with the lowest cost associated with the TDC interceptor compared to Alternatives B and C.

VI.B RECOMMENDATIONS - DEVELOPMENT ALTERNATIVE A

Because growth is expected in the vicinity of the new S.H.36 Loop and the expansion of the TDC units, WWTP capacity should be increased north of the existing WWTP. Building a new 2.2 MGD facility to handle the waste streams of the existing prisons and the new prison @ 10/15/3/5 immediately would reduce the load on the Gatesville WWTP which currently handles the waste of the existing prison; thereby yielding a higher quality effluent. When necessary, a new 1.0 MGD WWTP could be constructed to accommodate the City of Gatesville @ 10/15/3/5. Also, a separate facility should be built to handle the wastes of Fort Gates and North Fort Hood.

Costs associated with larger treatment plants and the location of plants as compared to expected growth significantly affect the "implementability" of Alternatives B or C. The interceptor routing of Alternative C, with its extensive system of large force mains and lift stations which are required immediately, prohibits recommendation of this alternative. In addition, the treatment level of 5/5/2/5, even with lower initial wasteloads, is cost prohibitive. With Alternative B, the cost of the TDC interceptor is not significantly greater in comparison with Alternative A; however, the location of the plant in the flood plain and growth expected both upstream and downstream, make this development alternative less desirable, particularly when the treatment level is essentially the same except for nitrogen removal. Also, the current facilities would have to be removed because they cannot meet the current State stream water quality standards. Alternative A has several benefits including reduced costs, the best ability phase and implement, location next to growth centers, reduced wasteloads on the existing WWTP resulting in a better effluent quality, and less strict treatment levels that meet State requirements.

IV.C PHASING FOR 1990

For the year 1990, Alternative A includes the construction of a 2.2 MGD WWTP and a 5000 gpm lift station to be located upstream of the existing City of Gatesville wastewater treatment plant. This facility will be constructed to treat wastewater from the existing prisons and the new Alfred Hughes unit. The construction of a new plant will reduce the wastewater flows to the existing WWTP, thus improving the effluent quality and defering improvements to the existing plant that will be required later.

Under development Alternative A, several new interceptors are planned for the region; however, the most immediate need exists along State Highway Loop 36 north to the prison units. For the year 1990, construction of interceptors will include both the 15"-18"-24" line "A" required for wastewater flows leading to the new wastewater treatment plant and the new wastewater treatment plant outfall. Section VII.C is a detailed estimate for the cost of this phase.

VII. DETAILED CAPITOL COSTS

VII.A WASTEWATER TREATMENT FACILITIES

ALTERNATIVE A

2.2 MGD	$ 6.00	Treatment Level 10/15/3/5
1.0 MGD	$ 2.83	Treatment Level 10/15/3/5
2.0 MGD	$ 5.80	Treatment Level 10/15/3/5

ALTERNATIVE B

3.2 MGD	$ 8.50	Treatment Level 10/15/3/5
2.0 MGD	$ 5.80	Treatment Level 10/15/3/5

ALTERNATIVE C

5.2 MGD	$ 11.00	Treatment Level 5/5/2/5

VII.B ESTIMATED OPERATION AND MAINTENANCE COSTS

ALTERNATIVE A

2.2 MGD	$ .41	Treatment Level 10/15/3/5
1.0 MGD	$ .21	Treatment Level 10/15/3/5
2.0 MGD	$ .37	Treatment Level 10/15/3/5

ALTERNATIVE B

3.2 MGD	$ .50	Treatment Level 10/15/3/5
2.0 MGD	$ .37	Treatment Level 10/15/3/5

ALTERNATIVE C

5.2 MGD	$ 1.10	Treatment Level 5/5/2/5

VII.C COST OF 1990 PHASE

2.2 MGD Proposed Wastewater Treatment Facility

and Alfred Hughes Outfall Line

ITEM	DESCRIPTION			COST
(1)	27000	L.F.	15 inch Sanitary Sewer	540,000.00
(2)	1000	L.F.	18 inch Sanitary Sewer	25,000.00
(3)	1000	L.F.	24 inch Sanitary Sewer	30,000.00
(4)	5000	GPM	Lift Station	190,000.00
(5)	500	L.F.	24 inch Outfall	15,000.00
(6)	40	EA.	Manholes	40,000.00
(7)	1	L.S.	Flow Meterline Sta @ TDC	20,000.00
(8)	300	L.F.	Bore & Case	300,000.00
(9)	1	L.S.	2.2 MGD Wastewater Treatment Plant	3,700,000.00
(10)	1500	L.F.	Entrance Road	70,000.00
(11)	1	L.S.	Trench Safety	30,000.00

Total Construction Cost	$4,960,000.00
Engineering	420,000.00
Surveying	60,000.00
Inspection	80,000.00
Legal/Fiscal	30,000.00
Power	30,000.00
Soils Testing	40,000.00
Discharge Permit	30,000.00
Contingencies	250,000.00
Land	100,000.00
TOTAL PROJECT COST	**$6,000,000.00**

VIII. MANAGEMENT OPTIONS

VIII.A OVERVIEW

As with any regional wastewater treatment facility, few acceptable management options exist. For any Gatesville Regional Facility, three possible management entities exist. First, the Brazos River Authority ("Authority") has the capability of operating and maintaining any wastewater facility in the Brazos Basin. The "Authority's" management background and staff could provide the necessary experience for the operation of any wastewater facility in the region. The City of Gatesville has been operating and managing the existing facility since its inception in 1962. This makes the City of Gatesville a qualified and logical management alternative. Third, a new entity such as a wastewater utility district to be created and agreed upon by the Cities of Gatesville, Fort Gates, and North Fort Hood could operate and maintain the regional facility (or facilities) subject to negotiation between all concerned parties and approval and designation by the Texas Water Commission.

With regard to the septic systems in the Fort Gates area, one alternative for management is the establishment of a septic system maintenance district. This concept has not been used in Texas, but may be an appropriate option for certain portions of the study area. Responsibilities of such a district could range from strictly maintenance to total control over septic system development and operation. The goal of this option is to minimize septic system problems which may arise due to poor design and installation or inadequate maintenance.

VIII.B RECOMMENDATION

Because the City of Gatesville has successfully maintained, operated, and upgraded the existing wastewater treatment facilities since 1962, our recommendation is to turn the Gatesville Regional Facilities over to the City of Gatesville upon their completion. The "Authority" can remain active as a supporting entity if the City of Gatesville should require any assistance or financing to properly operate or maintain the regional facilities. The City of Gatesville will employ reputable, experienced operators and superintendents in order to insure the proper operation of any of the regional facilities. To further support this recommendation, the City of Gatesville is currently operating and managing the 12 MGD Regional Water System that was partially funded by the Texas Water Development Board.

IX. FINANCING - RECOMMENDATIONS

The financial section has been written but in review by Mr. Luis Lobo - Assistant City Manager, City of Gatesville.

City of Gatesville

Drought Contingency Plan
Water Conservation Plan

I. Introduction

A. Introduction

A Water Conservation Plan and a Drought Contingency Plan are prepared to meet the guidelines established by the Texas Water Development Board and to reduce to historic growth in water use by water customers throughout the State. Conservation requirements were established by House Bill (HB) 2 and House Joint Resolution (HJR) 6. On November 5, 1985, Texas voters approved an Amendment to the Texas Constitution that provided for implementation of (HB)2.

Since the early 1960's, the per capita water usage in the State has increased about four (4) gallons per person, per decade. Furthermore, per capita water use during droughts is typically about one-third greater than during periods of average precipitation. The Water Conservatión Plan and Drought Contingency Plan are implemented to affect day to day activities such as bathing, cooking, toilet flushing, fire protection, lawn watering, swimming pools, laundry, dish washing, car washing and sanitation.

The water conservation program goal is to reduce the quantity of water required for each activity, where practical, for efficient water use. The program consists of a combination of voluntary and mandatory actions to be put into effect to reduce day to day water use, particularly during water shortage emergencies.

B. Goals

The goals of this water conservation program is to reduce the quantity of potable water required for each water use activity, where practical, through implementation of efficient water use practices. The water drought contingency plan provides procedures for voluntary and mandatory actions to be put into effect to temporarily reduce the demand upon a water supply system during a water shortage emergency. Drought contingency procedures include a combination of conservation and prohibition of certain uses. Both programs are imperative to operate effectively in all situations.

The conservation and drought plan covers residential and commercial activities including water for drinking, bathing, cooking, toilet flushing, fire protection, lawn watering, swimming pools, laundry, dish washing, car washing, and sanitation. The plan attempts to reverse the historic average annual increase of water consumption per person.

It is the goal of the water conservation plan to reduce per capita consumption by up to 15 percent. This reduction will also have a positive effect on wastewater collection and treatment systems.

The water conservation plan attempts to place the City of Gatesville in a state of readiness to reduce water consumption by as much as 50 percent during drought emergency situations. Since emergency situations onset is typically rapid, it is imperative that the plan have the City be prepared in advance.

C. Utility Evaluation Data

1. Population of Service Area — 1300 (No.)

2. Area of Service Area — 516 (Sq. Mi.)

3. Number and Type of Connections

Entity	Residential	Commercial	Industrial	Total
City of Gatesville	2184	216	0	2400
Ft. Gates WSC	439	21	0	460
Grove WSC	135	5	0	140
Flat WSC	147	8	0	155
Fort Hood Military Reservation	0	1	0	1
Coryell City Water District	0	906	37	943
Mountain WSC	260	18	0	278
Texas Department of Corrections	0	1	0	1
TOTAL				4378

4. Rate of New Connections 175 (RES) 16 (COMM) 0(IND)

5. Water Use Information

(a) Water Production

Entity	Average Daily	Peak Daily
City of Gatesville	0.60	1.20
Ft. Gates WSC	0.18	0.41
Grove WSC	0.08	0.18
Flat WSC	0.07	0.17
Ft. Hood Military Reservation	0.60	2.00
Coryell City Water District	0.35	0.90
Mountain WSC	0.10	0.25
Texas Department of Corrections	0.70	1.20
TOTAL	2.68	6.31

(b) Water Production for Prior 2 Years 970,000,000 (gal/yr)

(c) Average Months Water Production Prior 2 Years 80,000,000 (gal/yr)

(d) Water Production for Prior Year 978,000,000 (gal/yr)

(e) Average Daily Water Use 2.68 (mgal/day)

(f) Peak to Average Use Ratio 2.35

(g) Unaccounted Water 85%

6. Safe Annual Yield of Water Supply 6,000 (acre/ft.) = 1,955 (million gallons)

7. Peak Daily System Capacity 12.00 MGD

8. Major High Volume Customers

CUSTOMER	QUANTITY (GAL/YR)
Coryell County Hospital	7,570,000
Medical Plastics	6,500,000
Gatesville ISD	6,100,000
Kalyn Trailers	3,800,000

9. Wastewater Information

ENTITY	% OF WATER USERS SERVED	FLOW (GPD)
City of Gatesville	90	450,000
Ft. Gates WSC	8	12,000
Grove WSC	0	0
Flat WSC	0	0
Ft. Hood Military Reservation	100	350,000
Coryell City Water District	0	0
Mountain WSC	0	0
Texas Department of Corrections	100	600,000
TOTAL		1,412,000

10. Population and Water Use

Entity	Avg Day (GPD)	Peak Day (GPD)	Population
City of Gatesville	1.50	2.98	10,700
Ft. Gates WSC	0.31	0.71	2,000
Grove WSC	0.13	0.24	600
Flat WSC	0.12	0.22	600
Ft. Hood Military Reservation	1.00	3.31	8,000 *
Coryell City Water District	0.48	0.72	3,000
Mountain WSC	0.16	0.37	1,000
Texas Department of Corrections	1.40	2.48	6,000 **
TOTAL	5.10	11.51	31,900

* Temporary Troops Only
** Inmates

11. Percent Connections Metered in the System

Residential - 100% *

Commercial - 100% *

Industrial - 100% *

* Does not include Ft. Hood or TDC

12. Water Rate Schedule

Water Entity	Minimum Charge Per Month	Rate Per 1000 Gal	Tap Fee
Coryell City WSC	$30.00	$2.75	$1,350.00
Mountain WSC	$35.00	$2.75	$600.00
City of Fort Gates	$25.00	$2.00	$350.00
City of Gatesville	$20.00	$2.50	$200.00 *

* Plus piping costs

13. Average Annual Revenues from Water Sales

Gatesville Water System $500,000.00

Estimated Regional Water System $2,270,000.00 *

* Does not include Ft. Hood or TDC

II. Water Conservation Plan

A. The following planning elements are in accordance with requirements listed in TWDB Guidelines with similar numbers;

1. Education and Information

The City of Gatesville will inform City users of various recommended methods for implementing a reduction in water consumption. Generally, a majority of water consumption in a City is consumed by residential customers. Therefore the target area for educational information is to be the majority user and also contract customers.

a. First year program or activities will consist of seven activities:

1. An article will be placed in newspaper, explaining the Conservation Plan to be developed.

2. Provide each new customer with "Homeowner's Guide to Water Use and Water Conservation".

3. Newspaper article advising water customers that Homeowner's Guide is available at City Hall.

4. Mail out one brochure to water customers. "Water...Half-A-Hundred Ways to Save It."

5. Mail out one brochure to water customers either "How to Save Water Outside the Home" or "How to Save Water Inside the Home".

6. News article in newspaper highlighting certain methods for saving water.

7. A list of current materials on water conservation is contained in Attachment A to this plan.

b. Long-term program will consist of four activities each year after first year:

1. Mail out new brochures emphasizing new or innovative means for conserving water.

2. Newspaper article targeting one particular household water using utility or item and methods for conserving water (dishwasher, shower, toilet, laundry).

3. New customers will be advised of the City Conservation Program and will be provided with a copy of the Homeowners Guide.

4. Information for "Water Saving Methods that can be Practiced by the Individual Water User" is contained herein as Attachment B".

c. The education portion of the conservation plan is for public information only. The City of Gatesville cannot enforce regulations in the regional water service are outside of its corporate limits.

2. Plumbing Codes

The City of Gatesville Plumbing Code has been amended to include Appendix J of the Southern Standard Building Code, 1985 Edition. The Amendment also requires recirculation equipment for all new swimming pool installation and insulation of hot water piping for all new construction. A copy of the amendment to plumbing code is contained in Attachment C.

3. Retrofit Programs

Through the educational program, water users will be encouraged when purchasing new lawn watering equipment, plumbing fixtures, appliances, etc. to purchase water savings devices. City will work with local plumbing and fixture retail stores in order that such is available to the public.

4. Water Rate Structure

The City of Gatesville, along with all entities involved in the regional water supply system, has been significantly raising water rates to offset the relatively large capital retirement payment created by construction of the system. As a result, water conservation is being practiced by the water users. The water rates for the City is included in the Evaluation Data. At this time, it is our opinion that additional adjustments in these rates will place an undue burden on all citizens and commercial operations.

5. Universal Metering and Meter Repair

All water users, including City, utilities, and other public facilities shall be metered. New multi-family dwellings or apartments with five or more units shall be individually metered. The City of Gatesville will conduct tests on existing water meters at the following intervals:

(1) Master Meters - Annually

(2) 1 1/2 inch and larger- Annually

(3) 1 inch or smaller - Every 10 years

The meters will be pulled, calibrated and placed back into operation. Sufficient meters will be kept in stock to facilitate ease in meter rotation.

6. Water Conservation Landscaping

The City of Gatesville, through its public education program, shall encourage the use of native or drought tolerant landscaping and the use of efficient sprinkling systems. Rate structures, in place, also encourage conservation of outside water use. The combination of these items will positively affect outside water use.

Because of limited staff and enforcement personnel, ordinances specifically controlling landscaping and sprinkling fixtures could be effective at this time.

7. Leak Detection and Repair

With the completion of the regional water supply system, the City is undergoing a program of pipe replacement and rehabilitation. This program will be of great assistance in water loss reduction.

The City will establish a program to conduct a monthly or annual water use audit or accounting to determine the extent of unaccounted-for water use.

8. Recycling and Reuse

The City of Gatesville is presently studying its options regarding future wastewater disposal resulting from the impact of the new prison unit. The City is actively pursuing efforts to extend a pipeline to an eighteen hole golf course for irrigation purposes. The City is currently negotiating a contract to have these facilities in place within twelve months, contingent on meeting state requirements.

No large water using industry is located in the City. Industrial use of treated effluent is very limited.

9. Implementation and Enforcement

The City Manager, through his staff, will implement the Plan in accordance with Council adoption of the plan, adoption of Plumbing Codes and revisions thereof as set out in this Plan. Enforcement will be provided by:

a. Enforcing the existing building codes and revisions thereof for water conservation practices.

b. With the construction of the regional water system and the subsequent large capital debt, the City raised its water rates significantly thereby lowering water consumption by 10 to 15 percent. Since the City must offset the capital debt through revenue bonds, a large reduction in water consumption may adversely impact the City's ability to pay for regional system improvements resulting for the loss in revenues. Water conservation must be kept in perspective in the City's present position. The City proposes to establish a system of the following components.

(1) Service taps will not be provided customers who do not meet the requirements of installing water conservation plumbing in new construction.

(2) Building inspector will not certify any construction not meeting the plumbing codes.

(3) Water service will be discontinued for those not paying water bills.

10. Contracts with Other Political Subdivisions

Any political subdivision and/or wholesale customer contracting for water from the City of Gatesville must have (1) an approved Texas Water Development Board Water Conservation and Drought Contingency Plan in effect or (2) must officially adopt applicable provisions of the City of Gatesville's Water Conservation and Drought Contingency Plan.

B. Annual Reporting

The City through adoption of this Plan, commits to report to the Executive Director of the Texas Water Development Board annually, within sixty days after the anniversary date of loan closing. The report to the Director will contain information describing:

1. Progress in Conservation Plan Implementation.

2. Public response to plan implementation and operation

3. Quantitative effectiveness with reference to:

   a. System reduction

   b. Reduction in customer or per capita use

4. List of public information released during the year.

Attachment A

Contents of the Municipal Water Conservation Workshop Notebook

The notebook is distributed to participants at Board-sponsored Municipal Water Conservation workshops. In addition, single copies of the notebook can be provided to cities and utilities. Single copies of selected materials from the notebook can also be provided.

TITLE	PUBLISHED BY:	DESCRIPTION	LENGTH
Section 1: The Need For Conservation			
Texas Water Resources Conservation	TWDB	Paper	38 pages
SECTION 2: Water Conservation Techniques			
Efficient Use of Water in the Garden and Landscape (B-1496)	TAEX	Booklet	20 pages
Xeriscape	City of Austin	Booklet	20 pages
Water Pressure Reducing Valves	Watts Regulator	Booklet	21 pages
Texas Native Tree and Plan Directory, 1986	TDA	Book	162 pages
Sources of Leak Detection Equipment & Services	TWDB	List	2 pages
Sources of Water Saving Devices	TWDB	List	21 pages
Locating & Reducing Unaccounted for Water Through the Use of The Water Audit and Leak Detection	TWDB	Guidebook	30 pages
Water Rate Design Emphasizing Conservation Rate Structures	TWDB	Guidebook	30 pages
Model Water Ordinances	TWDB	Guidebook	25 pages
The Authority of Cities, Water Utilities, and Water Districts to Regulate and Enforce Water Conservation Measures	TWDB	Guidebook	25 pages
SECTION 3: ALTERNATE SOURCES			
The Cost of Conventional Water Supply Development and Treatment	TWDB	Paper	9 pages

Potential for Utilization of Brackish Groundwater	TWDB	Paper	21 pages
Guidelines for Water Reuse EPA-600/8-80-036	EPA	Book	105 pages

<u>SECTION 4:</u> <u>WORKSHOP EXERCISE</u>

Example Problem	TWDB	Loose-Leaf	15 Pages

<u>SECTION 5:</u> <u>PLAN ELEMENTS</u>

Guidelines for Municipal Water Conservation and Drought Contingency Planning and Program Development	TWDB	Loose-leaf	36 pages

<u>SECTION 6:</u> <u>PLAN DEVELOPMENT</u>

Water Conservation and Drought Contingency Plan Development Procedures	TWDB	Loose-leaf	58 pages

TEXAS WATER DEVELOPMENT BOARD

WATER CONSERVATION LITERATURE

Single copies of all of the following publications and materials can be obtained at no charge. The * indicates those publications that are available free to political subdivisions in small quantities. Larger quantities can be obtained through special arrangement or at the cost of printing. To make a request, write: CONSERVATION, Texas Water Development Board, Capitol Station, Austin, Texas 78711-3231

Agricultural Conservation Literature

Title	Published by:	Description	Length
Agricultural Water Conservation in Texas *	TWDB	Pamphlet with Tear-out	8 pages
Have Your Irrigation System Evaluated Free *	TWDB	Pamphlet	4 pages
LEPA Irrigation *	TWDB	Pamphlet	6 pages
Drip Irrigation *	TWDB	Pamphlet	6 pages
Plastic Ruler *	TWDB	6" X 1 1/4"	-
Furrow Dikes *	HPUWCD #1	Pamphlet	4 pages
Soil Moisture Monitoring *	HPUWCD #1	Pamphlet	4 pages
Center Pivot Irrigation Systems L-2219 *	TAEX	Pamphlet	4 pages
Surge Flow Irrigation L-2220 *	TAEX	Pamphlet	4 pages
Surge Irrigation * SCS	Pamphlet	6 pages	
Coloring Poster for Children *	TWDB	Coloring Poster	1 page
Water Conservation Coloring Book * (No. 1)	TWDB	Booklet	4 pages

Municipal Conservation Literature

Title	Published by:	Description	Length
Water Half-A-Hundred Ways to Save It. *	TWDB	Pamphlet	8 pages
Water Saving Ideas for Business and Industry *	TWDB	Pamphlet	8 pages
How to Save Water Outside The Home *	TWDB	Pamphlet	8 pages
How to Save Water Inside The Home	TWDB	Pamphlet	8 pages
Toilet Tank Leak Detector Tablets *	TWDB	2 Tablets	-
Municipal and Commercial Water Conservation Services	TWDB	Pamphlet with Tear-out	8 pages
A Homeowner's Guide to Water Use and Water Conservation	TWDB	Booklet	22 pages
Guidelines for Municipal Water Conservation and Drought Contingency Planning and Program Development	TWDB	Loose-Leaf	36 pages
How to Xeriscape	NXC	Pamphlet	10 pages
Texas Sesquicentennial Native Plant Landscape	TDA/TWDB	Pamphlet	8 pages
Municipal Water Conservation Workshop Notebook (See Attachment "A" for a Description of Contents)	TWDB	Notebook	6 sections
Water Conservation Coloring Book * (No. 2)	TWDB	Booklet	4 pages

Texas Water Resources and Planning Literature

Title	Published by:	Description	Length
TWDB Report 294 - Surveys of Irrigation in Texas	TWDB	Book	243 pages
Summary of Water For Texas (C-20)	TWDB	Pamphlet	8 pages
Water Planning in Texas	TWDB	Booklet	27 pages
Texas Water Development Board (Funding Programs)	TWDB	Pamphlet	4 pages
Water for Texas (GP-4-1)	TWDB	Books	
Volume 1 (Comprehensive Plan)	(Available for purchase only from the Texas Water Commission, P.E. Box 13087 Austin, Texas 78711)		72 pages
Volume 2 (Technical Appendix)			530 pages
Texas Water Facts	TWDB	Booklet	12 pages

Abbreviations:

HPUWCD #1	High Plains Underground Water Conservation District No. 1
NXC	National Xeriscape Council, Inc.
SCS	USDA - Soil Conservation Service
TAEX	Texas Agricultural Extension Service
TDA	Texas Department of Agriculture
TDWR	Texas Department of Water Resources
TWDB	Texas Water Development Board

PUBLICATIONS AND AUDIOVISUAL MATERIALS
AVAILABLE FOR LOAN FROM TEXAS
WATER DEVELOPMENT BOARD (TWDB) (a)

PUBLICATIONS

Title	Published by	Description	Length
Water Audit and Leak Detection Guidebook	California Dept. of Water Res.	Book	142 pages
Example Brochures and Promotional Material	Compiled by TWDB	Ringbinder	32 pages
Regional Teachers Guide Supplements	California Department of Water Res.	Books	Nos. 1-7

AUDIOVISUAL MATERIALS

Title	Published by	Description	Length
The Alternative is Conservation	Water Films	16 mm Film VCR/VHS Format	28 minutes
Water Follies	American Water Works Assoc. (AWWA)	16 mm Film VCR/VHS Format	7.5 minutes
Orangutans (Public Service Announcement)	AWWA VCR/VHS Format	16 mm Film VCR/VHS Format	30 seconds
Gooney Birds (Public Service Announcement)	AWWA VCR/VHS Format	16 mm Film VCR/VHS Format	30 seconds
Tanks (Public Service Announcement)	AWWA VCR/VHS Format	16 mm Film VCR/VHS Format	30 seconds
Spot Announcements	Lower Colorado River Authority	Audio Cassette	30 Seconds

(a) The films, video cassettes, and publications are provided for review purposes only. Permission to use any of this material for print or broadcast must be obtained from the producer or publisher of the material.

ATTACHMENT B

WATER SAVING METHODS THAT CAN BE PRACTICED BY THE INDIVIDUAL WATER USER

In-home water use accounts for an average of 65 percent of total residential use, while the remaining 35 percent is used for exterior residential purposes such as lawn watering and car washing. Average residential in-home water use data indicate that about 40 percent is used for toilet flushing, 35 percent for bathing, 11 percent for kitchen uses, and 14 percent for clothes washing. Water saving methods that can be practiced by the individual water user are listed below.

A. Bathroom

1. Take a shower instead of filling the tub and taking a bath. Showers usually use less water than tub baths.

2. Install a low-flow shower head which restricts the quantity of flow at 60 psi to no more than 3.0 gallons per minute.

3. Take short showers and install a cutoff valve or turn the water off while soaping and back on again only to rinse.

4. Do not use hot water when cold will do. Water and energy can be saved by washing hands with soap and cold water; hot water should only be added when hands are especially dirty.

5. Reduce the level of the water being used in a bath tub by one or two inches if a shower is not available.

6. Turn water off when brushing teeth until it is time to rinse.

7. Not let water run when washing hands. Instead, hands should be wet, and water should be turned off while soaping and scrubbing and turned on again to rinse. A cutoff valve may also be installed on the faucet.

8. Shampoo hair in the shower. Shampooing in the shower takes only a little more water than is used to shampoo hair during a bath and much less than shampooing and bathing separately.

9. Hold hot water in the basin when shaving instead of letting the faucet continue to run.

10. Test toilets for leaks. To test for a leak, a few drops of food coloring can be added to the water in the tank. The toilet should not be flushed. The customer can then watch to see if the coloring appears in the bowl within a few minutes. If it does, the fixture needs adjustment or repair.

11. Use a toilet tank displacement device. A one-gallon plastic milk bottle can be filled with stones or with water, recapped, and placed in the toilet tank. This will reduce the amount of water in the tank but still provide enough for flushing. (Bricks which some people use for this purpose are not recommended since they crumble eventually and could damage the working mechanism, necessitating a call to the plumber).

12. Install faucet aerators to reduce water consumption.

13. Never use the toilet to dispose of cleansing tissues, cigarette butts, or other trash. This can waste a great deal of water and also places an unnecessary load the sewage treatment plant or septic tank.

14. Install a new low-volume flush toilet that uses 3.5 gallons or less per flush when building a new home or remodeling a bathroom.

B. Kitchen

1. Use a pan of water (or place a stopper in the sink) for rinsing pots and pans and cooking implements when cooking rather than turning on the water faucet each time a rinse is needed.

2. Never run the dishwasher without a full load. In addition to saving water, expensive detergent will last longer and a significant energy saving will appear on the utility bill.

3. Use the sink disposal sparingly, and never use it for just a few scraps.

4. Keep a container of drinking water in the refrigerator. Running water from the tap until it is cool is wasteful. Better still, both water and energy can be saved by keeping cold water in a picnic jug on a kitchen counter to avoid opening the refrigerator door frequently.

5. Use a small pan of cold water when cleaning vegetables rather than letting the faucet run.

6. Use only a little water in the pot and put a lid on it for cooking most food. Not only does this method save water, but food is more nutritious since vitamins and minerals are not poured down the drain with the extra cooking water.

7. Use a pan of water for rinsing when hand washing dishes rather than a running faucet.

8. Always keep water conservation in mind, and think of other ways to save in the kitchen. Small kitchen savings from not making too much coffee or letting ice cubes melt in a sink can add up in a year's time.

C. Laundry

1. Wash only a full load when using an automatic washing machine (32 to 59 gallons are required per load).

2. Use the lowest water level setting on the washing machine for light loads whenever possible.

3. Use cold water as often as possible to save energy and to conserve the hot water for uses which cold water cannot serve. (This is also better for clothing made of today's synthetic fabrics.)

D. Appliances and Plumbing

1. Check water requirements of various models and brands when considering purchasing any new appliance that uses water. Some use less water than other.

2. Check all water line connections and faucets for leaks. If the cost of water is $1.00 per 1,000 gallons, one could be paying a large bill for water that simply goes down the drain because of leakage. A slow drip can waste as much as 170 gallons of water EACH DAY, or 5,000 gallons per month, and can add as much as $10.00 per month to the water bill.

3. Learn to replace faucet washers so that drips can be corrected promptly. It is easy to do, costs very little, and can represent a substantial amount saved in plumbing and water bills.

4. Check for water leakage that the customer may be entirely unaware of, such as a leak between the water meter and the house. To check, all indoor and outdoor faucets should be turned off, and the water meter should be checked. If it continues to run or turn, a leak probably exists and needs to be located.

5. Insulate all hot water pipes to avoid the delays (and wasted water) experienced while waiting for the water to "run hot".

6. Be sure the hot water heater thermostat is not set too high. Extremely hot settings waste water and energy because the water often has to be cooled with cold water before it can be used.

7. Use a moisture meter to determine when house plants need water. More plants die from over-watering than from being too dry.

E. Out-of-Door Uses

1. Water lawns early in the morning during the hotter summer months. Much of the water used on the lawn can simply evaporate between the sprinkler and the grass.

2. Use a sprinkler that produces large drops of water, rather than a fine mist, to avoid evaporation.

3. Turn soaker hoses so the holes are on the bottom to avoid evaporation.

4. Water slowly for better absorption, and never water on windy days.

5. Forget about watering the street or walks or driveways. They will never grow a thing.

6. Condition the soil with compost before planting grass or flower beds so that water will soak in rather than run off.

7. Fertilize lawns at least twice a year for root stimulation. Grass with a good root system makes better use of less water.

8. Learn to know when grass needs watering. If it has turned a dull grey-green or if footprints remain visible, it is time to water.

9. Not water too frequently. Too much water can overload the soil so that air cannot get to the roots and can encourage plant diseases.

10. Not over-water. Soil can absorb only so much moisture and the rest simply runs off. A timer will help, and either a kitchen timer or an alarm clock will do. An inch and one-half of water applied once a week will keep most Texas grasses alive and healthy.

11. Operate automatic sprinkler systems only when the demand on the town's water supply is lowest. Set the system to operate between four and six a.m.

12. Not scalp lawns when mowing during hot weather. Taller grass holds moisture better. Rather, grass should be cut fairly often, so that only 1/2 to 3/4 inch is trimmed off. A better looking lawn will result.

13. Use a watering can or hand water with the hose in small areas of the lawn that need more frequent watering (those near walks or driveways or in especially hot, sunny spots.)

14. Learn what types of grass, shrubbery, and plants do best in the area and in which parts of the lawn, and then plant accordingly. If one has a heavily shaded yard, no amount of water will make roses bloom. In especially dry sections of the state, attractive arrangements of plants that are adapted to arid or semi-arid climates should be chosen.

15. Consider decorating areas of the lawn with rocks, gravel, wood chips, or other materials now available that require no water at all.

16. Not "sweep" walks and driveways with the hose. Use a broom or rake

instead.

17. Use a bucket of soapy water and use the hose only for rinsing when washing the car.

Attachment C

ORDINANCE NO. 89 - ____

AN ORDINANCE AMENDING THE CODE OF ORDINANCES OF THE CITY OF GATESVILLE, TEXAS BY ADOPTING APPENDIX J (WATER CONSERVATION) OF THE STANDARD PLUMBING CODE, 1985 EDITION COMPLETED AND PUBLISHED BY THE SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL, INC.; PROVIDING A PENALTY NOT TO EXCEED $200.00 FOR EACH VIOLATION THEREOF; PROVIDING FOR PUBLICATION AND ORDAINING OTHER MATTERS RELATED TO THE FOREGOING

BE IT ORDAINED BY THE CITY OF GATESVILLE:

SECTION I: Chapter 8, Article VI, Section 8-75(a) of the Code of Ordinances of the City of Gatesville, Texas is hereby amended by adopting Appendix J (Water Conservation) of the Standard Plumbing Code, 1985 Edition published by the Southern Building Code Congress International, Inc.

SECTION II: That Appendix J of Standard Plumbing Code, 1985 Edition published by the Southern Building Code Congress International, Inc. adopted by Section I of this Ordinance is hereby amended to add the following language:

"All new swimming pools installed in the City of Gatesville after the effective date of this Ordinance shall be equipped with recirculating filtration equipment".

"All new hot water heaters installed in the City of Gatesville after the effective date of this Ordinance shall be all hot water pipes, to point of termination, insulated".

SECTION III: That any violation of the provisions of the said Appendix J of the Standard Plumbing Code adopted pursuant to Section I of this Ordinance shall be punishable by a fine not to exceed $200,00 upon conviction.

SECTION IV: That the City Secretary of the City of Gatesville, Texas is hereby authorized and directed to cause a true and correct copy of the caption of this Ordinance to be published in a newspaper having general circulation in the City of Gatesville, Coryell County, Texas and as an amendment to be published in the Code of Ordinances of the City of Gatesville, Texas.

SECTION V: That the Elective Commission of the City of Gatesville hereby determines that there is an urgent need in the best public interest of the City of Gatesville, Texas to adopt this Ordinance.

PASSED AND APPROVED THIS ______ day of __________, 1989

CITY OF GATESVILLE

ATTEST:

By:______________________________
John Ward
Mayor

____
City Secretary

ORDINANCE 89 - _____

AN ORDINANCE ADOPTING A CITY OF GATESVILLE WATER CONSERVATION PLAN AND DROUGHT CONTINGENCY PLAN; PROVIDING A PENALTY OF NOT LESS THAN $10.00 PER DAY NOR MORE THAN $200.00 PER DAY FOR EACH DAY OF NON-COMPLIANCE WITH THE PROVISIONS THEREOF; DECLARING A PUBLIC NEED OF AN EMERGENCY NATURE FOR THE ADOPTION HEREOF ON ONE READING; PROVIDING FOR PUBLICATION AND ORDAINING OTHER MATTERS RELATED TO THE FOREGOING

BE IT ORDAINED BY THE CITY OF GATESVILLE:

WHEREAS, that the City of Gatesville is in the process of issuing its $600,000 City of Gatesville, Texas, Water Quality Enhancement Loan, Series 1989;

WHEREAS, the Texas Water Development Board (the "Board") has committed to purchase the Bonds from the City, subject to the City complying with various rules and regulations; and

WHEREAS, the Board's rules require that the City adopt a Water Conservation/Drought Contingency Plan which has been approved by the Executive Director of the Board; and

WHEREAS, the City has previously submitted to the Board a proposed Water Conservation/Drought Contingency Plan which has been reviewed and commented upon by the Board and the City has made certain required changes therein and adopted certain additional ordinances related thereto as required by the Board; and

WHEREAS, the City has determined there is an urgent need in the best public interest of the City of Gatesville, Texas to adopt a Water Conservation Plan and Drought Contingency Plan, and the City commission further determines that such public need is of an emergency nature and the legal requirement of two separate readings of the subject ordinance be dispensed with and waived; and

WHEREAS, the City Council of the City now desires to evidence its approval of the Water Conservation/Drought Contingency Plan and adopt such plan as an official policy of the City; Now, Therefore, that such public need is of any emergency nature and the legal requirement of two separate readings of this Ordinance is hereby dispensed and waived.

BE IT ORDAINED BY THE CITY OF GATESVILLE, TEXAS:

SECTION I: Approval of the Plan: The City Council hereby approves and adopts as the City's Water Conservation Plan the Water Conservation/Drought Contingency Plan Attached hereto to be included in full as a part of this Ordinance as if recited verbatim herein. The City commits to implement the program according to procedures set forth in the adopted plan.

SECTION II: The City shall report to the Texas Water Development Board annually on the implementation and effectiveness of the plan in accordance with the outline set forth in the plan.

SECTION III: In regards to implementation and enforcement of the Conservation/Drought Contingency Plan the City Manager of the Waterworks System is designated as the official responsible for implementation and enforcement, and the following guidelines are adopted:

(a) Mild Conditions: At any time the average daily use exceeds 7,000,000 gallons per day for three consecutive days and/or when Lake Belton water surface level drops below elevation 575 MSL (594 MSL being normal) the City Manager shall be authorized to request voluntary compliance by all users and initiate other measures in accordance with the Conservation/Drought Contingency Plan as set out in the said attached plan.

(b) Moderate Conditions: At any time the average daily water exceeds 9,000,000 gallons per day for three consecutive days, and/or, when Lake Belton water surface level drops below elevation 565 MSL (594 MSL being normal), the City Manager shall implement compulsory compliance by all users in accordance with the Conservation/Drought Contingency Plan as set out in the said attached plan.

(c) Severe Conditions: At any time the actual failure of a major component of the system which would cause an immediate health or safety hazard and/or water demand exceeds 11,000,000 gallons per day for three consecutive days and/or when Lake Belton water surface level drops below elevation 550 MSL (594 MSL being normal). Simultaneously, a penalty shall be imposed on all users not acting in compliance with the Conservation/Drought Contingency Plan attached hereto in accordance with the standards of usage outlined within the plan and with the penalties established therein.

In the event the item 3 above, Critical Conditions persist for an extend period of time the City may ration water usage or terminate service to selected users of the system in accordance with the following sequence:

First:	Industrial Users
Second:	Commercial Users
Third:	Residential Users
Last:	Public Health and Safety Facilities

SECTION IV: Users of city water except for the City, that do not comply with Section III of this Ordinance shall be subject to a penalty and fine of not less than $10.00 per day nor more than $200.00 per day for each day of non-compliance and/or disconnection or discontinuance of water services to such users by the City.

SECTION V: The City Council finds and declares that a sufficient written notice of the date, hour, place and subject of this meeting of the Council was posted at a designated place convenient to the public at the City Hall for the time required by law preceding this meeting and that such place of posting was readily accessible at all times to the general public; that all of the forgoing was done as required by law; and that this meeting has been open to the public as required by law at all times during which this Ordinance and the subject matter thereof has been discussed, considered and formally acted upon.

The Commission further ratifies, approves, and confirms such written notice and the contents and posting thereof.

PASSED AND APPROVED THIS ______ day of ______________, 1989.

CITY OF GATESVILLE

BY:______________________
John Ward
Mayor

ATTEST

____
City Secretary

III. Drought Contingency Plan

A. Introduction

Drought, or a number of other uncontrollable circumstances can disrupt the normal availability of community of utility water supplies. Even though the regional water system may have adequate water supplies, the supply may be threatened during periods of extreme drought.

A drought contingency plan is a document to provide community leaders with a vehicle in which to implement measures to mitigate typical effects of such an occurrence. The plan is made up of five elements:

1. Trigger Conditions
2. Drought Contingency Measures
3. Information and Education
4. Initiation Procedures
5. Implementation

B. Trigger Conditions

The drought contingency plan consists of various levels of severity and the plan will be triggered by the occurrence of one of the following items:

1. Mild Conditions

    (a) When system production exceeds 7 million gallons per day for three consecutive days.

    (b) When Lake Belton water surface level drops below elevation 575 feet MSL (594 feet MSL being normal)

2. Moderate Conditions

    (a) When system production exceeds 11 million gallons per day for three consecutive days

    (b) When Lake Belton water surface level drops below elevation 565 feet MSL (594 feet MSL being normal)

3. Severe Conditions

systems and irrigation, recreational use of sprinklers, outside showers (in parks) and water slides.

b. The City Manager will monitor system function and establish hours for outside water use, depending upon System performance.

c. Information Center and publicity elements shall keep public advised of curtailment status.

d. Commercial and industrial use will be visited to insure volunteered conservation has been initiated.

3. Step III.

Step III curtailment shall be initiated upon existence of severe conditions as determined by the City Manager. The City Manager will ban the use of water for:

a. Vehicle washing, window washing, outside watering (lawn, shrubs, faucet dripping, garden, etc);

b. Public water uses which are not essential for health, safety and sanitary purposes. These uses include:

Street washing, fire hydrant flushing, filling pools, athletic fields and courses and dust control sprinkling.

c. Commercial uses not listed and industrial uses will be controlled to the extent dictated by the City Manager.

Business requiring water as a basic function of the business, such as nurseries, commercial car wash, laundromats, high pressure water cleaning, etc., will obtain written permission from the City Manager for intended water use.

The System Priority for water service shall be made on the following basis.

1.	Hospital	3.	Industrial	5.	Residential
2.	Schools	4.	Commercial	6.	Recreational

D. Information and Education

The public will be made aware of conservation and drought conditions by information and data transfer through the City's annual program. During periods of drought curtailment, Step I conditions establishes an information center, and information person, and utilizes the most effective methods developed for information dissemination on a daily basis.

Close observation of the first year information program should develop the most effective ways to communicate with customers. Posting notices, newspaper articles, radio coverage and direct mail to customers will be used during the first year activities.

E. Initiation Procedures

Initiation procedures employed at any period is described in this Plan. Each condition will be met with corresponding action by the City Manager and the City Manager will affect the curtailment, give notice, publicize and follow with implementation of curtailment.

F. Termination of Curtailment

Termination of each drought condition will begin when that specific condition has been improved to the extent that an upgraded condition can be declared by the City Manager. This process will be employed until full service can be provided. System priority will be considered in return to upgraded condition, returning hospitals, schools, etc., in priority order.

Termination will be initiated by the City Manager giving notice, etc., as was given to enact drought curtailment.

G. Modification, deletion and amendment

The City Manager can add, delete, and amend rules, regulations and implementation as needed/desired, and shall advise City Council of such amendments at its next regular or called meeting.

H. Means of Implementation

Adoption of this Plan, Drought Contingency Ordinance, and modification of Plumbing Code Ordinance will enable the City to implement and carry out enforcement of enacted ordinances to make the Plan effective and workable.

APPENDIX A

GATESVILLE REGIONAL WASTEWATER STUDY - DESIGN YEAR 1990

AREA	LINE SIZE	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	LAND USE	% MAXIMUM DEVELOPED	G/A/D	AVERAGE DAILY FLOWS
A	*	1477.04	38.77	1000.00		95.3	1150	480,322
A1	18	206.38	45.95		R16	24.9	1150	46,013
A2	15	777.00	30.90	101.00	R2,CF	93.0	750	449,957
A2a	*	114.19	66.90	29.95		11.4	1000	1,984
A2b	*	363.41	64.00	282.00		10.9	1000	1,905
A2c	6	96.98	27.92		R2	25.1	1050	18,230
A3	8	21.57	21.27		R6	99.0	1050	312
A4	8 - 6	290.40	42.09	190.00		7.4	1100	4,772
A4a	*	293.67	11.08	260.00	R2	9.6	1150	2,504
A5	*	492.00	96.61	380.00	R6	7.9	1150	1,398
A6	*	272.27	8.19	180.00		8.9	1000	7,517
A7	*	665.29	0.00	650.00		8.5	2700	3,526
A8	*	1103.08	0.00	1090.00		8.7	2700	3,087
B	18-12-8	865.01	255.59		R3,R6,CF G1,LR	16.0	1550	151,514
B1	10	107.39	12.41		CF,GB R16,LR	16.6	2150	33,980
B2	8	30.28	0.05		R16,GB	19.6	2100	12,468
B3	10	53.33	4.65		R16,GB	24.5	2100	25,087
B4	18	46.65	0.00		R16	13.3	1350	8,401
B5	*	430.60	0.50	420.00		14.8	700	1,049
B6	*	321.81	13.74	290.00	PD,CF	16.5	1140	3,407
C	15	575.07	5.32		CF,R6	28.0	1140	182,124
C1	10 - 6	112.56	1.11		R6,LR,R16	24.5	1750	47,862
C1a	8	34.19	2.22		R6	22.2	1050	7,466
C2	10 - 8	178.15	4.20		R2,R6 PO,LR	21.7	1550	58,616
C3	6	402.39	0.00	11.64	AH,R2 R6,LR	14.7	1450	83,515
C3a	8 - 6	203.85	0.00			44.8	1150	105,117
C3b	8	2163.04	0.00	2132.00	CF,LR OC,R32	99.0	2550	78,360
C3b1	8	44.98	0.00		R6	17.2	1050	8,142
C4	*	700.26	194.77	330.06	LR,PD,CF	13.1	2050	47,255
D	*	529.23	25.47		FORT GATES	3.5	1100	19,395
D1	*	106.00	0.00		FORT GATES	4.1	1100	4,781
D2	*	507.19	27.41		FORT GATES	2.9	1100	15,305
D3	*	247.86	8.49		FORT GATES	7.5	1100	19,748
D4	*	621.94	136.55		FORT GATES	6.7	1100	35,773
D4A	*	567.78	56.00		R6,FT.GATES	4.2	1100	23,644
D5	*	800.04	34.90		R16,LR,FT.G	1.7	1100	14,308
D5a	*	176.48	0.00		FORT GATES	1.6	1100	3,078

------------FORT GATES = 136,032

*PROPOSED

TOTAL = 2,011,922 GATESVILLE = 945,611

TDC = 930,279

GATESVILLE REGIONAL WASTEWATER STUDY - DESIGN YEAR 2000

AREA	LINE SIZE	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	LAND USE	% MAXIMUM DEVELOPED	G/A/D	AVERAGE DAILY FLOWS
A	*	1477.04	38.77	900.00		96.0	1150	594,250
A1	18	206.38	45.05		R16	25.0	1200	48,399
A2	15	777.00	30.90	40.00	R2	94.2	760	505,511
A2a	*	114.19	66.90	20.00		11.5	1050	3,295
A2b	*	363.41	64.00	230.00		11.0	1100	8,399
A2c	6	96.98	27.92		R2	25.2	1100	19,143
A3	8	21.57	21.27		R6	99.0	1100	327
A4	8 - 6	290.40	42.09	175.00		7.5	1150	6,323
A4a	*	293.67	11.08	246.00	R2	9.7	1200	4,259
A5	*	492.00	96.61	362.00	R6	8.1	1200	3,246
A6	*	272.27	8.19	166.00		9.0	1050	9,269
A7	*	665.29	0.00	633.00		8.6	2700	7,498
A8	*	1103.08	0.00	1070.00		8.8	2700	7,860
B	18-12-8	865.01	255.59		R3,R6,CF G1,LR	16.1	1600	156,987
B1	10	107.39	12.41		CF,GB R16,LR	16.7	2200	34,477
B2	8	30.28	0.50		R16,GB	19.7	2150	12,613
B3	10	53.33	4.65		R16,GB	24.6	2150	25,747
B4	18	46.65	0.00		R16	13.4	1400	8,752
B5	*	430.60	0.50	400.00		14.9	750	3,364
B6	*	321.81	13.74	280.00	PD,CF	16.6	1190	5,545
C	15	575.07	5.32		CF,R6	28.1	1190	190,519
C1	10 - 6	112.56	1.11		R6,LR,R16	24.6	1800	49,350
C1a	8	34.19	2.22		R6	22.3	1100	7,842
C2	10 - 8	178.15	4.20		R2,R6 LR,PO	21.8	1600	60,674
C3	6	402.39	0.00	11.00	AH,R2 R6,LR	14.8	1500	86,889
C3a	8 - 6	203.85	0.00			44.9	1200	109,834
C3b	8	2163.04	0.00	2130.00	CF,LR OC,R32	99.0	2550	83,409
C3b1	8	44.98	0.00		R6	17.3	1100	8,560
C4	*	700.26	194.77	328.00	LR,PD,CF	13.2	2100	49,200
D	*	529.23	25.47		FORT GATES	4.2	1150	24,332
D1	*	106.00	0.00		FORT GATES	5.6	1150	6,826
D2	*	507.19	27.31		FORT GATES	3.7	1150	20,667
D3	*	247.86	8.49		FORT GATES	9.1	1150	25,050
D4	*	621.94	136.55		R16,LR,FT.G	8.9	1150	49,680
D4a	*	567.78	56.00		FORT GATES	6.4	1150	37,667
D5	*	800.04	34.90		FORT GATES	2.9	1150	25,077
D5a	*	176.48	0.00		R6,FT.GATES	2.8	1150	5,593

-------------FORT GATES = 194,892

TOTAL = 2,306,431 GATESVILLE = 1,011,778

TDC = 1,099,761

*PROPOSED

GATESVILLE REGIONAL WASTEWATER STUDY - DESIGN YEAR 2010

AREA	LINE SIZE	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	LAND USE	% MAXIMUM DEVELOPED	G/A/D	AVERAGE DAILY FLOWS
A	*	1477.04	38.77	700.00		96.9	1175	840,576
A1	18	206.38	45.05		R16	26.7	1225	52,767
A2	15	777.00	30.99	10.00	R2,CF	96.3	790	559,934
A2a	*	114.19	66.90	10.00		13.4	1085	5,422
A2b	*	363.41	64.00	200.00		13.2	1125	14,762
A2c	6	96.98	27.92		R2	27.7	1125	21,521
A3	8	21.57	21.27		R6	99.0	1125	334
A4	8 - 6	290.40	42.09	140.00		9.9	1175	12,599
A4a	*	293.67	11.08	210.00	R2	10.6	1225	9,426
A5	*	492.00	96.61	330.00	R6	9.4	1225	7,530
A6	*	272.27	8.19	136.00		11.1	1100	15,639
A7	*	665.29	0.00	613.00		10.9	2725	15,531
A8	*	1103.08	0.00	1040.00		10.5	2725	18,049
B	18-12-8	865.01	255.59		R6,G1,CF G1,LR	18.4	1625	182,217
B1	10	107.39	12.41		CF,GB LR,R16	18.9	2225	39,941
B2	8	30.28	0.50		R16,GB	21.9	2175	14,185
B3	10	53.33	4.65		R16,GB	25.0	2175	26,470
B4	18	46.65	0.00		R16	14.2	1425	9,440
B5	*	430.60	0.50	350.00		16.7	775	10,367
B6	*	321.81	13.74	250.00	PD,CF	17.4	1215	12,248
C	15	575.07	5.32		CF,R6	28.9	1215	200,059
C1	10 - 6	112.56	1.11		R6,LR,R16	24.9	1825	50,646
C1a	8	34.19	2.22		R6	25.7	1125	9,243
C2	10 - 8	178.15	4.20		R2,R6 LR,PD	22.9	1625	64,731
C3	6	402.39	0.00	8.90	AH,R2 R6,LR	15.7	1525	94,211
C3a	8 - 6	203.85	0.00			45.9	1225	114,620
C3b	8	2163.04	0.00	2128.00	CF,LR R32,OC	99.0	2575	89,326
C3b1	8	44.98	0.00		R6	18.4	1125	9,311
C4	*	700.26	194.77	310.00	LR,PD,CF	14.6	2125	60,651
D	*	529.23	25.47		FORT GATES	5.5	1175	32,347
D1	*	106.00	0.00		FORT GATES	6.9	1175	8,594
D2	*	507.19	27.31		FORT GATES	5.2	1175	29,321
D3	*	247.86	8.49		FORT GATES	10.6	1175	29,814
D4	*	621.94	136.55		R16,LR,FT.G	9.8	1175	55,893
D4a	*	567.78	56.00		FORT GATES	8.2	1175	49,310
D5	*	800.04	34.90		R6,FT.GATES	4.4	1175	39,558
D5a	*	176.48	0.00		FORT GATES	4.3	1175	8,917

-------------FORT GATES = 253,752

TOTAL = 2,815,506 GATESVILLE = 1,161,244

TDC = 1,400,510

*PROPOSED

GATESVILLE REGIONAL WASTEWATER STUDY - DESIGN YEAR 2020

AREA	LINE SIZE	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	LAND USE	% MAXIMUM DEVELOPED	G/A/D	AVERAGE DAILY FLOWS
A	*	1477.04	38.77	680.00		96.9	1225	900,085
A1	18	206.38	45.05		R16	29.0	1250	58,482
A2	15	777.00	30.99	5.00	R2	98.1	825	599,718
A2a	*	114.19	66.90	5.00		14.5	1110	6,807
A2b	*	363.41	64.00	170.00		14.2	1150	21,133
A2c	6	96.98	27.92		R2	29.8	1150	23,667
A3	8	21.57	21.27		R6	99.0	1150	342
A4	8 - 6	290.40	42.09	120.00		11.6	1200	17,861
A4a	*	293.67	11.08	200.00	R2	12.2	1250	12,595
A5	*	492.00	96.61	310.00	R6	11.4	1250	12,168
A6	*	272.27	8.19	116.00		12.6	1125	20,990
A7	*	665.29	0.00	602.00		11.9	2750	20,712
A8	*	1103.08	0.00	1020.00		11.9	2750	27,188
B	18-12-8	865.01	255.59		R6,G1,CF	20.1	1650	202,114
B1	10	107.39	12.41		G1,LR CF,GB LR,R16	20.4	2250	43,596
B2	8	30.28	0.50		R16,GB	23.8	2200	15,593
B3	10	53.33	4.65		R16,GB	26.7	2200	28,595
B4	18	46.65	0.00		R16	15.5	1450	10,451
B5	*	430.60	0.50	330.00		18.1	800	14,494
B6	*	321.81	13.74	230.00	PD,CF	19.8	1240	19,168
C	15	575.07	5.32		R2,R6	30.2	1240	213,360
C1	10 - 6	112.56	1.11		R6,LR,R16	26.2	1850	54,020
C1a	8	34.19	2.22		R6	27.4	1150	10,074
C2	10 - 8	178.15	4.20		LR,R2	23.9	1650	68,597
C3	6	402.39	0.00	6.70	PO,R6 AH,R2 LR,R6	17.5	1550	107,331
C3a	8 - 6	203.65	0.00			46.8	1250	119,135
C3b	8	2163.04	0.00	2122.00	CF,LR OC,R32	99.0	2600	105,637
C3b1	8	44.98	0.00		R6	19.3	1150	9,983
C4	*	700.26	194.77	300.00	LR,PD,CF	16.3	2150	72,084
D	*	529.23	25.47		FORT GATES	7.4	1200	44,734
D1	*	106.00	0.00		FORT GATES	9.3	1200	11,830
D2	*	507.19	27.31		FORT GATES	7.9	1200	45,493
D3	*	247.86	8.49		FORT GATES	12.2	1200	35,044
D4	*	621.94	136.55		R16,LR,FT.G	11.7	1200	68,298
D4a	*	567.78	56.00		FORT GATES	9.4	1200	57,729
D5	*	800.04	34.90		FORT GATES	6.0	1200	55,090
D5a	*	176.48	0.00		R6,FT.GATES	6.0	1200	12,707

-------------FORT GATES = 330,924

TOTAL = 3,146,902 GATESVILLE = 1,316,175

TDC = 1,499,803

*PROPOSED

GATESVILLE REGIONAL WASTEWATER - DESIGN YEAR 2030

AREA	LINE SIZE(IN)	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	LAND USE	% MAXIMUM DEVELOPED	G/A/D	AVERAGE DAILY FLOWS
A	*	1447.04	38.77	555.00		95.7	1250	1,020,724
A1	18	206.38	45.05		R16	32.2	1300	67,533
A2	15	777.00	30.99	10.00	CF,R2	97.8	945	680,228
A2a	*	114.19	66.90	3.00		16.4	1160	8,426
A2b	*	363.41	64.00	145.00		16.8	1200	31,129
A2c	6	96.98	27.92		R2	31.4	1200	26,022
A3	8	21.57	21.27		R6	99.0	1200	356
A4	6	290.40	42.09	95.00		14.3	1250	27,404
A4a	*	293.67	11.08	175.00	R2	15.6	1300	21,819
A5	*	492.00	96.61	285.00	R6	14.4	1300	20,665
A6	*	272.27	8.19	90.00		15.7	1175	32,113
A7	*	665.29	0.00	577.00		14.1	2760	34,359
A8	*	1103.08	0.00	990.00		14.8	2760	46,191
B	18-12-8	865.01	255.59		CF,G1,R6 GB,LR	22.7	1700	235,175
B1	10	107.39	12.41		CF,GB LR,R16	22.4	2300	48,934
B2	8	30.28	0.50		R16,GB	26.9	2250	18,024
B3	10	53.33	4.65		R16,GB	29.1	2250	31,873
B4	18	46.65	0.00		R16	17.6	1500	12,316
B5	*	430.60	0.50	310.00		21.5	850	21,948
B6	*	321.81	13.74	210.00	CF,PD	20.6	1290	26,014
C	15 - 10	575.07	5.32		CF.R6	32.8	1290	241,355
C1	10 - 6	112.56	1.11		R6,LR,R16	28.7	1900	60,774
C1a	8	34.19	2.22		R6	29.6	1200	11,356
C2	10 - 8	178.15	4.20		LR,R2 PO,R6	25.7	1700	75,999
C3	6	402.39	0.00	5.20	AH,LR R2,R6	19.6	1600	124,559
C3a	8 - 6	203.85	0.00			48.2	1300	127,732
C3b	8	2163.04	0.00	2117.00	CF,LR OC,R32	99.0	2650	120,786
C3b1	8	44.98	0.00		R6	23.7	1200	12,792
C4	*	700.26	194.77	280.00	LR,PD,CF	22.0	2200	109,137
D	*	529.23	25.47		FORT GATES	9.9	1225	61,093
D1	*	106.00	0.00		FORT GATES	13.6	1225	17,660
D2	*	507.19	27.31		FORT GATES	10.2	1225	59,761
D3	*	247.86	8.49		FORT GATES	14.6	1225	42,811
D4	*	621.94	136.55		R16,LR,FT.	13.9	1225	82,650
D4a	*	567.78	56.00		FORT GATES	11.3	1225	70,843
D5	*	800.04	34.90		R6,FT.GATE	8.6	1225	80,607
D5a	*	176.48	0.00		FORT GATES	7.5	1225	16,214

TOTALS ------------FORT GATES = 431,640

3,727,384 GATESVILLE = 1,594,792

TDC = 1,700,952

*PROPOSED

APPENDIX B

EXPLANATION OF NOTATIONS

(1) A small case letter followed by a number, (b 6), tracks a main interceptor as collectors tie into it.

(2) A prime, (A2'), designation tracks addition of collectors as they lead to a main interceptor.

(3) A capitol letter with a number, (A8), indicates the beginning of the main interceptor route, the furthest from a treatment plant, either existing or proposed.

(4) A capitol letter with a number followed by a number, (C1 1), indicates additive flows along a collector similar to the prime designation.

(5) A capitol letter with a number and a small case letter, (C3b), indicates several branches of collectors at a point.

(6) The following collectors are the same for all three alternatives and flows for these collectors are base on 85% of maximum population densities: A2a, A2b, A4a, A5, A6, A7, A8, B5, D4a, D5, D5a.

CITY OF GATESVILLE AND CITY OF FORT GATES

DRAFT
1-23-89

3 PLANT SCENARIO - 2030 FLOWS

NTCPTR	CONTRIBUTING FLOWS	TOTAL GALLONS PER DAY	PEAK FACTOR	PEAK FLOW	LINE SIZE (INCHES)	GRADE (PERCENT)
A		1,020,724	2.5	2,551,811	15	(0.14-0.5)
a 1	= A + A8	1,066,915	2.5	2,667,288	15	(0.19-0.55)
a 2	= a 1 + A7	1,101,274	2.5	2,753,185	15	(0.19-0.55)
a 3	= a 2 + A6	1,133,388	2.5	2,833,469	15	(0.19-0.55)
a 4	= a 3 + A5	1,154,053	2.5	2,885,131	15	(0.2-0.6)
A4	= A4a + A4	49,223	4.0	196,894	8	0.33
a 5	= a 4 + A4	1,181,457	2.5	2,953,642	15	(0.2-0.6)
a 6	= a 5 + A3	1,181,813	2.5	2,954,533	15	(0.2-0.6)
A2'	= A2 + A2c	706,250	3.0	2,118,749	15	(0.2-0.6)
A2"	= A2' + A2b	737,379	3.0	2,212,136	15	(0.2-0.6)
A2"'	= A2" + A2a	745,804	3.0	2,237,413	15	(0.2-0.6)
a 7	= a 6 + A2"'	1,927,617	2.5	4,819,044	18	(0.5-1.4)
a 8	= a 7 + A1	1,995,150	2.5	4,987,876	18	(0.53-1.41)
B		235,175	3.5	823,113	8	0.33
B6		26,014	4.0	104,057	8	0.33
b 1	= B + B6	261,189	3.5	914,163	12	(0.19-0.43)
b 2	=.33B+B5+b 1	360,746	3.5	1,262,610	12	(0.3-0.8)
b 3	= b 2 + B4	373,061	3.5	1,305,714	12	(0.31-0.82)
b 4	=b 3+B3+.33B	482,542	3.5	1,688,898	15	(0.18-0.53)
b 5	= b 4 + B2	500,567	3.5	1,751,983	15	(0.18-0.53)

b 6	= b 5 + B1	549,500	3.5	1,923,251	15	(0.22-0.7)
C4		109,137	3.5	381,980	8	0.33
c 1	= .25C + C4	169,476	3.5	593,166	10	(0.25-0.56)
C3b 1	= C3b1 + C3b	133,578	3.5	467,524	10	(0.25-0.37)
C3 1	= C3b 1 + C3	258,137	3.5	903,480	12	(0.19-0.41)
C3 2	= C3a + C3 1	385,869	3.5	1,350,543	15	(0.14-0.35)
c 2	= C3 1 + c 1	427,613	3.5	1,496,646	15	(0.14-0.42)
c 3	= C2 + c 2	503,612	3.5	1,762,641	15	(0.18-0.6)
C1 1	= C1+.5C+C1a	192,807	3.5	674,825	10	(0.25-0.75)
c 4	= c 3 + C1 1	696,419	3.0	2,089,256	15	(0.26-0.85)
D1		17,660	4.0	70,638	6	0.54
d 1	= .25D + D1	32,933	4.0	131,732	6	0.54
D2		59,761	4.0	239,045	8	0.33
d 2	= d 1 + D2	92,694	4.0	370,776	8	0.33
D3		42,811	4.0	171,245	6	0.54
d 3	=.25D+d 2+D3	150,779	3.5	527,726	10	0.25
D4	= D4 + D4a	153,493	3.5	537,225	10	0.25
d 4	= d 3 + D4	304,272	3.5	1,064,951	12	0.19
D5 1	= D5 + D5a	96,822	4.0	387,286	10	0.25

CITY OF GATESVILLE AND CITY OF FORT GATES

DRAFT 2 PLANT SCENARIO - 2030 FLOWS

1-23-89

NTCPTR	CONTRIBUTING FLOWS	TOTAL GALLONS PER DAY	PEAK FACTOR	PEAK FLOW	LINE SIZE (INCHES)	GRADE (PERCENT)
A		1,020,724	2.5	2,551,811	15	(0.14-0.5)
a 1	= A + A8	1,066,915	2.5	2,667,288	15	(0.19-0.55)
a 2	= a 1 + A7	1,101,274	2.5	2,753,185	15	(0.19-0.55)
a 3	= a 2 + A6	1,133,388	2.5	2,833,469	15	(0.19-0.55)
a 4	= a 3 + A5	1,154,053	2.5	2,885,131	15	(0.2-0.6)
A4	= A4a + A4	49,223	4.0	196,894	8	0.33
a 5	= a 4 + A4	1,181,457	2.5	2,953,642	15	(0.2-0.6)
a 6	= a 5 + A3	1,181,813	2.5	2,954,533	15	(0.2-0.6)
A2'	= A2 + A2c	706,250	3.0	2,118,749	15	(0.2-0.6)
A2"	= A2' + A2b	737,379	3.0	2,212,136	15	(0.2-0.6)
A2"'	= A2" + A2a	745,804	3.0	2,237,413	15	(0.2-0.6)
a 7	= a 6 + A2"'	1,927,617	2.5	4,819,044	18	(0.5-1.4)
a 8	= a 7 + A1	1,995,150	2.5	4,987,876	18	(0.53-1.4)
B		235,175	3.5	823,113	8	0.33
B6		26,014	4.0	104,057	8	0.33
B4	= B4 + a 8	2,007,466	2.5	5,018,665	21	(0.24-0.55)
b 1	= B + B6	261,189	3.5	914,163	12	(0.19-0.41)
b 2	=.33B+B5+b 1	360,746	3.5	1,262,610	12	(0.19-0.41)
b 3	= b 2+B4+a 8	2,368,211	2.5	5,920,528	21	(0.24-0.55)
b 4	=b 3+B3+.33B	2,477,692	2.5	6,194,231	21	(0.24-0.55)

b 5	= b 4 + B2	2,495,717	2.5	6,239,292	24	(0.18-0.35)
b 6	= b 5 + B1	2,544,650	2.5	6,361,626	24	(0.18-0.35)
C4		109,137	3.5	381,980	8	0.33
c 1	= .25C + C4	169,476	3.5	593,166	10	(0.25-0.58)
C3b 1	= C3b1 + C3b	133,578	3.5	467,524	8	0.33
C3 1	= C3b 1 + C3	258,137	3.5	903,480	12	(0.19-0.41)
C3 2	= C3a + C3 1	385,869	3.5	1,350,543	15	(0.14-0.35)
c 2	= C3 1 + c 1	427,613	3.5	1,496,646	15	(0.14-0.35)
c 3	= C2 + c 2	503,612	3.0	1,510,835	15	(0.14-0.35)
C1 1	= C1+.5C+C1a	192,807	3.5	674,825	10	(0.25-0.75)
c 4	= c 3 + C1 1	696,419	3.0	2,089,256	15	(0.26-0.85)
D1		17,660	4.0	70,638	6	0.54
d 1	= .25D + D1	32,933	4.0	131,732	6	0.54
D2		59,761	4.0	239,045	8	0.33
d 2	= d 1 + D2	92,694	4.0	370,776	8	0.33
D3		42,811	4.0	171,245	6	0.54
d 3	=.25D+d 2+D3	150,779	3.5	527,726	10	0.25
D4	= D4 + D4a	153,493	3.5	537,225	10	0.25
d 4	= d 3 + D4	304,272	3.5	1,064,951	12	0.19
D5 1	= D5 + D5a	96,822	4.0	387,286	10	0.25

CITY OF GATESVILLE AND CITY OF FORT GATES

DRAFT
1-23-89

1 PLANT SCENARIO - 2030 FLOWS

NTCPTR	CONTRIBUTING FLOWS	TOTAL GALLONS PER DAY	PEAK FACTOR	PEAK FLOW	LINE SIZE (INCHES)	GRADE (PERCENT)
A		1,020,724	2.5	2,551,811	15	(0.14-0.5)
a 1	= A + A8	1,066,915	2.5	2,667,288	15	(0.19-0.55)
a 2	= a 1 + A7	1,101,274	2.5	2,753,185	15	(0.19-0.55)
a 3	= a 2 + A6	1,133,388	2.5	2,833,469	15	(0.19-0.55)
a 4	= a 3 + A5	1,154,053	2.5	2,885,131	15	(0.19-0.55)
A4	= A4a + A4	49,223	4.0	196,894	8	0.33
a 5	= a 4 + A4	1,181,457	2.5	2,953,642	15	(0.2-0.6)
a 6	= a 5 + A3	1,181,813	2.5	2,954,533	15	(0.2-0.6)
A2'	= A2 + A2c	706,250	3.0	2,118,749	15	(0.2-0.6)
A2"	= A2' + A2b	737,379	3.0	2,212,136	15	(0.2-0.6)
A2"'	= A2" + A2a	745,804	3.0	2,237,413	15	(0.2-0.6)
a 7	= a 6 + A2"'	1,927,617	2.5	4,819,044	18	(0.5-1.4)
a 8	= a 7 + A1	1,995,150	2.5	4,987,876	18	(0.53-1.41)
B		235,175	3.5	823,113	8	0.33
B6		26,014	4.0	104,057	8	0.33
B4	= B4 + a 8	2,007,466	2.5	5,018,665	21	(0.26-0.56)
b 1	= B + B6	261,189	3.5	914,163	12	(0.19-0.41)
b 2	=.33B+B5+b 1	360,746	3.5	1,262,610	15	(0.14-0.5)
b 3	= b 2+B4+a 8	2,368,211	2.5	5,920,528	21	(0.26-0.56)
b 4	=b 3+B3+.33B	2,477,692	2.5	6,194,231	21	(0.35-0.8)

b 5	= b 4 + B2	2,495,717	2.5	6,239,292	24	(0.28-0.52)
b 6	= b 5 + B1	2,544,650	2.5	6,361,626	24	(0.28-0.52)
C4		109,137	3.5	381,980	8	0.33
c 1	= .25C + C4	169,476	3.5	593,166	10	(0.25-0.58)
C3b 1	= C3b1 + C3b	133,578	3.5	467,524	8	0.33
C3 1	= C3b 1 + C3	258,137	3.5	903,480	12	(0.19-0.41)
C3 2	= C3a + C3 1	385,869	3.5	1,350,543	15	(0.14-0.35)
c 2	= C3 1 + c 1	427,613	3.5	1,496,646	15	(0.14-0.43)
c 3	= C2 + c 2	503,612	3.0	1,510,835	15	(0.14-0.43)
C1 1	= C1+.5C+C1a	192,807	3.5	674,825	10	(0.25-0.75)
c 4	= c 3 + C1 1	696,419	3.0	2,089,256	18	(0.11-0.23)
C	= C4 + b 6	3,350,206	2.5	8,375,516	24	(0.32-0.65)
C'	L.S. & F.M	3,350,206	2.5	8,375,516	20	5860 gpm LIFT STATION
D1		17,660	4.0	70,638	6	0.54
d 1	=.25D+ D1+ C	3,383,139	2.5	8,457,848	24	(0.35-0.8)
D2		59,761	4.0	239,045	8	0.33
d 2	= d 1 + D2	3,442,901	2.5	8,607,251	24	(0.35-0.8)
D3		42,811	4.0	171,245	6	0.54
d 3	=.25D+d 2+D3	3,500,985	2.5	8,752,463	24	(0.35-0.8)
D4	= D4 + D4a	153,493	3.5	537,225	10	0.25
d 4	= d 3 + D4	3,654,478	2.5	9,136,195	24	(0.35-0.8)
D5 1	= D5 + D5a	96,822	4.0	387,286	10	0.25

CITY OF GATESVILLE AND CITY OF FORT GATES

ALL PLANT SCENARIOS AT 85% MAXIMUM DEVELOPMENT FLOWS

NTCPTR	TOTAL GALLON PER DAY	PEAK FACTOR	PEAK FLOW	LINE SIZE (INCHES)	GRADE (PERCENT)
A2a	46,628	4.0	186,512	6	(0.54-0.67)
A2b	157,498	4.0	629,993	10	(0.25-0.65)
A4a	118,887	4.0	475,548	8	(0.40-1.70)
A5	121,981	4.0	487,924	8	(0.40-1.70)
A6	173,862	4.0	695,450	10	(0.25-0.80)
A7	207,128	4.0	828,513	10	(0.25-1.15)
A8	265,286	4.0	1,061,143	12	(0.23-0.60)
B5	86,772	4.0	347,089	8	(0.33-0.95)
D4a	272,578	4.0	1,090,314	12	(0.23-0.60)
D5	380,202	4.0	1,520,808	15	(0.14-0.44)
D5a	147,316	4.0	589,264	10	(0.25-0.60)

AREA	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	% MAXIMUM DEVELOPED	G/A/D	AVERAGE DAILY FLOWS
A2a	114.19	66.90	0	85.0	1160	46,628
A2b	363.41	64.00	145	85.0	1200	157,498
A4a	293.67	11.08	175	85.0	1300	118,887
A5	492.00	96.61	285	85.0	1300	121,981
A6	272.27	8.19	90	85.0	1175	173,862
A7	665.29	0.00	577	85.0	2760	207,128
A8	1103.08	0.00	990	85.0	2760	265,286
B5	430.60	0.50	310	85.0	850	86,772
D4a	567.78	56.00	250	85.0	1225	272,578
D5	800.04	34.90	400	85.0	1225	380,202
D5a	176.48	0.00	35	85.0	1225	147,316

AREA	LINE SIZE(IN)	TOTAL ACRES	FLOOD PLAIN	ADDITIONAL UNDEV.AREA	LAND USE	% MAXIMUM DEVELOPED	G/A/D	DAILY FLOWS
A	*	1447.04	38.77	555		95.7	1250	1,020,724
A1	18	206.38	45.05		R16	32.2	1300	67,533
A2	15	777	30.99	10	CF,R2	97.8	945	680,228
A2a	*	114.19	66.9	3		16.4	1160	8,426
A2b	*	363.41	64	145		16.8	1200	31,129
A2c	6	96.98	27.92		R2	31.4	1200	26,022
A3	8	21.57	21.27		R6	99.0	1200	356
A4	6	290.4	42.09	95		14.3	1250	27,404
A4a	*	293.67	11.08	175	R2	15.6	1300	21,819
A5	*	492	96.61	285	R6	14.4	1300	20,665
A6	*	272.27	8.19	90		15.7	1175	32,113
A7	*	665.29	0	577		14.1	2760	34,359
A8	*	1103.08	0	990		14.8	2760	46,191
B	18-12-8	865.01	255.59		CF,G1,R6	22.7	1700	235,175
					GB,LR			
B1	10	107.39	12.41		CF,GB	22.4	2300	48,934
					LR,R16			
B2	8	30.28	0.5		R16,GB	26.9	2250	18,024
B3	10	53.33	4.65		R16,GB	29.1	2250	31,873
B4	18	46.65	0		R16	17.6	1500	12,316
B5	*	430.6	0.5	310		21.5	850	21,948
B6	*	321.81	13.74	210	CF,PD	20.6	1290	26,014
C	15 - 10	575.07	5.32		CF.R6	32.8	1290	241,355
C1	10 - 6	112.56	1.11		R6,LR,R16	28.7	1900	60,774
C1a	8	34.19	2.22		R6	29.6	1200	11,356
C2	10 - 8	178.15	4.2		LR,R2	25.7	1700	75,999
					PO,R6			
C3	6	402.39	0	5.2	AH,LR	19.6	1600	124,559
					R2,R6			
C3a	8 - 6	203.85	0			48.2	1300	127,732
C3b	8	2163.04	0	2117	CF,LR	99.0	2650	120,786
					OC,R32			
C3b1	8	44.98	0		R6	23.7	1200	12,792
C4	*	700.26	194.77	280	LR,PD,CF	22.0	2200	109,137
D	*	529.23	25.47		FORT GATE	9.9	1225	61,093
D1	*	106	0		FORT GATE	13.6	1225	17,660
D2	*	507.19	27.31		FORT GATE	10.2	1225	59,761
D3	*	247.86	8.49		FORT GATE	14.6	1225	42,811
D4	*	621.94	136.55		R16,LR,FT	13.9	1225	82,650
D4a	*	567.78	56		FORT GATE	11.3	1225	70,843
D5	*	800.04	34.9		R6,FT.GAT	8.6	1225	80,607
D5a	*	176.48	0		FORT GATE	7.5	1225	16,214

*PROPOSED

TOTALS ---------------------------

2,026,432 FORT GATES = 431,640

GATESVILLE = 1,594,792

APPENDIX C

DRAFT
3-07-89

CITY OF GATESVILLE

ENGINEERING ESTIMATE (3 PLANT SCENARIO)

INTERCEPT	QUANT	UNIT	DESCRIPTION	PRICE	TOTAL
A			SANITARY SEWER		
	27,000	L.F.	15" SAN. SEWER	20.00	$540,000.00
	1,000	L.F.	18" SAN. SEWER	25.00	$25,000.00
	300	L.F.	BORE AND CASE	1000.00	$300,000.00
	1,000	L.F.	24" SAN. SEWER	30.00	$30,000.00
	30,000	L.F.	TRENCH SAFETY SYSTEM	1.00	$30,000.00
	40	EA.	MANHOLES	1000.00	$40,000.00
			SUBTOTAL - SANITARY SEWER		$965,000.00
A2a			SANITARY SEWER		
	1,200	L.F.	6" SAN. SEWER	10.00	$12,000.00
	1,080	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,080.00
			SUBTOTAL - SANITARY SEWER		$13,080.00
A2b			SANITARY SEWER		
	5,750	L.F.	10" SAN. SEWER	15.00	$86,250.00
	1	EA.	ROAD CROSSINGS	450.00	$450.00
	5,175	L.F.	TRENCH SAFETY SYSTEM	1.00	$5,175.00
			SUBTOTAL - SANITARY SEWER		$91,875.00
A4			SANITARY SEWER		
	1,250	L.F.	8" SAN. SEWER	12.00	$15,000.00
	1,125	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,125.00
			SUBTOTAL - SANITARY SEWER		$16,125.00
A4a			SANITARY SEWER		
	3,000	L.F.	8" SAN. SEWER	12.00	$36,000.00
	300	L.F.	BORE AND CASE	500.00	$150,000.00
	2,700	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,700.00
			SUBTOTAL - SANITARY SEWER		$188,700.00

A5

SANITARY SEWER

8,250	L.F.	8" SAN. SEWER	12.00	$99,000.00
7,425	L.F.	TRENCH SAFETY SYSTEM	1.00	$7,425.00
		SUBTOTAL - SANITARY SEWER		$106,425.00

A6

SANITARY SEWER

8,400	L.F.	10" SAN. SEWER	15.00	$126,000.00
7,560	L.F.	TRENCH SAFETY SYSTEM	1.00	$7,560.00
		SUBTOTAL - SANITARY SEWER		$133,560.00

A7

SANITARY SEWER

4,250	L.F.	10" SAN. SEWER	12.00	$51,000.00
300	L.F.	BORE AND CASE	500.00	$150,000.00
3,825	L.F.	TRENCH SAFETY SYSTEM	1.00	$3,825.00
		SUBTOTAL - SANITARY SEWER		$204,825.00

A8

SANITARY SEWER

5,400	L.F.	12" SAN. SEWER	18.00	$97,200.00
300	L.F.	BORE AND CASE	500.00	$150,000.00
4,860	L.F.	TRENCH SAFETY SYSTEM	1.00	$4,860.00
		SUBTOTAL - SANITARY SEWER		$252,060.00

B

SANITARY SEWER

6,750	L.F.	8" SAN. SEWER	12.00	$81,000.00
6,075	L.F.	TRENCH SAFETY SYSTEM	1.00	$6,075.00
		SUBTOTAL - SANITARY SEWER		$87,075.00

B5

SANITARY SEWER

5,500	L.F.	8" SAN. SEWER	12.00	$66,000.00
4,950	L.F.	TRENCH SAFETY SYSTEM	1.00	$4,950.00
		SUBTOTAL - SANITARY SEWER		$70,950.00

B6

SANITARY SEWER

4,000	L.F.	8" SAN. SEWER	12.00	$48,000.00
3,600	L.F.	TRENCH SAFETY SYSTEM	1.00	$3,600.00
		SUBTOTAL - SANITARY SEWER		$51,600.00

C4

SANITARY SEWER

4,300	L.F.	8" SAN. SEWER	12.00	$51,600.00
3,870	L.F.	TRENCH SAFETY SYSTEM	1.00	$3,870.00
		SUBTOTAL - SANITARY SEWER		$55,470.00

D1

SANITARY SEWER

1,050	L.F.	8" SAN. SEWER	12.00	$12,600.00
945	L.F.	TRENCH SAFETY SYSTEM	1.00	$945.00
		SUBTOTAL - SANITARY SEWER		$13,545.00

D2

SANITARY SEWER

5,300	L.F.	8" SAN. SEWER	12.00	$63,600.00
1	EA.	ROAD CROSSINGS	450.00	$450.00
4,770	L.F.	TRENCH SAFETY SYSTEM	1.00	$4,770.00
		SUBTOTAL - SANITARY SEWER		$68,820.00

D3

SANITARY SEWER

2,350	L.F.	8" SAN. SEWER	12.00	$28,200.00
1	EA.	ROAD CROSSINGS	450.00	$450.00
2,115	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,115.00
		SUBTOTAL - SANITARY SEWER		$30,765.00

D4

SANITARY SEWER

2	EA.	250 G.P.M. LIFT STATION	40000.00	$80,000.00
10,000	L.F.	4" FORCE MAIN	10.00	$100,000.00
3,135	L.F.	8" SAN. SEWER	12.00	$37,620.00
300	L.F.	BORE AND CASE	500.00	$150,000.00
11,822	L.F.	TRENCH SAFETY SYSTEM	1.00	$11,822.00

D4a

SANITARY SEWER

2	EA.	250 G.P.M. LIFT STATION	40000.00	$80,000.00
2,030	L.F.	4" FORCE MAIN	10.00	$20,300.00
3,500	L.F.	10" SAN. SEWER	15.00	$52,500.00
3,150	L.F.	TRENCH SAFETY SYSTEM	1.00	$3,150.00
		SUBTOTAL - SANITARY SEWER		$155,950.00

D5

SANITARY SEWER

1,300	L.F.	15" SAN. SEWER	20.00	$26,000.00
1,170	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,170.00
		SUBTOTAL - SANITARY SEWER		$27,170.00

D5a

SANITARY SEWER

3,250	L.F.	10" SAN. SEWER	15.00	$48,750.00
1	EA.	ROAD CROSSINGS	450.00	$450.00
2,925	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,925.00
		SUBTOTAL - SANITARY SEWER		$52,125.00

D5 1

SANITARY SEWER

1,800	L.F.	10" SAN. SEWER	15.00	$27,000.00
1	EA.	250 G.P.M. LIFT STATION	40000.00	$40,000.00
1,300	L.F.	4" FORCE MAIN	10.00	$13,000.00
2,790	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,790.00
		SUBTOTAL - SANITARY SEWER		$82,790.00

D

SANITARY SEWER

11,500	L.F.	8" SAN. SEWER	12.00	$138,000.00
10,350	L.F.	TRENCH SAFETY SYSTEM	1.00	$10,350.00
		SUBTOTAL - SANITARY SEWER		$148,350.00

TOTAL $3,015,702.00

DRAFT
3-07-89

CITY OF GATESVILLE

ENGINEERING ESTIMATE (2 PLANT SCENARIO)

INTERCEPT	QUANT	UNIT	DESCRIPTION	PRICE	TOTAL
A			SANITARY SEWER		
	27,000	L.F.	15" SAN. SEWER	20.00	$540,000.00
	1,000	L.F.	18" SAN. SEWER	25.00	$25,000.00
	300	L.F.	BORE AND CASE	1000.00	$300,000.00
	11,800	L.F.	24" SAN. SEWER	30.00	$354,000.00
	41,172	L.F.	TRENCH SAFETY SYSTEM	1.00	$41,172.00
	40	EA.	MANHOLES	1000.00	$40,000.00
			SUBTOTAL - SANITARY SEWER		$1,300,172.00
A2a			SANITARY SEWER		
	1,200	L.F.	6" SAN. SEWER	10.00	$12,000.00
	1,080	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,080.00
			SUBTOTAL - SANITARY SEWER		$13,080.00
A2b			SANITARY SEWER		
	5,750	L.F.	10" SAN. SEWER	15.00	$86,250.00
	1	EA.	ROAD CROSSINGS	450.00	$450.00
	5,175	L.F.	TRENCH SAFETY SYSTEM	1.00	$5,175.00
			SUBTOTAL - SANITARY SEWER		$91,875.00
A4			SANITARY SEWER		
	1,250	L.F.	8" SAN. SEWER	12.00	$15,000.00
	1,125	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,125.00
			SUBTOTAL - SANITARY SEWER		$16,125.00
A4a			SANITARY SEWER		
	3,000	L.F.	8" SAN. SEWER	12.00	$36,000.00
	300	L.F.	BORE AND CASE	500.00	$150,000.00
	2,700	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,700.00
			SUBTOTAL - SANITARY SEWER		$188,700.00

A5

SANITARY SEWER

8,250 L.F.	8" SAN. SEWER	12.00	$99,000.00
7,425 L.F.	TRENCH SAFETY SYSTEM	1.00	$7,425.00
	SUBTOTAL - SANITARY SEWER		$106,425.00

A6

SANITARY SEWER

8,400 L.F.	10" SAN. SEWER	15.00	$126,000.00
7,560 L.F.	TRENCH SAFETY SYSTEM	1.00	$7,560.00
	SUBTOTAL - SANITARY SEWER		$133,560.00

A7

SANITARY SEWER

4,250 L.F.	10" SAN. SEWER	15.00	$63,750.00
300 L.F.	BORE AND CASE	500.00	$150,000.00
3,825 L.F.	TRENCH SAFETY SYSTEM	1.00	$3,825.00
	SUBTOTAL - SANITARY SEWER		$217,575.00

A8

SANITARY SEWER

5,400 L.F.	12" SAN. SEWER	18.00	$97,200.00
300 L.F.	BORE AND CASE	500.00	$150,000.00
4,860 L.F.	TRENCH SAFETY SYSTEM	1.00	$4,860.00
	SUBTOTAL - SANITARY SEWER		$252,060.00

B

SANITARY SEWER

6,750 L.F.	8" SAN. SEWER	12.00	$81,000.00
6,075 L.F.	TRENCH SAFETY SYSTEM	1.00	$6,075.00
	SUBTOTAL - SANITARY SEWER		$87,075.00

B5

SANITARY SEWER

5,500 L.F.	6" SAN. SEWER	10.00	$55,000.00
4,950 L.F.	TRENCH SAFETY SYSTEM	1.00	$4,950.00
	SUBTOTAL - SANITARY SEWER		$59,950.00

B6

SANITARY SEWER

4,000 L.F.	8" SAN. SEWER	12.00	$48,000.00
3,600 L.F.	TRENCH SAFETY SYSTEM	1.00	$3,600.00
	SUBTOTAL - SANITARY SEWER		$51,600.00

C4

SANITARY SEWER

4,300 L.F.	8" SAN. SEWER	12.00	$51,600.00
3,870 L.F.	TRENCH SAFETY SYSTEM	1.00	$3,870.00
	SUBTOTAL - SANITARY SEWER		$55,470.00

D1

SANITARY SEWER

1,050 L.F.	8" SAN. SEWER	12.00	$12,600.00
945 L.F.	TRENCH SAFETY SYSTEM	1.00	$945.00
	SUBTOTAL - SANITARY SEWER		$13,545.00

D2

SANITARY SEWER

5,300 L.F.	8" SAN. SEWER	12.00	$63,600.00
1 EA.	ROAD CROSSINGS	450.00	$450.00
4,770 L.F.	TRENCH SAFETY SYSTEM	1.00	$4,770.00
	SUBTOTAL - SANITARY SEWER		$68,820.00

D3

SANITARY SEWER

2,350 L.F.	8" SAN. SEWER	12.00	$28,200.00
1 EA.	ROAD CROSSINGS	450.00	$450.00
2,115 L.F.	TRENCH SAFETY SYSTEM	1.00	$2,115.00
	SUBTOTAL - SANITARY SEWER		$30,765.00

D4

SANITARY SEWER

2 EA.	250 G.P.M. LIFT STATION	40000.00	$80,000.00
10,000 L.F.	4" FORCE MAIN	10.00	$100,000.00
3,135 L.F.	8" SAN. SEWER	12.00	$37,620.00
300 L.F.	BORE AND CASE	500.00	$150,000.00
11,822 L.F.	TRENCH SAFETY SYSTEM	1.00	$11,822.00
	SUBTOTAL - SANITARY SEWER		$199,442.00

D4a

SANITARY SEWER

2	EA.	250 G.P.M. LIFT STATION	40000.00	$80,000.00
2,030	L.F.	4" FORCE MAIN	10.00	$20,300.00
3,500	L.F.	10" SAN. SEWER	15.00	$52,500.00
3,150	L.F.	TRENCH SAFETY SYSTEM	1.00	$3,150.00
		SUBTOTAL - SANITARY SEWER		$155,950.00

D5

SANITARY SEWER

1,300	L.F.	15" SAN. SEWER	20.00	$26,000.00
1,170	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,170.00
		SUBTOTAL - SANITARY SEWER		$27,170.00

D5a

SANITARY SEWER

3,250	L.F.	10" SAN. SEWER	15.00	$48,750.00
1	EA.	ROAD CROSSINGS	450.00	$450.00
2,925	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,925.00
		SUBTOTAL - SANITARY SEWER		$52,125.00

D5 1

SANITARY SEWER

1,800	L.F.	10" SAN. SEWER	15.00	$27,000.00
1	EA.	250 G.P.M. LIFT STATION	40000.00	$40,000.00
1,300	L.F.	4" FORCE MAIN	10.00	$13,000.00
2,790	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,790.00
		SUBTOTAL - SANITARY SEWER		$82,790.00

D

SANITARY SEWER

11,500	L.F.	8" SAN. SEWER	12.00	$138,000.00
10,350	L.F.	TRENCH SAFETY SYSTEM	1.00	$10,350.00
		SUBTOTAL - SANITARY SEWER		$148,350.00

TOTAL	$3,352,624.00

DRAFT
3-07-89

CITY OF GATESVILLE

ENGINEERING ESTIMATE (1 PLANT SCENARIO)

INTERCEPT	QUANT	UNIT	DESCRIPTION	PRICE	TOTAL
A			SANITARY SEWER		
	27,000	L.F.	15" SAN. SEWER	20.00	$540,000.00
	1,000	L.F.	18" SAN. SEWER	25.00	$25,000.00
	300	L.F.	BORE AND CASE	1000.00	$300,000.00
	11,800	L.F.	24" SAN. SEWER	30.00	$354,000.00
	41,172	L.F.	TRENCH SAFETY SYSTEM	1.00	$41,172.00
	40	EA.	MANHOLES	1000.00	$40,000.00
			SUBTOTAL - SANITARY SEWER		$1,300,172.00
A2a			SANITARY SEWER		
	1,200	L.F.	6" SAN. SEWER	10.00	$12,000.00
	1,080	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,080.00
			SUBTOTAL - SANITARY SEWER		$13,080.00
A2b			SANITARY SEWER		
	5,750	L.F.	10" SAN. SEWER	15.00	$86,250.00
	1	EA.	ROAD CROSSINGS	450.00	$450.00
	5,175	L.F.	TRENCH SAFETY SYSTEM	1.00	$5,175.00
			SUBTOTAL - SANITARY SEWER		$91,875.00
A4			SANITARY SEWER		
	1,250	L.F.	8" SAN. SEWER	12.00	$15,000.00
	1,125	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,125.00
			SUBTOTAL - SANITARY SEWER		$16,125.00
A4a			SANITARY SEWER		
	3,000	L.F.	8" SAN. SEWER	12.00	$36,000.00
	300	L.F.	BORE AND CASE	500.00	$150,000.00
	2,700	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,700.00
			SUBTOTAL - SANITARY SEWER		$188,700.00

A5

SANITARY SEWER

8,250 L.F.	8" SAN. SEWER	12.00	$99,000.00
7,425 L.F.	TRENCH SAFETY SYSTEM	1.00	$7,425.00
	SUBTOTAL - SANITARY SEWER		$106,425.00

A6

SANITARY SEWER

8,400 L.F.	10" SAN. SEWER	15.00	$126,000.00
7,560 L.F.	TRENCH SAFETY SYSTEM	1.00	$7,560.00
	SUBTOTAL - SANITARY SEWER		$133,560.00

A7

SANITARY SEWER

4,250 L.F.	10" SAN. SEWER	15.00	$63,750.00
300 L.F.	BORE AND CASE	500.00	$150,000.00
3,825 L.F.	TRENCH SAFETY SYSTEM	1.00	$3,825.00
	SUBTOTAL - SANITARY SEWER		$217,575.00

A8

SANITARY SEWER

5,400 L.F.	12" SAN. SEWER	18.00	$97,200.00
300 L.F.	BORE AND CASE	500.00	$150,000.00
4,860 L.F.	TRENCH SAFETY SYSTEM	1.00	$4,860.00
	SUBTOTAL - SANITARY SEWER		$252,060.00

B

SANITARY SEWER

6,750 L.F.	8" SAN. SEWER	12.00	$81,000.00
6,075 L.F.	TRENCH SAFETY SYSTEM	1.00	$6,075.00
	SUBTOTAL - SANITARY SEWER		$87,075.00

B5

SANITARY SEWER

5,500 L.F.	8" SAN. SEWER	12.00	$66,000.00
4,950 L.F.	TRENCH SAFETY SYSTEM	1.00	$4,950.00
	SUBTOTAL - SANITARY SEWER		$70,950.00

B6

SANITARY SEWER

4,000 L.F.	8" SAN. SEWER	12.00	$48,000.00
3,600 L.F.	TRENCH SAFETY SYSTEM	1.00	$3,600.00
	SUBTOTAL - SANITARY SEWER		$51,600.00

C4

SANITARY SEWER

4,300 L.F.	8" SAN. SEWER	12.00	$51,600.00
3,870 L.F.	TRENCH SAFETY SYSTEM	1.00	$3,870.00
	SUBTOTAL - SANITARY SEWER		$55,470.00

D1

SANITARY SEWER

1,050 L.F.	8" SAN. SEWER	12.00	$12,600.00
945 L.F.	TRENCH SAFETY SYSTEM	1.00	$945.00
	SUBTOTAL - SANITARY SEWER		$13,545.00

D2

SANITARY SEWER

5,300 L.F.	8" SAN. SEWER	12.00	$63,600.00
1 EA.	ROAD CROSSINGS	450.00	$450.00
4,770 L.F.	TRENCH SAFETY SYSTEM	1.00	$4,770.00
	SUBTOTAL - SANITARY SEWER		$68,820.00

D3

SANITARY SEWER

2,350 L.F.	8" SAN. SEWER	12.00	$28,200.00
1 EA.	ROAD CROSSINGS	450.00	$450.00
2,115 L.F.	TRENCH SAFETY SYSTEM	1.00	$2,115.00
	SUBTOTAL - SANITARY SEWER		$30,765.00

D4

SANITARY SEWER

2	EA.	250 G.P.M. LIFT STATION	40000.00	$80,000.00
10,000	L.F.	4" FORCE MAIN	10.00	$100,000.00
3,135	L.F.	8" SAN. SEWER	12.00	$37,620.00
300	L.F.	BORE AND CASE	500.00	$150,000.00
11,822	L.F.	TRENCH SAFETY SYSTEM	1.00	$11,821.50
		SUBTOTAL - SANITARY SEWER		$199,441.50

D4a

SANITARY SEWER

2	EA.	250 G.P.M. LIFT STATION	40000.00	$80,000.00
2,030	L.F.	4" FORCE MAIN	10.00	$20,300.00
3,500	L.F.	10" SAN. SEWER	15.00	$52,500.00
3,150	L.F.	TRENCH SAFETY SYSTEM	1.00	$3,150.00
		SUBTOTAL - SANITARY SEWER		$155,950.00

D5

SANITARY SEWER

1,300	L.F.	15" SAN. SEWER	20.00	$26,000.00
1,170	L.F.	TRENCH SAFETY SYSTEM	1.00	$1,170.00
		SUBTOTAL - SANITARY SEWER		$27,170.00

D5a

SANITARY SEWER

3,250	L.F.	10" SAN. SEWER	15.00	$48,750.00
1	EA.	ROAD CROSSINGS	450.00	$450.00
2,925	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,925.00
		SUBTOTAL - SANITARY SEWER		$52,125.00

D5 1

SANITARY SEWER

1,800	L.F.	10" SAN. SEWER	15.00	$27,000.00
1	EA.	250 G.P.M. LIFT STATION	40000.00	$40,000.00
1,300	L.F.	4" FORCE MAIN	10.00	$13,000.00
2,790	L.F.	TRENCH SAFETY SYSTEM	1.00	$2,790.00
		SUBTOTAL - SANITARY SEWER		$82,790.00

D

SANITARY SEWER

11,500	L.F.	24" SAN. SEWER	30.00	$345,000.00
10,350	L.F.	TRENCH SAFETY SYSTEM	1.00	$10,350.00
		SUBTOTAL - SANITARY SEWER		$355,350.00

C

SANITARY SEWER

1	EA.	5850 G.P.M. LIFT STATION	400000.00	$400,000.00
6,080	L.F.	18" FORCE MAIN	28.00	$170,240.00
9,120	L.F.	24" SAN. SEWER	30.00	$273,600.00
13,680	L.F.	TRENCH SAFETY SYSTEM	1.00	$13,680.00
		SUBTOTAL - SANITARY SEWER		$857,520.00
		TOTAL		$4,428,143.50