REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE
LIVE OAK RIDGE AREA
OF SAN PATRICIO COUNTY, TEXAS

PREPARED FOR THE

SAN PATRICIO MUNICIPAL WATER DISTRICT

AUGUST, 1989

PREPARED BY

NAISMITH ENGINEERS, INC.
CORPUS CHRISTI, TEXAS

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**REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
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**SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989**

ACKNOWLEDGEMENTS

The preparation of the Regional Water and Wastewater Master Plan for the Live Oak Ridge area of San Patricio County, Texas, has required the assistance and cooperation of a number of capable individuals. Naismith Engineers, Inc. wishes to express their appreciation to Mr. W.D. Miller and the Board of Directors of the San Patricio Municipal Water District; to Mr. Brad Arvin and members of the Homeport Steering Council; to Mr. Steve Elliott and Board of Directors of the San Patricio County Drainage District; and to Mr. Bob Wear of the Texas Water Development Board. The cooperation and assistance of the San Patricio County Commissioners and the Councils and Staffs of the Cities of Aransas Pass and Ingleside are also acknowledged and appreciated.

This Master Planning Report was funded in part by a Grant from the Texas Water Development Board and sponsored by the San Patricio Municipal Water District. Other financial assistance was provided by the Cities of Aransas Pass and Ingleside, the San Patricio County Drainage District and the Homeport Steering Council.

**REGIONAL WATER AND WASTEWATER MASTER PLAN
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**SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989**

T A B L E O F C O N T E N T S

MAPS, TABLES, AND FIGURES

MAPS

TABLES

FIGURES

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**REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
SAN PATRICIO COUNTY, TEXAS**

**SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989**

I. EXECUTIVE SUMMARY

This Planning Report has been prepared to outline the adequacy of existing water and wastewater facilities in the Live Oak Ridge area of San Patricio County, Texas, and to present the basic elements of a regional water and wastewater Master Plan to meet the anticipated infrastructure needs resulting from the impact of the New Naval Station Ingleside and the areas growing industrial base. The study area is generally located in the extreme Southeast portions of San Patricio and Aransas Counties and includes the city limits and extra territorial jurisdictions of the Cities of Aransas Pass and Ingleside. Portions of the study area fall within the Northeast most extra territorial jurisdictions of the City of Corpus Christi.

The basic water supply to the study area is surface water from the Nueces River, provided by the San Patricio Municipal Water District. Public distribution of potable water and collection of wastewater is provided by the Cities of Ingleside and Aransas Pass. Much of the study area presently has neither public water nor wastewater service available. Many shallow wells exist and septic tank systems are common. These constitute potential health problems, especially during extended periods of wet weather. The new Naval Station Ingleside Facility, together with the anticipated residential development, and increased commercial and industrial activity in the study area will undoubtedly exceed present public water and wastewater service capabilities. This plan addresses present and future water and wastewater service needs and identifies the most efficient and cost effective means to meet these needs without duplication of service and the attendant unnecessary expense.

Information contained in this planning report includes the following:

Mapping of existing water and wastewater facilities, major transportation routes, and other cultural features on one foot contour aerial photogrammetric base mapping;

A detailed inventory of existing water; wastewater system components

Mapping of recommended water and wastewater components and additions for the study area includes; service area delineation, collection and distribution main sizes and locations, and recommended system components.

Composite water and wastewater facility maps of the study area have also been produced at a scale of 1 inch equals 1000 feet and should be made readily available by city and county staff, and to anyone who is interested in the growth of the study area. These two maps indicate where water and sewer service is already available and outline future service areas and required infrastructure improvements.

A review existing water and wastewater facility in the study area indicates that the basic water supply and transmission facilities are adequate for the future growth of the area. Recent and concurrent expansions of wastewater Treatment Facilities in both cities have insured adequate wastewater treatment capacity through the year 2009 for the city of Aransas Pass and well past the year 2010 in the city of Ingleside. This conclusion is based on the population projections contained in Section II.D. Any drastic changes in population or in industrial activity will alter these projections.

The principle challenge for the study area is not the treatment and transmission of water or the treatment of wastewater, it is the collection of wastewater and the distribution of water in mains of sufficient size for adequate fire protection. Meeting this challenge will insure that developing areas can be adequately served.

The inability to transport wastewater from the potential growth areas is a major concern facing both cities. Existing facilities are for the most part, inadequately sized to accommodate the additional demands placed on the system by areas yet to be developed. The contents of this Master Plan outline present deficiencies and recommended improvements based on projected land usage and system development requirements.

Sizing of future water and wastewater facilities is dependant on several dynamic factors. Changing residential and industrial growth patterns greatly affect demand projections which in turn effect recommended improvements as outlined in this planning report. Therefore, it is recommended that this Master Plan be continually updated as actual conditions deviate significantly from those anticipated. It should be realized that the recommended improvements outlined in this report were designed so that the planning areas could be adequately served when fully developed. In many areas, full development is not likely to occur for many years to come. Some areas may never become fully

developed. For this reason it is important to stage construction so that service can be expanded in a systematic manner without excessively burdening existing utility and municipal funding capabilities.

Cost estimates have been prepared for the major water and wastewater facilities required to extend adequate service to future developing areas. Tables outlining unit costs for water and wastewater system improvements have been included in Section V of this report in order to allow City planners to quickly and efficiently prepare total project costs for utility extensions.

If major water and wastewater system extensions are planned and constructed in accordance with this master plan, the system will be adequate to serve the study area when it is fully developed.

II. GENERAL INFORMATION

A. Scope and Purpose: The purpose of this report is to determine the adequacy of existing water and wastewater facilities in the Live Oak Ridge area of San Patricio County, Texas, and to present the basic elements of a regional water and wastewater master plan to meet the anticipated needs arising from the impact of the new Naval Station Ingleside and the area's growing industrial base. The following items have been included in this plan:

Mapping of existing water and wastewater facilities, major transportation routes, and other cultural features on one foot contour aerial photogrammetric base mapping;

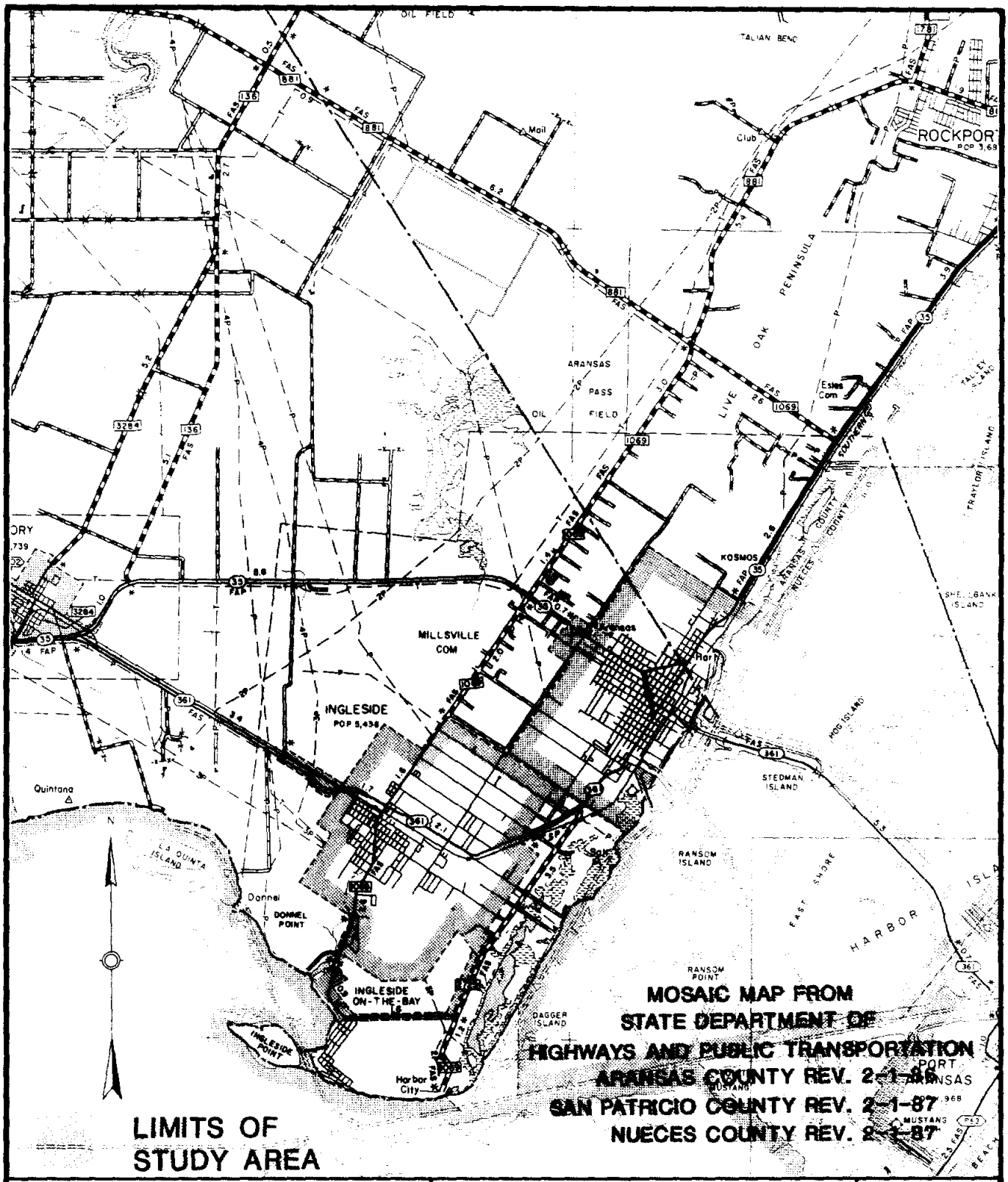
An inventory of existing system components; and

Mapping of recommended water and wastewater improvements and additions for the study area.

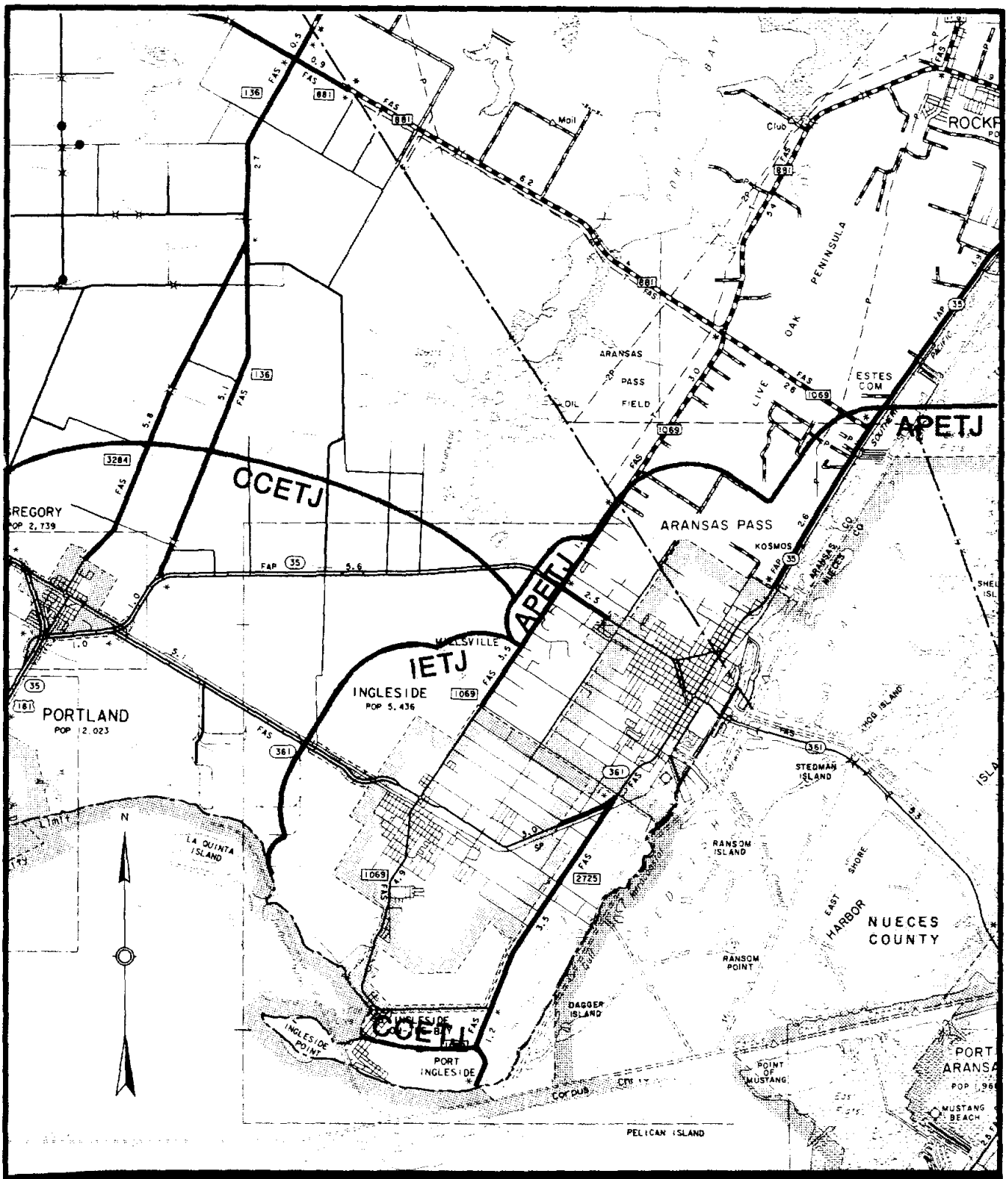
This planning report has been prepared to assist the governmental entities of the Live Oak Ridge Area of San Patricio County with the implementation of the study results in a systematic and cooperative manner.

B. Authorization: This plan was developed in fulfillment of a contract between the San Patricio Municipal Water District, the Texas Water Development Board, and Naismith Engineers, Inc., dated June 15, 1988. Financial assistance is being provided to the District by the Cities of Aransas Pass and Ingleside, which are located in the study area, as well as by the San Patricio County Drainage District and the Homeport Steering Council.

C. Location of the Study Area: The study area is located in extreme southeast San Patricio and Aransas Counties, Texas, approximately 25 miles southeast of the City of Sinton, the county seat of San Patricio County. Access to the study area is provided by State Highways 35 and 361 from the west, State Highway 35 from the north, and the Port Aransas Causeway from the east. Rail access is provided by the Southern Pacific Railroad from both the north and the west. The study area is bounded by Redfish Bay to the east and Corpus Christi Bay to the south. Map I, on the following page, outlines the boundaries of the study area. Principal political boundaries, including the limits of the Cities of Aransas Pass, Ingleside, and Corpus Christi, as well as their areas of Extra Territorial Jurisdiction (ETJ), have been shown on Map II, on page 3.



REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS	MAP I – LOCATION OF THE STUDY AREA	DATE AUGUST 1989 NEI JOB NO. 2799
NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	PAGE 2



REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS	MAP II – POLITICAL SUBDIVISIONS WITHIN THE STUDY AREA	DATE AUGUST 1989 NEI JOB NO. 2799
NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	PAGE 3

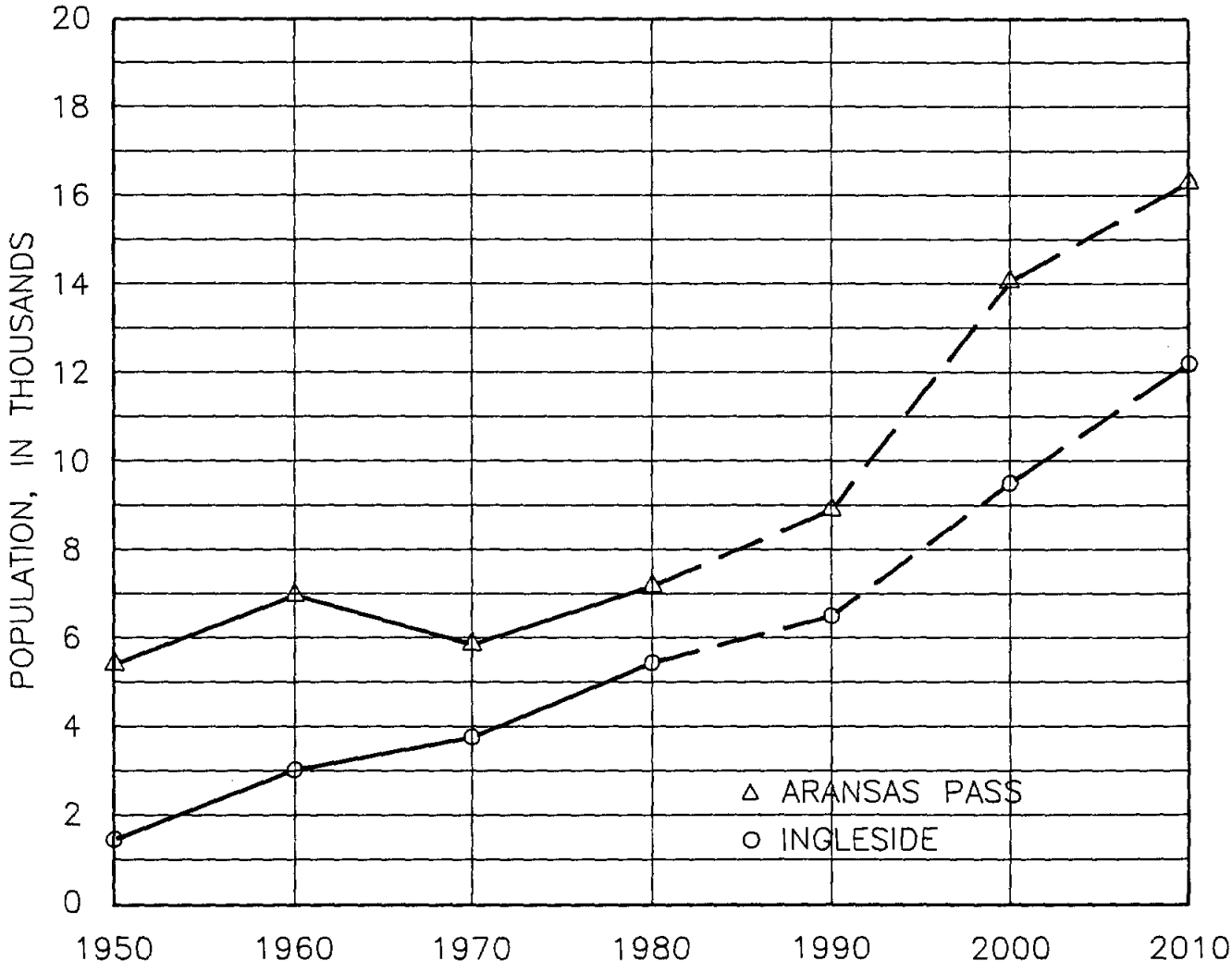
D. Population of the Study Area: Population data for the study area was obtained from the "Certifiable Report: Corpus Christi Designated Area and Lower Nueces Basin Planning", (Ref. 4) prepared by the Coastal Bend Council of Governments (CBCOG). Figure I, on page 5, shows the historical populations for the cities of Aransas Pass and Ingleside, as well as the projected populations, at ten year intervals from 1990 to 2010.

In addition to these projections, Table I, below, shows population projections from other sources for comparison. The analyses contained in this report were performed using data from the 1987 CBCOG report.

TABLE I - Comparative Population Projections
for the Study Area

Source/City	1990	2000	2010
CBCOG 1987			
Aransas Pass	8,900	14,050	16,300
Ingleside	6,500	9,500	12,200
CBCOG 1988			
Aransas Pass	9,200	11,300	13,900
Ingleside	6,500	9,500	12,200
Texas Water Development Board 1988			
Aransas Pass	8,575	9,470	10,876
Ingleside	6,572	8,368	9,583

Due to the impact of Naval Station Ingleside on the study area, a projected distribution of the Naval Station personnel (Ref. 44) has been included in Table II, on the following page.



Population projections from "Certifiable Report: Corpus Christi Designated Area and Lower Nueces Basin Planning", prepared by the Coastal Bend Council of Governments, 1987. (Ref. 4)

REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS	FIGURE I – POPULATION PROJECTIONS FOR THE STUDY AREA	DATE AUGUST 1989 NEI JOB NO. 2799
NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	PAGE 5

TABLE II - Distribution of Naval Staion Ingleside Personnel

Location	Percentage of Base Personnel
On Base	21.2
Corpus Christi	20.4
Aransas Pass	12.6
Rockport	12.1
Ingleside	9.1
Portland	7.0
Port Aransas	3.5
Gregory	3.4
Sinton	1.3
Taft	1.2
Other Areas	8.2

E. Topography of the Study Area: Live Oak Ridge runs parallel to the coastline, from the Naval Station Ingleside site, north through the eastern portion of the City of Aransas Pass. The elevation along the top of the ridge ranges from 30 to 35 feet (National Geodetic Vertical Datum). Major drainage for the eastern portion of the study area is directly into Redfish Bay. McCampbell Slough, which flows from State Highway 361 northwest to Port Bay and then to Copano Bay, drains the northern portion of the City of Ingleside and the western portion of the City of Aransas Pass. Kinney Bayou flows from State Highway 361, southward to Ingleside Cove and drains the southern portion of the City of Ingleside.

As detailed in the "Soil Survey for Aransas and San Patricio Counties", (Ref. 29), the terrain in the areas outside of these cities is primarily flat to slightly sloping. The land is primarily used for range land or wildlife habitat, covered with short range grasses and mesquite brush. Some residential development exists between Aransas Pass and Ingleside, particularly along the major thoroughfares. Soils in the study area consist almost exclusively of white to light gray fine sands belonging to the Galveston-Mustang-Dianola association. These sands are highly permeable and in some areas may be moderately to extremely saline. Very few defined natural drainageways exist. (Ref. 29) In some areas, these surface sands are underlain by a clay layer.

The natural water table in the area is found to be anywhere from and few inches to several feet below the natural ground surface. The high water table, combined with the natural soil conditions, has considerable bearing on the economic development of water and wastewater facilities in this region.

F. Mapping: Aerial photogrammetric mapping showing one foot contour intervals at a scale of one inch to 200 feet was provided by the San Patricio County Drainage District. Photographs utilized for the preparation of these maps were taken in September of 1987 and September of 1988, and provided up to date cultural information for the study analysis. This mapping was used to inventory and locate existing water and wastewater facilities, optimize design alternatives, prepare cost estimates, and delineate service areas as well as to outline locations for recommended water and wastewater improvements. An index to the project mapping has been included in Appendix I.

G. Concurrent Planning and Design: At the time this study was being performed, water and wastewater facilities to serve Naval Station Ingleside from the City of Ingleside's existing system were being designed. For the purposes of this study, it has been assumed that these facilities will be constructed in the very near future. Consequently, these proposed improvements, along with other, near term improvements for the study area, have been shown as existing facilities. The design details of these improvements will be given later in this report.

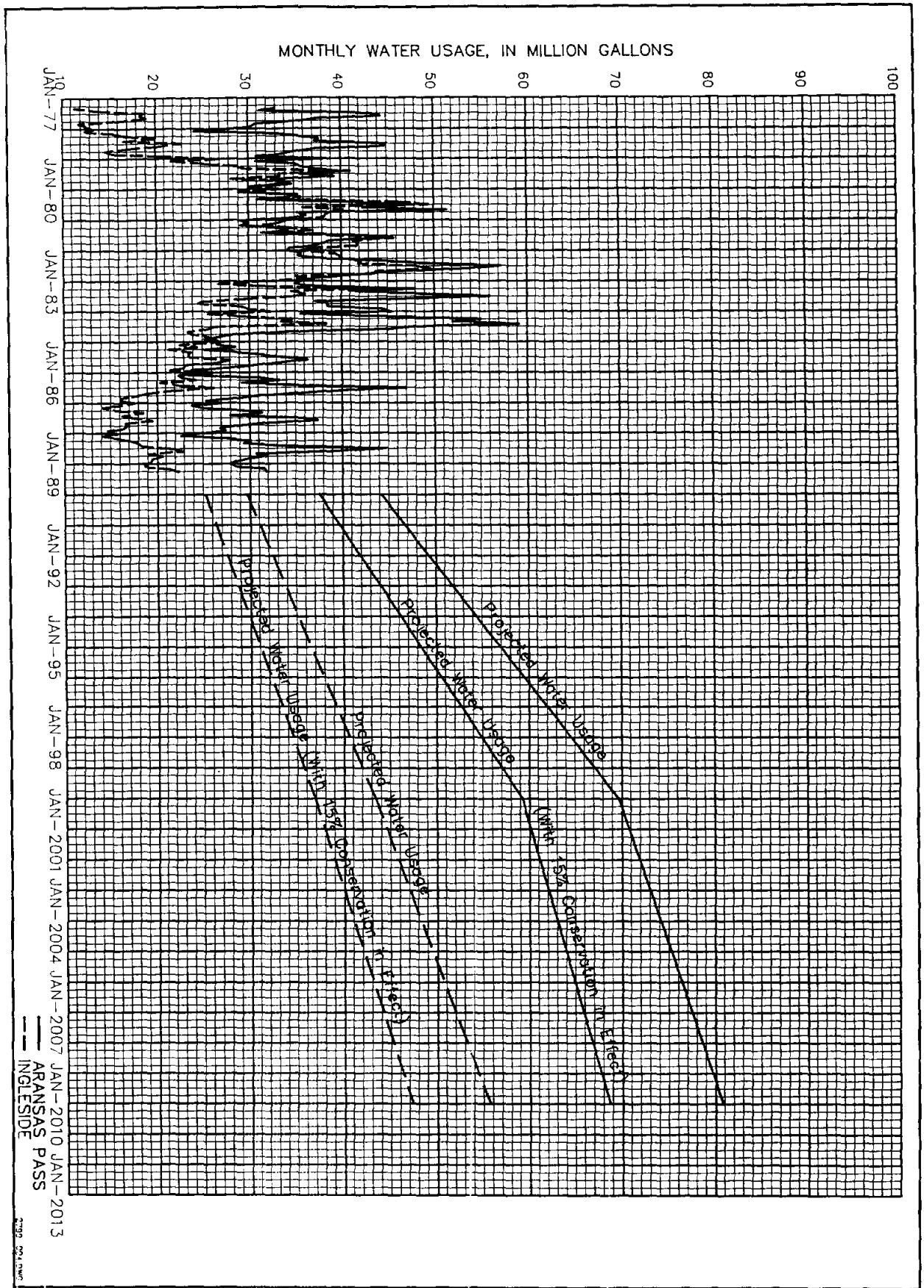
III. WATER TREATMENT, STORAGE, AND DISTRIBUTION FACILITIES

A. Water Source for the Study Area: The primary source of water supply for the study area is the San Patricio Municipal Water District. The District purchases both treated and untreated water from the City of Corpus Christi. The water supply is taken from the Lower Nueces River, near Calallen, some 35 miles downstream of Lake Corpus Christi. The area's water supply comes from two primary sources: Lake Corpus Christi and Choke Canyon Reservoir, both in the Nueces-Rio Grande Coastal Basin, Zone I. (Ref. 26) The City of Corpus was the local sponsor for Choke Canyon reservoir, a Bureau of Reclamation project. This reservoir is designed to operate in conjunction with Lake Corpus Christi, to insure a future water supply beyond the year 2020 for the Coastal Bend area. The District has consistently supported the City of Corpus Christi in its efforts to obtain additional yield from the Nueces River System, and has paid a pro-rata share of the costs involved through its purchase of water.

Data presented in a study by the Texas Water Development Board (Ref. 26) indicates that municipal and industrial surface water requirements for the Nueces-Rio Grande Coastal basin, Zone 1 area will total about 139.6 thousand acre-feet annually by the year 2000, and 258.8 thousand acre-feet by 2030. The yield of the Choke Canyon Reservoir-Lake Corpus Christi system will be approximately 224.8 thousand acre feet annually. This would indicate that demand in the basin could exceed supply from existing facilities in the 2020-2030 decade. The District will continue to work closely with the City of Corpus Christi and other area entities in mutually planning for the future need.

It should be noted that the local area is concerned with water quality as well as water quantity. Most of the Nueces River basin is sparsely developed, and water quality is generally very good. To assist in protection of this water quality, a water Quality Management Plan for the Nueces-Rio Grande Coastal Basin was developed, as directed by the Federal Water Pollution Control Act.

Aransas Pass and Ingleside both receive water from the District, which they in turn distribute through their own city water systems. In addition to the Cities of Aransas Pass and Ingleside, the San Patricio Municipal Water District also provides treated water to the Cities of Gregory, Odem, Portland, and Taft, all of which are located in San Patricio County. The District also supplies treated water to the City of Rockport and the surrounding area, through the Aransas County Conservation and Reclamation



REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

WATER USAGE IN THE STUDY AREA

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI # 2799

PREPARED FOR THE
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FIGURE II – WATER USAGE IN THE STUDY AREA

District, and the City of Port Aransas, through the Nueces County Water Control and Improvement District No. 4. Several small water supply corporations, which have been formed to supply treated water to rural portions of the county, use the District as their primary source. These include the Seaboard Water Supply Corporation west of Odem, and the Rincon Water Supply Corporation in the central area of the County. The District also serves the Reynolds Metals Company plant, the E.I. duPont de Nemours plant, and the Occidental Chemical (OxyChem) Company plant with untreated water for process use. (Ref. 1)

Some portions of the study area are served by shallow groundwater wells. Since the number and location of these is not readily available, the analysis of these was considered beyond the scope of this study.

B. Water Usage:

1. Historical Water Usage: Monthly water usage totals for the Cities of Aransas Pass and Ingleside were obtained from District records. (Ref. 1,12) The recorded water usage from 1977 to 1989 and the projected water usage to the year 2010 for both cities is shown in Figure II, on page 9. An inspection of the data reveals that the maximum water usage in the study area occurred in the early 1980's and has steadily decreased since that time. While the population base continues to increase, the reduction in water usage has been due primarily to a decline in industrial activity.

a. City of Aransas Pass: Maximum water usage by the City of Aransas Pass for this period occurred in June of 1984 with a recorded monthly usage of approximately 59 million gallons. The peak monthly water usage in 1988, which occurred in July, was 44.7 million gallons. (Ref. 12)

b. City of Ingleside: The maximum water usage for Ingleside occurred in August of 1982 with a recorded usage of approximately 50 million gallons. Ingleside's peak monthly water usage in 1988 was 22.8 million gallons and occurred in July. (Ref. 12)

2. Contractual Obligations: Currently the District is under contract to be able to supply a total of 20.0 million gallons per day (MGD) to their industrial consumers, principally Reynolds, duPont, and OxyCehm. The Cities of Aransas Pass and Ingleside, as

member cities of the District, purchase water at a flat rate fee for all water taken. (Ref.1,12)

C. Summary of Existing Water System Facilities: As previously mentioned, the principle water suppliers for the study area are the San Patricio Municipal Water District, and the Cities of Aransas Pass and Ingleside.

1. San Patricio Municipal Water District: The San Patricio Municipal Water District maintains facilities to supply both treated and untreated water to a wide variety of customers in the area. (Ref. 1)

a. Existing Treated Water Facilities: The District currently has two means by which to provide treated water. The first is through a twenty-four inch treated water line from the City of Corpus Christi Cunningham water treatment plant. This line was originally installed by the Reynolds Metals Company and later deeded to the City of Corpus Christi. The line was purchased by the District from the City in 1982. Water service is provided to the Cities of Odem, Taft, Gregory, and Portland through this line. The District maintains a booster pump station along this line to provide adequate capacity to meet peak demands. The Odem Treated Water Booster Station has a 110,000 gallon storage reservoir and three service pumps.

The second way the District can provide treated water is through the District's own treatment plant, which is located approximately 3 miles northwest of Ingleside on State Highway 361. This plant draws untreated water from a twelve million gallon ground storage reservoir at the plant site and has a peak hydraulic capacity of approximately ten MGD. Treatment capacity of the plant is approximately nine MGD. The plant can also receive treated water directly from the District's twenty-four inch line. Present peak day production from this plant has ranged between seven and eight MGD.

The District maintains 4 million gallons of treated water storage at the plant site. One million gallons are provided in an underground clearwell, and 3 million gallons are provided in an above ground concrete storage tank. The District also has a 250,000 gallon elevated storage tank, located near the intersection of Highway 361 and Avenue A.

Treated water from the plant is transported to the study area in transmission lines of various sizes. Two pump stations

are maintained with two pumps each to pressurize these transmission lines. An eighteen inch line in the right-of-way of State Highway 361 runs from the plant to the intersection of Highway 361 and Avenue A. A twelve inch line runs from the plant parallel to Highway 361 then along California Street and connects to the eighteen inch line just outside of Ingleside. An eight inch line runs from the twelve inch line in California Street, through downtown Ingleside, and connects to the eighteen inch line at the intersection of Highway 361 and Avenue A. From this intersection, a 12 inch line runs along Highway 361 to the service point for the Nueces County Water Control and Improvement District No. 4 and then to the South Commercial Street Pump Station in Aransas Pass. A twenty-four inch line also runs from this intersection northward along Avenue A, to the Avenue A Pump Station in Aransas Pass, and continues to the service point for the Aransas County Conservation and Reclamation District.

b. Existing Untreated Water Facilities: Untreated water is taken directly from the Nueces River at the W.A. Edwards Nueces River Pump Station. It is then transported in a thirty-six inch transmission line to the Reynolds Metals Company's Red Mud Lake. From here the line is reduced to thirty inches and continues to just outside the District's treatment plant property. The line is then reduced to twenty-four inches and continues to the twelve million gallon ground storage reservoir. This line is also connected to the headworks of the treatment plant, and is valved to allow raw water to be pumped directly into the plant, bypassing the reservoir. A connection is also provided from the ground storage reservoir to the E.I. duPont de Nemours plant to supply process water. The District's plant typically uses the reservoir as it's primary source of supply.

Along this transmission line the District maintains a three million gallon ground storage reservoir and booster pumping facility near Odem. The line is valved to allow water from the Edwards River Pump Station to be pumped either to the Odem booster station or directly to the treatment plant. The Odem booster station provides the capacity to meet peak demand conditions.

2. City of Aransas Pass: The City is currently a member city in the District. This entitles the City to elect a voting member on the District's Board of Directors. The City's water system currently has an "Approved" status with the Texas Department of Health, as outlined in later sections of this Report.

a. Source of Water: As previously mentioned, the District supplies water to the City of Aransas Pass at two different points. The first point is the Avenue A Pump Station near the intersection of Avenue A and State Highway 35. This station draws water from the twenty-four inch line running along Avenue A. The second point of take is the South Commercial Street Pump Station located near the current southern city limit and State Highway 361. This station draws from the District's twelve inch line running along State Highway 361. (Ref. 1)

b. Storage Facilities: The City has a total storage capacity of 1,750,000 gallons. The Avenue A pumping station has a 1,000,000 gallon ground storage tank. The South Commercial Street Pump Station has a 250,000 gallon ground storage tank. The City's elevated storage tank, located near the intersection of Arch Street and Wilson Avenue has a capacity of 500,000 gallons.

c. Pressure Maintenance Facilities: The elevated storage tank operates as the primary pressure maintenance facility. The City has a total rated pumping capacity of 5,600 gallons per minute (gpm). The Avenue A Pumping Station has three pumps, two of which are identical. The South Commercial Street Pump Station has two identical pumps. Table III, below, gives the data for each of the pumps in the system. In addition, the operating curve and the nameplate data for each pump have been included in Appendix V.

TABLE III - City of Aransas Pass Pump Data

Pump	Rated Capacity (gpm)	Rated Head (ft.)	Horsepower	Speed (rpm)
South Commercial Street				
1 & 2	500	150	25	1750
Avenue A				
3	600	162	35	1750
4 & 5	2000	160	100	1750

d. Distribution System: The distribution system is well looped. It consists primarily of cast iron and asbestos-cement pipes. At the time of this study, the distribution system served 2936 connections, of which only 2593 are active. These facilities have been located on the project mapping in Appendix II. (Ref. 15)

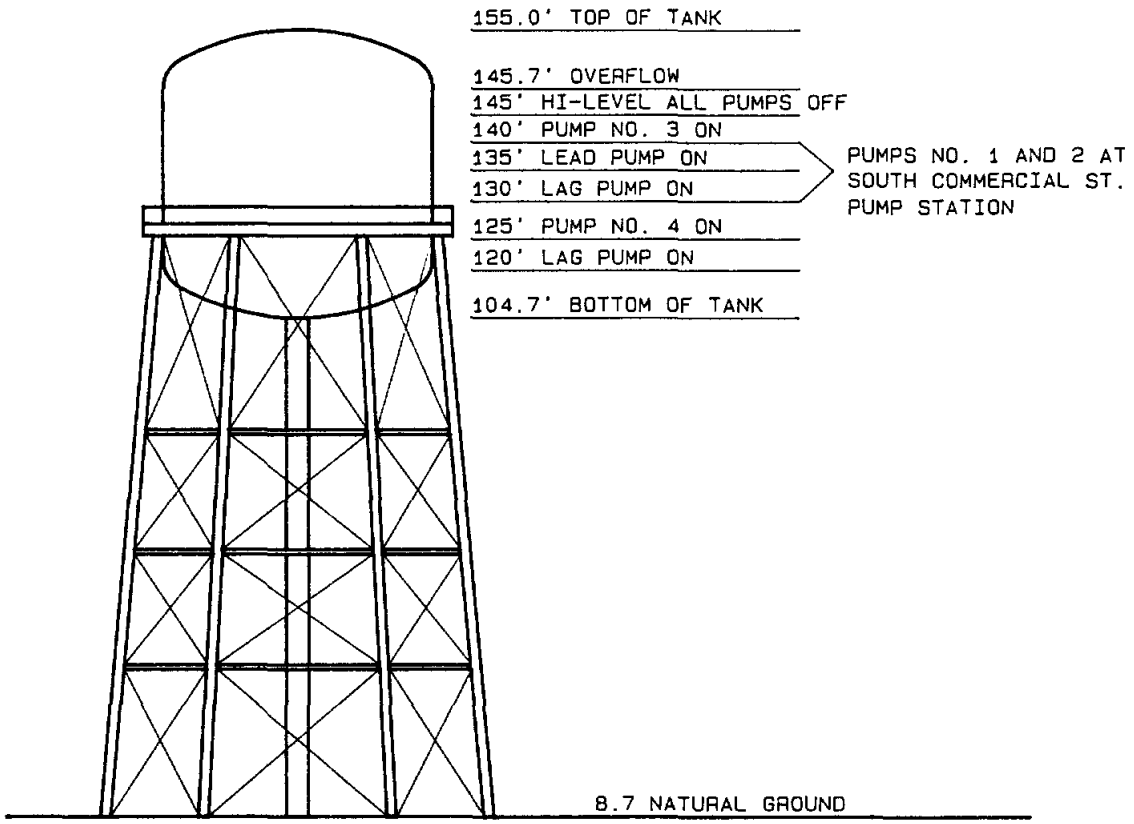
e. System Operation and Controls: Pumps in the system are operated by a semi-automatic control system, with sensors in the elevated tank, which turns the pumps on and off based on the elevated tank level. Figure III, on page 15, shows the approximate level control operation diagram for the pumps in the system. No data was available for the exact operational scheme of the control system.

3. City of Ingleside: Ingleside is currently a member city in the District. As previously mentioned, this entitles the City to elect a voting member on the District's Board of Directors. Ingleside's water system also has an "Approved" status with the Texas Department of Health, as outlined in later sections of this report.

a. Source of Water: The City of Ingleside draws water from the District facilities at each of its two water pumping stations. Treated water is delivered to Pump Station No. 1, on Waco Street, by the District's twelve inch line crossing the duPont property. Pump Station No. 2, on Fourth Street, draws water from the twelve inch line along State Highway 361. (Ref. 1)

b. Storage Facilities: The City of Ingleside Water System includes storage facilities at the two water pumping stations, and an elevated storage tank for a total storage capacity of 1,850,000 gallons. Pump Stations No. 1 and No. 2 have 400,000 gallons and 1,200,000 gallons of ground storage capacity, respectively. The City also has one 250,000 gallon elevated storage tank, located near the intersection of Avenue E and Eighth Street. As previously mentioned, at the time this study was being performed, facilities were being designed to serve Naval Station Ingleside. Improvements proposed for the water system included several line size upgrades and an additional 500,000 gallon elevated storage tank located near the Naval Station Ingleside site. These facilities are outlined in detail in the "Preliminary Engineering Study and Report for Improvements to the Water System of the City of Ingleside, Texas". (Ref 20) This will increase total storage capacity to 2,350,000 gallons and elevated storage capacity to 750,000 gallons. These improvements have been located on the project mapping and were used in the analysis of the existing system. However, the exact location and characteristics of these improvements will be dictated by the final design.

c. Pressure Maintenance Facilities: In addition to the elevated storage tank, the City maintains two water pumping



500,000 GALLON ELEVATED STORAGE TANK
CITY OF ARANSAS PASS

REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS	FIGURE III – LEVEL CONTROL OPERATION DIAGRAM – CITY OF ARNANSAS PASS	DATE AUGUST 1989 NEI JOB NO. 2799
NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	PAGE 15

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stations. Pump Stations No. 1 and No. 2 both contain three pumps each. The City's total rated pumping capacity is 8,400 gpm. The pumps are identical at both stations. Table IV, below, gives the pump data for each of the 3 sizes of pumps. Appendix V contains the operating curve and the nameplate data for each size of pump. (Ref. 6, 9)

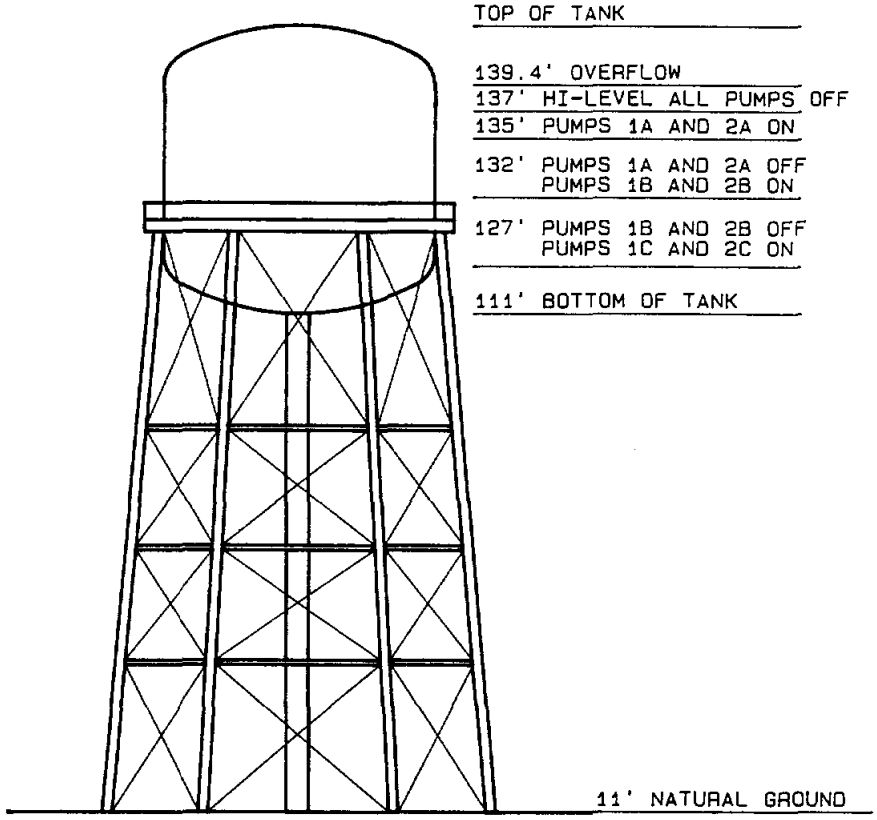
TABLE IV - City of Ingleside Pump Data

Pump	Rated Capacity (gpm)	Rated Head (ft.)	Horsepower	Speed (rpm)
A	600	160	40	1750
B	1200	160	75	1750
C	2400	160	125	1750

d. Distribution System: The distribution system is composed of 2 inch through 12 inch pipe, with materials consisting primarily of cast iron, asbestos cement, and PVC. Appendix II shows the location of these facilities on the project mapping. The system currently serves 2,050 connections. (Ref. 6, 7, 9)

e. System Operation and Controls: The system is operated with a semi-automatic control system, with sensors in the elevated tank, which turns pumps on and off based on the elevated tank level. At the present time, this control system is only partially functioning. The level control diagram for the current operation of the system pumps is shown in Figure IV, on page 17. (Ref. 6) Once the new 500,000 gallon elevated storage tank is placed in service, it will be used to dictate the operation of the system pumps. The proposed operational scheme is outlined in the "Preliminary Engineering Study and Report for Improvements to the Water System of the City of Ingleside, Texas." (Ref. 20)

D. Evaluation and Analysis of Existing Facilities: Treated water facilities for both the Cities of Aransas Pass and Ingleside were evaluated on the criteria used by the Texas State Department of Health (Ref. 2) and the Texas State Board of Insurance (Ref. 19). The scope of this Report is not such that it permits a complete and comprehensive evaluation of the entire system. An attempt was made to evaluate system components for which information was readily obtainable. Criteria considered applicable to this study are outlined below.



250,000 GALLON ELEVATED STORAGE TANK
CITY OF INGLESIDE

REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS	FIGURE IV – LEVEL CONTROL OPERATION DIAGRAM – CITY OF INGLESIDE	DATE AUGUST 1989 NEI JOB NO. 2799
NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	PAGE 17

1. Texas State Department of Health Criteria: The Department's "Rules and Regulations for Public Water Systems" (Ref. 2) outlines the minimum criteria that water systems in the State of Texas must meet. Both City systems fit under the category of "Community Public Water Systems" with "Surface Water Supply". Applicable requirements are outlined below.

a. Water Source: Requirements for water sources are covered in Section 337.204.

b. Water Treatment: Water treatment requirements are contained in Section 337.205.

Since the Cities of Aransas Pass and Ingleside do not treat water, their systems will not be evaluated based on the above criteria.

c. Water Distribution: Requirements for water distribution systems are contained in Section 337.206. The system shall be designed to maintain a minimum pressure of 35 pounds per square inch (psi) at all points in the system, under normal operating conditions. In addition, the system shall be designed to maintain a minimum pressure of 20 psi at all points in the system under peak demand conditions. (Section 337.206 (c)). This criteria, as well as that outlined in Section 337.208 (a), will be evaluated in Section II.E., "Distribution System Pressure Analysis".

d. Water Storage: Water Storage requirements are contained in Section 337.207. Elevated and ground storage tanks shall not be located within 500 feet of any municipal or industrial sewage treatment plant. (Section 337.207 (f))

e. Minimum System Capacity Requirements: Minimum system capacity requirements are covered in Section 337.208.

(1) Pressure: The system shall be designed to maintain a minimum pressure of 35 pounds per square inch (psi) at all points in the system at flowrates of at least 1.5 gpm per connection. (Section 337.208 (a)). This criteria will be evaluated in Section II.E., "Distribution System Pressure Analysis".

(2) Total Storage Capacity: Total storage capacity of 200 gallons per connection shall be provided. (Section 337.208 (a)(2)(C)(i)).

(3) Pressure Maintenance Facilities: Elevated storage capacity of 100 gallons per connection or pressure tank storage of 20 gallons per connection shall be provided. For systems with over 2500 connections, 100 gallons per connection of elevated storage capacity is required. (Section 337.208 (a)(2)(c)(iii)).

(4) Service Pump Capacity: Each pump station or pressure plane will have two or more pumps with a total capacity of 2 gpm per connection or a total capacity of 1,000 gpm and able to meet peak demand.

f. State Approval Recognition: To have State Approval Recognition, a water system must meet or exceed the requirements outlined in Section 337.210.

2. Texas State Board of Insurance Criteria: The Board's "Key Rate Schedule for Grading Cities and Towns of Texas with Reference to Their Fire Defenses and Physical Conditions" (Ref. 19) outlines additional minimum criteria that water systems in the State of Texas must meet.

a. Water Supply: A total water supply capacity of 130 gallons per capita per day is required.

b. Ground Storage: Ground Storage capacity of 130 gallons per capita per day is required, with a minimum of 50,000 gallons required.

c. Elevated Storage: Elevated Storage capacity of 130 gallons per capita per day for 10 hours is required.

3. City of Aransas Pass System: The City of Aransas Pass system currently serves a population of 8,172 people with 2,936 connections.

a. Location of Storage Facilities: A review of the project mapping reveals that none of the storage facilities maintained by the City of Aransas Pass are located within 500 feet of a municipal or industrial sewage treatment facility.

b. System Capacity:

(1) Total Storage: TDH criteria require 200 gallons per connection for 2,936 connections for a total of 587,200 gallons. The City currently has 1,750,000 gallons of total

storage capacity, which exceeds this minimum criteria and is capable of serving 8,750 connections. This should handle the projected growth well beyond the year 2010.

(2) Pressure Maintenance Facilities: Since the City has no pressure tanks, the TDH requires 100 gallons of elevated storage per connection for 2,936 connections for a total of 293,600 gallons. The TSBI criteria require 130 gallons of elevated storage for 10 of 24 hours for 8,172 people for a total of 442,650 gallons. The existing 500,000 gallon elevated tank provides capacity adequate to meet the TDH requirements until approximately the year 2004. It also meets the minimum criteria for the TSBI, up to a service population of 9,230. According to the population projections previously presented, this should be adequate only until 1991. Since this is just two years away, the City should begin planning for additional elevated storage as soon as possible, to avoid penalties on its Key Rate.

(3) Ground Storage: TSBI criteria require 130 gallons of ground storage per capita for 8,172 people for a total of 1,062,360 gallons. The existing 1,250,000 gallons of ground storage capacity will meet this minimum requirement, up to a service population of 9,615. Based on the population projections, this would be adequate only until 1992. Since this is also a short time away, the City should begin planning for additional ground storage capacity to avoid penalties on its Key Rate.

Although the system exceeds the storage capacities required by the TDH, it will soon be deficient in capacity according to the TSBI criteria used to assess penalties in Key Rate values. Although failure to add additional storage capacity would not jeopardize the City's "Approved" status with the TDH, it would penalize the Key Rate used to determine fire insurance rates.

(4) Service Pump Capacity: The TSBI criteria require a total water supply capacity of 130 gallons per capita per day. Since the City gets its water from the District, its service pumps would be considered its source of supply. This would require a pumping capacity of 130 gallons per day for 8,172 people, or 1,062,360 gallons per day. This is equivalent to 738 gpm of required capacity, which is exceeded by the current capacity of 5,600 gpm.

TDH criteria require a service pump capacity of 2 gpm per connection for 2,936 connections for a total of 5,872 gpm. In

addition there must be at least two pumps at each pump station. As previously stated, the City maintains three pumps at the Avenue A Pump Station and two pumps at the South Commercial Street Station. However, the total existing pumping capacity of 5,600 gpm is less than the required minimum. Since the City is currently deficient in pumping capacity, steps should be taken immediately to acquire additional pumping capacity. This deficiency could adversely affect the City's "Approved" status with the TDH.

4. City of Ingleside System: The City of Ingleside system currently serves a population of 6,200 people with 2,050 connections.

a. Location of Storage Facilities: A review of the Project Mapping reveals that neither of the City's pumping station facilities are located within 500 feet of a municipal or industrial sewage treatment facility. However, the City's 250,000 gallon elevated water storage tank is located within this 500 foot zone. Scaled horizontal measurements from the Project Mapping indicate that the tank is located approximately 440 feet from the influent chamber of the City's sewage treatment plant. The tank is located only 230 feet from the sludge drying beds. A proposed expansion to the wastewater treatment plant will be located even closer to the existing tank. The location of this tank does not comply with current TDH standards and could affect the City's "Approved" status.

b. System Capacity:

(1) Total Storage: TDH criteria require 200 gallons per connection for 2050 connections for a total of 410,000 gallons. The City currently has 2,350,000 gallons, which exceeds this minimum criteria. The current capacity is sufficient to serve 11,750 connections, which should be adequate well beyond the year 2010.

(2) Pressure Maintenance Facilities: Since the City has no pressure tanks, the TDH requires 100 gallons of elevated storage per connection for 2,050 connections for a total of 205,000 gallons. The TSBI criteria require 130 gallons of elevated storage for 10 of 24 hours for 6,200 people for a total of 335,833 gallons. The capacity provided in the existing 250,000 gallon elevated tank and the proposed 500,000 gallon elevated tank exceeds the minimum criteria of the TDH and the TSBI. With the capacity to serve 7,500 connections or a service population of

13,846 these facilities should be adequate well beyond the year 2010.

(3) Ground Storage: TSBI criteria require 130 gallons of ground storage per capita for 6,200 people for a total of 806,000 gallons. The existing 1,600,000 gallons of ground storage capacity exceed this minimum requirement. The current capacity will serve a population of 12,308 and should be adequate beyond the year 2010.

(4) Service Pump Capacity: The TSBI criteria require a total water supply capacity of 130 gallons per capita per day. Since the City of Ingleside also gets its water from the District, its service pumps would be considered its source of supply. This would require a pumping capacity of 130 gallons per day for 6,200 people, or 806,000 gallons per day. This is equivalent to 600 gpm of required capacity, which is exceeded by the current capacity of 8,400 gpm.

TDH criteria require a service pump capacity of 2 gpm per connection for 2,050 connections for a total of 4,100 gpm. In addition there must be at least two pumps at each pump station. As previously stated, the City maintains three pumps at each of two pump stations. The total existing pumping capacity of 8,400 gpm combined with the configuration exceeds these requirements.

E. Distribution System Pressure Analysis: The purpose of a detailed computerized pressure analysis is to enable the determination of deficiencies within the water distribution system. With computerized analysis, numerous scenarios, both existing and proposed can be analyzed quickly. The capability to determine the effects of existing and future water service demands enables the City to operate, maintain, and plan for future expansion in the most cost effective manner.

After compiling information on the existing water distribution systems and completing a detailed inventory of all other water system components, computerized distribution system pressure analyses for both City systems were prepared. Major distribution system components and all distribution lines six inches or larger in diameter which were included in the City's looped distribution system were used in the analysis. Lines smaller than six inches in diameter and those larger than six inches in diameter that are "dead end" lines were not considered as an integral part of the distribution network. The lines located on the Project Mapping represent the major water distribution system network.

Computer programming utilized for system analysis was the University of Kentucky Pipe Network Analysis Program, 1984 Version. (Ref. 5) The program required as input the length, diameter, and a friction factor based on pipe material for each pipe in the distribution network. For each pipe junction (or node), the approximate elevation (on National Geodetic Vertical Datum) and an estimated water demand for the area served by that node were required as input data. Flowrates used for each node were calculated based on existing daily water usage records and peak flow data, proportioned by the service area for each point. Flow calculations were based on criteria outlined in the Rules and Regulations for Public Water Systems, prepared by the Texas Department of Health. (Ref. 2) Table V, below, gives the Hazen-Williams coefficients used in the analysis.

Table V - Hazen Williams Coefficients
for Various Pipe Materials Used in the Analysis

Pipe Material	Value
Cast Iron	75
Asbestos-Cement	115
Reinforced Concrete	110
Polyvinyl Chloride (PVC)	130

Based on an assumed hydraulic grade line elevation at the elevated storage tank and the pump performance curves for all pumps in the system, an iterative flow and pressure balance was performed. From this information the program computed the hydraulic grade line elevation (and pressure) for each point in the system and the demand and/or inflow from the service pumps and the elevated storage tank.

F. Results of Distribution System Pressure Analysis: Various scenarios for each system were analyzed. Because of the large amount of data generated by the analysis, the complete results have not been included in this report. They have, however, been included in a separate volume. A summary of the results of these analyses is given below.

1. City of Aransas Pass: To determine compliance with the minimum operating pressure requirement of 35 psi, as outlined in the TDH criteria, (Ref. 2) the computer model developed for the

City of Aransas Pass System was subjected to a total flow of 4,404 gpm. This is equivalent to 1.5 gpm per connection for the 2,936 connections on the system. The minimum pressures computed by the program was 46 psi. This is in excess of the minimum 35 psi required.

2. City of Ingleside: The procedure outlined above was followed with the City of Ingleside water system. A total flow of 3,075 gpm was used in the analysis. This is equivalent to 1.5 gpm per connection for the 2,050 connections on the system. A minimum pressure of 48 psi was computed. This is in excess of the minimum 35 psi required.

G. Recommended Improvements: Because of deficiencies in the existing City systems and the lack of service in undeveloped areas, numerous water system improvements have been recommended. The criteria for these improvements and the procedures used for the design are given below.

1. Design of Recommended Improvements:

a. Projected Water Usage: Projected water usage in the study area was based upon the population projections outlined previously, combined with current relationships between total water usage, the number of service connections, and the estimated per capita demand.

(1) City of Aransas Pass: The historical water usage for the City of Aransas Pass was given previously in Figure II, on page 9. As mentioned previously, the City system now serves 2,936 connections with 8,172 people. With a total of 44.7 million gallons used in July of 1988, this yields an average daily flow in the peak month of 1.49 MGD. This is an average per capita usage of 182 gallons per day. Typical residential usage is approximately 100 gallons per capita per day (gpcd). (Ref. 25) To further determine the residential portion of the total water usage, data was collected for the largest industrial consumers on the City system. Their usage represented approximately 13 percent of the total used in 1988. When the remaining portion of the total water usage for 1988 is divided by the population, it yields an average usage of 125 gpcd. In addition, an analysis of the average dry day flow into the Aransas Pass wastewater treatment plant shows an average flow of 61.2 gpcd. With an average wastewater to water return rate of 50 percent, this would place the residential water usage at approximately 122 gpcd. These two pieces of information suggest a heavy industrial water usage. An

analysis of the historical water usage data for the last eleven years reveals that the ratio of peak monthly water usage to average monthly water usage is approximately 1.3. This would suggest a peak residential usage rate of 163 gpcd. When combined with the data in the population projections, this would yield an estimated average daily water usage rate in the year 2010 of 2.29 MGD.

(2) City of Ingleside: The City of Ingleside's historical water usage is also given in Figure II, on page 9. The peak monthly water usage in 1988 was 22.3 million gallons. This is equivalent to an average daily flow of 0.743 MGD. Serving 2,050 connections and 6200 people, this yields a peak monthly per capita usage of 120 gallons per day. This is in excess of the 100 gpcd mentioned earlier, but below the 163 gpcd peak monthly usage for Aransas Pass. An analysis of the wastewater treatment plant records shows an average dry day flow of 64.5 gpcd. Assuming the same 50 percent wastewater to water return rate, the typical water usage is 129 gpcd. An analysis of the historical water usage for the last eleven years reveals a ratio of approximately 1.3 for the peak montly flow to the average monthly flow. This would put the peak monthly usage at 168 gpcd. Comparing these rates to the actual usage rate suggests either a higher wastewater to water return rate or a much lower per capita usage. Because of the proximity of the two communities, a projected water usage rate of 150 gpcd is considered reasonable. Combining this usage rate with the data from the population projections yields an estimated peak water usage rate in the year 2010 of 1.83 MGD.

b. Distribution System Design Criteria: Recommended improvements were designed based on the minimum standards for distribution piping from the American Water Works Association's (AWWA) "Manual of Water Supply Practices - Distribution System Requirements for Fire Protection". (Ref. 31) This source recommended that the smallest pipe diameter in the network be 6 inches. In high value districts the minimum pipe diameter should be 8 inches. The smallest dead end line should be 8 inches. The longest spacing for a minimum 6 inch grid should be 600 feet. The largest spacing of 12 inch supply mains should be 3000 feet.

c. Distribution System Appurtenances: The AWWA has also made recommendations on minimum valve and hydrant locations. Although valves and hydrants were not located on the project mapping, the final design of any improvements should incorporate these recommendations.

(1) **Valves:** Valves should be installed on each branch of a cross, tee, or wye. Valves should also be installed to isolate each hydrant. The maximum spacing of valves on main lines should be 800 feet. The maximum spacing of valves in high value districts should be 500 feet.

(2) **Hydrants:** The maximum hydrant spacing is dependent on the required fire flow. Fire flows of 1000 gpm or greater require a maximum hydrant spacing of 300 feet, while flows of 250 gpm require a maximum spacing of 1000 feet. In addition, fire department use typically requires a maximum hydrant spacing of 300 feet in congested areas and 600 feet in residential areas. Good design practice calls for hydrants at intersections, in the middle of long (greater than 300 feet) blocks, and near the end of long dead end streets. Hydrants should also be required within large properties accessible to fire apparatus. Final hydrant locations should be coordinated with the local fire department.

The following is a summary of the recommended improvements resulting from the Evaluation of the existing systems, and the design of facilities to serve existing undeveloped areas.

2. **Unincorporated Areas of San Patricio County:** The widespread use of septic tank systems combined with the highly permeable soils near the surface make the use of shallow ground water wells very undesirable from the standpoint of public health. During extended periods of wet weather, there is the potential for these shallow ground water wells to become contaminated from the numerous septic tank systems in the area. Adequate public water supply capabilities could remove the need for reliance on these shallow groundwater wells. This is desirable in that it would avoid a potential public health threat.

3. **City of Aransas Pass:** As was outlined in the system evaluation, some deficiencies do exist. The following improvements are recommended to remove these deficiencies.

a. **Storage Improvements:** Since the City system is deficient in ground storage, according to TSBI criteria, an additional 1,000,000 ground storage tank should be constructed and located at a site adjacent to the South Commercial Street Pump Station. This should provide adequate capacity for the projected growth beyond the year 2010.

b. Pressure Maintenance Improvements: An additional elevated storage tank, with a capacity of 500,000 gallons should be constructed and located as shown on Sheet II-38 of the Project Mapping. This location would insure adequate pressure to serve areas north and west of the City and would reduce cost of operation by taking advantage of natural contours. An additional 11,000 gpm of pumping capacity will also be needed by the year 2010. Additional pumping capacity could be added in stages. However, since the City is currently deficient in pumping capacity, an additional pump should be sought immediately. This could be accomplished by placing an additional 500 gpm pump at the South Commercial Street Station. This station was originally designed for three pumps and most of the piping is already in place. This additional pump could be placed with a minimal cost to the City. The total additional pumping capacity, along with the additional elevated storage recommended should provide adequate capacity beyond the year 2010.

c. Distribution System Improvements: Recommended distribution system improvements have been shown on the project mapping, in Appendix II. Consisting primarily of lines eight inches in diameter and larger, this plan will provide a good basic skeleton for expanding the City's system. Additional looping will facilitate the maintenance of acceptable system pressures.

4. City of Ingleside: As outlined previously there are several improvements to the City's system pending in addition to those recommended in this study.

a. Storage Improvements: The design details for the facilities currently being designed are covered in the "Preliminary Engineering Study and Report for Improvements to the Water System of the City of Ingleside, Texas" (Ref. 20). These facilities have been incorporated into this Report exactly as designed. With the exception of the 500,000 gallon elevated storage tank, no other storage improvements have been proposed.

b. Distribution System Improvements: In addition to the distribution system improvements outlined in the "Preliminary Engineering Study and Report for Improvements to the Water System of the City of Ingleside, Texas" (Ref. 20), several other improvements have been proposed. These have been shown on the Project Mapping, in Appendix II. They consist primarily of lines eight inches in diameter and larger. This plan will provide a good basic skeleton for an expanded water system. The adequate

looping provided will facilitate the maintenance of acceptable system pressures.

H. Implementation of Proposed Improvements: It is unknown how the study area will actually develop. All of the recommended facilities have been designed to serve a fully developed area. It is for this reason that the total flow from all of the service areas is greater than the projected flow based on the population projections. Estimates for the timing of major facilities (i.e. treatment, storage, and pumping capacity) expansions have been based on the population projections.

1. Staged Development Options: Water distribution system expansions, unlike wastewater collection systems, are much easier to extend. Dead end systems can be completed on a temporary basis with completion of looped systems occurring as system demand and growth warrants. Computer models prepared during this analysis are also available to the area communities to utilize as special conditions arise that warrant flow capabilities analysis. The construction timetable and physical location of individual water mains will depend primarily on the timing and location of future development.

2. Cost Estimates: Cost Estimates for the major water line extensions have been prepared, based on 1989 dollars and fully developed service areas. These have been included in Section V.

I. Emergency Distribution System Connections: During evaluation of the existing distribution systems for the Cities of Aransas Pass and Ingleside, it was evident that an emergency connection between the existing water systems could be provided. This emergency connection would allow either system to operate off of the pressure from the other system in the event that an emergency disabled one system. The facilites required for this connection could be constructed jointly. This connection would require approximately 1300 lineal feet of 12 inch PVC waterline. An air gap would be provided by leaving out one joint of pipe at an above ground location. During non-emergency operation, this connection would be flanged off on both ends. When emergency conditions required, a single joint of flanged pipe could be placed to complete the emergency connection. Figure XV in Appendix II details the proposed design for this connection.

The same type of emergency connection could be constructed to connect the City of Aransas Pass system to the Aransas County Conservation and Reclamation District system operated by the City

of Rockport. This connection would require approximately 7,500 lineal feet of 12 inch PVC waterline.

Both emergency connection locations are indicated in the proposed water distribution system plan sheets.

IV. WASTEWATER COLLECTION AND TREATMENT FACILITIES

A. Summary of Existing Wastewater System Facilities: Currently both the Cities of Ingleside and Aransas Pass operate their own collection and treatment facilities. In May of 1976 a report outlining options for a subregional wastewater treatment facility was completed. (Ref. 13) Several alternatives to wastewater treatment options for the area were investigated including combining the City of Aransas Pass and Ingleside systems into one system which conveyed wastewater to a new treatment plant located between the two cities and discharging into Redfish Bay. (Ref. 10,16) As a result of this study, both cities completed new wastewater treatment facilities. The design capacities of these facilities are documented later in this report.

With the exception of a few industrial customers the Cities of Aransas Pass and Ingleside are responsible for almost all of the wastewater treatment in the study area. In the undeveloped and/or unincorporated areas, on-site sewage disposal systems (ie. septic tanks and drain fields) provide treatment and disposal. Where low density residential development has occurred (lot sizes of one acre or more) these on-site treatment facilities have and can work fairly well. However, there are installations within the study area where high water table and dense development have occurred and these systems have not functioned adequately and are not in compliance with current TDH standards. Since future growth and development patterns are unknown, this study assumes a fully developed residential area and the recommended collection systems have been designed based on this assumption.

1. City of Aransas Pass:

a. Collection Facilities: The City of Aransas Pass collection system consists of fifteen wastewater lift stations and collection lines ranging from six inches to twenty-four inches in diameter. Locations and sizes of existing collection facilities has been shown on the project mapping in Appendix III. (Ref. 8,15,17)

b. Treatment and Disposal Facilities: The City of Aransas Pass currently has one 1.6 MGD wastewater treatment plant. This plant is designed to handle a maximum monthly average flow of 1.0 MGD. Design flow for the two hour peak is 3.1 MGD. The design influent Biochemical Oxygen Demand (BOD) concentration is 403 milligrams per liter (mg/l) with a maximum monthly loading of

5378 lbs. per day. This plant discharges effluent directly into Redfish Bay. Currently the plant is permitted for an effluent BOD concentration of 20 mg/l, and a Total Suspended Solids (TSS) concentration of 20 mg/l. (Ref. 30)

Malcolm Pirnie, Inc., Houston, Texas, assisted in preparing the "Water and Wastewater Planning Study, Ingleside-Homeport Area, San Patricio County, Texas" (Ref. 9), in which was included a process summary for this plant. This process summary have been included in Table VI, on the following pages.

Table VI - Process Summary
City of Aransas Pass Wastewater Treatment Plant

Influent	Units	Existing Design	Current Conditions
Treatment Plant Flow			
Maximum Month	MGD	1.6	0.5
Maximum Day	MGD	2.0	1.0
Peak (2-hour)	MGD	3.1	3.1
Organic Loading			
BOD-5 Conc.	mg/l	403	400
BOD-5 Max. Month	lbs/day	5378	1668
Aeration Basins			
Volume	million gallons	2.898	2.898
MLSS	mg/l	2500	2500
F:M (MLSS Basis)	lbs-BOD/lb-MLSS	0.09 (1)	0.03
Space Loading (Max. Month)	lb-BOD/1000 cf/day	14 (2)	4
Hydraulic Ret. Time (Max. Month)	min	43	139
Hydraulic Ret. Time (Max. Day)	min	35	70

(1) Required F:M ratio is less than 0.1 (MPI)
(2) Required Space Loading is less than 12.5 lb-BOD/1000 cf/day. (TDH)

Table VI (Continued) - Process Summary
City of Aransas Pass Wastewater Treatment Plant

Clarification	Units	Existing Design	Current Conditions
No. of Clarifiers		2	2
Diameter	ft	65	65
Surface Area	sf	6637	6637
Overflow Rate (Peak)			
Peak Flow	gal/sf/day	467 (3)	467
Max. Month Flow	gal/sf/day	241 (4)	75
Weir Loading			
Peak Flow	gal/day/ft	7590 (5)	7590
Max. Month Flow	gal/day/ft	3918	1224
Chlorine Contact Basins			
Number of Basins		2	2
Volume	gal	44880	44880
Detention Time			
Peak Flow	min	21 (6)	21
Max. Month Flow	min	40	129

(3) Required Overflow Rate, based on peak flow, is less than 600 gal/sf/day. (TDH)
(4) Required Overflow Rate, based on maximum monthly flow, is less than 240 gal/sf/day. (TDH)
(5) Required Weir Loading, based on peak flow, is less than 20,000 gal/day/ft. (TDH)
(6) Required Detention Time, based on peak flow, is greater than 20 minutes. (TDH)

(Ref. 9,30)

The City of Aransas Pass has an emergency generator located at the Wastewater Treatment Plant. Specifications are as listed below:

Catipiller Type 3046 II, 893 cu-in.
325 KVA, 260 KW, 0.8 PF
480 Volt, 1800 RPM, 60 HR
3 phone, 10 wire

2. City of Ingleside:

a. Collection Facilities: The City of Ingleside Wastewater collection system consists of seven wastewater lift stations and collection lines ranging from six inches to twenty-four inches in diameter. A large trunk line is currently being designed to provide service to the Naval Station Ingleside site. The design details of this trunk line are contained in the "Preliminary Engineering Study and Report for Improvements to the City of Ingleside Wastewater Collection and Treatment Facilities" (Ref. 22) Locations and sizes of all collection facilities are shown on the project mapping in Appendix III. (Ref. 22)

b. Treatment and Disposal Facilities: The City of Ingleside currently has one 1.0 MGD wastewater treatment plant. This plant is designed to handle a maximum monthly average flow of 1.0 MGD. Design flow for the two hour peak is 4.0 MGD. The design influent Biochemical Oxygen Demand (BOD) loading on the plant is 200 mg/l with a maximum monthly load of 1700 lbs. per day. The plant discharges into Kinney Bayou, which conveys the effluent to Corpus Christi Bay. (Ref. 14)

A process summary was also prepared for the City of Ingleside Wastewater Treatment Plant in the "Water and Wastewater Planning Study, Ingleside-Homeport Area, San Patricio County, Texas" (Ref. 9). This has been included in Table VII, on the following pages.

Table VII - Process Summary
City of Ingleside Wastewater Treatment Plant

Influent	Units	Existing Design	Current Conditions
Treatment Plant Flow			
Maximum Month	MGD	1.0	0.4
Maximum Day	MGD	3.0	1.0
Peak (2-hour)	MGD	4.0	4.0
Organic Loading			
BOD-5 Conc.	mg/l	200	170
BOD-5 Max. Month	lbs/day	1700	567
Aeration Basins			
Volume			
Contact Basins	million gallons	0.1027	0.1027
Rearation Basins	million gallons	0.2567	0.2567
MLSS			
Contact Basins	mg/l	2500	500
Rearation Basins	mg/l	3500	900
F:M (MLSS Basis)	lbs-BOD/lb-MLSS	0.18 (1)	0.24
Space Loading (Max. Month)	lb-BOD/1000 cf/day	35 (2)	12
Hydraulic Retention Time (Max. Month)			
Contact Basins	hours	2.5	6.2
Rearation Basins	hours	3.2	3.2
Hydraulic Retention Time (Max. Day)			
Contact Basins	hours	0.82	2.16
Rearation Basins	hours	3.17	3.17

(1) Required F:M ratio is less than 0.25 (MPI)
(2) Required Space Loading is less than 50 lb-BOD/1000 cf/day. (TDH)

Table VII (Continued) - Process Summary
City of Ingleside Wastewater Treatment Plant

Aeration System	Units	Design Conditions	
Blowers			
Number		3	3
Capacity (Each)	cfm	2008	2008
Firm Capacity	cfm	4016	4016
Non-Process Air Req.	cfm	1062	1062
Total Oxygen Provided			
Air Provided	cfm/lb-BOD load.	1.7 (3)	5.2
Assumed Diffuser			
Wastewater QTE	%	6.0	6.0
Oxygen Provided	lb/day	4211	4211
Oxygen Provided	lb/lb-BOD rem.	2.7 (4)	8.4
Final Clarification			
No. of Clarifiers		2	2
Diameter	ft	54	54
Surface Area	sf	4480	4580
Overflow Rate (Peak)			
Peak Flow	gal/sf/day	873 (5)	873
Max. Month Flow	gal/sf/day	218 (6)	87
Weir Loading			
Peak Flow	gal/day/ft	11789 (7)	11789
Max. Month Flow	gal/day/ft	2947	1179

(3) Required rate at which air must be provided is greater than 1.0 cfm/lb-BOD loading. (TDH).
(4) Required rate at which oxygen must be provided is greater than 2.0 lbs/lb-BOD removed. (MPI).
(5) Required Overflow Rate, based on peak flow, is less than 1000 gal/sf/day. (TDH)
(6) Required Overflow Rate, based on maximum monthly flow, is less than 400 gal/sf/day. (TDH)
(7) Required Weir Loading, based on peak flow, is less than 20,000 gal/day/ft. (TDH)

Table VII (Continued) - Process Summary
City of Ingleside Wastewater Treatment Plant

Return Sludge Pump	Units	Existing Design	Current Conditions
(Airlift Type)			
Number		4	4
Capacity (Each)	gpm	675	675
Firm Capacity (one in each train)	MGD	1.94	1.94
Percent of Influent Flow	%	194 (8)	486
Chlorine Contact Basins			
Number of Basins		2	2
Volume	gal	44880	44880
Detention Time			
Peak Flow	min	21 (9)	21
Max. Month Flow	min	40	129

(8) Required Sludge Return percentage is greater than 150% of the influent flow. (TDH)
(9) Required Detention Time, based on peak flow, is greater than 20 minutes. (TDH)

(Ref. 9,14)

The City of Ingleside presently maintains a portable catapiller generator that is capable of supplying either 480V or 240V. The generator was recently (1988) reworked and retrofitted with step down transformers and quick disconnect to allow for connection to the city's main sanitary sewer lift stationary as well as the city's water pumping facilities.

In addition to this existing plant, an expansion is currently being designed. The site selected for this expansion was based on the "Homeport Wastewater Project Evaluation of Possible Sites for the Wastewater Treatment Facilities for the City of Ingleside" (Ref. 21). Process and preliminary design details were published in the "Preliminary Engineering Study and Report for Improvements to the City of Ingleside Wastewater Collection and Treatment Facilities" (Ref. 22). This expansion was incorporated into this Report exactly as designed.

B. Evaluation and Analysis of Existing Wastewater Facilities:

1. Texas Department of Health Criteria: All existing and proposed wastewater facilities have been analyzed in conformance with the "Design Criteria for Sewage Systems" as prepared by the Texas Department of Health and the Texas Department of Water Resources (Ref. 3). This document establishes minimum design criteria necessary to comply with existing State statutes pertaining to effluent quality, and to insure that facilities are designed in accordance with good public health and water quality management and control practices. (Ref. 24) Design standards for collection systems, lift stations and wastewater treatment are all contained within the design guide and are not included with this report.

2. Unincorporated Areas of San Patricio County: Many areas outside the incorporated City Limits and within the study limits have been established with a pattern of low density residential type use, (lot sizes of one acre or more). In many of these areas the use of on-site treatment systems and disposal methods such as septic tanks and drain fields has worked relatively well. Future development is anticipated to be more dense than can be adequately served by on-site systems, and therefore collection systems and central treatment will be required. This Report assumes that all unincorporated areas will at sometime in the future be incorporated into either the City of Ingleside or Aransas Pass collection and treatment systems. One area of special attention given by this Report addresses existing problems in the Ingleside on the Bay area located south of the City of Ingleside along FM 1069.

Sanitary Sewage Service to Ingleside on the Bay Area:

The density of existing development, limited right-of-way, existing improvements, high water table and topography of the area all make for servicing the area with a conventional gravity collection system difficult and expensive. One alternative that would service at least some of the Ingleside on the Bay area would be that of a pressure collection system. A pressure collection system is not necessarily a substitute for conventional gravity collection systems, but lends itself as an alternative to supplement gravity collection when conditions make a gravity collection systems impractical.

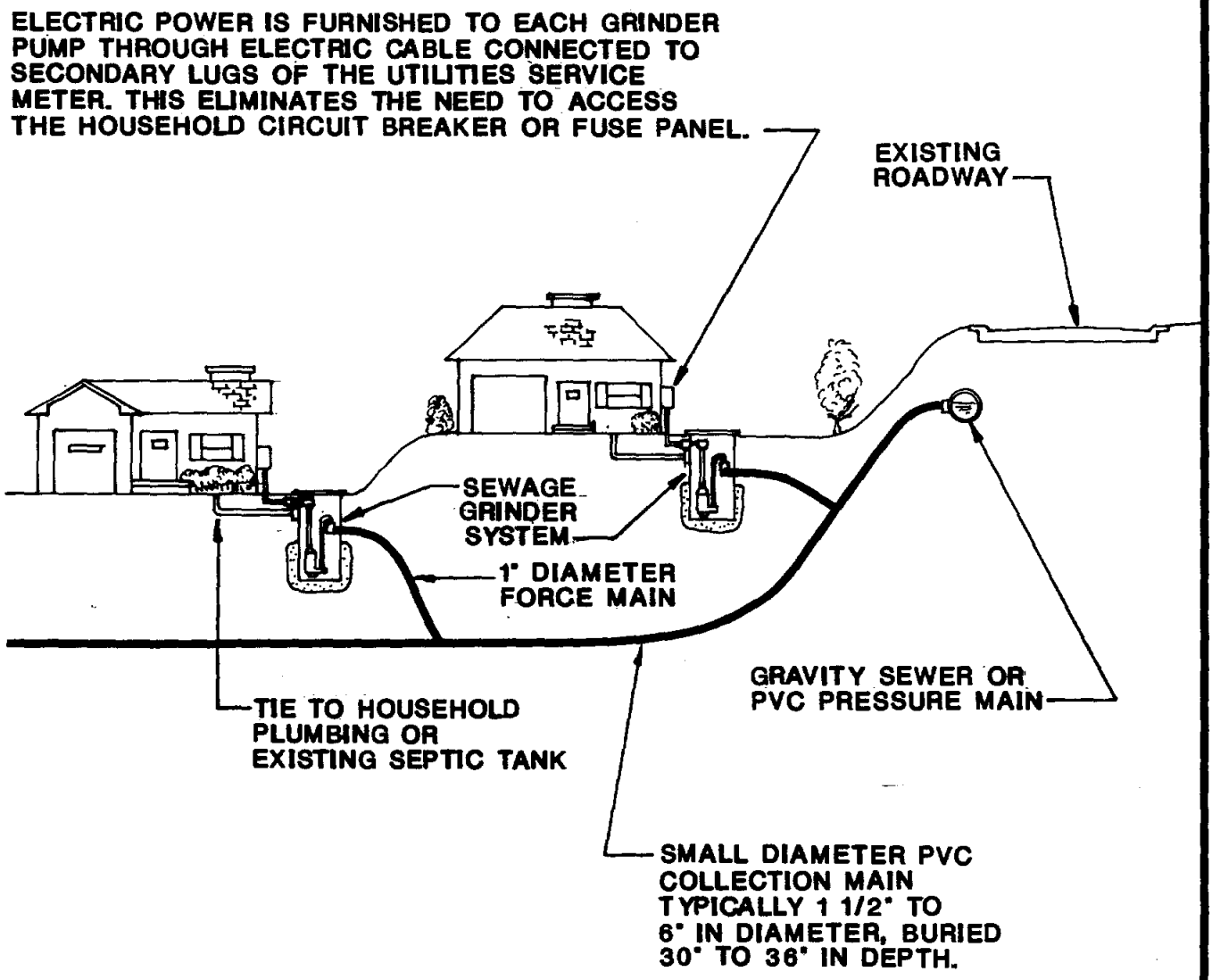
In lieu of using deep mains complete with manholes and lift stations, a pressure collection system complete with individual grinder pumps at each household discharges into small diameter (2"-4") pressure mains installed in narrow, shallow trenches. This concept greatly reduces construction requirements, alleviates potential damage to existing streets and other improvements and costs associated with the same.

Ingleside on the Bay has had a long history of wastewater problems associated with poorly functioning septic systems and drain fields. Lack of available property, density of growth, and the high water table have all had an environmental, as well as economic, impact on the Ingleside on the Bay area.

For the purposes of this report it is recommended that detailed hydraulic system analyses and construction cost estimates be prepared for a complete grinder pump/pressure collection system and a combination pressure and conventional collection system prior to design of a conventional collection system. Design and operation criteria for pressure collection systems are given in the "Design Criteria For Sewage Systems" (Ref. 3,28) These are listed below.

1. Management: A responsible management structure shall be established, to the satisfaction of the Reviewing Authority, to be in charge of the operation and maintenance of a pressure sewer system.

    a. Pumping units and grinder pumps shall be regarded as integral components of the system and not as a part of the home plumbing.
    b. A reliable community power source shall be provided.



REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS	FIGURE XVI TYPICAL APPLICATION OF GRINDER PUMP/PRESSURE COLLECTION SYSTEM	DATE AUGUST 1989 NEI JOB NO. 2799
NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	PAGE 39

2. Sewers: The engineer may be guided in his design of pressure sewers by the following considerations:

   a. The number of pumping units pumping at any one time.
   b. Flow velocities in the range of 2 to 5 feet per second.
   c. The installation of air relief valves.
   d. The provision of a means to flush all lines in the system.
   e. The installation of cleanouts.
   f. Development of procedures whereby portions of the pressure system may be rerouted with temporary lines in the event of leaks, construction, or repair.

3. Pumps: Pumping units and grinder pumps used in pressure sewer systems should be reliable, easily maintained, and should have compatible characteristics.

   a. Pumps and grinder pump units shall be provided with backflow prevention devices.
   b. Sufficient holding capacity should be provided in the pumping compartment to allow for wastewater storage during power outages and equipment failures of short duration.
   c. Pumping units should not be installed in the settling chamber of a septic tank if the septic tank is to be used for solids reduction.
   d. Alarms, warning lights, or other suitable indicators of unit malfunction shall be installed in the system.
   e. Whenever any pumping unit handles waste from two or more residential housing units or from any public establishment, dual grinder pump units shall be provided to assure continued service in the event of equipment malfunction.

Figure XV, on the following page, shows a typical installation of a pressure collection system.

3. City of Aransas Pass: As is typical of small communities where growth has been somewhat slow to occur, the existing collection system has in most instances reached its service area limits.

a. Collection Lines: In some areas of the City additional extensions are possible within existing service area boundaries. In other areas, present population density and inflow

has exceeded downstream collection system capabilities. Furthermore, the City's existing collection system has been subject to loose joints from settling of the sandy soil especially in the older sewer mains. Grease and sand buildup is another common problem which requires constant maintenance attention. Most of the lines throughout the City are subject to effects of a high water table and were laid in soils composed of sand or sandy clay which has often found its way into the collection system. A detailed Infiltration/Inflow study was prepared for the City of Aransas Pass in 1976 (Ref. 8) and detailed results are contained therein. As of 1976 the City's existing collection system contained 281.32 inch miles of pipe and the infiltration rate was calculated to be 409 gallons per inch diameter per mile per day (GIMD). This average infiltration rate applies only to the lines existing at the time of that study. Since individual service lines are shallow they typically do not contribute to long-term infiltration.

b. Lift Stations: During discussions with City staff it was evident that several lift stations including the Main Ransom Lift Station were having operational problems. Correspondence with the City's consultant (Ref. 43) indicated that one of the 40 hp submersible pumps was out of service with a burned out motor and that the three existing pumps could not meet peak flow requirements as set forth by TDH criteria. Under present operation, the lift station can meet daily flow requirements with the existing pumps. However, wet weather flows may require that the 40 hp pump be operational. The pump should be repaired as soon as possible to avoid the potential problems caused by overloading this lift station. A lack of adequate ventilation within the control building has also created severe corrosion problems in the electrical controls. It is recommended that the City isolate the wet well and valve box permanently from the control panel to prevent sewer gasses from reaching it.

The other major problem pointed out by City staff concerned the lift station located on Goodnight Street between 7th and 8th Streets. Problems here appear to be in downstream conveyance capacity. This lift station serves an area of approximately 712 acres with an estimated average daily flow rate of 742 gpm. A force main to the existing 10 inch line in DeBerry Street with further extensions to McCampbell Street as required, should provide capacity adequate to alleviate this problem.

As stated previously the city maintains an emergency generator at the Wastewater Treatment Plant. However no emergency power is available at the Main Ransom Lift Station. It is recommended that the city investigate necessary measures to provide emergency power from the plant site to the Ransom Lift Station or investigate use of a Portable Generator complete with quick disconnects for use at any of the cities existing Lift Stations.

4. City of Ingleside: As with the City of Aransas Pass, the existing City of Ingleside collection system has reached nearly to its limits. Several areas remain where extension of service within the existing service area limits can be accomplished without detrimental effects on down stream conveyance capacity. However, in most areas, future service beyond present service limits will be difficult without major expansion of trunk mains to the existing treatment plant location.

a. Collection Lines: Problems associated with infiltration/inflow and problems with settling loose joints have also been a problem within the City's system in the past. Recently the City has abandoned an older section of 12 inch line in FM 1069 in the vicinity of the Southern Pacific Railroad. This diversion to the N. O. Simmon Lift Station should relieve an existing problem. However in the long run it will reduce system capacity to serve an extended area. A detailed Infiltration/Inflow study was prepared for the City of Ingleside in 1976 and results, in detail, are contained therein. (Ref. 8). As of 1976, the City's existing collection system had 137.60 inch miles of pipe and yielded an infiltration rate of 65.4 GIMD. The low infiltration rate in the presence of relatively high groundwater levels in sandy soils is a good indicator that the majority of the existing lines are well constructed.

Review of existing construction plans, line sizes and flowline elevations also indicate that many of the lines within the City collection system have been placed below minimum grades established by TDH criteria. This, over time, results in sand and other sediments accumulating in the lines and requires maintenance and cleaning on a more regular basis. A detailed review of each individual lift station has not been included in this Report since downstream capacity is typically the factor controlling system expansion within a given service area. If problems exist with pump controls, corrosion, or pumping capacity then each lift station should be investigated and recommendations made on a case by case basis. This report outlines lift stations that can be

abandoned as future trunk mains are constructed. This will reduce overall operating requirements to service a particular area.

C. Recommended Collection and Treatment Improvements: As with the water systems evaluated previously, deficiencies in the existing City wastewater systems and the lack of service in undeveloped areas, warranted the design of numerous wastewater system improvements. The design criteria and procedures used for these improvements are detailed below.

1. Design of Recommended Improvements:

a. Service Areas: The wastewater generated from the study area will be primarily from residential sources. Future commercial and industrial activity in this area, in addition to Naval Station Ingleside, will generate wastewater that is not representative of typical municipal wastewater. Adequate provisions should be made in the cities' industrial wastewater pretreatment requirements to prevent excessive biological loading on the wastewater treatment plants.

Proposed service areas considered in this study were based on several factors and are indicated on the project mapping in Appendix III. The primary factor being considered was topography. When collection systems are being planned, they should take advantage, whenever possible, of the natural fall of the land. The project mapping provided detailed topographic information which allowed for the optimization of collection system design. Location of the treatment facilities also assist in locating logical service boundaries. In some portions of the study area, regulatory agencies, such as the Public Utilities Commission, had previously established service areas. These legally established service areas were respected in all cases. In the other portions of the study area, where there were no previously defined service areas, only logical and cost effective means to collect and treat wastewater, based on sound engineering practice, were considered. Political divisions such as city limits and extra territorial jurisdictions were considered a low priority criteria when selecting service area boundaries.

b. Quantity of Wastewater: For the purpose of designing the various portions of the wastewater collection system, the entire study area was considered to be a fully developed residential area. The domestic flow from a fully developed residential area was based on an assumed population density of 15 people per acre, and a per capita flow of 100 gallons per day.

(Ref. 3) At the Engineer's discretion, based on existing and anticipated land usage and density, some portions of the systems were analyzed and designed based on a population density of 10 people per acre. Infiltration/Inflow was taken to be 1000 gallons per acre per day. (Ref. 28)

c. Peaking Factors: Since it is necessary to design wastewater collection systems for the expected peak flows rather than the average flows, a factor related to population was used to convert average domestic flows to peak domestic flows. A more detailed explanation on the use of this factor is contained in the "Master Sanitary Sewer Plan for Flour Bluff Area for the City of Corpus Christi, Texas" (Ref. 27) The factor is computed using the following equation:

$$M = \frac{5}{P^{*}(1/5)}$$

where M = peaking factor
P = tributary design population, in thousands

The resulting peak flow is obtained by multiplying the factor by the average daily flow. It was felt that it was unreasonable to apply this factor to the design infiltration/inflow, thus the total peak flow for design purposes would be the peak domestic flow added to the infiltration/inflow.

d. Hydraulic Design: It is not the intent of this report to attempt to establish the line and grade of all collection lines within the study area, but to design a system of trunk mains that will be deep enough to serve the fully developed area on the grades that topography dictates. To establish the grades shown for the large collection lines, it was necessary to determine whether the most remote and lowest portions of the area being served could be reached by the system. It was assumed that the minimum size line would be eight inches and the upper end of the line would be at least four feet deep.

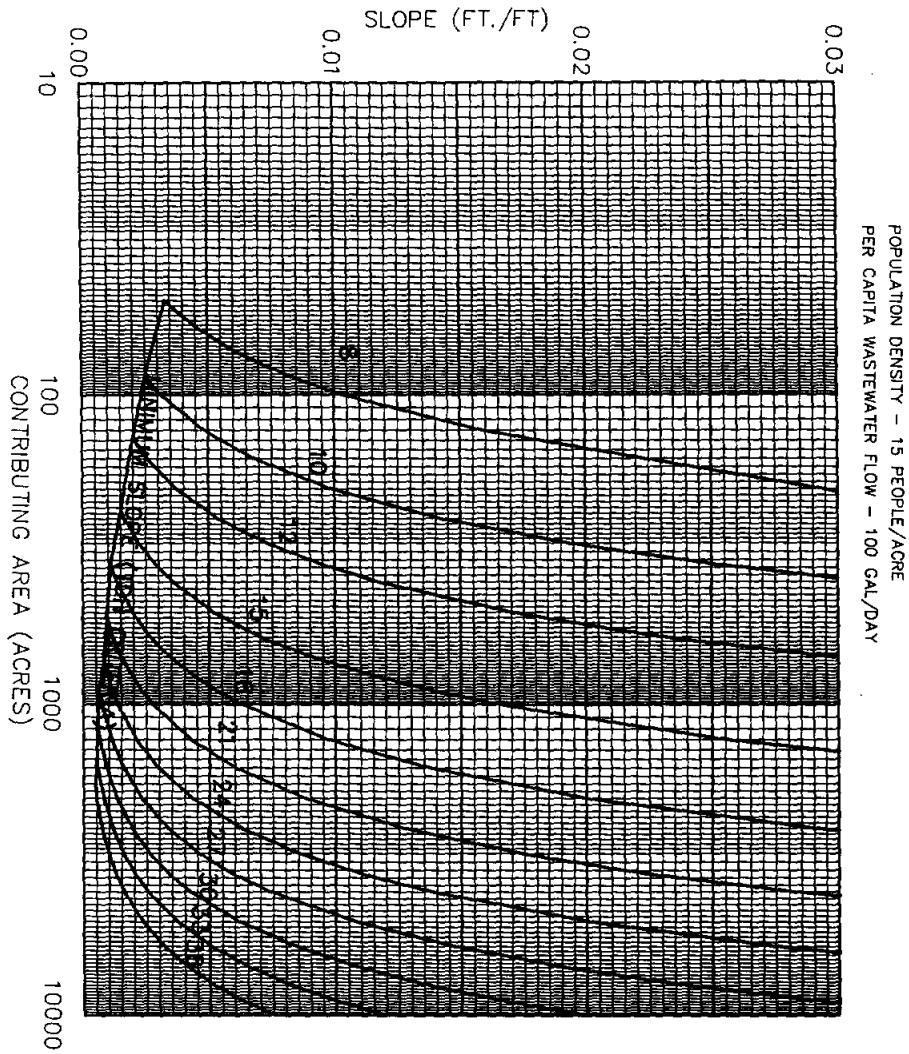
Due to the flat terrain and the shallow water table in some portions of the study area, it was necessary to design some of the lines on minimum grades. Minimum grades used for the various sizes of pipe are those sufficient to give mean velocities, when flowing full or half-full, of not less than two feet per second. These velocities are computed using Manning's formula with a roughness coefficient of 0.013. (Ref. 28) Whenever possible, the lines were designed to be laid at a depth of not less than four feet nor more than twenty feet. Selection of

locations for pumping station and force mains was dictated by topography while avoiding parallel gravity and force mains wherever possible.

e. Collection System Design Charts: To aid in the design of the wastewater collection system, charts were developed which related total contributing area to slope, for various sizes of pipe and development densities. This was made possible since the design per capita wastewater generation and the inflow rate was assumed to be constant. A total flow was derived using the population density, the per capita wastewater generation, and the inflow. This was then plotted versus slope for various pipe sizes. In accordance with TDH design criteria, the minimum slope was then superimposed on the charts. All gravity collection lines were designed using this method. Charts were developed for 15, 10 and 5 people per acre. These charts have been included in this Report as Figures V, VI, and VII, on the following pages. The majority of the collection system design was based on a population density equal to 15 people per acre. However, several areas existed where it was determined by the design that 10 people per acre would be more representative of the anticipated development. A design chart of 5 people per acre has been included only as a reference for future system analysis for areas of low density growth. In these areas, use of individual on-site treatment systems may prove to be the most efficient and cost effective.

f. Collection Line Profiles: Hydraulic profiles of major trunk main extensions indicated on the project mapping have been prepared and are included as Figures XIII and XIV in Appendix III. The natural ground profiles were plotted from contour information contained on the project mapping. Profiles were prepared for gravity trunk mains, force mains and lift stations, complete with sizes, and flowline elevations.

g. Lift Station Design: Special attention to sizing and construction of lift stations should be given, since initial lift station capacity may not equal the ultimate capacity requirements for a fully developed service area. The acquisition of easements or rights of way and oversizing of wet wells should be considered when planning for future improvements and expansions. Oversizing of wet wells will provide for sand and grit storage, and for removal from the system as low flowrates are actually occurring. Modifications to pumps and piping are minor items of consideration when modifying lift stations for increased capacity needs. Standby power or provisions for quick connections to portable



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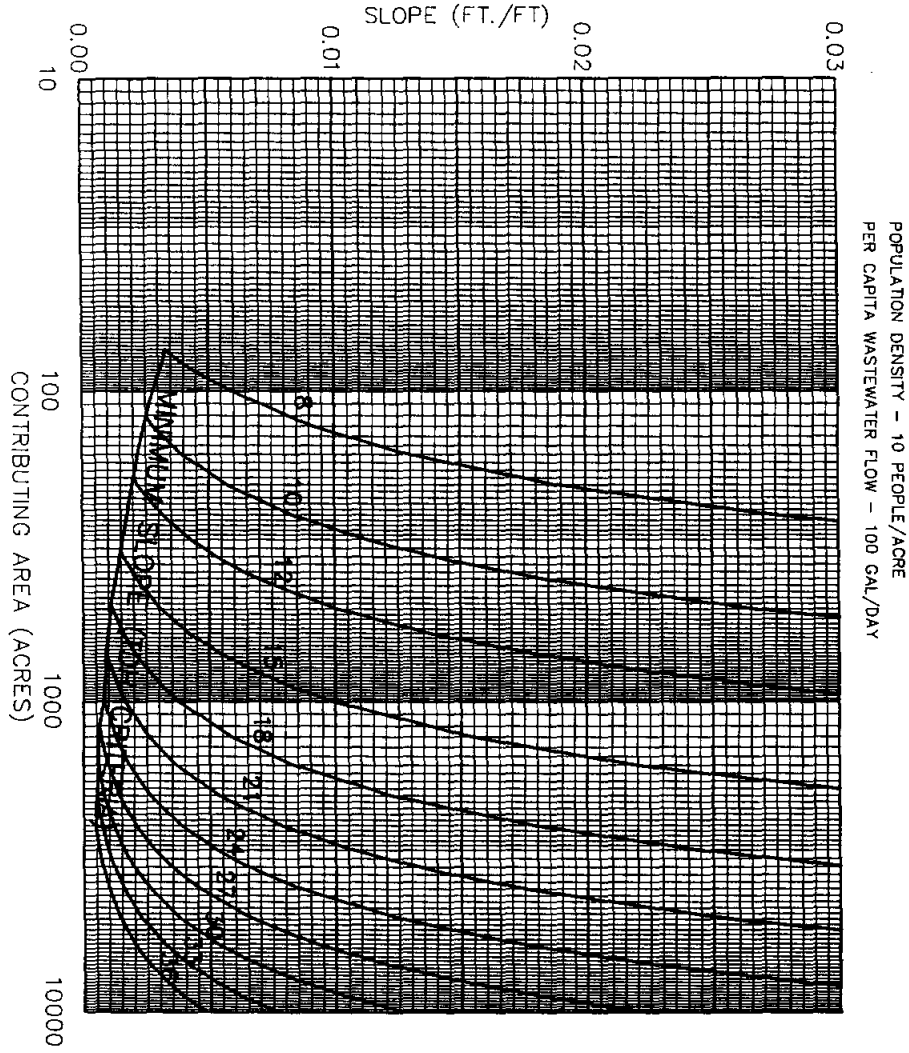
PAGE 46	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE V – WASTEWATER COLLECTION SYSTEM PIPE SELECTION CHART – SLOPE VS. CONTRIBUTING AREA 15 PEOPLE PER ACRE, 100 GAL PER CAPITA PER DAY



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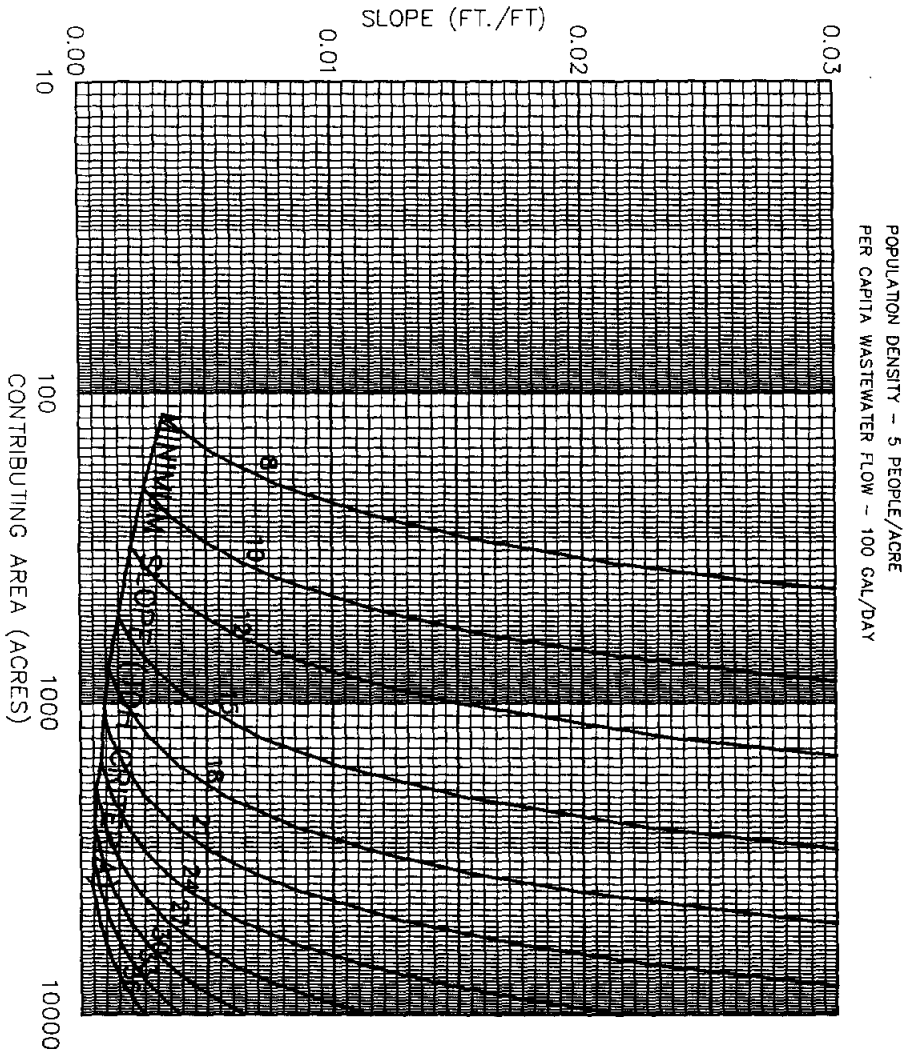
PAGE 47	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE VI – WASTEWATER COLLECTION SYSTEM PIPE SELECTION CHART – SLOPE VS. CONTRIBUTING AREA 10 PEOPLE PER ACRE, 100 GAL PER CAPITA PER DAY



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PAGE 48	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE VII – WASTEWATER COLLECTION SYSTEM PIPE SELECTION CHART – SLOPE VS. CONTRIBUTING AREA 5 PEOPLE PER ACRE, 100 GAL PER CAPITA PER DAY

generators for new lift stations should be provided to protect against overflow and facilitate wastewater removal.

Lift station design should be consistent with current TDH requirements and design considerations should include:

1. Pumping and power cost analysis.
2. Simplicity of design to reduce maintenance requirements.
3. Provisions for adequate ventilation and odor control.
4. Aesthetically pleasing appearance.
5. Provisions for overflow protection.
6. Provisions for emergency operation consideration.

h. Construction Techniques: To avoid excessive infiltration/inflow into the collection system, minimum construction standards should be maintained. Collection lines should be constructed using pipe, such as PVC, with rubber gasketed pressure joints. Manholes, cleanouts, and abandoned service lines should be adequately sealed and grouted.

2. City of Aransas Pass:

a. Collection Facilities: As stated previously, if the City of Aransas Pass is to expand its wastewater service capabilities to anticipated growth areas in and around the present City limits, major extension of wastewater trunk mains will be required. The basic recommendations for the wastewater system layout are shown on the project mapping, in Appendix III. They show existing and proposed collection lines, complete with pipe sizes and manhole invert elevations where available, and proposed lift station and force main locations and capacities.

For the most part, the existing collection system is adequate to allow for full development within the present service area. The only major exception to this is the area servicing the lift station located on Goodnight Street between 7th and 8th Streets. The existing collection system appears to be adequate for full future development within this area. However, lift station modifications along with rerouting a new 10" force main to the gravity system located along DeBerry Avenue are required to relieve an overloaded downstream collection system. As development increases in this area, along with an increased density in the DeBerry service area, the 10" force main will

require further extension to a proposed trunk main to be located along McCampbell Street.

Although many trunk main extensions have been included in this master plan, several major trunk mains have been outlined in detail below. These are the major system extensions which will allow for future service area expansion. The sizes of recommended gravity trunk mains and force mains have been indicated on project mapping for full service area development. Phasing or staging of development of these improvements is addressed in Section IV.E.1 of this report.

(1) Main A-1: This trunk main is comprised of two components that will allow the area south of the City below Avenue A and Highway 361 to develop and encourage development of a large area located between Avenue B and FM 1069. Ultimate development in these service areas will require that a 24" and 27" inch gravity line be constructed from the existing main Ransom Lift Station to the intersection of Highland and Saunders Streets. A force main consisting of 2-14" diameter pipes will be required for full development from Highland and FM 1069 to the Main Ransom Lift Station. Many options are available for the phasing of these improvements. This system is the major link to encouraging development in the service areas previously described.

(2) Main A-2: This trunk sewer system is a major collection for the service area located between Avenue A and Fm 1069 and is comprised of three major lift stations coupled with force main extensions and relatively large gravity trunk mains. Staged development of this system will allow for future wastewater treatment options to be considered if future development is to occur in the area north of Highway 35 between Avenue A and FM 1069.

(3) Main A-3: Two 12" diameter force mains located parallel to the Southern Pacific Railroad Track from the main Ransom Lift Station to the existing lift station located just west of Highway 35 near Stapp and Houston will allow for development of a large area north of the City between Avenue A and the Southern Pacific Railroad. Future lift station modifications will be required to serve the area. As development along Highway 35 occurs, collection systems can be developed with lift stations and force mains extended to the existing lift station locations. As density of development grows and growth along Highway 35 between Avenue A and The Redfish Bay expands northward, a new package type

treatment plant should be constructed and routing of subsequent collection systems modified.

(4) Main A-4: This trunk main is composed of 12" and 15" trunk mains servicing an area bounded by Avenue A and Rife Street and between Maddox and Gile and is an extension of the Main III System.

(5) Main A-5: This trunk main consists of 21", 18", 15" and 12" pipes and is an extension of Main A-3 system servicing an area directly north of Main IV service area.

(6) Main A-6: This trunk main serves a large area located south of the City and is comprised of 21", 18", 15" and 12" trunk mains. Outfall of sewage is into the 24" trunk in the Main A-1 system.

(7) Main A-7: An 18" sewer trunk main extension from the Main I lift station at Highland southward to Beasley will service an area bounded by Johnson Lane and Beasley and between Avenue A and FM 1069.

b. Treatment Facilities: The City of Aransas Pass existing 1.6 MGD treatment plant as described previously is capable of serving the projected population increase until the year 2009 based on population projections indicated in this report with an estimated flow of 100 gpcd. These projected flows are shown in Table VIII, on the following page. If lower actual flow rates are realized, the existing treatment plant facility will be able to provide wastewater treatment capabilities past the year 2010.

TABLE VIII - PROJECTED WASTEWATER FLOWS

YEAR	Population	Flow (75 gpcd)	Flow (100 gpcd)
1990	8,900	0.668	0.890
2000	14,050	1.054	1.405
2010	16,300	1.223	1.63

Since the existing treatment plant was designed with the projected discharge of wastewater from the shrimping industry, available organic capacity exists in the plant which will allow for future expansion given sewage strength in excess of typical residential sewage (200 mg/l). This additional organic capacity will also allow for future plant expansion to occur with hydraulic modifications at that time. Detailed review of future plant expansion requirements would be required when the plant reaches 75 percent of its present capacity and is not addressed as a part of this Master Plan.

Design of the collection system comprised of Main A-1, A-2 can allow, with minor changes in the collection system, for locating, designing, and constructing a new treatment facility north of Highway 35 and east of FM 1069 if future development within that service area occurs at a high residential density. At some future point in time, consideration of this option will need to be addressed in lieu of expansion of the existing plant facility to service growth northward of this service area. With the McCampbell Slough outfall into the Port Bay system, many natural biological treatment options exist. Consideration of an alternative wet lands/natural biological type treatment systems would be warranted. Man made type wet lands treatment systems cannot only treat municipal type sewage, but offer enhanced wildlife habitat which conventional treatment plants cannot offer.

In addition to the environmental benefits wetlands or lagoons provide, this type of treatment system offers lower initial construction costs and reduced operational requirements. Investigations into the use of package type treatment plants should also be considered when analyzing improvements being considered for future growth areas.

3. City of Ingleside:

a. Collection Facilities: As with the City of Aransas Pass, existing collection systems are reaching their capacity to service existing service areas. Major sewer trunk main extensions to encourage growth in presently underdeveloped areas will be required. The basic recommendations for sanitary sewer layout is indicated on the Project Mapping, showing existing sewers, existing invert elevations, proposed sewers, pipe sizes, manhole invert locations, and proposed lift station locations and capabilities.

Unlike the City of Aransas Pass, the City of Ingleside is somewhat confined in its future growth capabilities by geographic and industrial constraints. With the existing treatment plant capacity and proposed near term expansions, future design of collection system options is somewhat limited to options available with all major collection trunk sewers leading to the existing plant site.

Existing sanitary sewer trunk mains are for the most part adequate to facilitate full development within the present service area boundaries. As future development occurs and proposed main trunk extensions are constructed, several existing lift stations will be allowed to be abandoned, allowing for extension of existing sewer systems. Staging of proposed trunk main as recommended in this Master Plan will aid greatly in encouraging future growth and sanitary sewage service and allow for the ultimate completion of trunk mains as development warrants. Several major sewer trunk main extensions have been outlined below with a brief description of the service areas and size requirements. Cost estimates and profiles have been completed for each and are contained in Section V and Appendix III respectively.

(1) Main I-1: This trunk main system is the major link in providing sanitary sewage to the areas east of the proposed new Homeport Roadway located near the top of Live Oak Ridge. It is this system that will convey sanitary sewage to the existing plant site on Eighth Street. This major system is comprised of a lift station, 2-12" force mains from FM 2725 to a proposed 27" gravity line starting at Eighth Street and Green Briar Drive and ending at the Main Lift Station located at the treatment plant. If staged properly this system could be constructed with minimal initial improvements and allow for

expansion on large service areas. Staged construction of this system is included in Section IV.E.1 of this Report.

(2) Main I-2: This trunk sewer is the major collection main servicing the area north of Tiner Lane between FM 1069, Highway 361 and Beasley. It is comprised of 27", 21", 18", and 12" sewer pipe constructed at minimum allowable grades.

(3) Main I-3: This trunk main comprised of 21" and 10" sewers is the main extension of I-2 serving an existing development area primarily west of Avenue A.

(4) Main I-4: This trunk main is proposed to serve the area north along FM 2725 from the I-1 lift station to just north of Tiner Lane. Trunk sewers are comprised of 21", 18", and 12" pipes in this system.

(5) Main I-5: A system of 21", 18" and 15" trunk sewers is required to service the area south along FM 2725 from the I-1 lift station site.

(6) Main I-6: This trunk sewer extension is necessary to serve any low lying area east of Live Oak Park and west of the proposed future Homeport Roadway. The system of 10" and 15" pipe outfalls into a lift station which can be incorporated into the Main I-1 system as staged development occurs. Full development of this system along with full development of the Main I-1 system will require that a 10" force main be constructed from the lift station parallel to the 2-12"s force main to the proposed 27" gravity line at Green Briar Drive. Incorporation of this service area and lift station is discussed in the staged development section of this Report.

b. Treatment Facility: Since existing treatment plant capacity (1.0 MGD) along with proposed future treatment plant improvements (1.0 MGD) outlined in the "Preliminary Engineering Study and Report for Improvements to the City of Ingleside Wastewater Collection and Treatment Facilities" (Ref. 22) exceeds future treatment plant capacity needs to fully serve the study area. No additional analysis has been prepared as a part of this Master Plan. However, the projected wastewater flows to the Ingleside treatment plant are given in Table IX, below.

TABLE IX - PROJECTED WASTEWATER FLOWS

YEAR	POPULATION	FLOW (75 GPCD)	FLOW (100 GPCD)
1990	6,500	0.488	0.650
2000	9,500	0.713	0.950
2010	12,200	0.915	1.220

E. Implementation of Recommended Improvements: Since sizing and placement of future water and wastewater facilities is dependent on several dynamic factors, changing residential and industrial growth patterns greatly affects demand projections and therefore will greatly effect recommended improvements as outlined in this planning report. It is recommended that this plan be continually updated as actual conditions deviate from those anticipated conditions.

It should be realized that recommended improvements outlined in this report have been designed so that the planning areas could be adequately served when fully developed. In many areas full development is not likely to occur for many years to come and in some areas, it may never become fully developed. It is therefore important to stage construction in such a manner that service can be expanded in a structured manner without over burdening existing utility and capital funds.

1. Staged Development Options: Planning of a staged development approach to service growing areas will greatly reduce initial construction costs, encourage system development and aid in providing for a better sewage system at low flow conditions which are predominate as the serve areas reach full development. To construct the trunk mains to meet anticipated future growth projections based on fully developed areas would not only be economically unsound, it could also result in long detention times , low velocities and encourage the sewage to become septic. Careful consideration needs to be given in all future service extensions to utilize systems to their capabilities prior to construction of the next phase of improvements. This should greatly reduce the tying up of capital funds while full development may or may not occur for quite some time. By following the general outline, grades and recommendations of this Master Plan, development of minor collection systems consistent with long range planning improvements will be insured. While it

is not possible to outline all available options with regards to staging improvements within this study area, several projects in each city have been discussed below as examples of how the sanitary sewage collection systems could be staged to initiate the development into new service areas.

a. City of Aransas Pass:

(1) Main A-1 System: In order to extend sanitary sewage service to the potential growth areas west of Avenue A, a major sewer, force mains and gravity trunk sewers is required. For the City of Aransas Pass to encourage future growth in this area, providing the basic sanitary sewage facility is a necessity. While the full development of this service area requires a lift station at FM 1069, dual 14" force mains and a 27" gravity outfall, staging of these improvements might include construction of the following:

Construct a lift station at FM 1069.

Provide one 14" force main or smaller, possibly a 10" or 12" (This would require upsizing of future dual line and pipe cost is minor when all other costs figured) to Avenue A.

Construct 12" and 15" gravity line from Avenue A to Saunders where an existing 12" line exists.

These improvements could provide initial service capabilities to the new service area. As development occurs and funds become available for future capital expenditures, the 12" force main from FM 1069 to Avenue A could be extended to the main lift station located at Ransom Channel. This then allows the 12" and 15" gravity system to incorporate additional capabilities as density of development continues east of Avenue A. The 27" gravity outfall could be constructed to the main lift station. This 27" gravity main could be constructed as a single gravity line or as dual gravity lines. If dual lines are considered steeper minimum slopes will be required and depth of sewage facilities might outweigh the benefit of a single sewer system.

(2) Main A-2 System: Main A-2 system is another trunk collection system that could be developed in stages when portions of Main A-1 are completed. As development occurs on the

area between Avenue A and FM 1069, the following staged approach might be considered.

> Develop major trunk mains to service the area from Avenue A to FM 1069.
>
> In lieu of construction of 30" and 27" gravity trunk lines initially, either construct dual gravity lines of smaller size with careful attention to depth requirements or construct small inexpensive lift stations with small diameter force mains which could be eliminated as future growth demands warrant.

As development density increases particularly west of Highway 35 between Avenue A and FM 1069, further improvements could be completed from Highway 35 to the Main A-1 lift station and Highland Avenue.

As development continues northward in this service are, future requirements would allow for the City to increase capacities of the A-1 and A-2 trunk system or consider the construction of a new plant in the area north of Highway 35 and west of FM 1069. This option would reduce future size requirements as Main A-1 and the A-2 system east of Highway 35.

b. City of Ingleside:

(1) Main I-1: If providing sanitary sewage service to the areas east of Live Oak Ridge along FM 2725 and the areas south of 8th Street along the Live Oak Ridge is desirable, the following staged development might be considered.

> Construct a lift station at the junction of I-6 and I-1 with a 12" force main to the existing 12" gravity system at Green Briar. This allows for encouragement of sanitary sewage system development to a large portion of the central Live Oak Ridge area.

As development continues along FM 2725 a lift station at FM 2725 and 8th Street could be constructed with a 12" force main to the lift station located at the I-6, I-1 junction.

As density of development in the area exceeds the I-6, I-1 lift station capacity, the force main from the FM 2725 lift station could be extended to Green Briar and 8th Street where additional capacity to the treatment plant located would be required. Either a 27" gravity trunk main or a smaller diameter dual system could be developed respecting steeper hydraulic grade requirements. The existing 12" gravity system in Green Briar Avenue could either be plugged and service areas south of 8th Street tied to the new system or the new gravity line to the plant could be placed at a higher elevation and physically separated from the existing gravity sewer.

(2) Main I-2: Main I-2 trunk system also serves a large area that is considered to be a future growth area by the City. Phasing of construction in this area could include the following:

> Extension of a 10" gravity line in Tiner from the existing 12" line to Avenue A would allow for initial development in an area subject to rapid development.
>
> Initial service east of Avenue A along the I-3 system could include an inexpensive temporary lift station at Avenue A and McCullough with a force main to the Tiner Lane system.
>
> As density of development reaches system capacity the extension of the I-2 gravity system and I-3 system should begin. Modifications to the N. O. Simmons Lift Station may also be required along with force main extensions to either the existing 15" collection system in Sixth Street or to the treatment plant location.

(3) Main I-3: Since much of the service area for Main I-3 has an existing relatively high density of development, it may warrant initial sanitary sewage service extension into this area prior to full development of the Main I-2 trunk sewer main. This could be accomplished by first placing the 12", 10" and 8" main east of Avenue A to the lines and grades as indicated in the Project Mapping. A small temporary lift station could be constructed at the intersection of Avenue A and McCullough with a

6" temporary force main to the proposed 10" line in Tiner Lane. The 10" main on Tiner Lane would be constructed from the existing 12" in the N. O. Simmons project area to Avenue A and Tiner Lane. This phased approach would allow for the extension of service east of Avenue A and could be later directed into the Main I-2 system as development dictates.

2. Cost Estimates: Cost estimates for the major sewer trunk mains listed below have also been prepared and are based on 1989 dollars and full service area development. They are included in Section V.

V. COST ESTIMATES

Cost estimates have been prepared for the major water and wastewater facilities required to extend adequate service to future developing areas. Estimates have been prepared assuming fully developed service areas. Tables IX and XI have also been prepared for staged development where appropriate. Tables XI and XIII have been prepared as a summary of total project costs for both fully developed and recommended first stage construction.

While cost estimates for proposed major facilities has not been prioritized, they have been indicated in a logical sequence of construction that would facilitate future expansion of service capabilities. Future development patterns of the area will dictate the final sequencing of construction.

Listed below in Tables IX and XI estimated unit costs utilized in the preparation of cost estimates. These unit costs are in 1989 dollars and reflect prices to be expected with the local conditions in the study area. No cost of land or right-of-way have been included unless noted otherwise. Unit cost data has been included to allow the governmental entities in the area to estimate costs for lateral water and wastewater services and to adjust cost estimates as development dictates.

Cost estimates for water and wastewater system improvements to the Ingleside on the Bay area have been designed based on full density development. Water system improvements, including fire protection and service connections, where appropriate, was estimated at approximately $320,000. Wastewater system improvements based on a conventional gravity collection system complete with lift stations, manholes, and service connections was estimated at approximately $985,000. As stated in Section IV.B.2 on page 36, alternate design considerations for wastewater collection systems for this area should be investigated.

A. Water: Waterline prices include all labor and materials (AWWA C-900 PVC pipe) fittings, valves, and street repairs, etc. Prices do not include fire hydrants.

TABLE X - ESTIMATED UNIT COSTS FOR RECOMMENDED WATER FACILITIES

PIPE SIZE	COST/FOOT	FIRE HYDRANTS
8"	$15.00/LF	$1,500.00/ea - complete in place
10"	19.00/LF	
12"	25.00/LF	
16"	33.00/LF	

B. Wastewater: Wastewater trunk mains include all labor and materials (PVC pipe class industrial), safety provisions, dewatering, and pavement repairs. Prices do not include manholes.

TABLE XI - ESTIMATED UNIT COSTS FOR RECOMMENDED WASTEWATER FACILITIES

PIPE	CLASS	0-6	6-8	8-10	10-12	12-14	14-16
8"	SDR 35	14.00	17.00	20.00	23.00	26.00	31.00
10"	SDR 35	16.00	19.00	22.00	25.00	28.00	33.00
12"	SDR 35	22.00	26.00	30.00	34.00	38.00	44.00
15"	SDR 26	30.00	35.00	40.00	45.00	50.00	55.00
18"	SDR 26	40.00	45.00	50.00	55.00	60.00	65.00
21"	SDR 25	52.00	58.00	64.00	70.00	76.00	82.00
24"	SDR 25	65.00	71.00	77.00	83.00	89.00	95.00
27"	SDR 25	75.00	83.00	91.00	99.00	109.00	115.00
30"	SDR 25	100.00	110.00	120.00	130.00	140.00	150.00

Manholes: Costs include all labor and materials for fiberglass manholes with H-20 highway loading and manhole rug and cover.

	0-6	6-8	8-10	10-12	12-14	14-16
48" diameter	1600	1900	2200	2500	2800	3100
60" diameter	2300	2600	2900	3200	3500	3800

TABLE XII - COST ESTIMATES FOR WATER SYSTEM IMPROVEMENTS TO SERVICE THE LIVE OAK RIDGE PLANNING AREA

WATER FACILITY DESCRIPTION	ESTIMATED COST BASED ON FULL DEVELOPMENT OF FACILITIES INDICATED ON PROJECT MAPPING
1. New 500,000 gallon elevated storage tank located at Myrtle and Avenue A (Highway 35) Aransas Pass. Cost includes all materials and labor complete in place including single pedestal spheroidal tank, land, sitework, yard piping, valves, fencing, access road, electrical, 10% contingency, engineering and administrative costs.	$680,000.00
2. Additional ground storage and pumping capacity at Commercial Street Water Plant, City of Aransas Pass. Cost includes all materials and labor complete in place including 1,000,000 gallon ground storage tank, foundation, painting, yard piping, new service pump, electrical, controls, fencing, related site work, engineering and administrative costs.	372,000.00
3. New 16" water main from Avenue A Pump Station to new elevated storage tank location at Avenue A and Myrtle. Costs include all labor and materials complete in place	190,200.00

TABLE XIII - COST ESTIMATES FOR SANITARY SEWER TRUNK MAINS TO SERVICE THE LIVE OAK RIDGE PLANNING AREA

SEWER TRUNK MAIN DESIGNATION	ESTIMATED PROJECT COSTS: COST BASED ON FULL DEVELOPMENT OF FACILITIES AS INDICATED ON PROJECT MAPPING	RECOMMENDED FIRST STAGE CONSTRUCTION
Main I-1	$1,308,720.00 (1)	$ 390,000.00 (2)
Main I-2	1,209,480.00 (1)	1,044,480.00 (3)
Main I-3	381,960.00	280,440.00 (4)
Main I-4	548,700.00	
Main I-5	413,232.00	
Main I-6	300,528,00	
Main A-1	$2,255,532.00 (1)	$1,033,344.00 (5)
Main A-2	1,516,337.00	
Main A-3	1,159,272.00 (1)	836,076.00 (6)
Main A-4	292,656.00	
Main A-5	213,790.00	
Main A-6	602,808.00	
Main A-7	274,056.00	

NOTES:

(1) Includes costs for full development of service areas for both lift stations, gravity trunk sewers and force mains.
(2) Cost of two lift stations, initial pump and piping, 12" forcemain from FM 2725 to lift station and 12" forcemain from lift station to 12" gravity in Green Briar.
(3) Cost includes full development design with only 1-14" forcemain to Eighth Street Lift Station.
(4) Cost includes 10" line from N. O. Simmons property to Avenue A along Tiner Lane. Construction of temporary lift station at McCullough at Avenue A along with 12", 10" and 8" extensions east of Avenue A along McCullough.
(5) Includes lift station, one 12" forcemain from FM 1069 (Avenue B) to Saunders and Highland, 24", 27" and 36" gravity trunk to Main Plant Lift Station.
(6) Cost includes full development design with only 1-12" forcemain to Main Plant Lift Station.

VI. FINANCIAL PLAN

A. The Task to Be Done: The goal of the communities of Live Oak Ridge should be to have available an adequate supply of housing at rental and purchase prices within the income ranges that will be produced by Homeport Ingleside and its related growth. Ingleside and Aransas Pass should be the home of the employees of Homeport. Housing is generally a private sector function, involving many small business interests. These small businesses should respond to the housing demand if land, served by adequate water and sewer facilities and adequately drained, is available at a reasonable price.

The task of this report is to determine what needs to be done to assure that water and sewer service is available to an ample supply of platted lots so that housing can be developed on those lots at a competitive price.

The water and sewer systems serving the Live Oak Ridge area are described in detail in other segments of this report. In addition, Ingleside is in the final stages of developing additional water and sewer facilities to serve the Navy. This report assumes that the Economic Development Administration grant application by Ingleside receives final approval and that the facilities to serve the Navy and the area in the general vicinity of Highway 1069 are constructed. If the grant is not received, additional capital expenditures by Ingleside of approximately $1,500,000 may be indicated.

Since the Ingleside water system in 1981-1982 delivered 235% (a) of its 1987-1988 demand, and Aransas Pass in 1983-84 delivered 148% (b), it should be apparent that adequate water facilities exist for major growth. In essence, Navy related growth will first fill in for lost water sales which were the result of the decline of off-shore exploration and local refining.

Recent and current expansions of wastewater treatment facilities have provided and are providing sewage treatment capacity adequate for at least the next twenty years. Forecasts elsewhere in this report provide the basis for these conclusions.

It should be noted that when comparing existing wastewater rates that both cities utility rates include amoritazation of bonds used to complete major wastewater plant expansion projects during the early 1980's. For the city of Aransas Pass the need to insure

rates due to near term plant expansion requests should not be required based on projected growth figures.

The main challenge is thus not treatment and transmission of water or treatment of sewage. It is collecting the sewage and transporting it to the plant and distributing water in mains sufficient for fire protection so that developing areas can be served.

B. Financing Water and Sewer Improvements - Recent History:

1. Ingleside - In the early 1980's Ingleside incurred substantial revenue and tax backed debt to finance water and sewer system improvements for a demand that soon dramatically declined. As of September 1988, $2,278.00 (c) of this debt remained outstanding. Financing facilities for the Navy and for additional sewage treatment capacity is requiring the sale of approximately $1,250,000 of revenue supported debt and $3,650,000 of debt to be supported by the water and sewer service contract with the Navy. Ingleside's consultant's forecast of income and expenditures, including the proposed Navy contract is set forth on Exhibit 1.

Ingleside's consultant has provided a forecast of revenue and expenditures (d), based on the proposed contract with the Navy. This forecast indicates that Ingleside should receive between $650,000 and $890,000 each year from the Navy from 1989-90 to 1998-99. Thereafter, the Navy will be a usual customer, having already paid for the capital improvements needed to serve the Navy. In 1998-99, the consultant forecasts that the Navy will be directly paying about 12% of the City's total water and sewer operating income, in addition to the final annual payment for the debt incurred to build the facilities to serve the Navy.

Recognizing that the water and sewer system had a net loss of $68,279 in 1987-88 (e) and that Ingleside's General Fund was heavily encumbered by pending litigation and a judgement on appeal (f), new debt does not appear to be an easily obtainable option for financing additional improvements, unless such debt is first supported by a property tax increase or an increase in property values resulting from new construction or annexations. This conclusion should be reassessed, as soon as the Navy's contract has been executed and the facilities built, to determine if additional debt could be incurred using only operating revenue for repayment.

2. **Aransas Pass** - Cash of about $190,000 per year, equal to annual depreciation on the water and sewer system, has been allocated for system improvements. As of September 30, 1988, the system had net current assets of $298,825 (g), of which about $700,000 was available for one time construction expenditures. If this practice is continued, $150,000 to $200,000 per year should be available for water and sewer extensions, in addition to the unspent balance of the approximately $700,000 which was available on September 30, 1988. In the alternative, this depreciation cash flow of $150,000 to $200,000 could be used for annual debt service for a bond issue of $1,500,000 to $2,000,000 with the proceeds of the bond issue being used for water and sewer system extensions to serve homeport related growth.

C. The Cost of Water and Sewer Service: Water and sewer services on Live Oak Ridge are already high priced commodities. The cost of utilities to a new development is composed of two major elements, the actual cost to physically connect the property, including charges to make that connection possible, and the monthly cost to use the system, once connected. First, let's discuss the cost of monthly service and the ability of that revenue source to finance extensions to serve new customers.

D. Multiple Layer Water Service: Each state of the water supply process is administered by a separate unit of government with the result that 3 layers of government are involved in delivering every gallon of water. The selling price increases significantly as the water moves from entity to entity. The City of Corpus Christi provides the supply and some treatment. The San Patricio Municipal Water District treats most of the water used and transports all of the treated water to the Aransas Pass and Ingleside distribution systems and distributes a small quantity directly to customers.

The April 1989 published rates of the entities involved and of the City of Portland for comparison, since it is in the immediate vicinity, are indicated in Table XIV, on the following page.

TABLE XIV - COMPARATIVE WATER RATES FOR CITIES IN THE AREA

RESIDENTIAL

Gallons	Corpus (h) Christi	San (i) Patricio	(j) (3) Ingleside	Aransas Pass (4)	(5) Portland
3,000	$ 5.13	$ 10.00	$ 11.85	$ 12.20	$10.00
10,000	15.21	24.00	31.45	27.60	21.20
30,000	50.07	62.00	89.45	71.60	51.85
50,000	94.27	98.00	147.45	115.60	80.35
all over at ------ per 1000	2.63	$1.70 to 1.35	$3.00 to 3.10	$2.20	$1.40

COMMERCIAL

	(1)	(2)			
3,000	$ 6.62	$ 10.00	$ 13.71	$ 16.80	$12.00
10,000	16.21	24.00	33.31	31.90	23.20
30,000	41.66	62.00	91.31	78.90	54.05
100,000	128.46	183.00	299.31	239.90	152.05
500,000	524.46	748.00	1,397.31	1,159.90	712.05
1,000,000	1,019.46	1,423.00	2,592.31	2,309.90	1,412.05
all over at------- per 1000	$.61 to .82	$1.35	$2.14 to 2.34	$2.30	$1.40
Wholesale to Communities		$.75 and .85			

Notes:

(1) For 5/8" - 3/4" meter. For other meter sizes add from $2.88 to $181.52 per month. Outside City limits is 200% except over 1,000,000 when difference is $.35 then $.19 per 1000 gallons.

(2) For 5/8" - 3/4" meter. Add $2.50 to $50.00 per month for larger meters.

(3) Outside City. Additional minimum from $8.76 to $10.56 and $.90 to $1.09 per 1000 gallons.

(4) Outside City minimum $2.50 to $3.00 more plus $.20 to $.30 per 1000 gallons, $.50 per month reduction from minimum for over 65 with tax exemption.

(5) Outside City add 50%.

E. Sewer: Table XV, below gives comparative rates for sewer service.

TABLE XV - COMPARATIVE SEWER RATES FOR CITIES IN THE AREA-1988

RESIDENTIAL

Gallons	Corpus Christi	Ingleside	Aransas Pass	Portland
2,000	6.05	$ 10.62	$ 12.50	$ 7.50
10,000	13.81	27.74	13.38	11.75
30,000	18.66 max.	70.54	15.58	17.87
over 30,000	maximum 15,000	maximum 15,000	no maximum $.11/1000	no maximum $.28/1000

NON-RESIDENTIAL

2,000	9.08	10.62	55.00-170.00	10.00
10,000	16.84	27.74	59.88-175.60	16.96
30,000	36.24	70.54	72.08-189.60	26.22
50,000	55.64	113.35	84.28-203.60	34.62
over 50,000	.97	2.14	.61 to 1.10	.42 30% of water bill

F. Recent Rate History: For comparison purposes, the residential water rates in effect in the same five jurisdictions in 1982 inside the city limits (m) are set forth in Table XVI, on the following page.

TABLE XVI - COMPARATIVE WATER RATES FOR CITIES IN THE AREA-1982

Gallons	Corpus Christi	San Patricio	Ingleside	Aransas Pass	Portland
3,000	$ 2.85	$ 5.00	$ 7.50	$ 6.55	$ 5.10
10,000	13.06	12.70	10.50	9.15	7.70
30,000	24.14	32.70	48.00	41.65	39.10
50,000	37.14	49.70	86.00	67.65	62.60

In seven years the rates for water service on Live Oak Ridge have generally doubled. For the single family residence using 10,000 gallons per month the rates have tripled, but in Corpus Christi the increase has only been 70%. The basic factors involved have been increasing cost of wholesale water, increasing power costs for pumping and treatment, inflation, and the dramatic drop in water consumption as indicated by the following system information, in Tables XVII and XVIII, below.

TABLE XVII - METERED WATER SALES

(Gallons) Metered Consumer Sales (1)	Ingleside	Aransas Pass	Total
1978-79	283,690,900	389,683,100	673,374,000
79-80	378,960,500	376,539,100	755,499,600
80-81	394,754,100	372,472,200	767,226,300
81-82	432,655,200	445,557,800	878,213,000
82-83	359,942,900	429,326.500	789,269,400
83-84	312,285,800	477,549,100	789,834,900
84-85	244,404,700	350,413,000	594,817,700
85-86	258,373,900	373,698,600	632,072,500
86-87	177,199,600	353,082,000	530,281,600
87-88	183,308,700	321,690,200	504,998,900
10 year total	3,025,576,300	3,890,011,600	6,915,587,900

(1) Excluding San Patricio's retail customers

TABLE XVIII - WATER AND SEWER CONNECTIONS

Year	(p) (1) Ingleside	(q) (2) Aransas Pass	Total
		WATER	
1980-81	2028	2556	4584
1987-88	2001	2521 (3)	4522
		SEWER	
1980-81	1080	2162	3242
1987-88	1172	2104 (3)	3276

Notes:

(1) Highest year between 1980-81 and 1987-88 was 2,145 in 1985-86.

(2) Years between 1980-81 and 1987-88 apparently recorded in an inconsistent manner. And it reflects high of 2,908 water accounts in 1986-87 and 2,448 fewer customers in 1987-88.

(3) May 1989 actual.

G. The Cost to Connect:

1. Uniqueness of Existing Land Development: Almost all of Live Oak Ridge was laid out and platted in the early 1900's as the Burton and Danforth Subdivision. Some of the original lots have since been replatted into five or ten acre tracts or into subdivisions. Some of these divisions of the original lots and blocks have been recorded as legal plats and some have simply been recorded as metes and bounds sales. Any such unplatted sale, since Aransas Pass and Ingleside have had platting ordinances setting forth platting requirements, have been illegal, but that does not alter the fact of their existence. It simply makes more complicated the process of getting such illegally divided property ready for development.

Basically the only areas in large tract ownership and ready for subdividing are located along FM 1069 in south Ingleside and the area east of Avenue B (FM 1069) from Highway 361 to north of Aransas Pass. Unfortunately, most of this land, not included in the Burton and Danforth plat, is either in the flood plain or has been tentatively held back from the market for industrial development.

2. **Replatting the Burton and Danforth:** Those staff members from both Aransas Pass and Ingleside who are most familiar with existing land ownerships in the Burton and Danforth blocks believe that there are few owners who have accumulated land in adjacent lots. If this is correct, replatting will be held up until such land accumulation happens or else each subdivision will be limited in its size and design to the original 20 acre or smaller lot. Thus, it is not likely that many owners will step forward as the representative of 40 or more acres and propose that they pay for all water and sewer facilities needed to serve their tract. Rather, the more usual situation will be an owner of 20 or less acres announcing a development plan and stating that the development can not go forward unless the developer gets some assistance in paying for offsite and over-sized, over-depth requirements which the developer will contend the small size of the development will not allow the project to finance.

3. **Zoning Limitations:** Neither Aransas Pass nor Ingleside have adopted any special provisions to make replatting or reuse of the Burton and Danforth lots easier. Most of the vacant property in both Cities is zoned for a minimum lot size of 7,000 square feet for agriculture. In addition, Aransas Pass has zoned much of the platted area in its southwest quadrant as residential with a 16,000 square foot minimum lot size. Neither community has any substantial undeveloped area where mobile homes are allowed. Only a small area in each community allows duplex or multi-family use.

If zoning limitations are not modified, most of the growth will need to be accommodated on single family lots and will involve utility extension costs which will be difficult for the owners of property being replatted to finance unless the cities have some means available to advance the neighbors share or in some other way assist in off-site, over-sized, and over-depth costs.

4. **Developer's Responsibilities:** Both Aransas Pass and Ingleside place the full responsibility for water and sewer extensions, including sewage lift stations, on the developer of

the property (r). In each case the owner of a full lot in the Burton and Danforth Subdivision is entitled to one water and/or sewer connection to his property. In both cities the owner must extend the needed mains from their existing location with no assurance that the applicant will receive any reimbursement. In addition, Ingleside requires additional fees to help offset the cost of having utilities available to serve.

Aransas Pass provides for future reimbursement to the developer from front foot charges received from others using the line paid for by the developer. It also provides the City participation in the cost of over-size and over-depth costs if the City has money to commit to that purpose at the time the plat is approved.

Ingleside requires payment of an acreage charge and a tap charge greater than the cost of making the tap. The acreage charge is placed in a fund for the future reimbursement of off site, over-depth, and over-size expenditures by future developers. Even lift stations are the responsibility of the developer with reimbursement only if the fund has money available from other developers. No payments have been received by Ingleside under the provisions of these sections of the City Code. Ingleside's Code provides that the developer must go to the nearest standard facility and provides that the distance involved can be up to one mile. For all practical purposes all of Ingleside's growth area is within one mile of standard water and sewer facilities.

5. **Impact Fees:** The tap fees being charged by Ingleside are probably impact fees. Either the procedure to adopt impact fees set forth in State law needs to be followed or the tap charges need to be revised to become lot or acreage fees going into the transmission and distribution trust funds. The alternative is to simply reduce tap charges with the amount being based on direct costs plus reasonable administration and overhead.

The Impact Fee Law which was passed in 1987 (s) has been reportedly substantially revised by the 1989 Legislature. As soon as copies of the new law are available for review, both cities will need to review current charges to be sure that such charges are in compliance with the new law.

H. Needed Improvements - Now: Certain water and sewer main improvements are needed now to be sure that ample areas in both communities are in a position to be developed with a reasonable front end cost by the developer. These projects are identified in

other sections of this Report. In addition funds to reimburse developers for off site, over-size, and over-depth requirements should be created in some manner if Live Oak Ridge is to receive the economic impact that could be possible from the Homeport project.

I. Financial Options: The financial options available to finance water and sewer lines and sewage lift stations during the 1990's include the following options:

1. Reduce the cost of the existing services and commit the savings to capital improvements. This alternative is always politically exciting but very hard to accomplish. The only substantial potential in this area is to try to reduce either the layers of government or the costs being charged by those layers.

2. Increase the number of customers and use the front foot charges and part of the monthly income from the new customers for debt service costs for bonds to be sold to provide for extensions to make the service possible. The same approach can be used to generate operating income to be directly spent for construction costs, although the amount of construction will obviously be much less.

3. Borrow more money, backed by taxes, to insure that appropriate areas such as near schools that are well drained, become the most attractive growth areas.

4. Pursue further use of impact fees. Since there are no people standing in line to pay the present fees, raising those fees, even if supported by a full fee setting study and by appropriate public hearings and advisory committee reports, might not produced money or water and sewer lines.

Additional discussion about several of these options may be helpful.

J. Water System Simplification: It should be apparent that water rates are already high in the Live Oak Ridge area. A new family in the Live Oak Ridge area using 10,000 gallons of water a month will pay from $12.05 in Aransas Pass to $30.26 in Ingleside more per month for water and sewer service than the same family would pay in Corpus Christi. This disparity may result in water rates being a negative factor as new families choose a place to live. These costs could be reduced by any of the following actions:

1. Corpus Christi could reassess its rates for the sale of treated and raw water to San Patricio. Statewide concerns recently discussed at length before the State Legislature might encourage such a reassessment.

2. Ingleside and Aransas Pass could consolidate the existing distribution systems into one system, enabling better use of pumping and storage facilities, reduce equipment duplication, and improve personnel utilization. Such a consolidation could include sewage collection and treatment or be limited to only the water system.

Without some major change, existing water rates, particularly in Ingleside, will tend to eliminate operating income as a source of city participation in new construction and also make water rate increases to provide for new construction difficult to support from both an equity and political standpoint.

K. Water Customers Without Sewer Service: Ingleside provides water service to over 800 customers who are not sewer customers. If most of these accounts were also sewer customers, monthly income would increase by at least $12,000 or $144,000 per year. One time front foot or fee for service charges would add almost $400,000, assuming a $5 per front foot charge and an average lot width in the areas without service of 100'. The existing City Code provides for a front foot charge of $4.60 for water and $5.40 for sewer with both figures escalating with the consumer's price index as of September of each year with the base year apparently 1987. These costs are assumed to apply to both sides of the street. Obviously these fees could be increased until they reflect 50% of full cost. A petition program could be initiated to give priority to those who, by their signature indicate that they are willing to pay their share to connect as soon as the lines are available. A time payment plan could also be initiated. Unserved potential customers represent a financial asset that should be involved as part of the financial solution to providing utilities to more vacant lots.

In Aransas Pass the City provides water service to over 400 customers who do not have sewer service. The City will extend a line 100' without charge. Its reimbursement for longer extensions is based on material costs only. Setting a fee that more nearly represents full cost, charging for every foot of extension, using a petition system to sign up customers in advance, and providing for monthly payments of the front foot charge could all be

considered as possibilities to make cash available for needed extensions.

L. Summary: The issue is simple. Will the Live Oak Ridge area receive a substantial share of growth to be caused by Port Ingleside or will it go elsewhere?

It is not a question of an adequate supply of platted lots. Platted lots are in abundance.

It is not a question of major water and sewer facilities being in short supply. The existing water supply, water transmission facilities, and sewage treatment facilities can easily handle 100% growth.

The need is to provide water and sewer mains to the existing lots in such a way that people can afford to buy the lots and to pay the monthly bills. The solution must be complex and must involve a number of separate actions. Fortunately each of the actions is attainable, but prompt actions is indicated.

M. Needed Additional Study: In addition to the specific areas of concern mentioned in the report, other related concerns have become evident in the course of this study. They include:

1. The proposed demand for rental units and small homes for purchase may not have been assumed when the zoning maps for Ingleside and Aransas Pass allocated land to certain zoning districts. A review of land use demand may now be indicated, if the two communities wish to capture a significant percent of Homeport initiated growth.

2. Adjacent parcels in joint ownership need to be identified. The nature of ownerships and the size of common holdings are important in planning a community's growth. In addition, the status of property resubdivision, including both approved and unapproved lot divisions, should be accurately mapped.

3. A map indicating where water and sewer service is already available and where only water service is available and should be readily reviewable by visitors to City Hall and anyone who is interested in community growth.

4. The projects that should happen first are those which can also serve existing improvements and cause growth that can best be served by existing drainage, schools, other public facilities, and

private activities like stores, churches, and other public and private services. A list of projects that meet these criteria should be developed.

5. The Ingleside water and sewer code provisions need to be updated and clarified. Unfortunately there has not been sufficient activity under the ordinance to work out its problems.

6. If impact fees are to be used by either Aransas Pass or Ingleside, full studies as are required by the 1987 law and the 1989 amendments will be needed before use of impact fees will be feasible.

FOOT NOTES

(a) City of Ingleside, Texas, Annual Financial Report Year Ending September 30, 1988, page 60.

(b) Annual Financial Report, City of Aransas Pass, Texas, September 30, 1988, Page 93.

(c) Ingleside, Financial Report, 9/30/88, page 66.

(d) Homeport Water and Wastewater Service, Annual Operating Statement Data, May 3, 1989, Archie Walker Engineering, Inc.

(e) Ingleside Financial Report, 9/30/88, page 5.

(f) Ibid, page 1

(g) Aransas Pass Annual Financial Report, 9/30/88, page 43, 44.

(h) City of Corpus Christi, Department of Public Utilities, Water Rates and Wastewater Service Charges, Revised 8/1/88.

(i) San Patricio Municipal Water District, Report on Examination of Financial Statements and Additional Information, Year Ended December 31, 1988, page 11.

(j) Ingleside Financial Report, 9/30/88, page 62.

(k) Aransas Pass, City Code, Chapter 29, Section 29-28, page 1820-23.

(l) City of Portland, Ordinance #709 Rewater and Sewer Rates, Approved March 19,. 1985.

(m) Comparison Inside City Water Rates, 11 Water Systems, April 1982, R. M. Townsend.

(n) Ingleside Financial Report, 9/30/88, page 60.

(o) Aransas Pass Financial Report, 9/30/88, page 93.

(p) Ingleside Financial Report, 9/30/88, page 61.

(q) Aransas Pass Financial Report, 9/30/88, page 93.

(r) City Code, City of Aransas Pass, Chapter 29, Water and Sewer Service, Article II Utilities, Section 29-27 to 29-30 Article III Water and Sewer Main Extension, Section 29-40 to 29-59
and
City Code, City of Ingleside, Chapter 11, Utilities. Section I Water and Section 2 Sewer.

(s) Senate Bill 336, 1987 Legislature, State of Texas.

VII - WATER CONSERVATION PLAN

Two events have occurred this decade which have emphasized the need for water conservation and a drought contingency plan for the City of Corpus Christi and for those entities in the Coastal Bend area dependent on the Nueces River for their water supply, including the Cities of Aransas Pass and Ingleside and the County of San Patricio.

From May 1982 through September 1984, this area experienced a drought of greater magnitude than any since the 1950's. In order to ensure an adequate water supply for municipal and industrial uses, it was necessary for the City of Corpus Christi along with the San Patricio Municipal Water District and others to develop short-term interim water supply sources and to implement a water conservation program.

In 1985, the 69th Texas Legislature recognized that water is a limited resource which is being subjected to increasing demands. Legislation was passed and the Texas Constitution amended to require that before a water supplier can obtain financial assistance from the State's Development Fund or the Water Loan Assistance Fund, the supplier must have adopted a water conservation and drought contingency plan.

Water used in the residential, commercial, and industrial sector involves the day-to-day activities of all customers and includes water used for drinking, bathing, cooking, dish washing, sanitation, fire protection, lawn watering, recreational purposes, and industrial processes. Since the early 1960's, per capita water use in the State has increased about four gallons per person per decade. More importantly, per capita water use during droughts is usually about one-third greater than during periods of average precipitation.

The objective of a conservation program is to reduce the quantity required for each water using activity, insofar as practical, through the implementation of efficient water use practices.

The water conservation plan should address all feasible aspects of conservation for the particular entity including one or more of the following methods:

--Education and Information
--Plumbing Codes
--Retrofit Programs
--Water Rate Structures
--Universal Metering
--Water Conserving Landscaping
--Leak Detection
--Recycling and Reuse
--Implementation and Enforcement.

The drought contingency plan must include the following six elements to meet the minimum TWDB requirements:

--Trigger Conditions
--Drought Contingency Measures
--Information and Education
--Initiation Procedures
--Termination Notification
--Implementation Procedures.

The City of Corpus Christi, Texas, is the final source of water for the study area, since they own the majority of the water rights. In 1986, the City of Corpus Christi published a water conservation plan that was reviewed and accepted by the Texas Water Development Board. The District has always cooperated fully with the City of Corpus Christi in water conservation and resource planning. In May of 1989 the District, as a part of this report, published a plan, based largely on the City of Corpus Christi plan. Since the District and the member Cities of Ingleside and Aransas Pass are contractually obligated to follow this plan, it has been included in this report, in its entirety, in Appendix IV. Specific details outlining conservation measures such as retrofit programs, plumbing codes, etc. are included in detail in the City of Corpus Christi Plan. This plan is readily available to all area entities receiving water from the City of Corpus Christi and is not included as a part of this report. It must be clearly understood that prior to submission of an application to the Texas Water Development Board for financial assistance from the development fund or the water loan assistance fund, the San Patricio Municipal Water District and any of its member Cities must have a water conservation and drought contingency plan that has been approved by the Texas Water Development Board. Furthermore, a successful application is required to have a program in place before loan funds can be released.

Both the Cities of Ingleside and Aransas Pass are encouraged to utilize treated wastewater effluent for irrigation purposes as a means to conserve treated water. The City of Aransas Pass has a new city park project located adjacent to the existing 1.6 MGD treatment plant site. Future expansions of the park facilities include on-site ponds that could easily be incorporated into an irrigation system with treated effluent being used to maintain water surface levels and a supply for irrigation water. The City of Ingleside also has a large park area (Live Oak Park) located approximately 5,000 feet from the existing wastewater treatment plant. Future plans for this park facility could also include an irrigation system utilizing treated effluent. Possible development of the Kinney Bayou drainage ditch into a parkway development could also incorporate an irrigation system utilizing treated effluent from the wastewater treatment plant. Design considerations must include those provisions specified in the Texas Water Commission permits and other State regulations.

Since the primary focus of this planning report is to analyze existing and proposed water and wastewater transmission and collection systems based on full development within a service area, utilization of projected flow rates and conservation measures was not used as a basis of design. Sizing of water system improvements including pumping, storage and main sizes is determined by criteria set forth in Texas State Board of Insurance and Texas Department of Health criteria. Sizing of lift stations, gravity trunk mains and force mains is determined based on Texas Department of Health criteria.

While the use of conservation measures was not used for design purposes, it should be considered an important part of any municipal or industrial water or wastewater system.

Many communities throughout the United States have used conservation measures to successfully cope with various water and wastewater problems. Reductions in water use of as much as 25 percent or more have been achieved, but the normal rate is from 5 percent to 15 percent. As a result of reduced water use, wastewater flows have also been reduced by 5 percent to 10 percent.

Some examples of how conservation measures will provide a direct benefit to this area include the requirements for the supply and treatment of potable water and the treatment of wastewater effluent. The San Patricio Municipal Water District provides the study area with treated water. If the two Cities

were effectively able to reduce their need for treated water through conservation methods, it would extend the San Patricio Municipal Water District's treatment plant life. An example of this is given in Table XIX, on the following page.

TABLE XIX - POTENTIAL IMPACT OF WATER CONSERVATION METHODS ON WATER USAGE

Municipality	Present Water Use (GPD)	Projected Yr 2000 (GPD)	Projected Yr 2000 With Conservation
City of Aransas Pass (8,172 population)	1,634,400	2,322,000	1,974,000
City of Ingleside (6,200 population)	930,000	1,445,000	1,228,000
Total	2,564,400	3,767,000	3,202,000

(Based on population and a projected usage rate of 125 gpcd for Aransas Pass and 150 gpcd for the City of Ingleside.)

If a 15% reduction can be achieved through conservation efforts by the year 2000, it will reduce potable water treatment plant requirements by approximately 565,000 gpd.

The same type of scenario holds true for wastewater treatment plants. Extended treatment plant life can be achieved through the reduction of influent through conservation measures. Table XX, on the following page, shows what might be expected if a reduction in wastewater flows of approximately 10%.

TABLE XX - POTENTIAL IMPACT OF WATER CONSERVATION METHODS ON WASTEWATER FLOWS

Municipality	Existing Flow Rate (MGD actual)	Year 2000 Flow Rate (MGD)	Year 2000 Flow Rate With Conservation (MGD)
City of Aransas Pass (1.6 MGD plant)	0.50	1.4	1.28
City of Ingleside (1.0 MGD Existing Plant with 1.0 MGD expansion)	0.40	0.95	0.86

(Projections based on future population projections and on an estimated wastewater flow of 100 GPCD. Flow rates for Ingleside do not include wastewater from the Naval Station Ingleside facility.)

VIII. CONCLUSIONS AND RECOMMENDATIONS

This Master Plan has been prepared as a guide to the Cities of Aransas Pass and Ingleside and to the County of San Patricio for the planning and implementation of water and wastewater improvements to serve the Live Oak Ridge area of San Patricio County. The development of the total study area will occur over a period of many years. While the nature and order of development cannot be precisely determined in advance, it is anticipated that development will be primarily residential and commercial in nature, and that the areas directly adjacent to the existing developed areas and the areas located between the two cities will develop first. Development to the west and north of the City of Aransas Pass will occur as system extensions are made. It is also anticipated that the areas south and east of the City of Ingleside will develop as water and wastewater service is extended.

Phasing of construction and locations of improvements recommended in this Master Plan should be considered flexible particularly as they pertain to the wastewater collection system.

Locations of recommended wastewater collection mains and service area boundaries are approximate. Due to the flatness of topography in many areas, it may be desirable to change the size of a line or shape of a service area. Prior to deviating from the plan set forth, effects on adjacent service areas and sewer grades should be thoroughly evaluated.

If major water and wastewater system extensions are planned and constructed in accordance with this Master Plan, the system will be adequate to serve the study area when it is fully developed.

Following are specific recommendations with regards to the Master Plan development:

1. The Master Water and Wastewater Plan should be followed to insure that development of these facilities occurs in an orderly, systematic and cooperative manner.

2. Short term planning of construction should be consistent with long range plans particularly as they pertain to wastewater collection mains and lift stations.

3. Both Cities should begin detailed studies of site and right-of-way requirements for pumping stations, storage improvements, and water and wastewater main extensions.

4. This Master Plan should be reviewed and updated at least every five years or as actual conditions deviate from anticipated conditions.

5. Both Cities should begin research into funding options to pay for future service extensions. Reviewing and updating City ordinances and investigating impact fees and other utility assessment programs should begin immediately. An investigation into combining water and wastewater facilities for the two cities and the possibility of privatization of the operation of these utilities should be considered in the future as a means by which to raise the necessary capital funds for system expansion.

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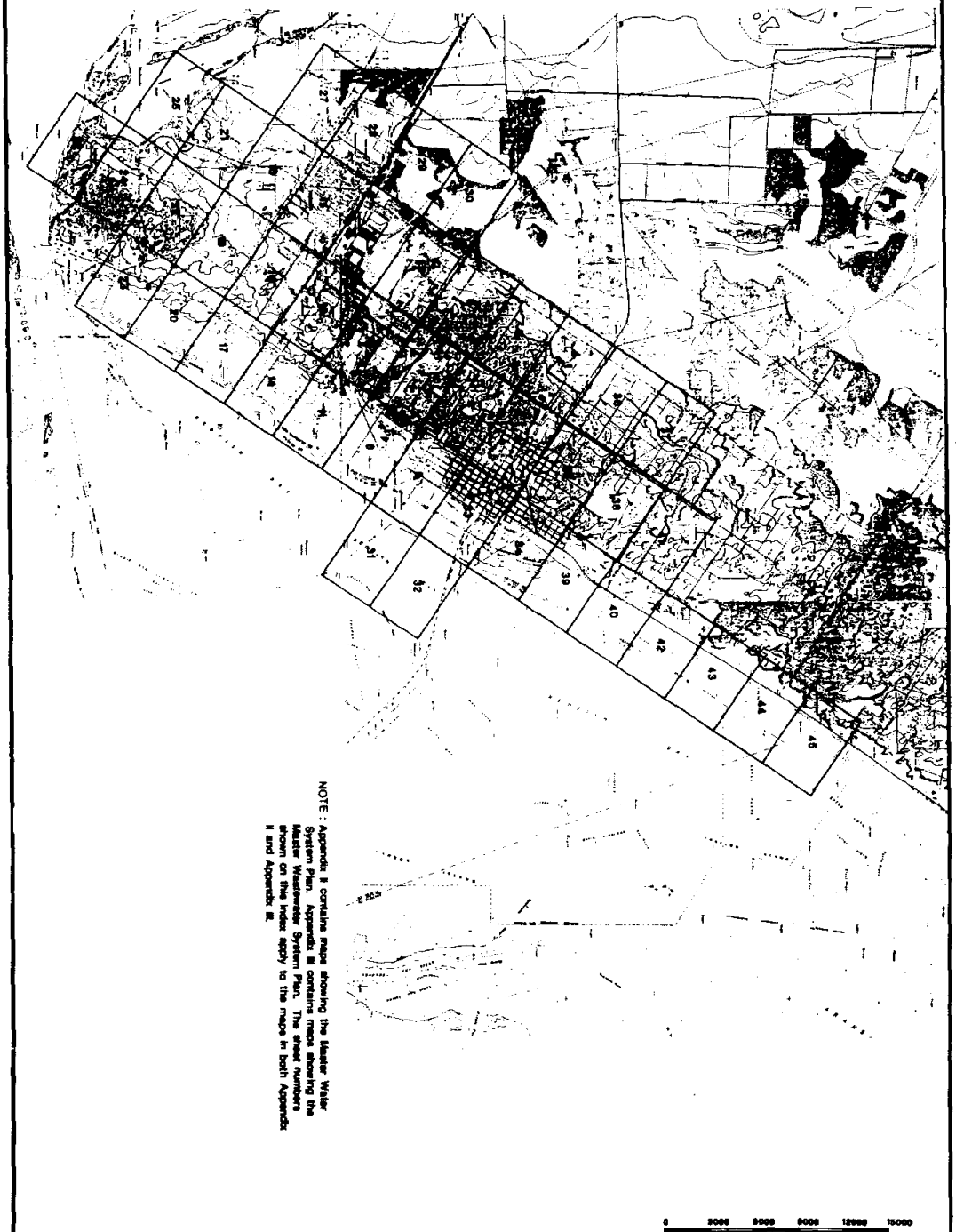
REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
SAN PATRICIO COUNTY, TEXAS

SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989

APPENDIX I - INDEX TO PROJECT MAPPING



NOTE : Appendix II contains maps showing the Master Water System Plan. Appendix III contains maps showing the Master Wastewater System Plan. The sheet numbers shown on this index apply to the maps in both Appendix II and Appendix III.

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GRAPHIC SCALE IN FEET

REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

INDEX TO PROJECT MAPPING

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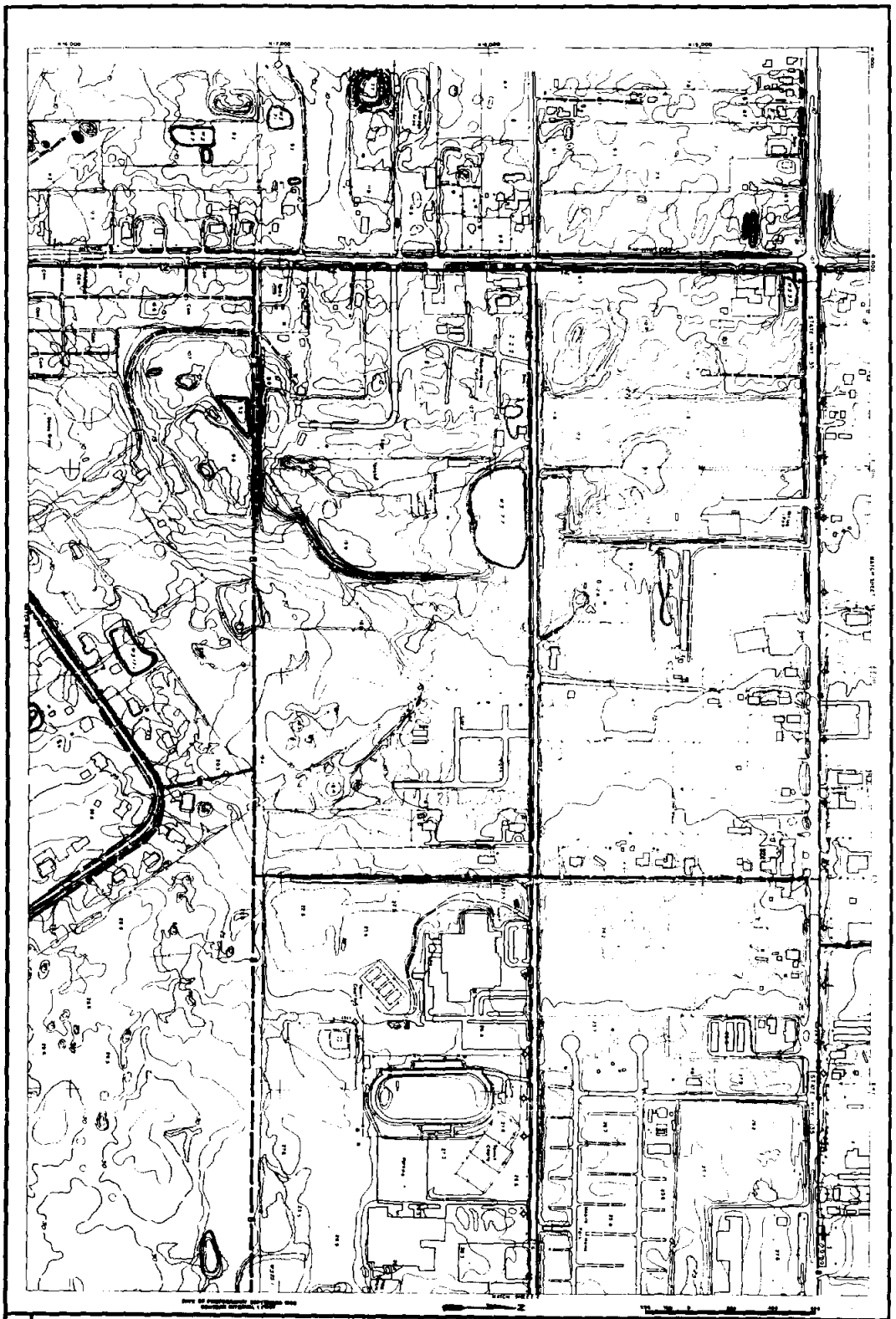
45 - PROJECT MAPPING SHEET NUMBER

I-1

REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
SAN PATRICIO COUNTY, TEXAS

SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989

APPENDIX II - MASTER WATER SYSTEM PLAN



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

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- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
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- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

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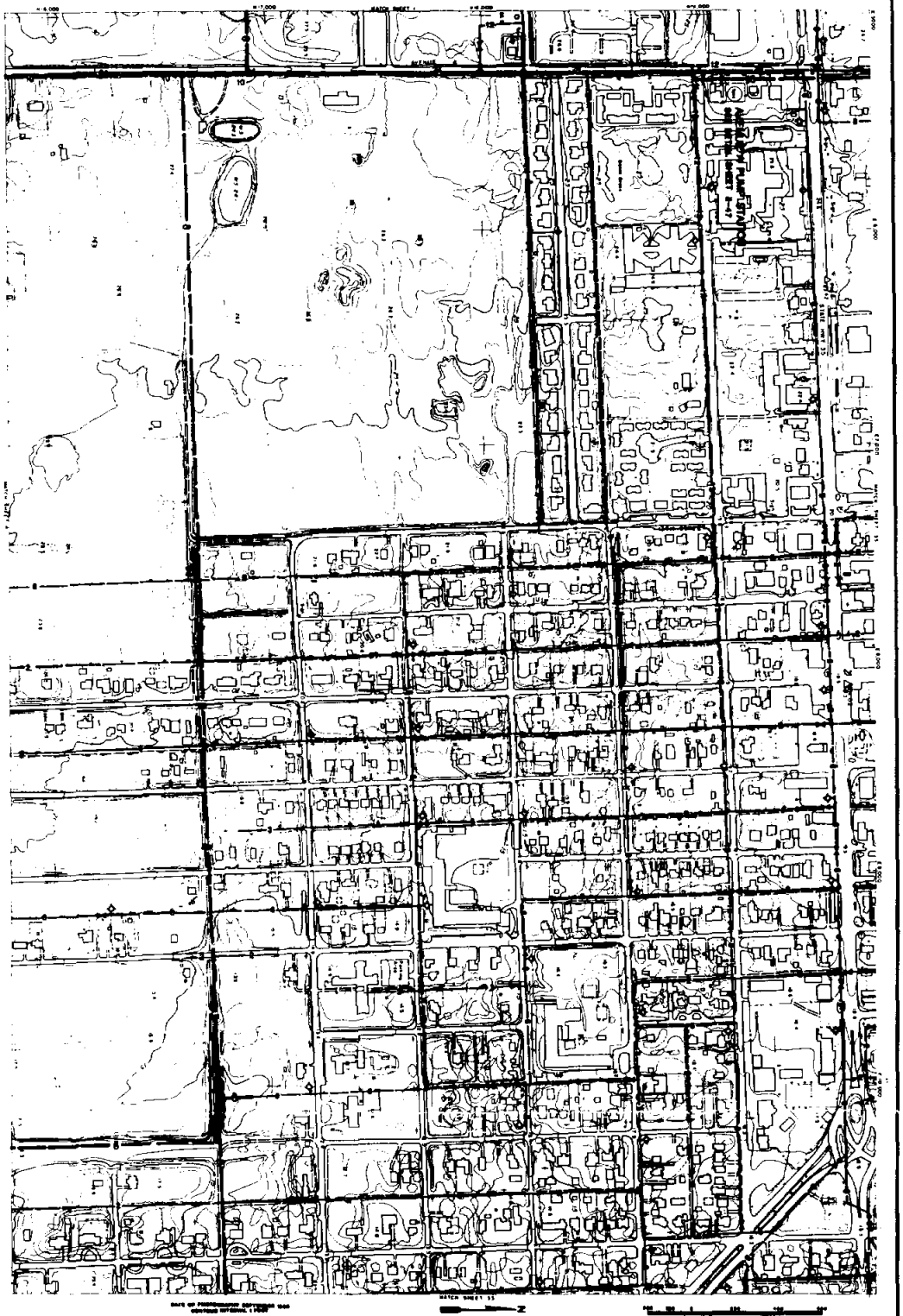
II - 1



REGIONAL WATER AND WASTEWATER MASTER PLAN

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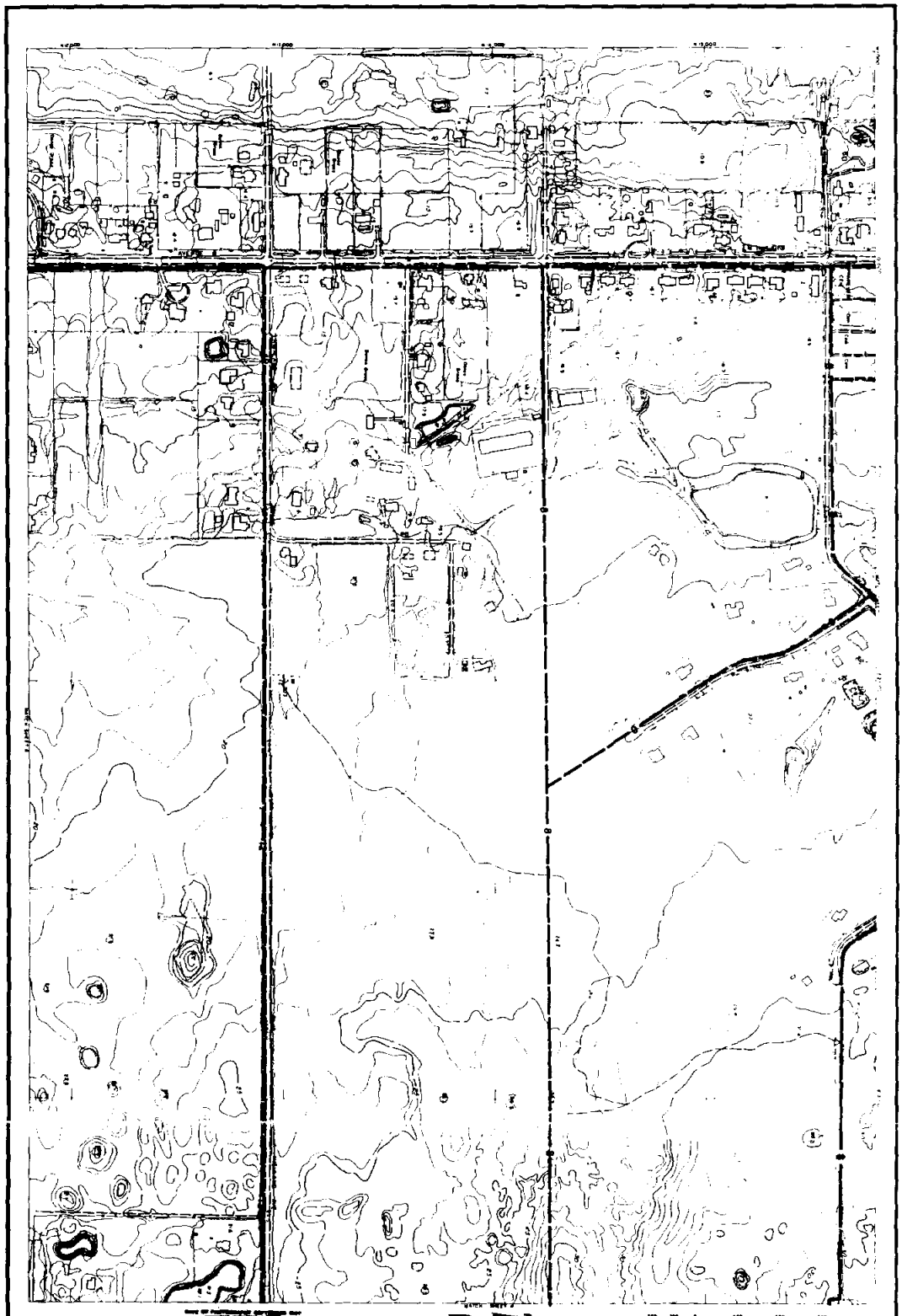

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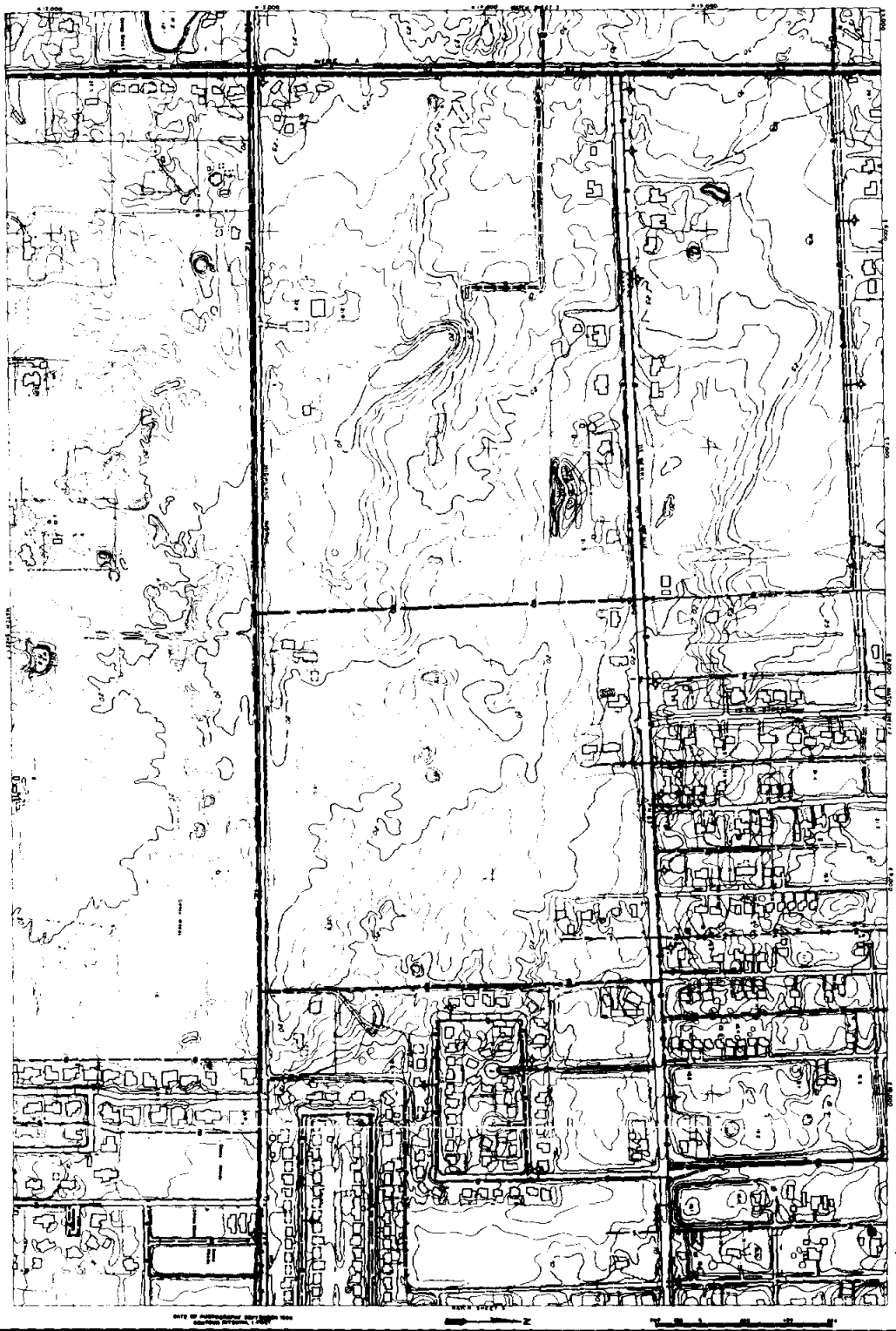

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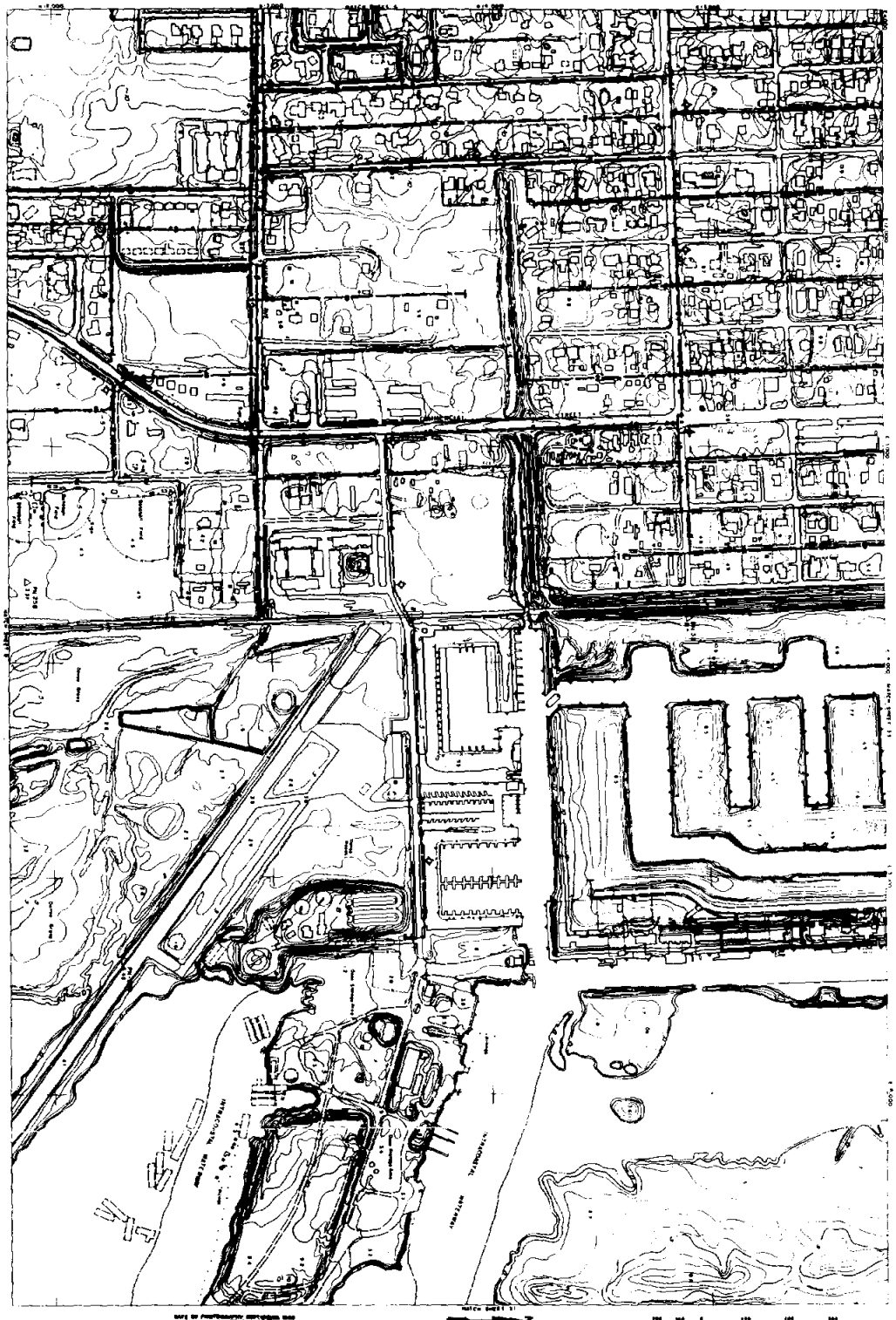

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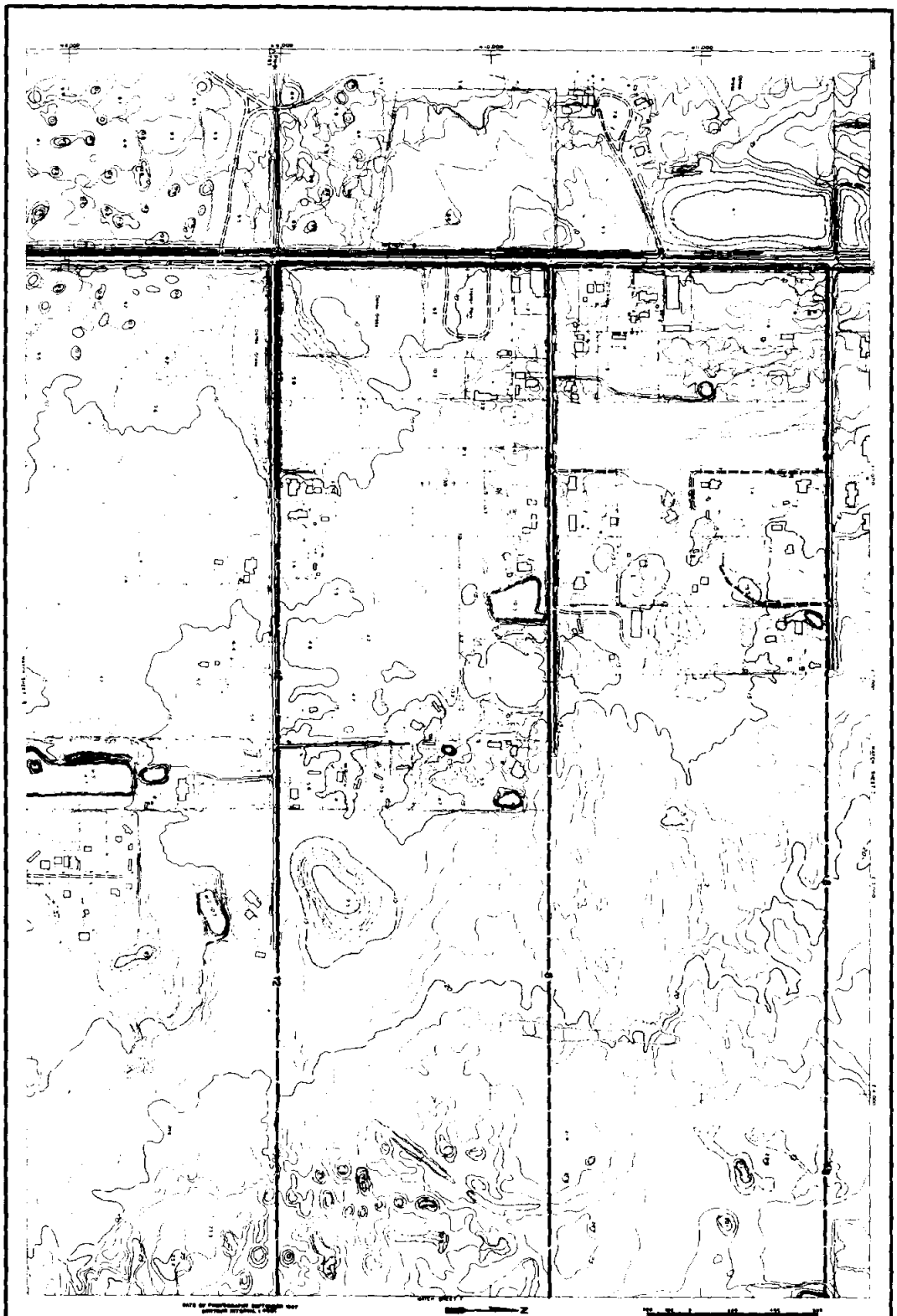

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MASTER WATER SYSTEM PLAN

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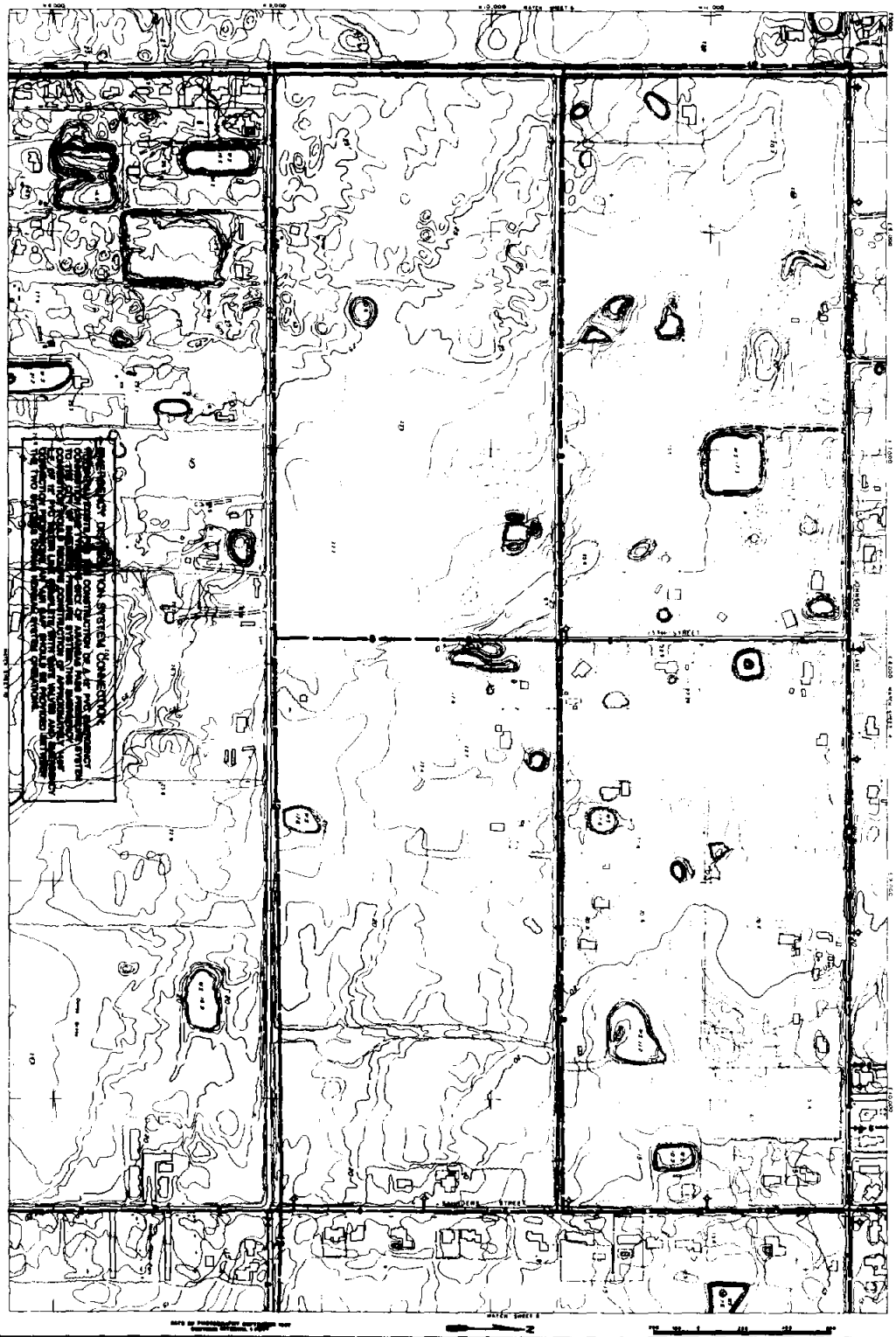
MAPPING PURCHASED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NE#2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

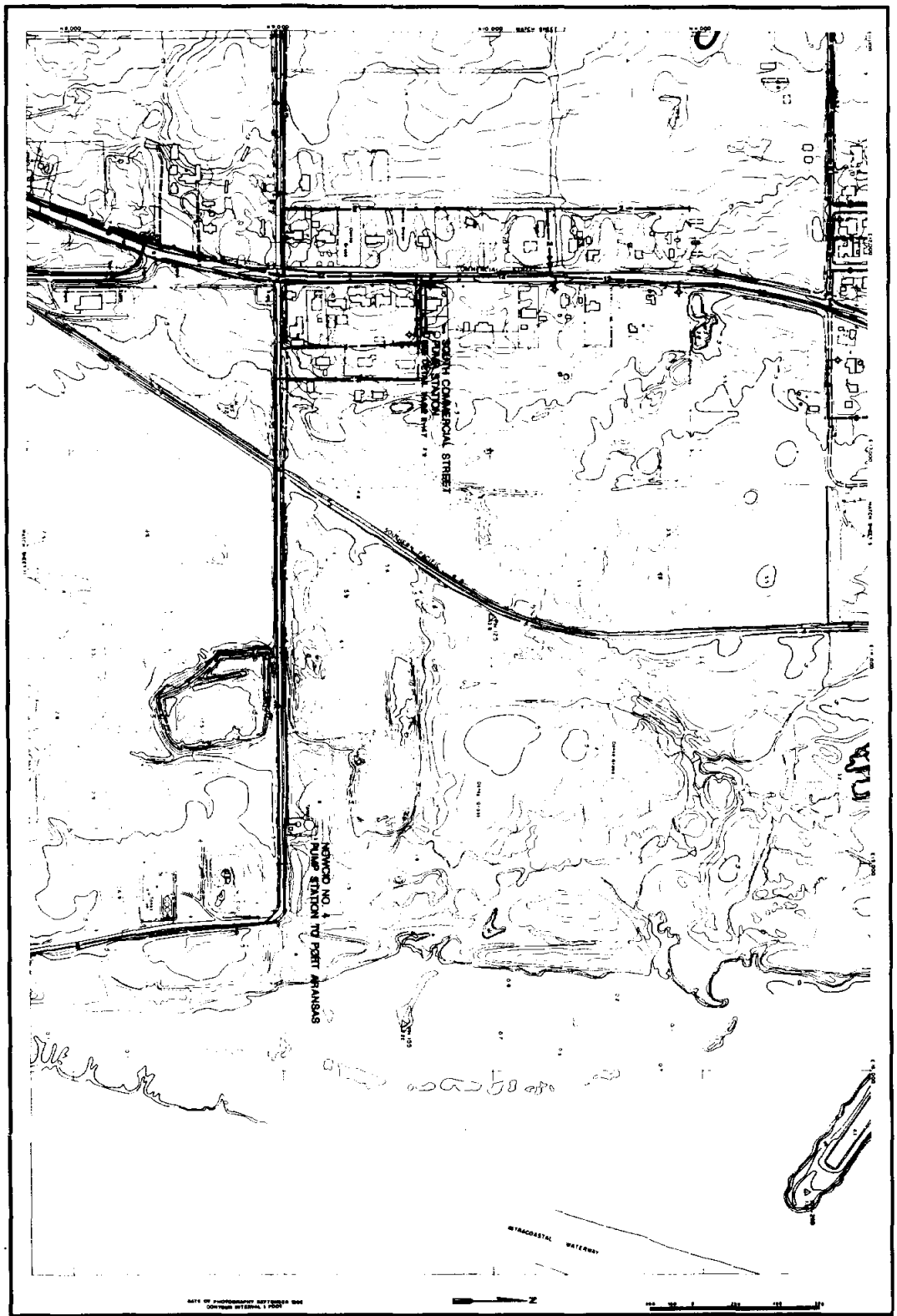
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 7



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 NEI #2799

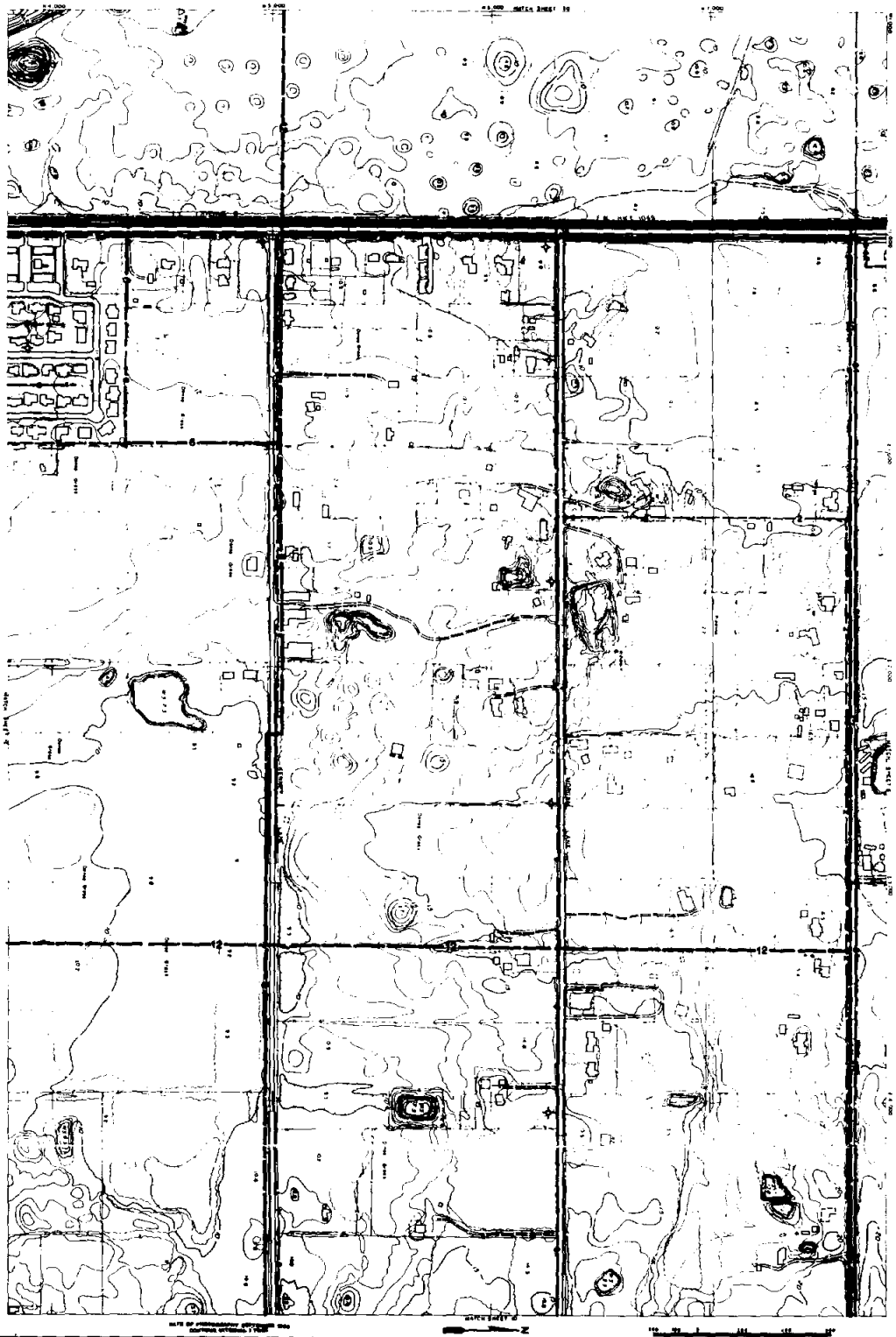
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- 10 EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- 10 PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- 10 EXISTING WATER LINE (SIZE IN INCHES)
- 10 PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 8



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NEI #1790

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

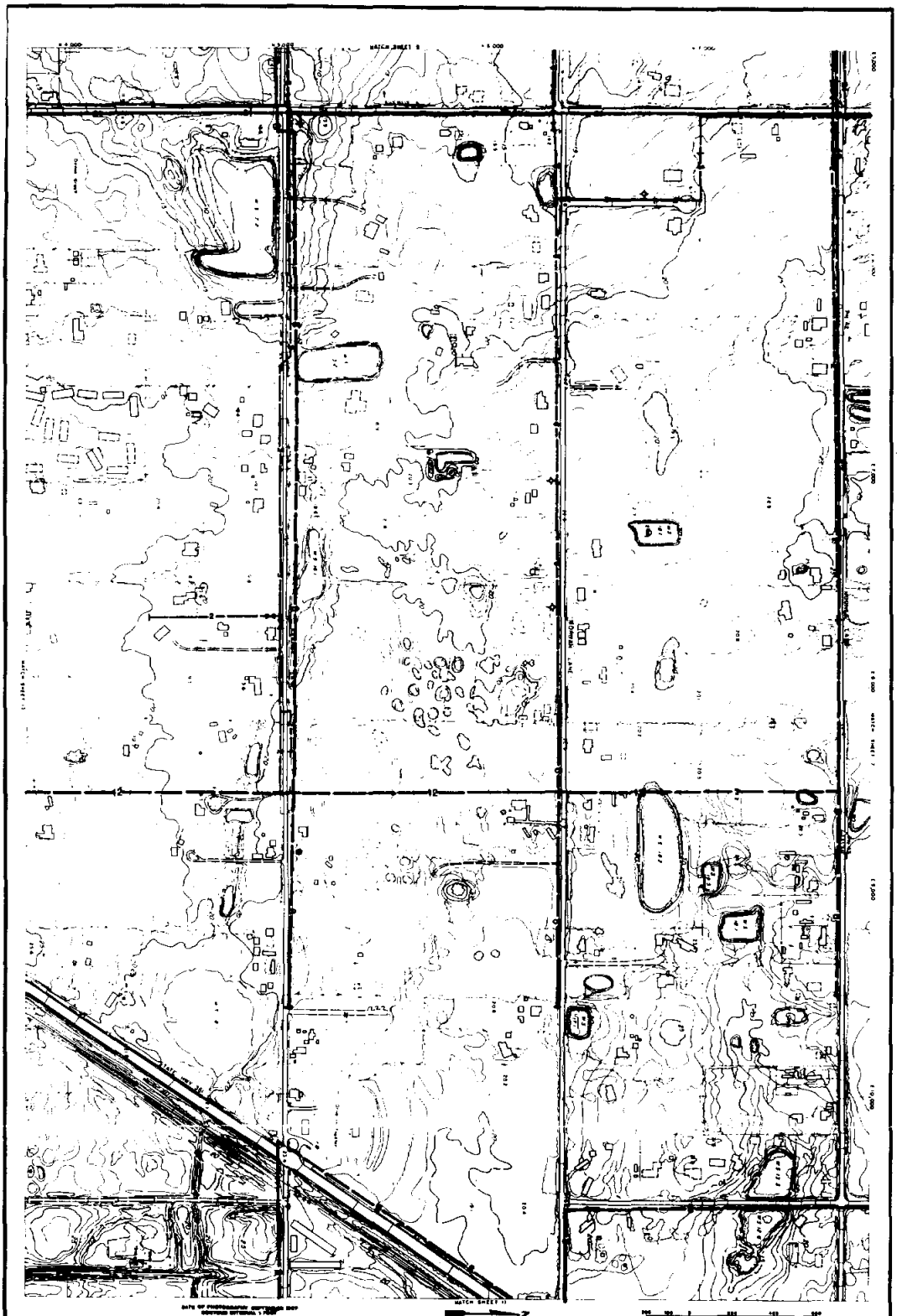
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 9



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

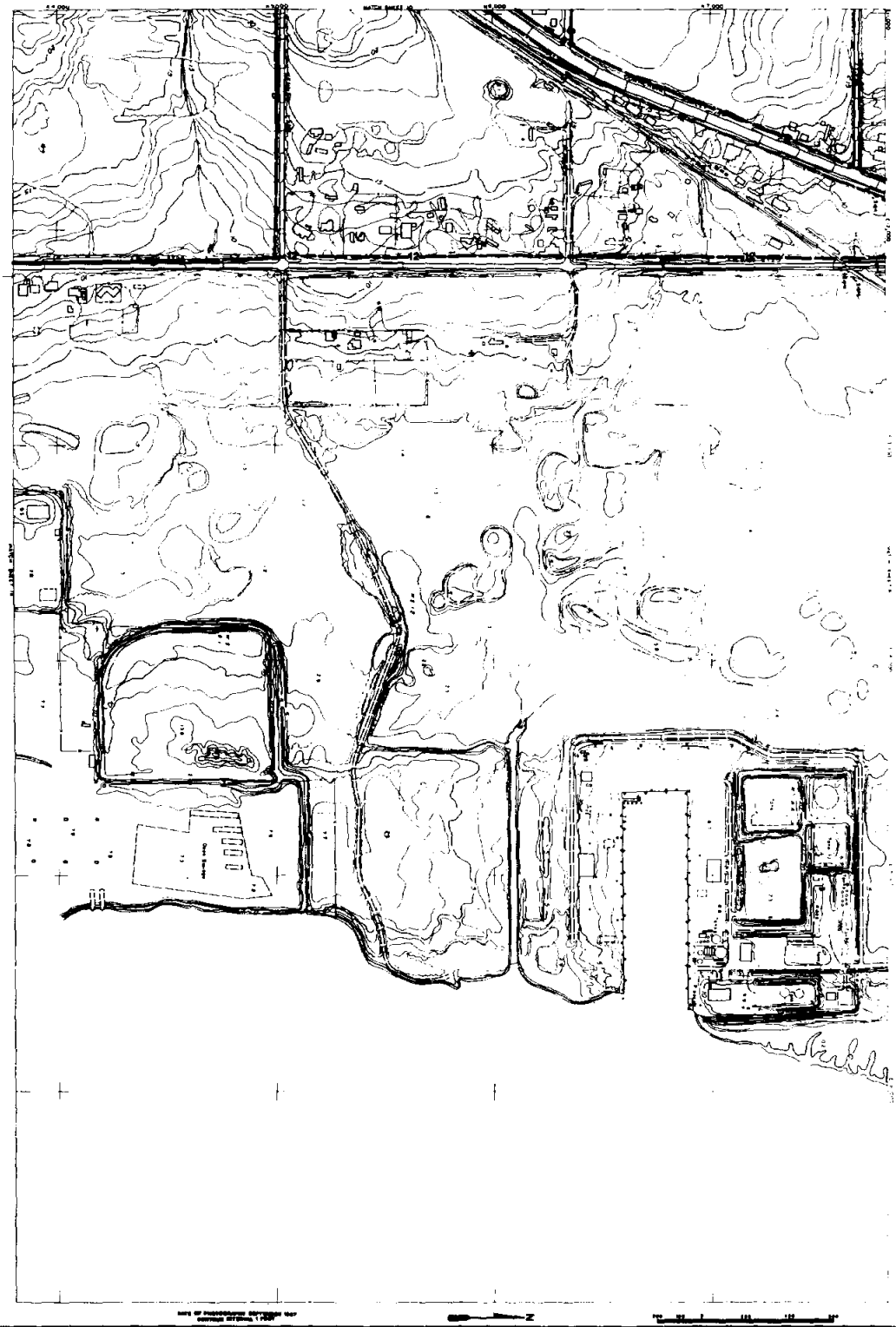
AUG. 1980 | NE-8709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

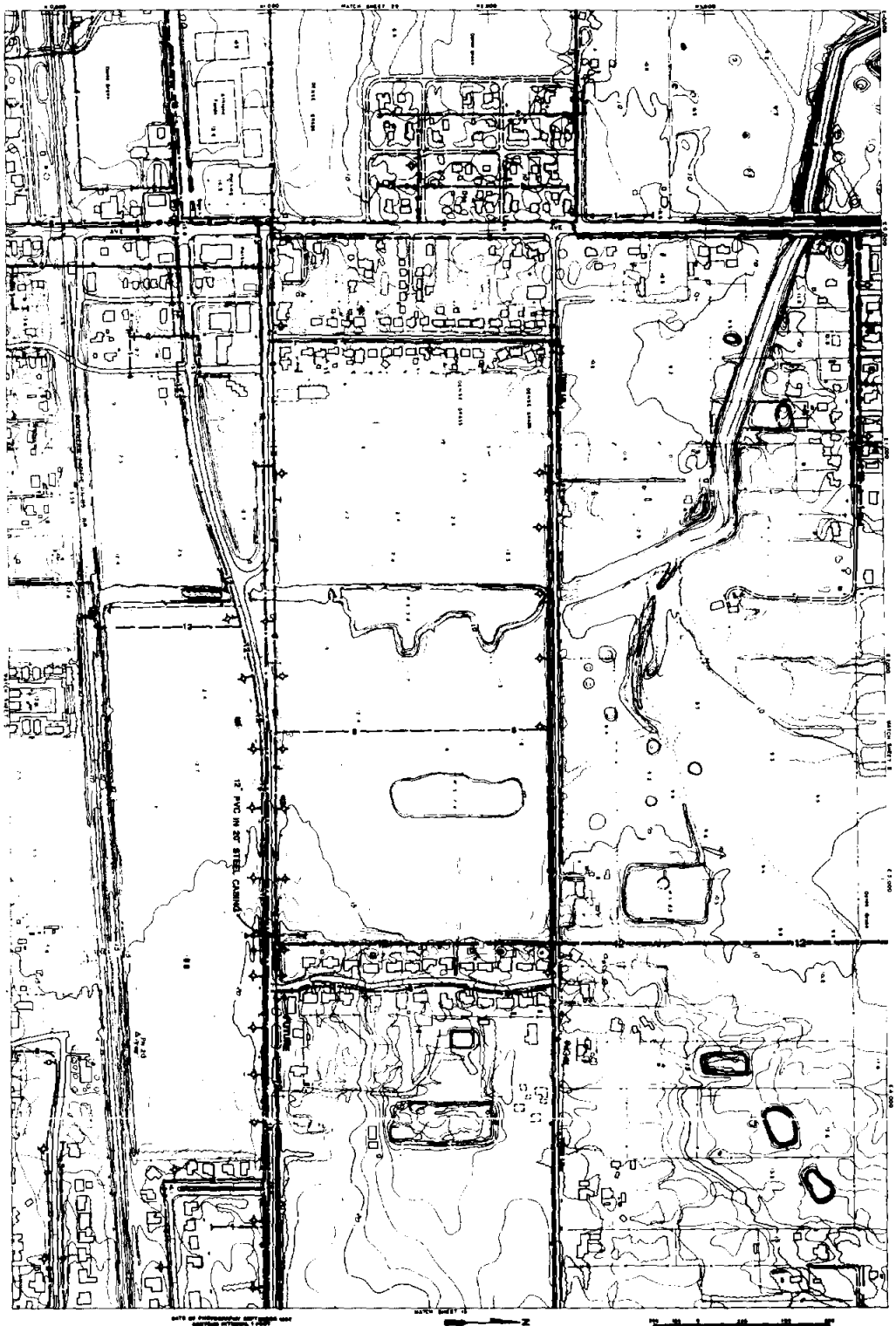
AUG. 1980 | NE-82799

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NES#2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

—10— EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)

—10— PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)

—10— EXISTING WATER LINE (SIZE IN INCHES)

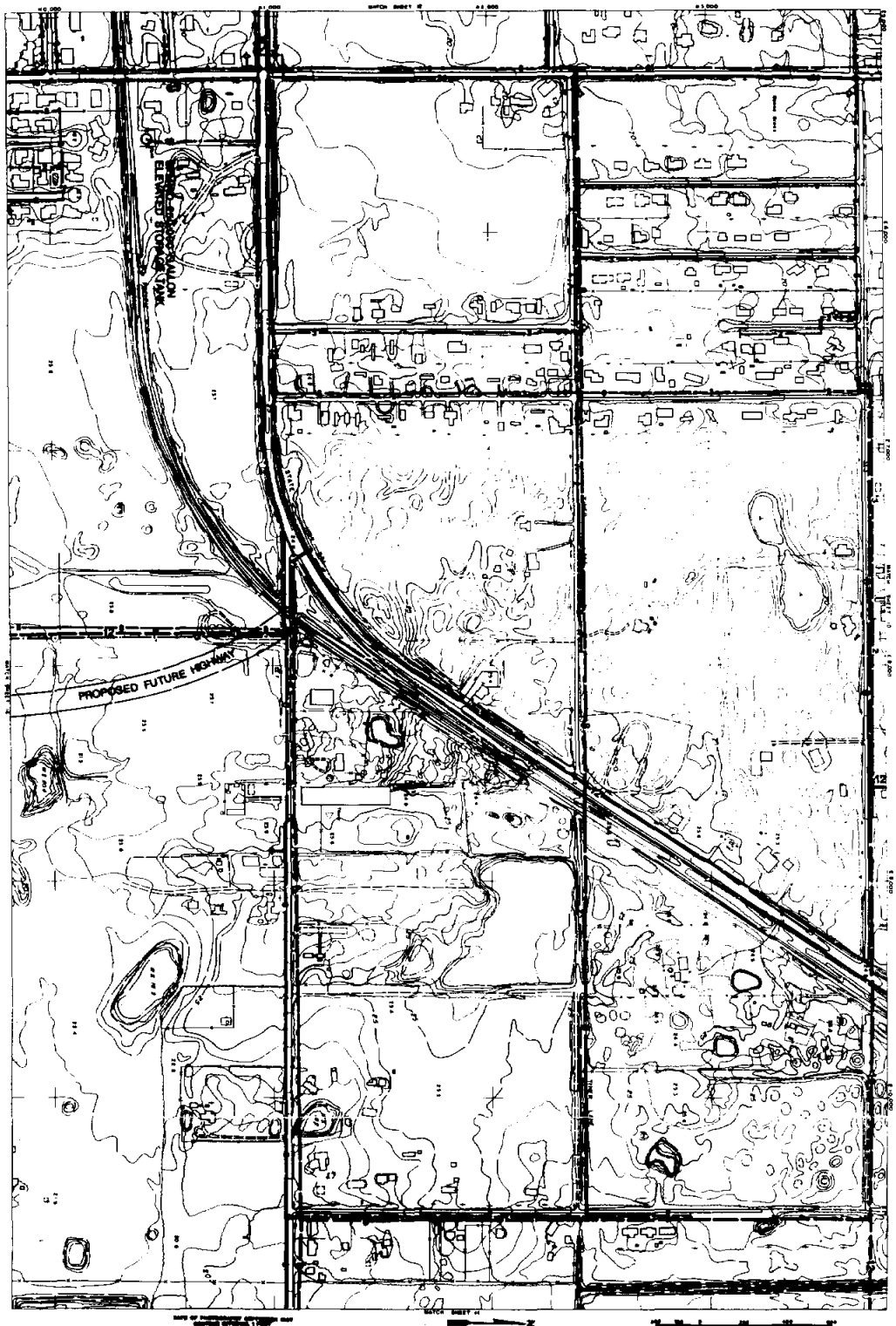
—10— PROPOSED WATER LINE (SIZE IN INCHES)

EXISTING WATER VALVE — PROPOSED WATER VALVE

EXISTING FIRE HYDRANT — PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

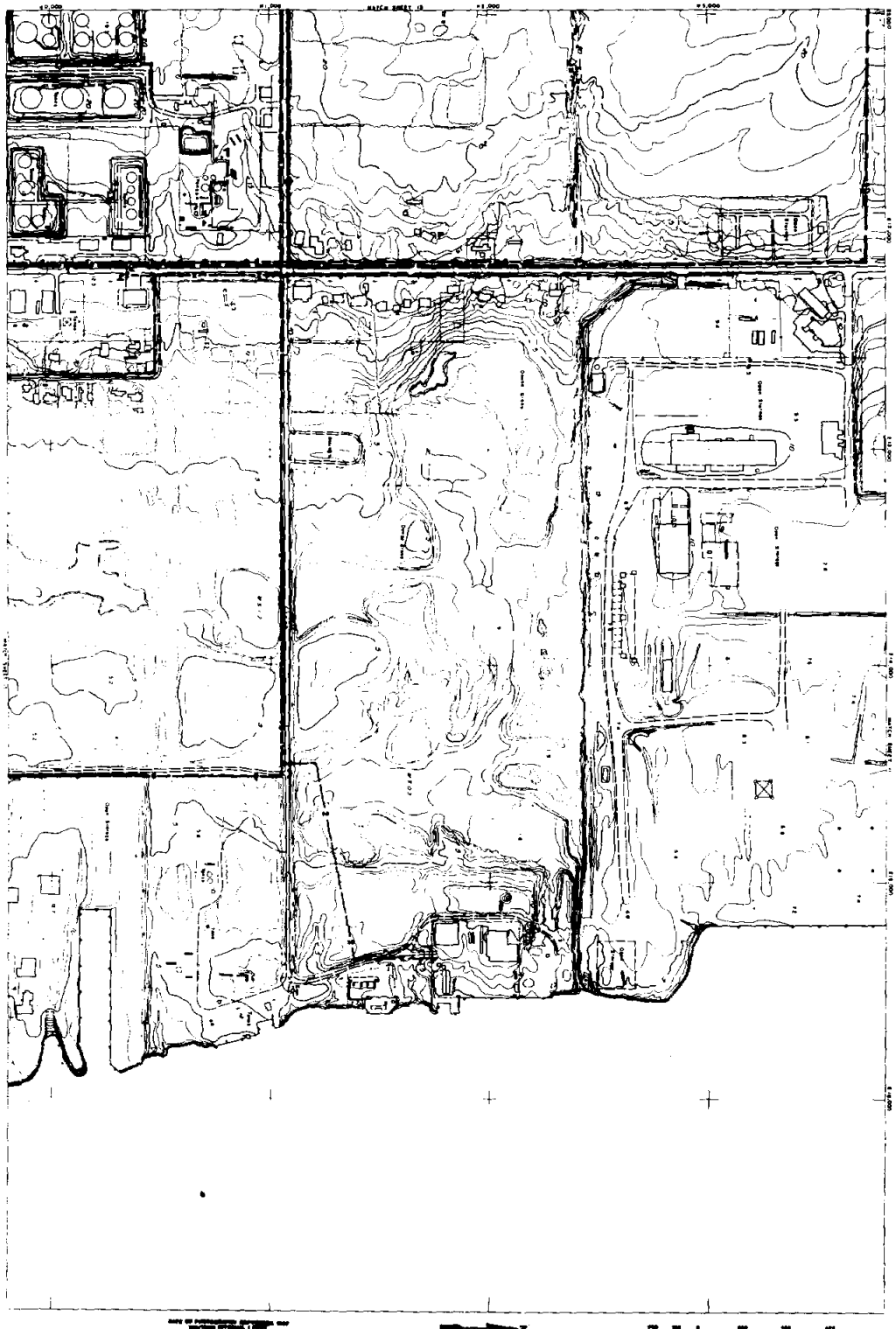
AUG. 1980 | NE-P2706

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAUMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988

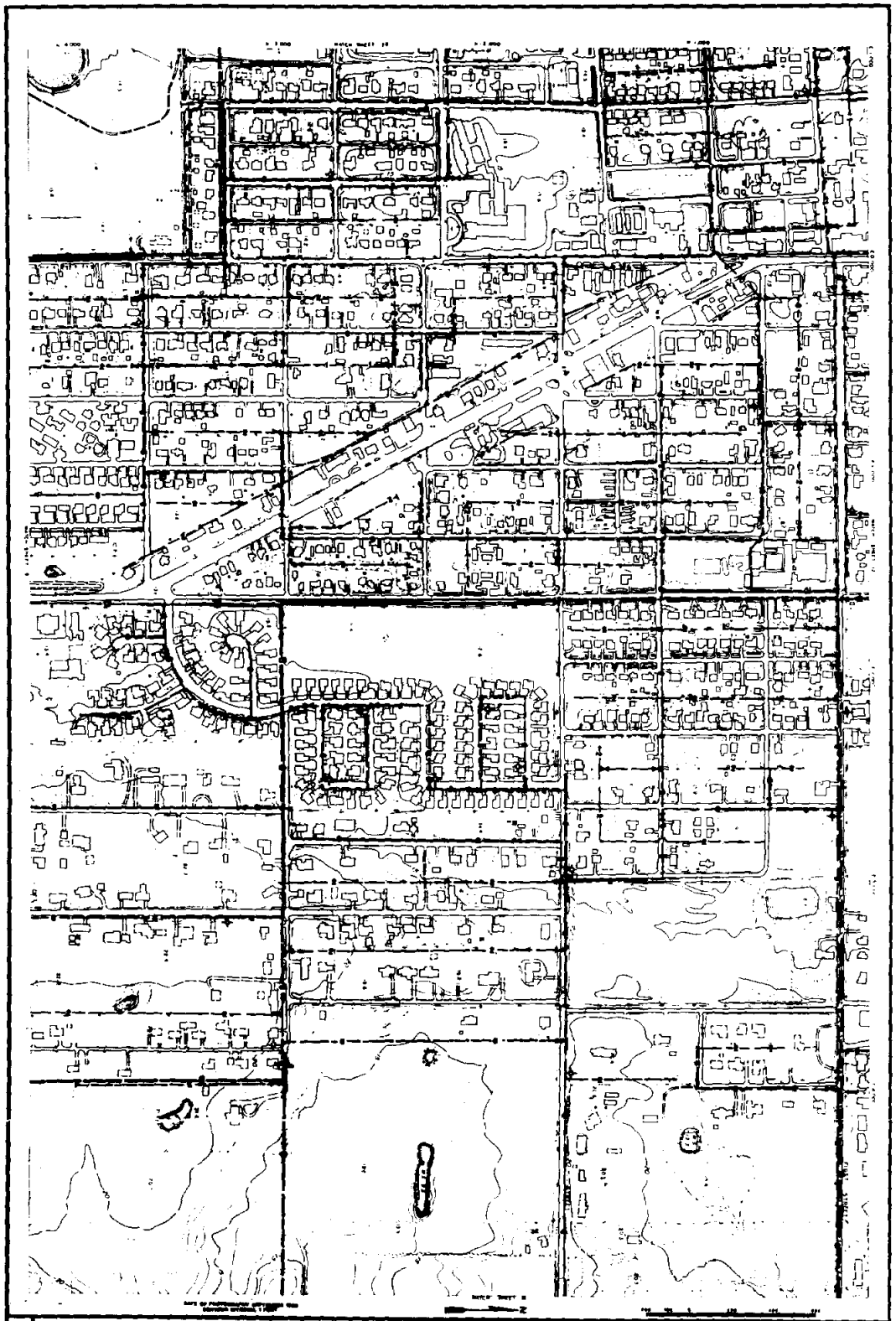
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NEP 2750

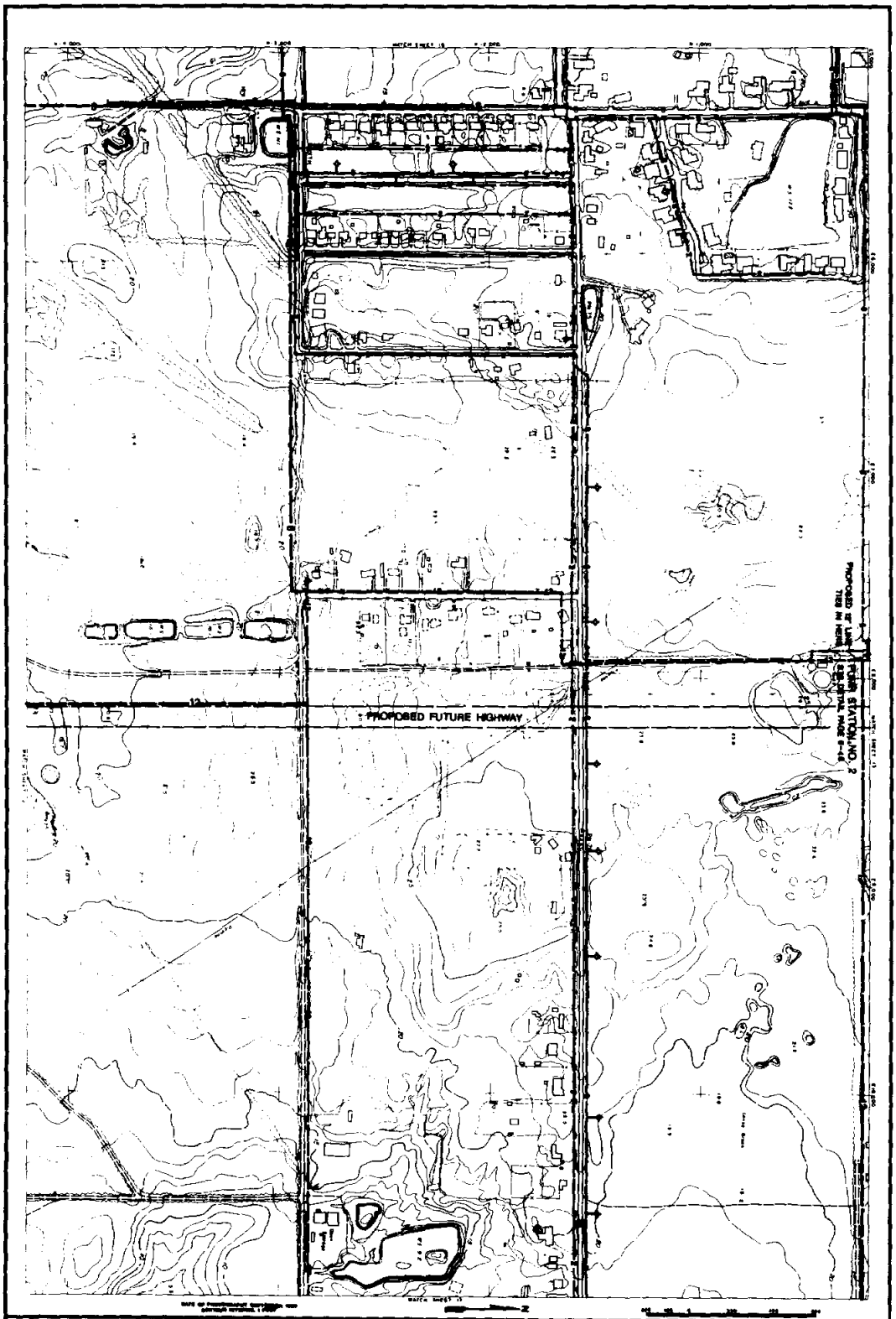
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

HASMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980

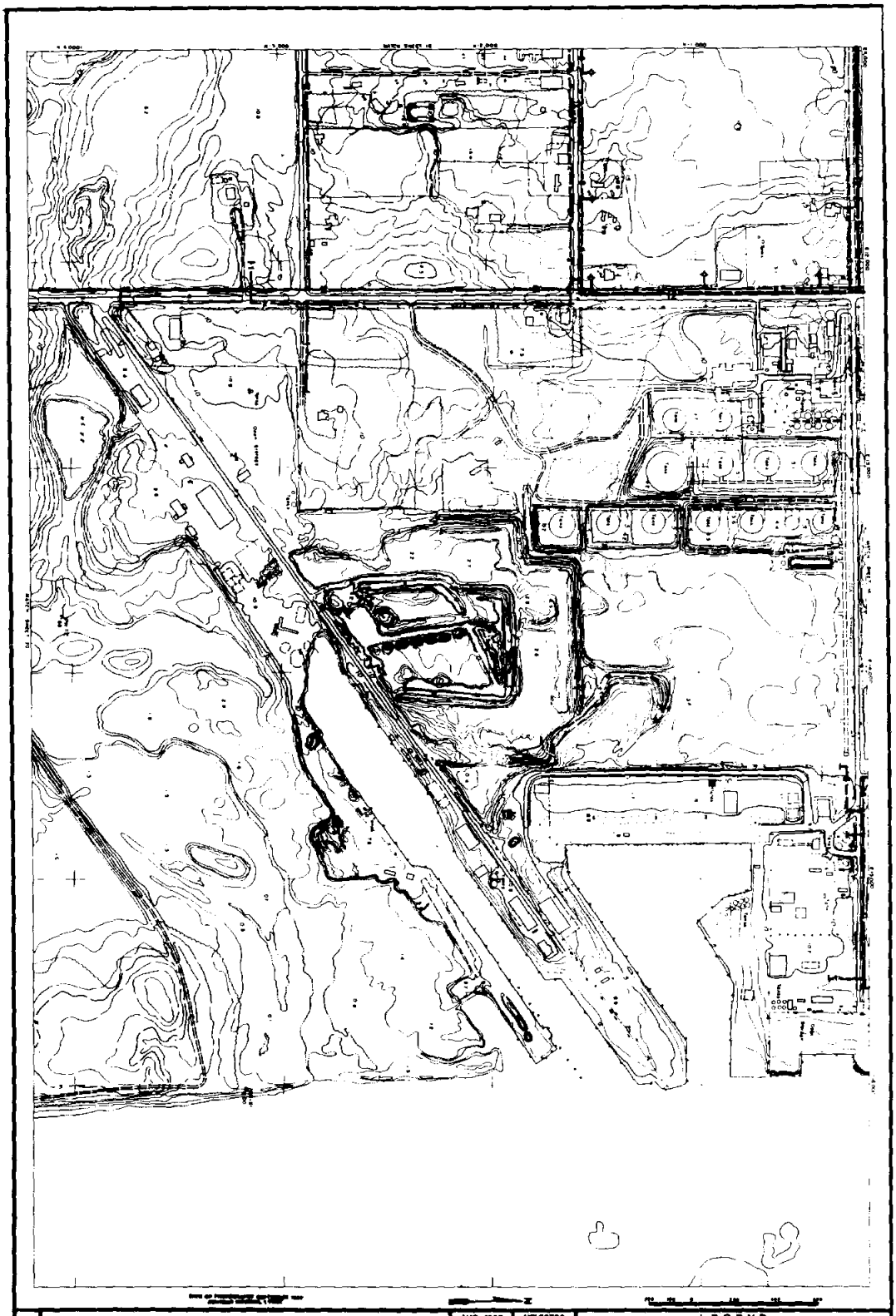
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

HARMSTH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NE#2706

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

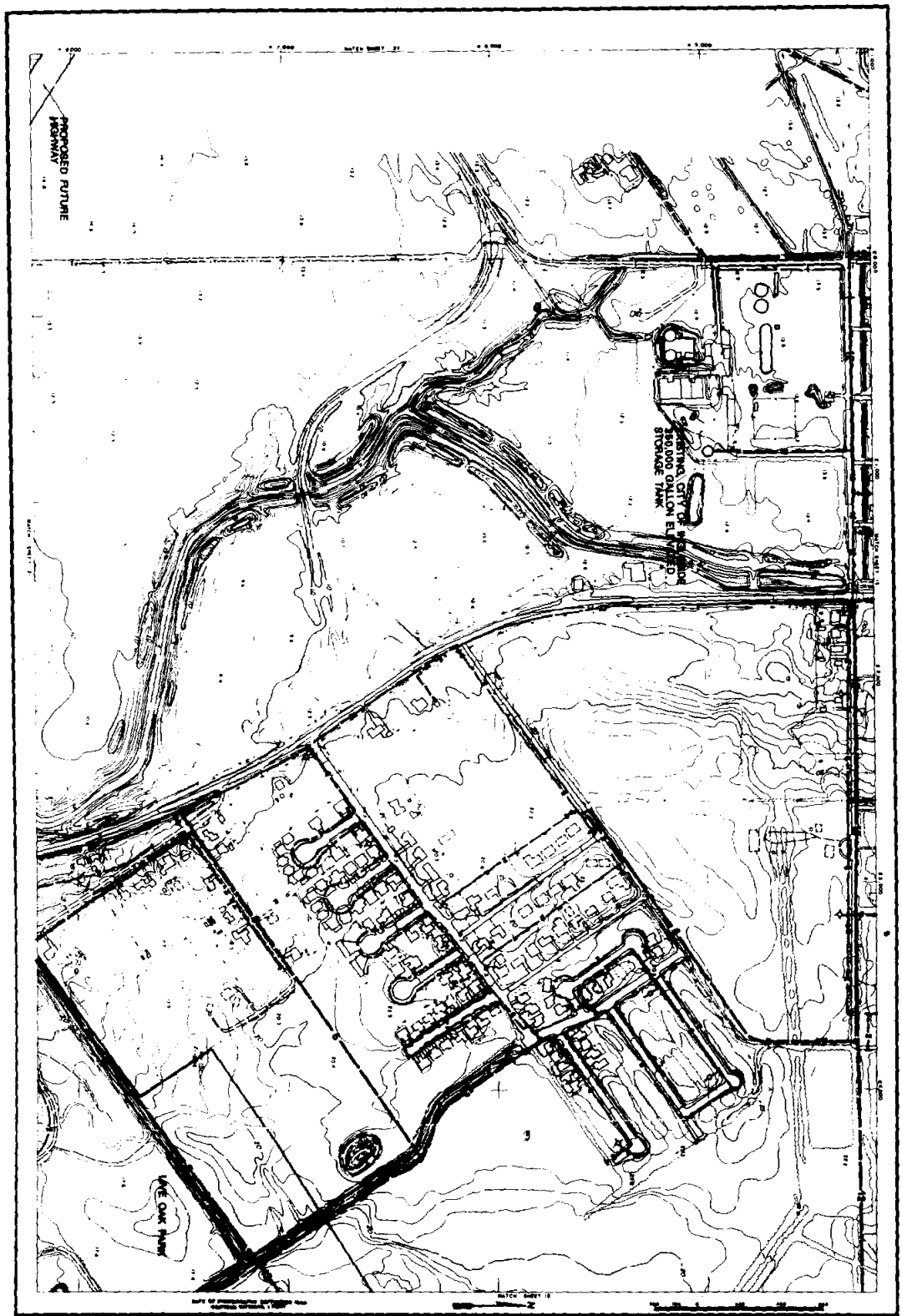
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 17



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

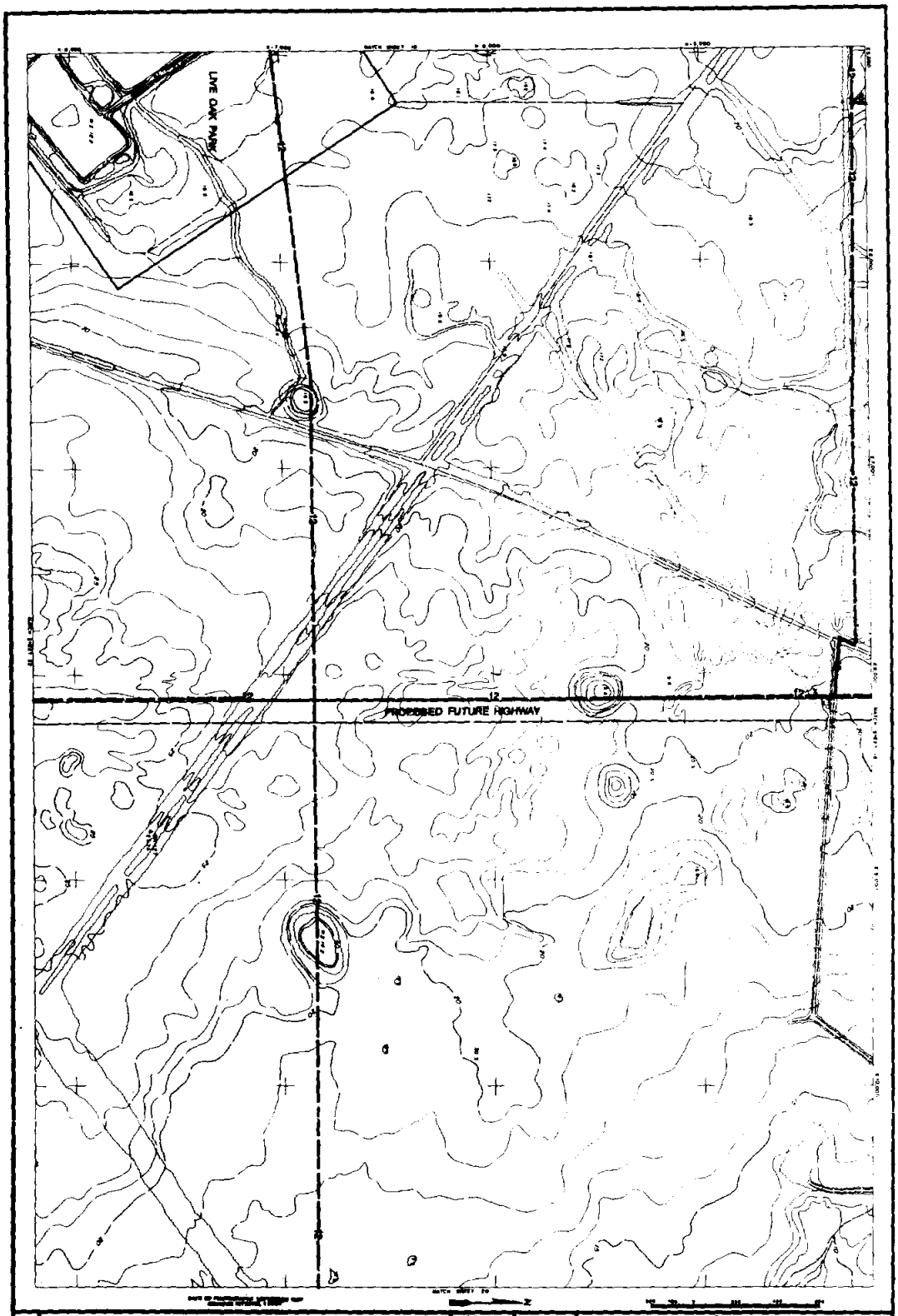
AUG. 1980

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

HAMMETT ENGINEERING, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1969 | HE-P-2706

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 19

REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

HASMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NED-2730

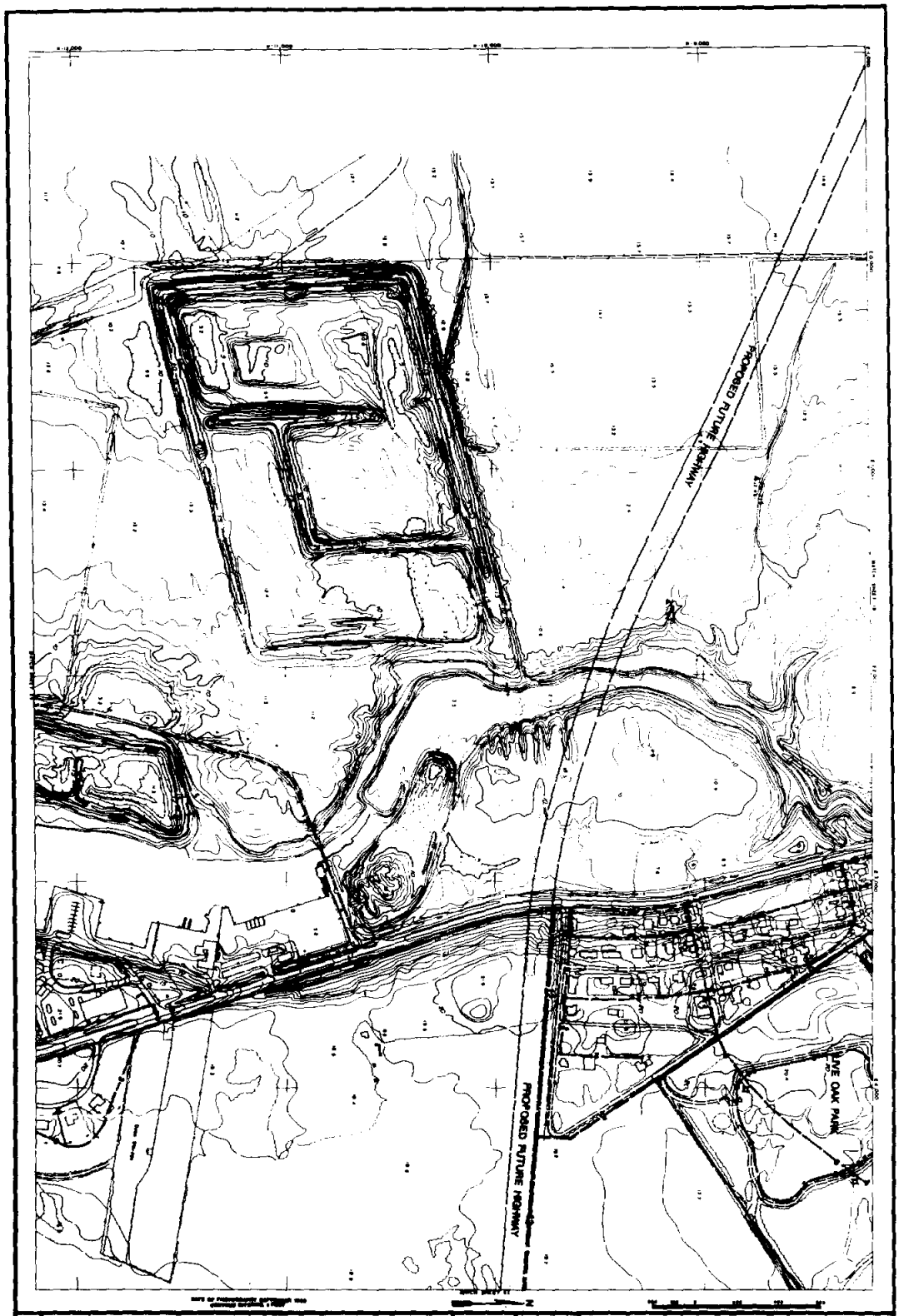
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

HAINSMITH ENGINEERING, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1999 | NSP2799

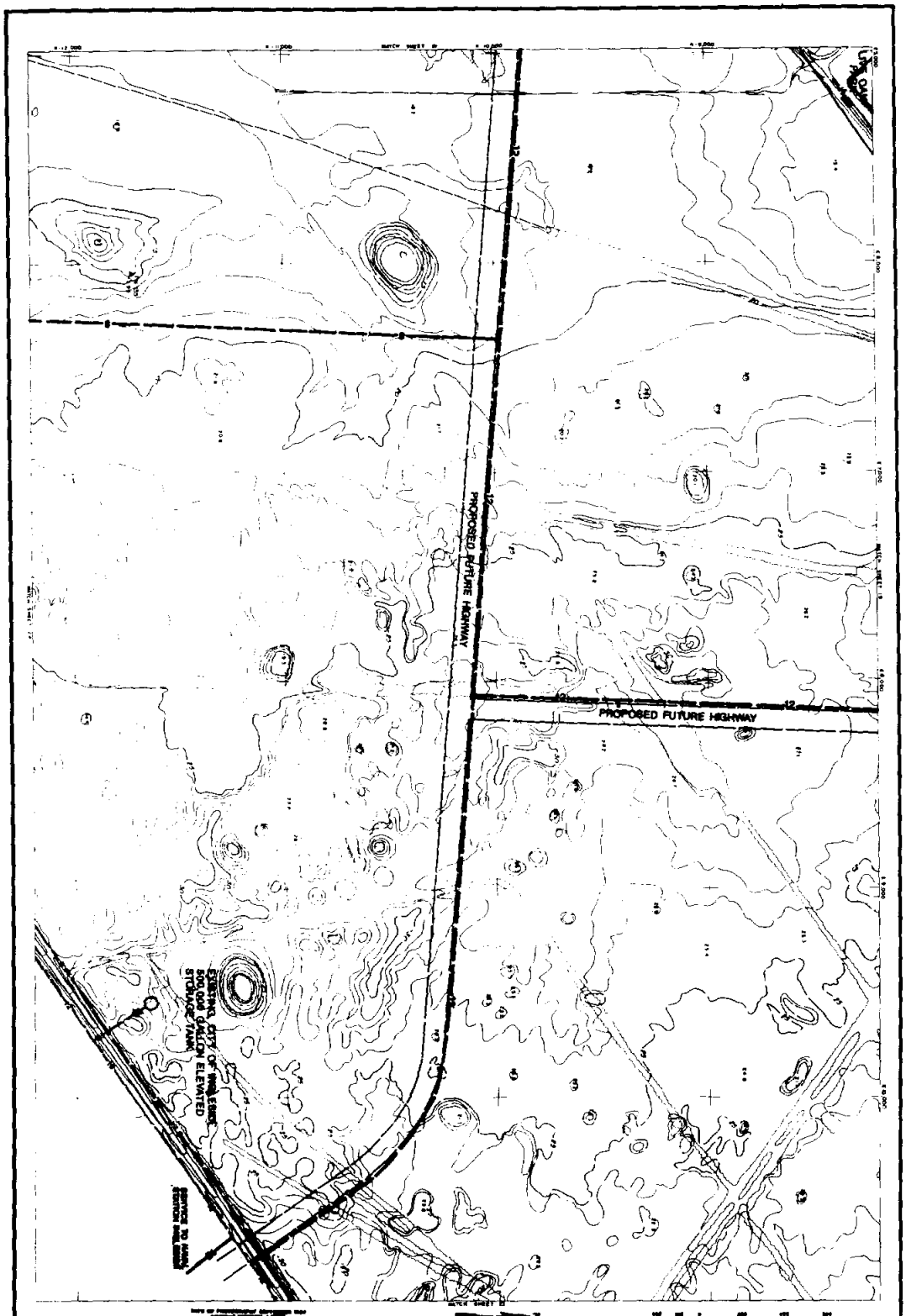
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
CAPITAL FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

M - 21



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

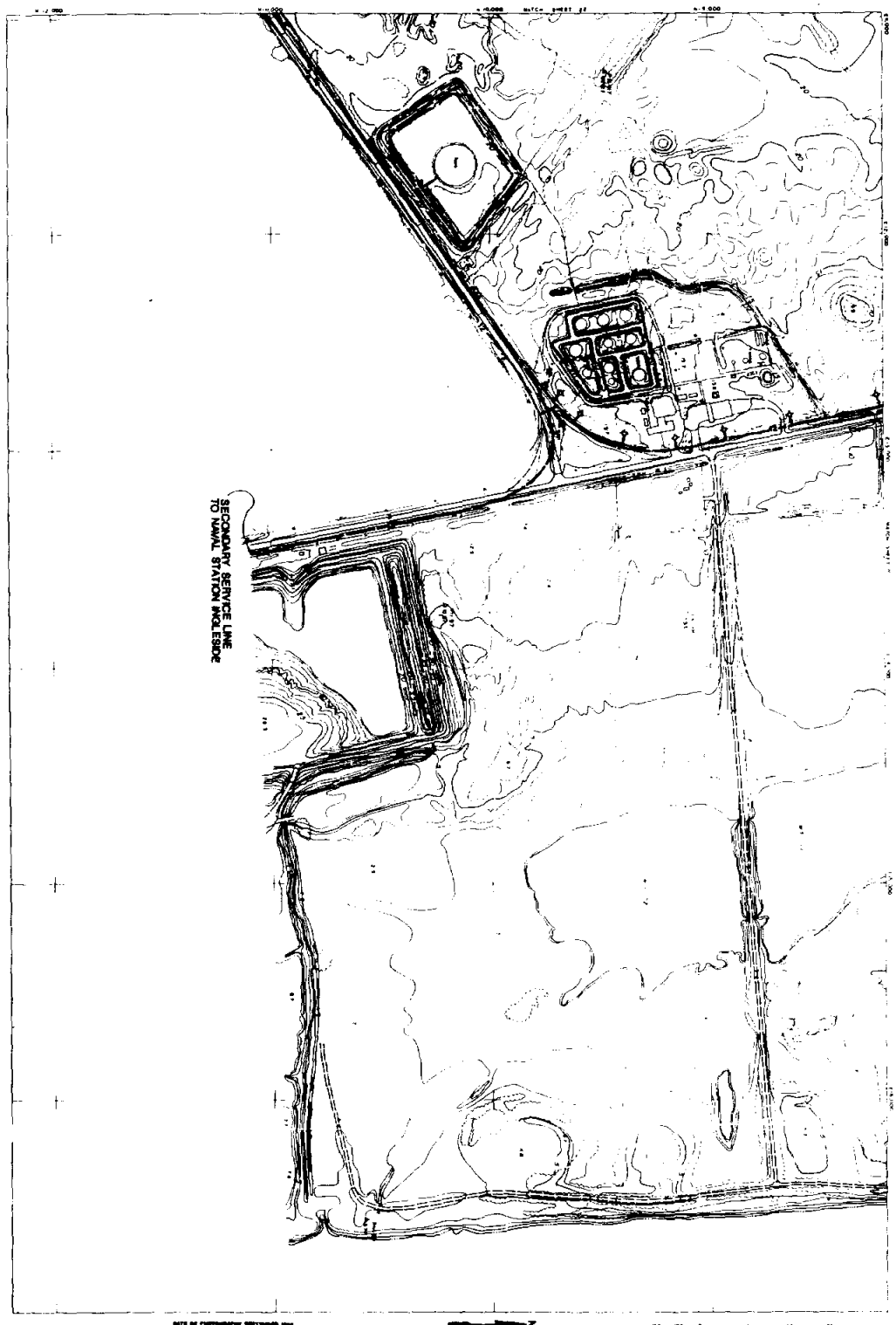
AUG. 1988 | NE#8706

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NE-2706

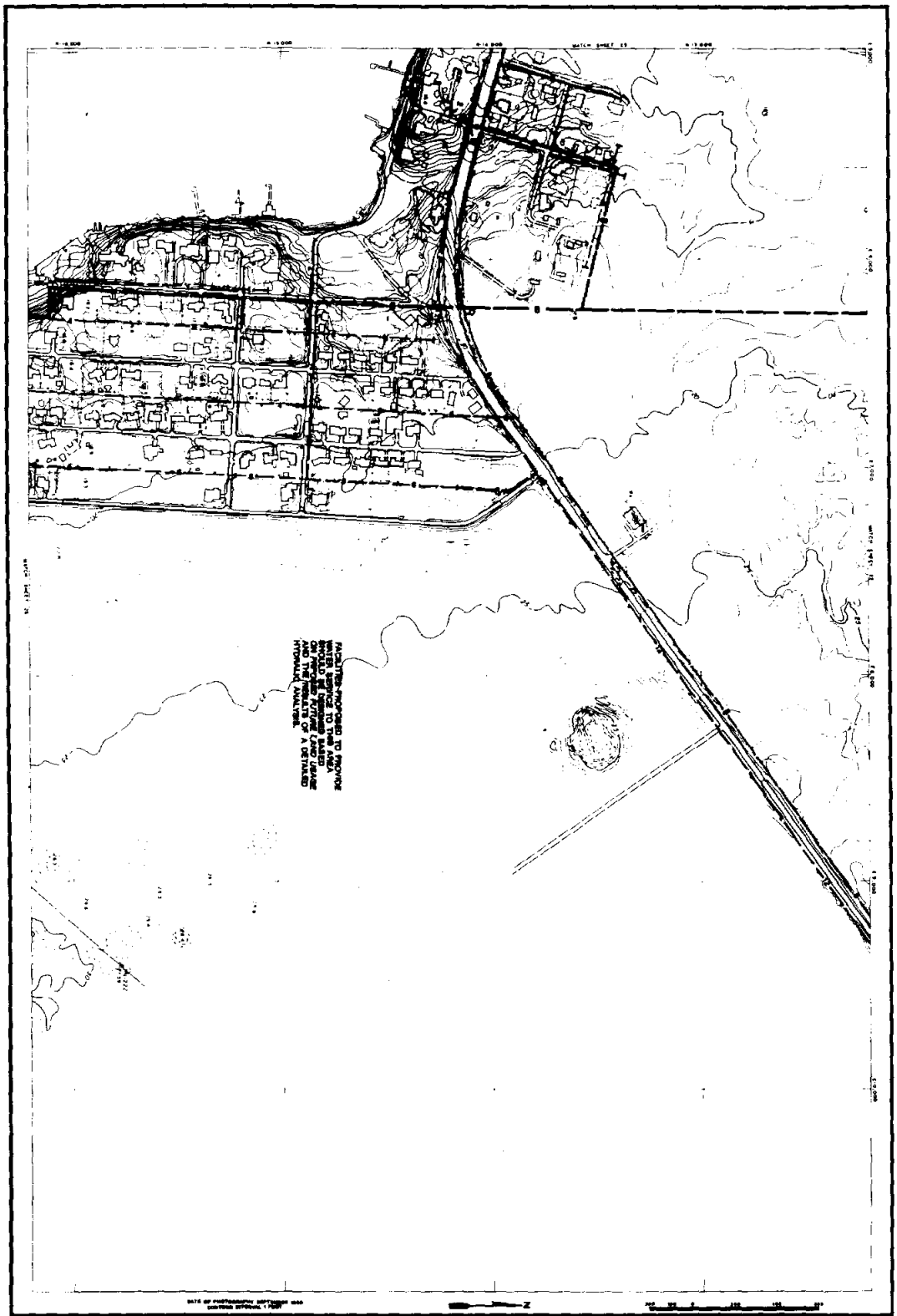
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NE#2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

—10— EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)

—10— PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)

—10— EXISTING WATER LINE (SIZE IN INCHES)

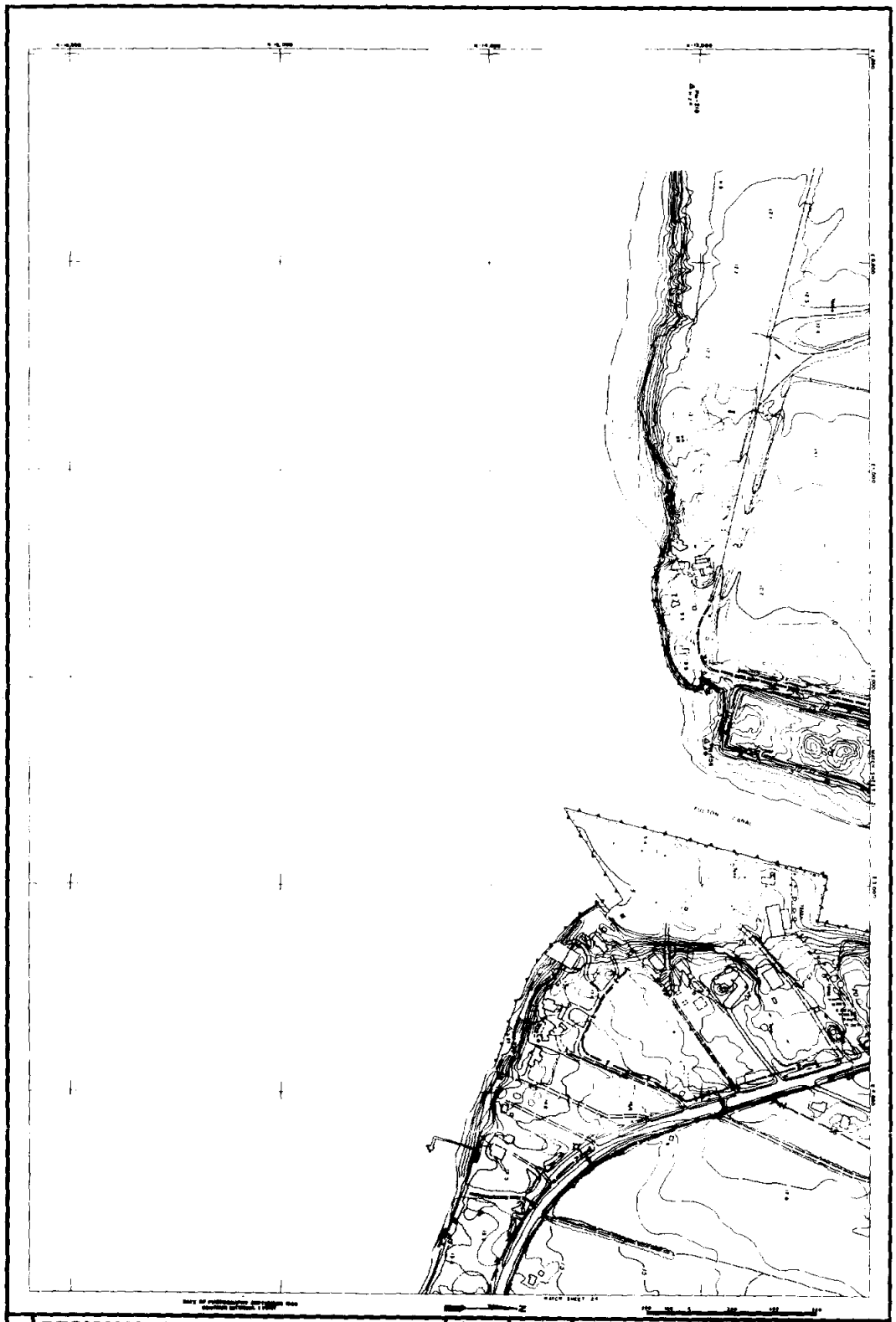
—10— PROPOSED WATER LINE (SIZE IN INCHES)

⋈ EXISTING WATER VALVE ⋈ PROPOSED WATER VALVE

◇ EXISTING FIRE HYDRANT ◆ PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1990 | NE-P7709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
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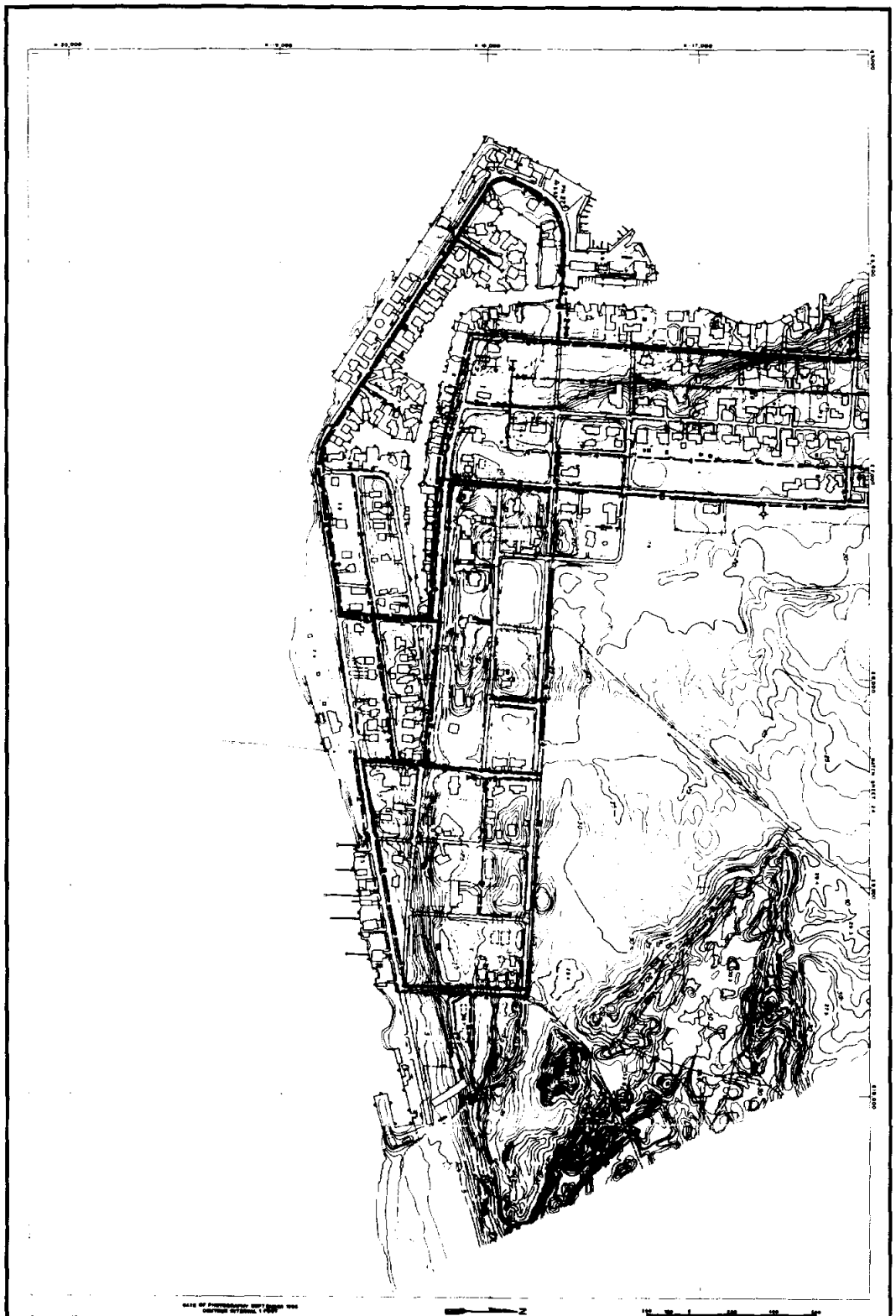
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE BAY PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

HAMMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | HE#2709

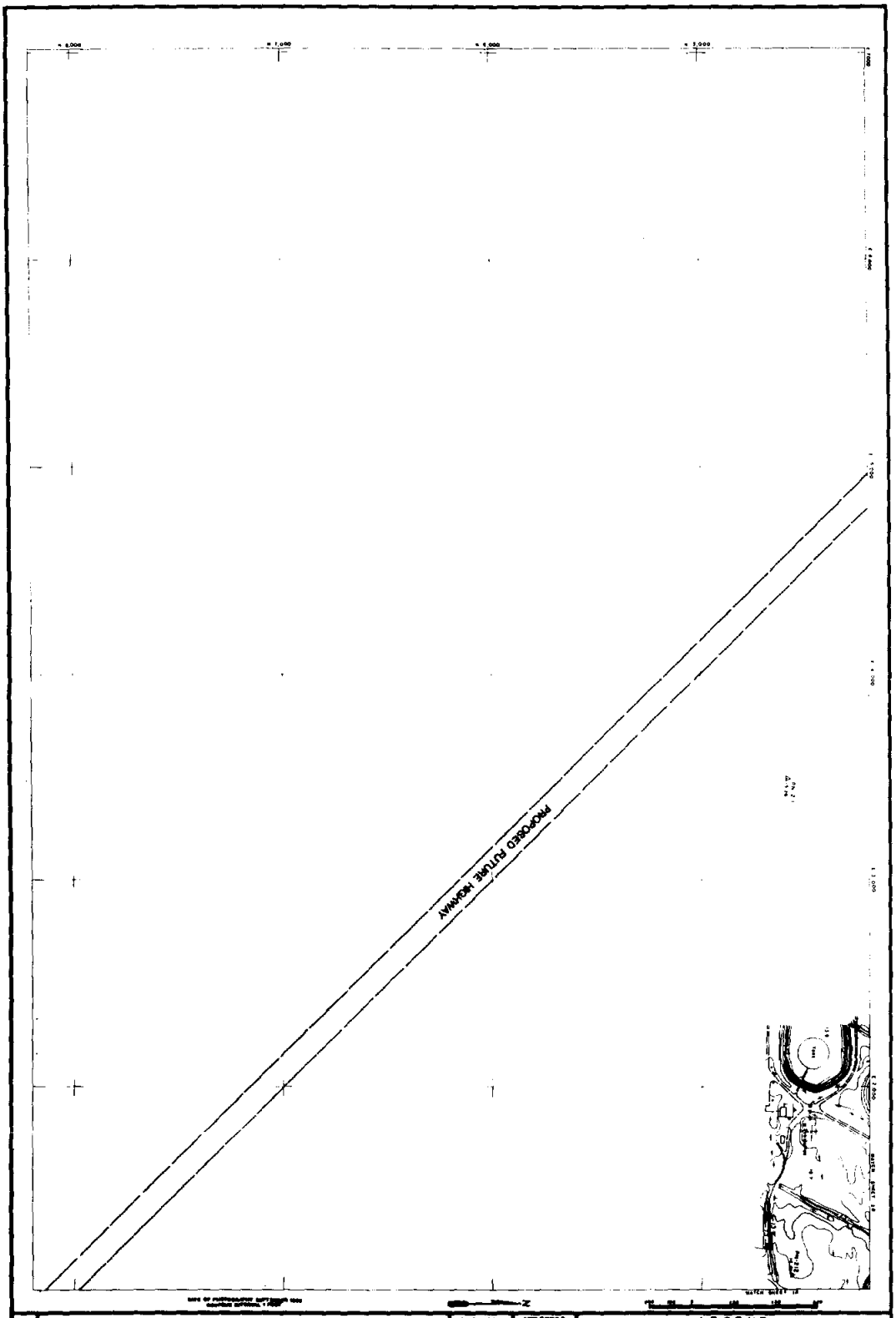
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1999 | NEP-2790

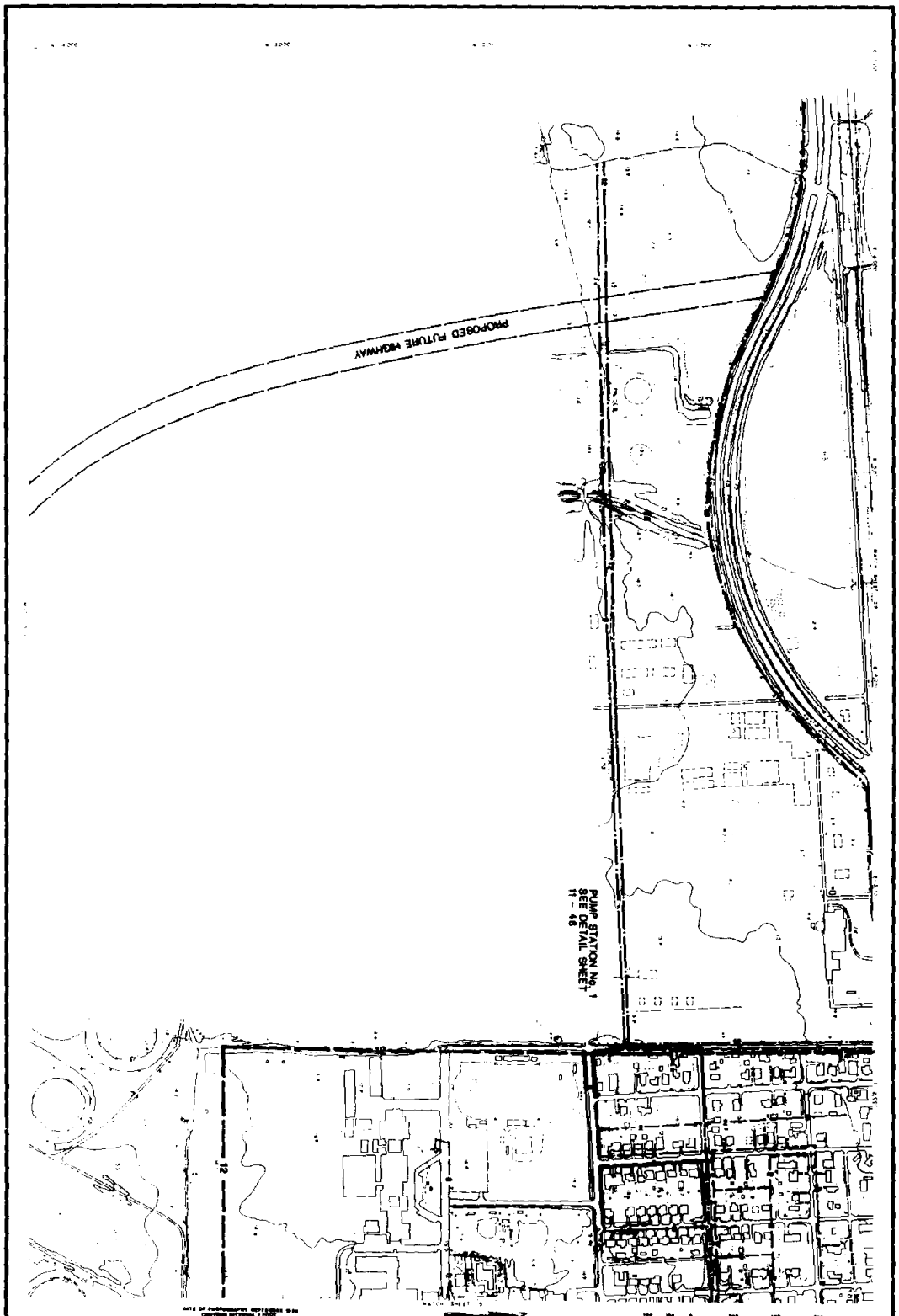
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

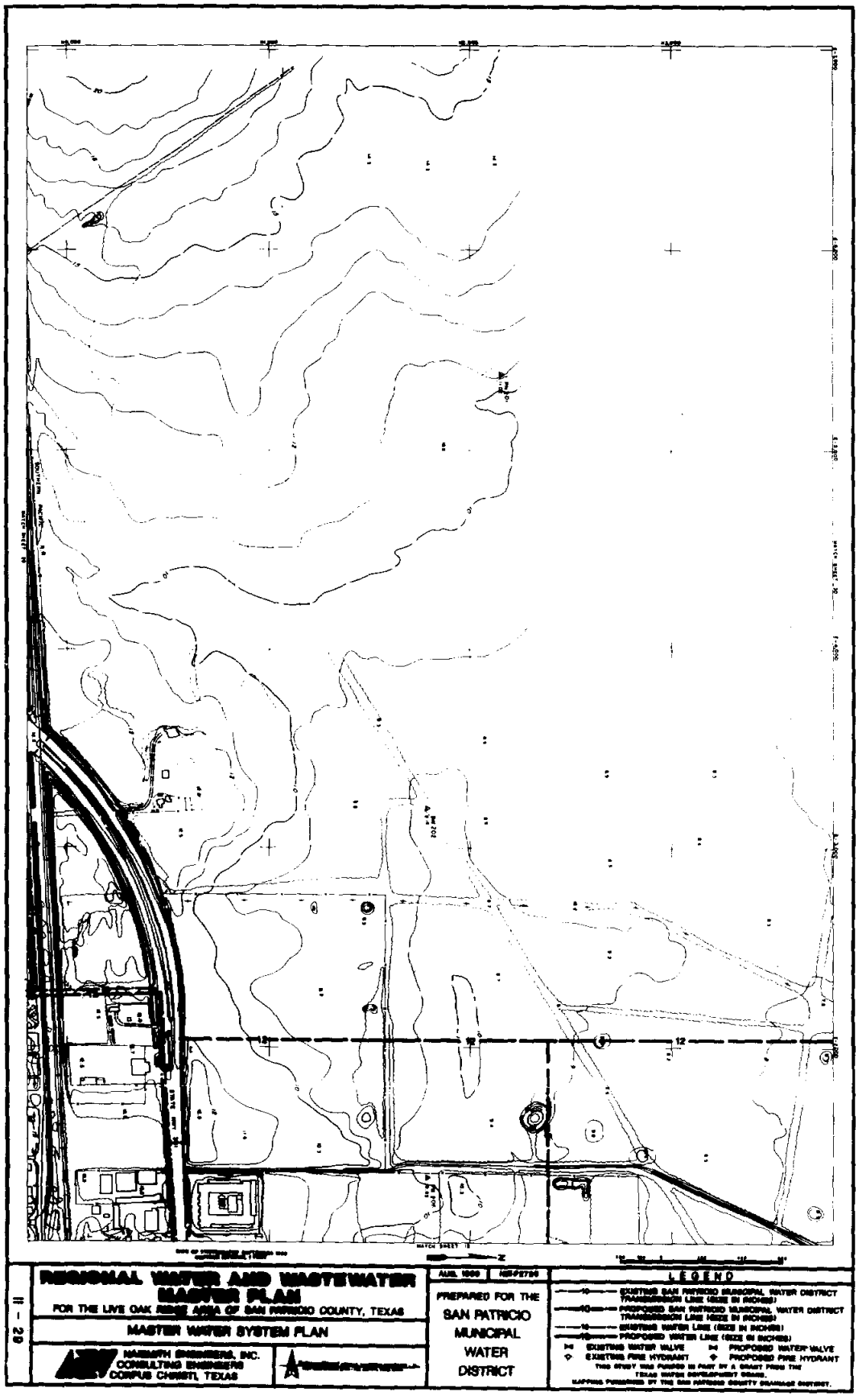
AUG. 1980 | NE#2799

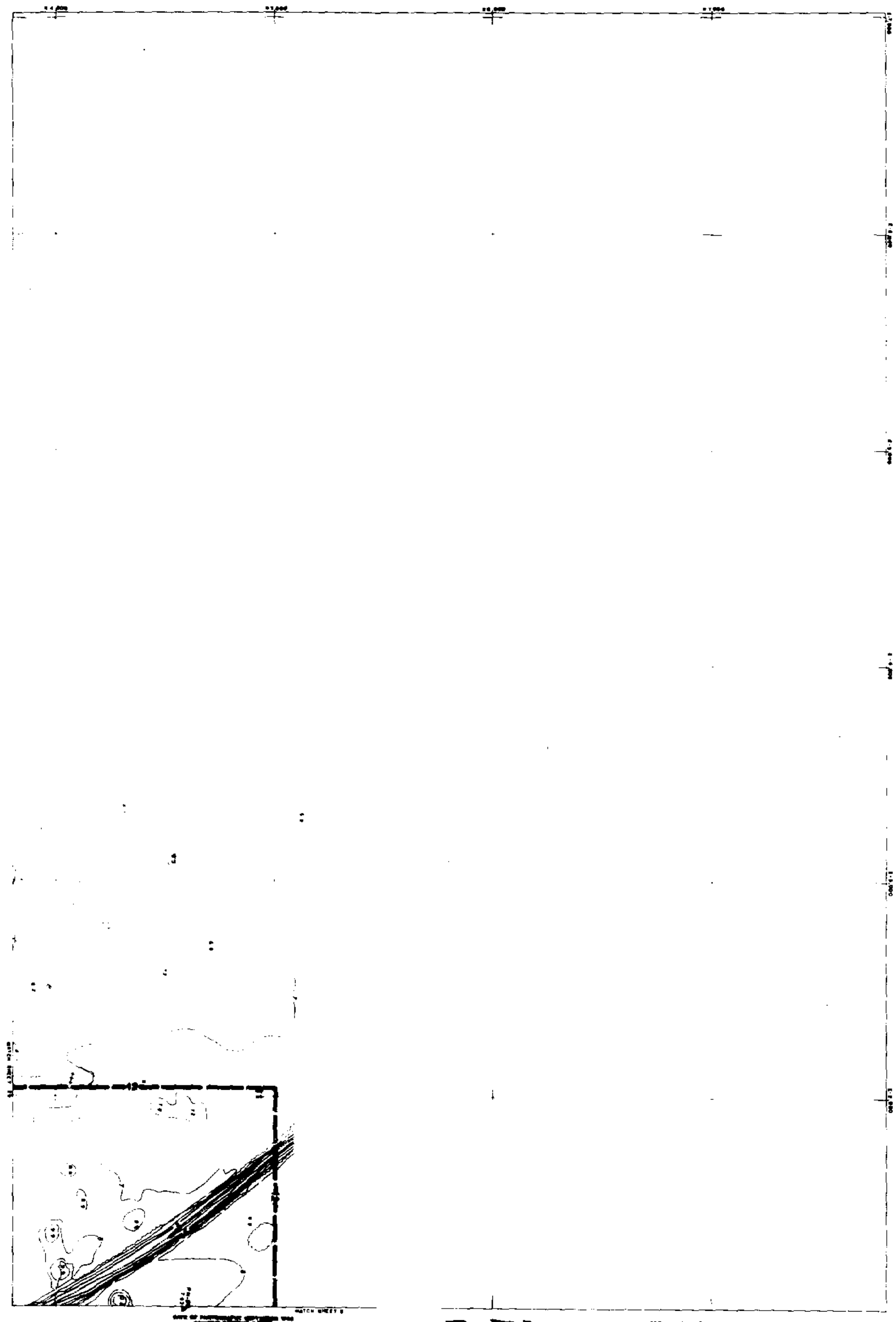
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT


REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS
MASTER WATER SYSTEM PLAN
NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT
LEGEND
EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
EXISTING WATER LINE (SIZE IN INCHES)
PROPOSED WATER LINE (SIZE IN INCHES)
EXISTING WATER VALVE
PROPOSED WATER VALVE
EXISTING FIRE HYDRANT
PROPOSED FIRE HYDRANT
THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980

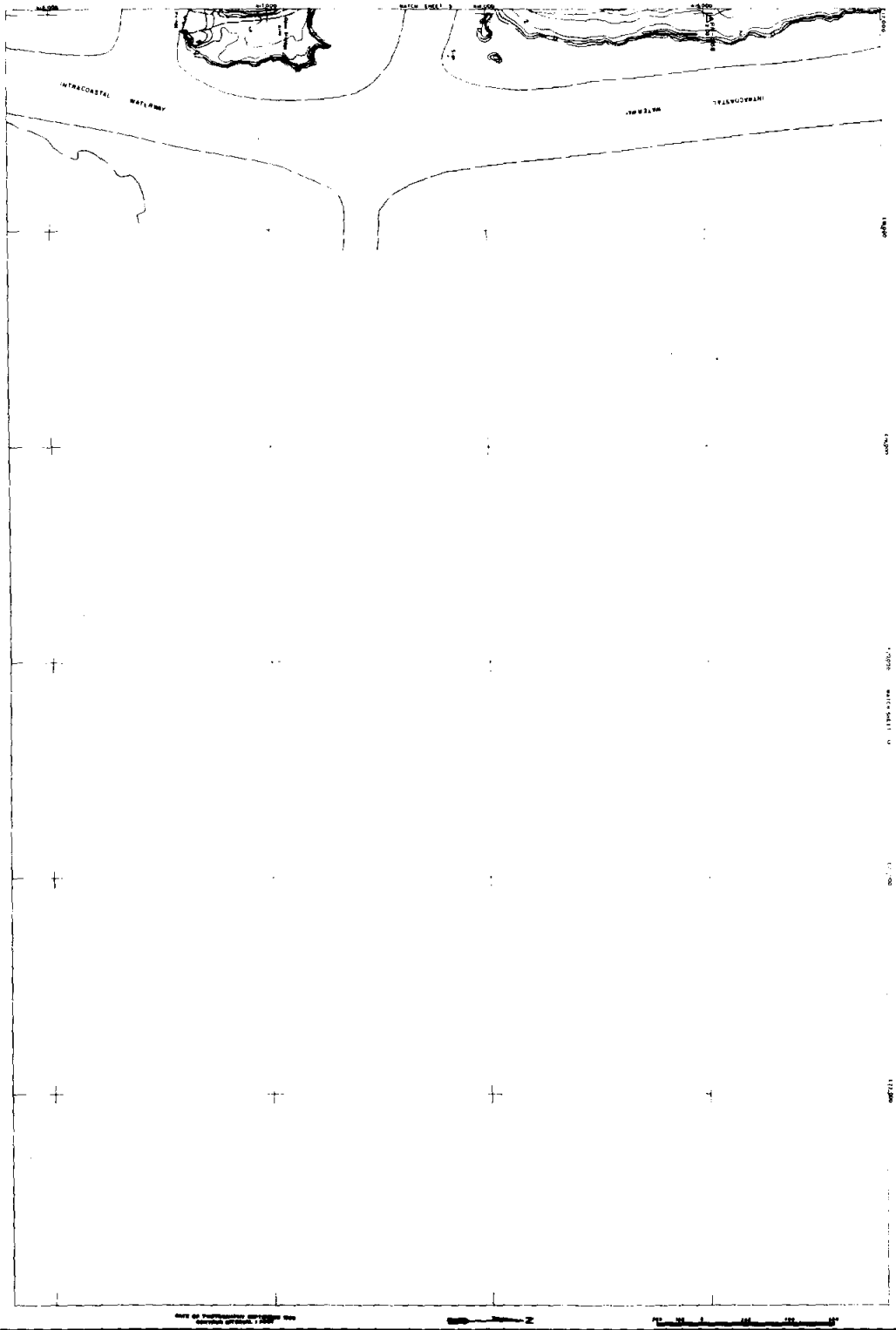
PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

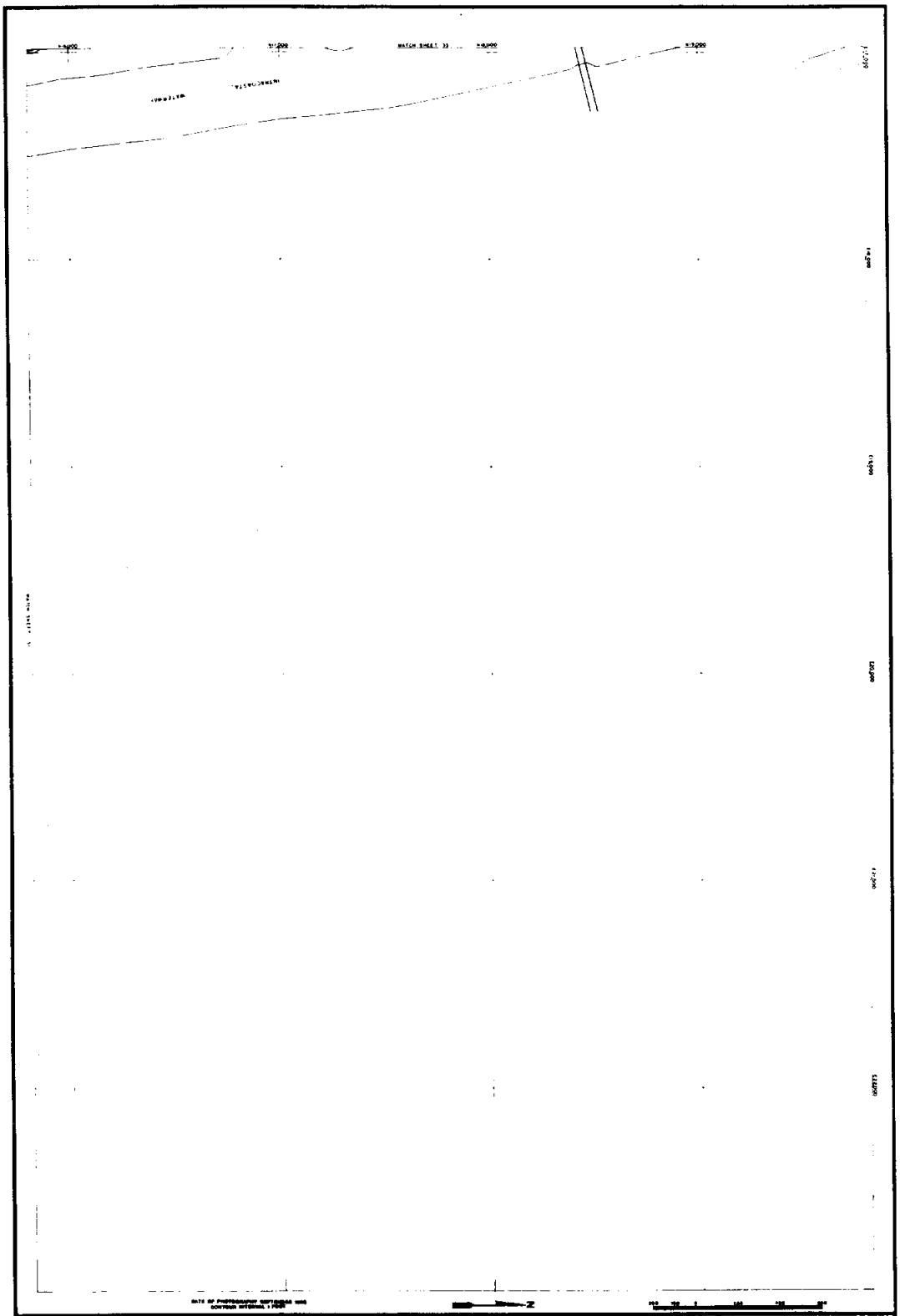
AUG. 1969 | NE-62790

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

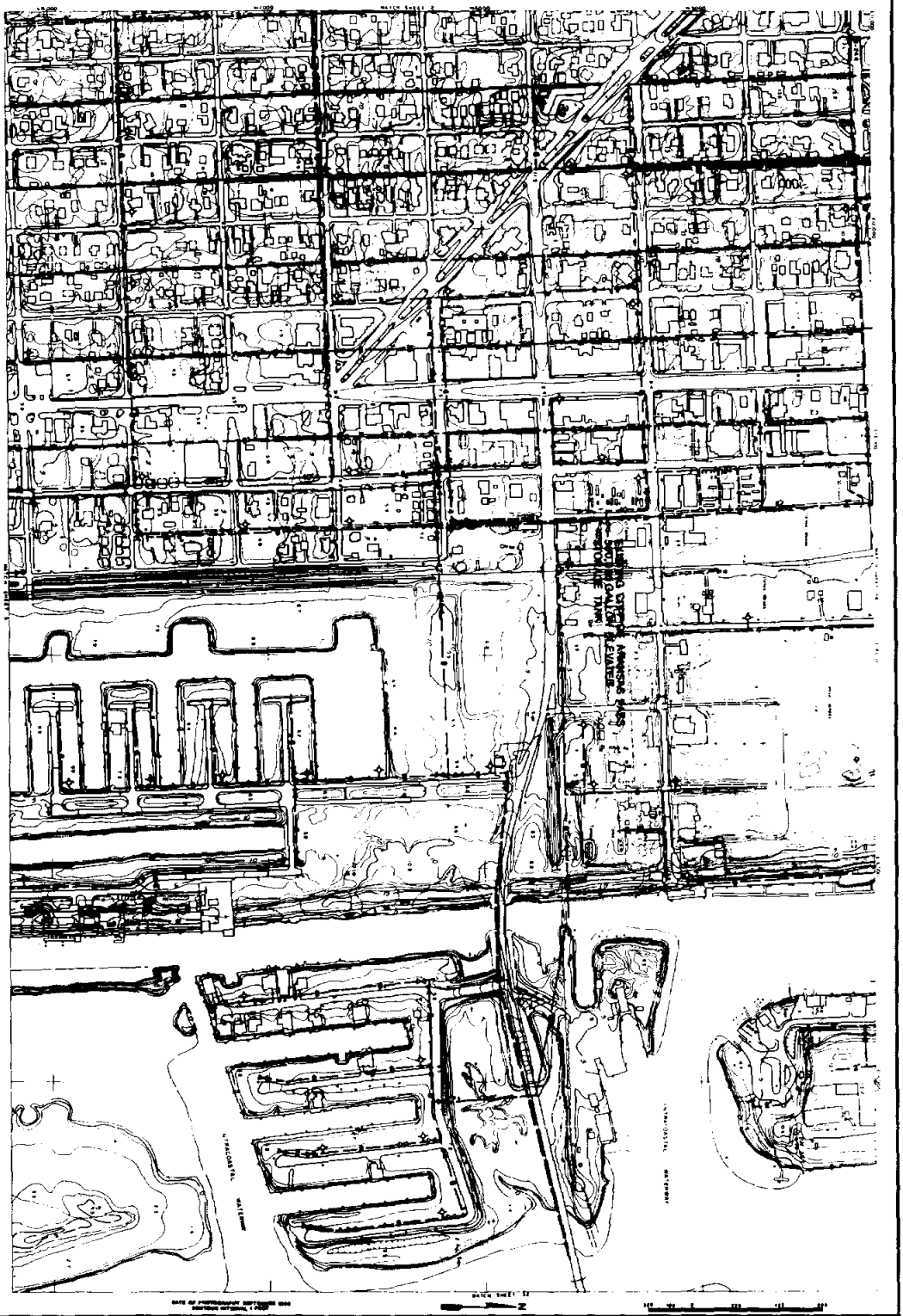
AUG. 1988 | NEI#2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1982 | NE#2706

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

—10— EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)

—10— PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)

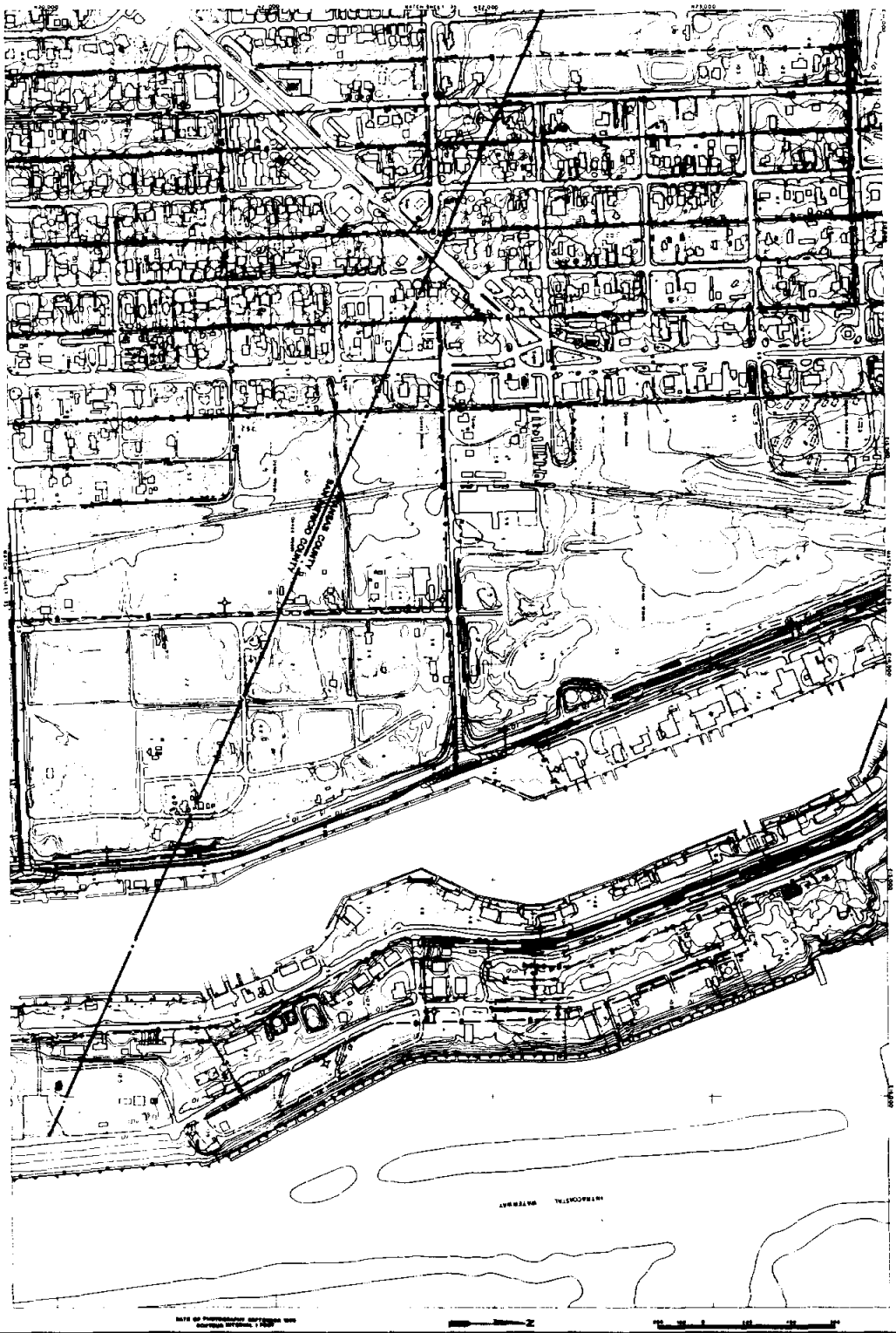
—10— EXISTING WATER LINE (SIZE IN INCHES)

—10— PROPOSED WATER LINE (SIZE IN INCHES)

EXISTING WATER VALVE | PROPOSED WATER VALVE

EXISTING FIRE HYDRANT | PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NEI-87706

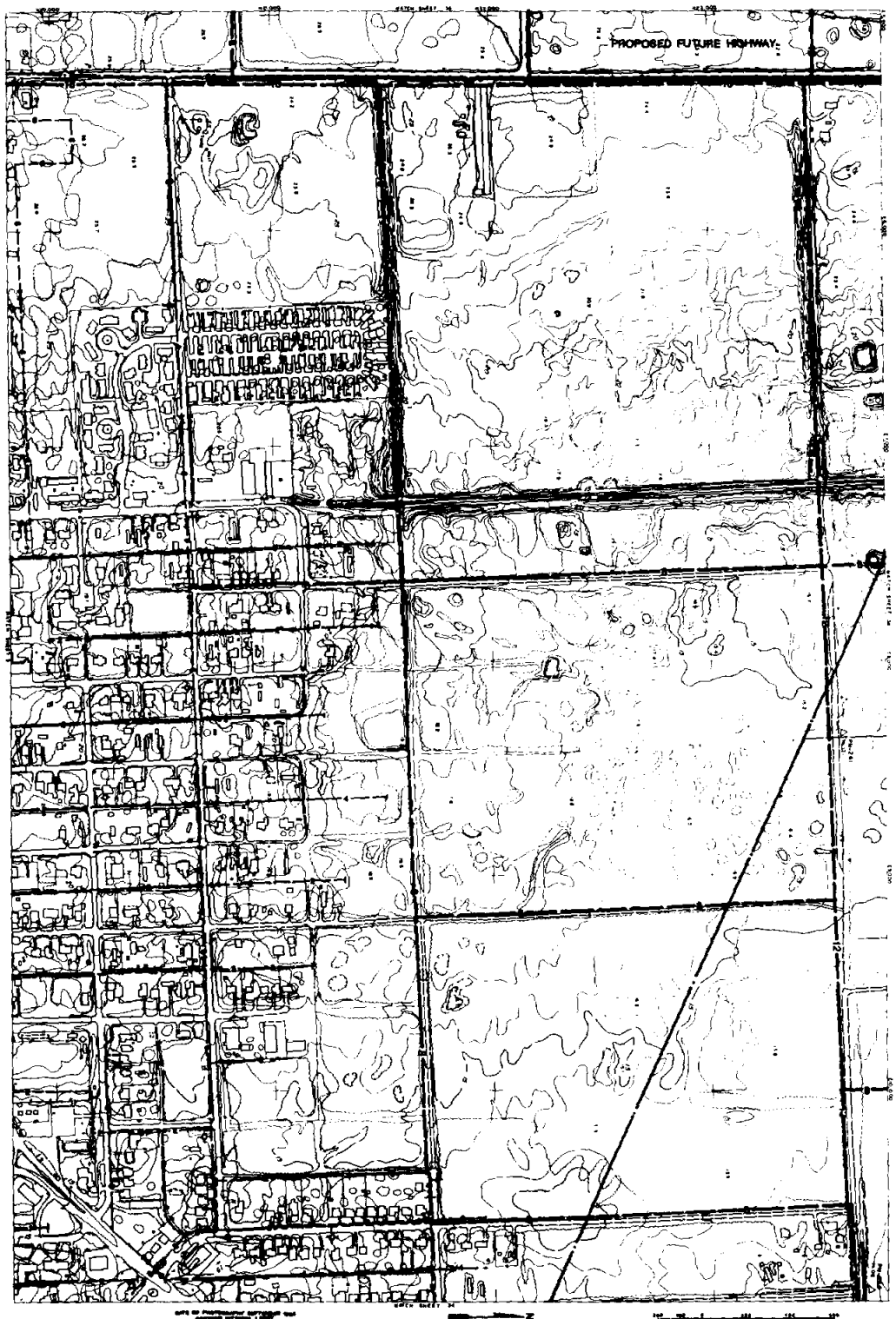
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1990

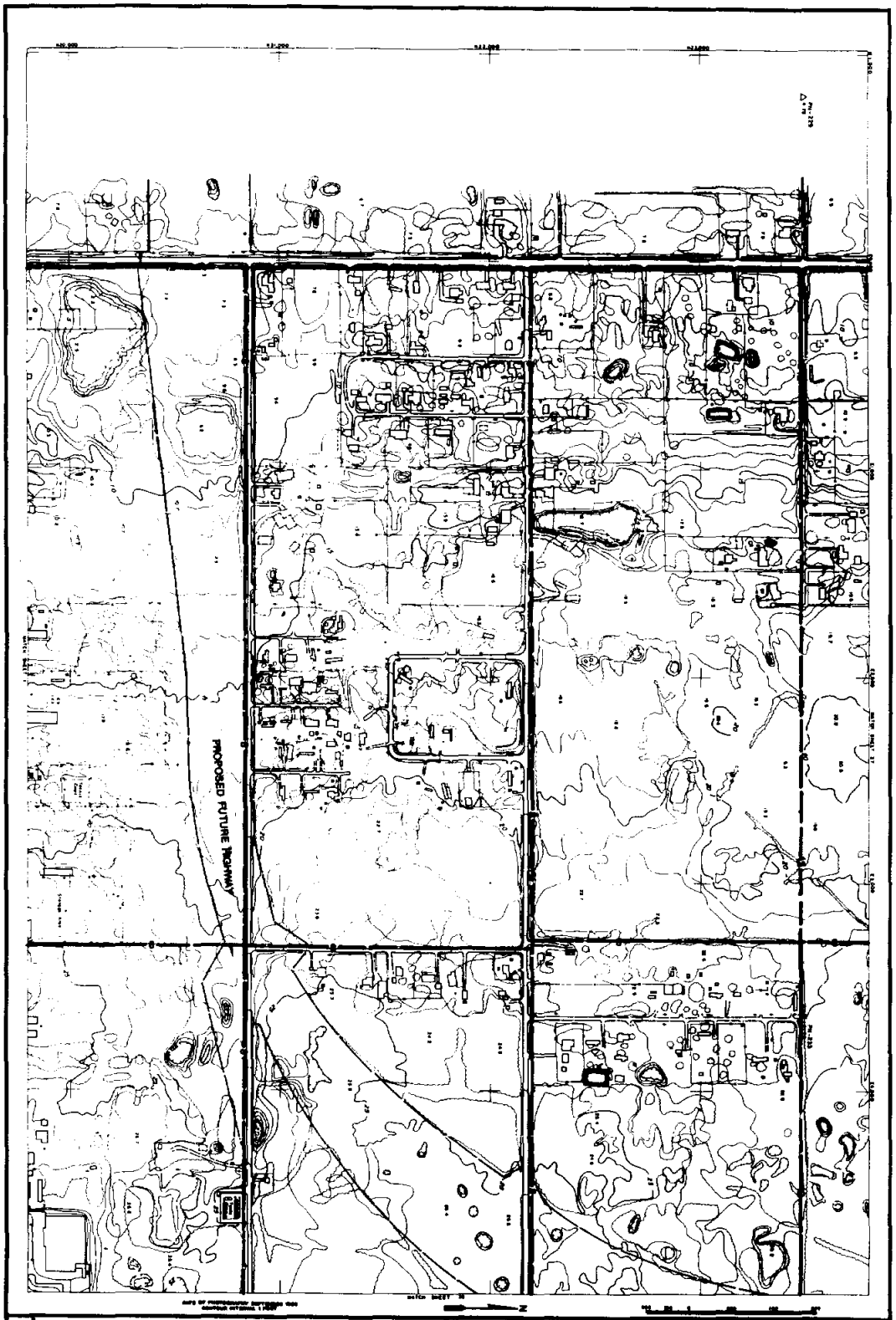
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

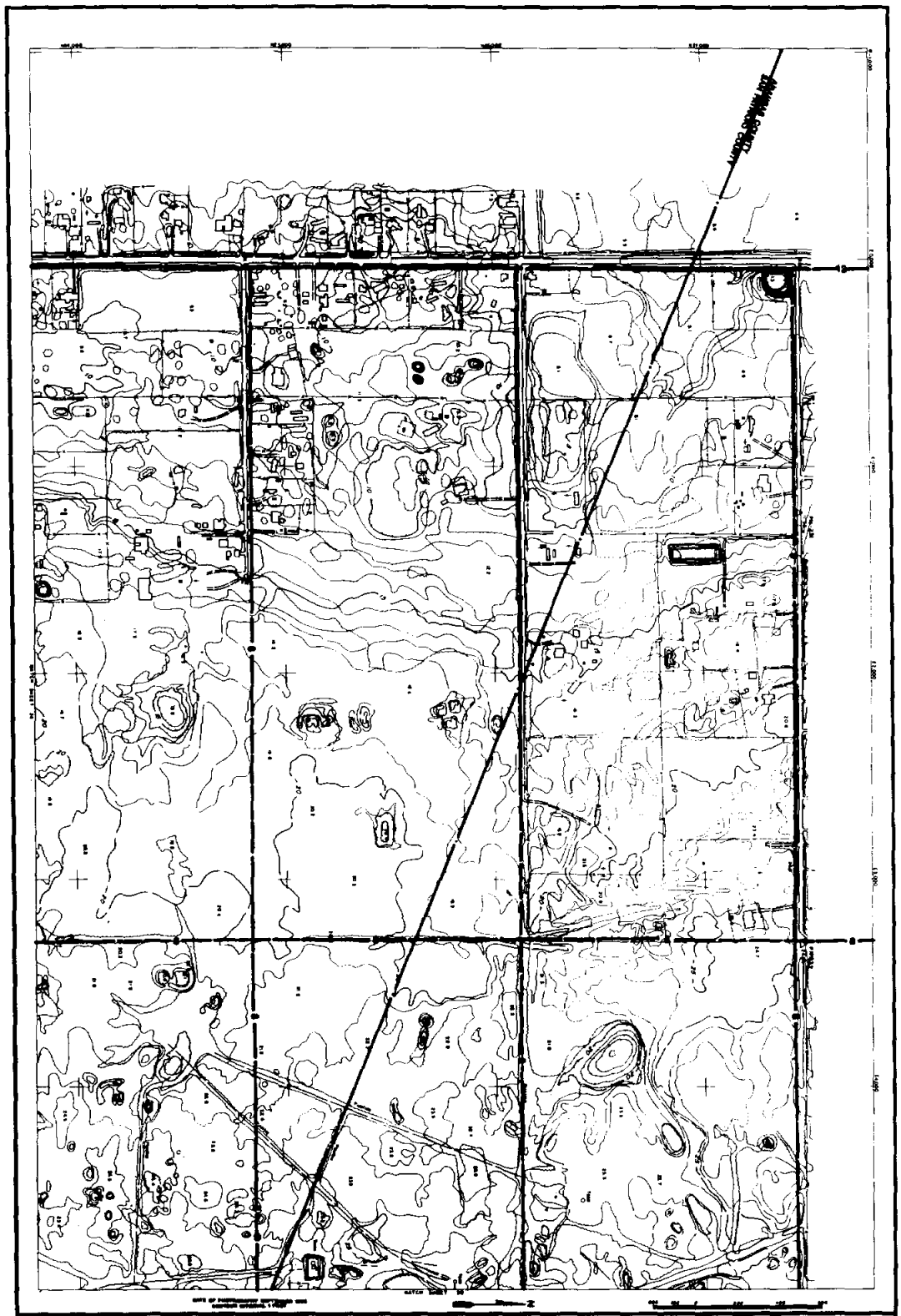
AUG. 1980 | NE-9708

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NE-8720

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

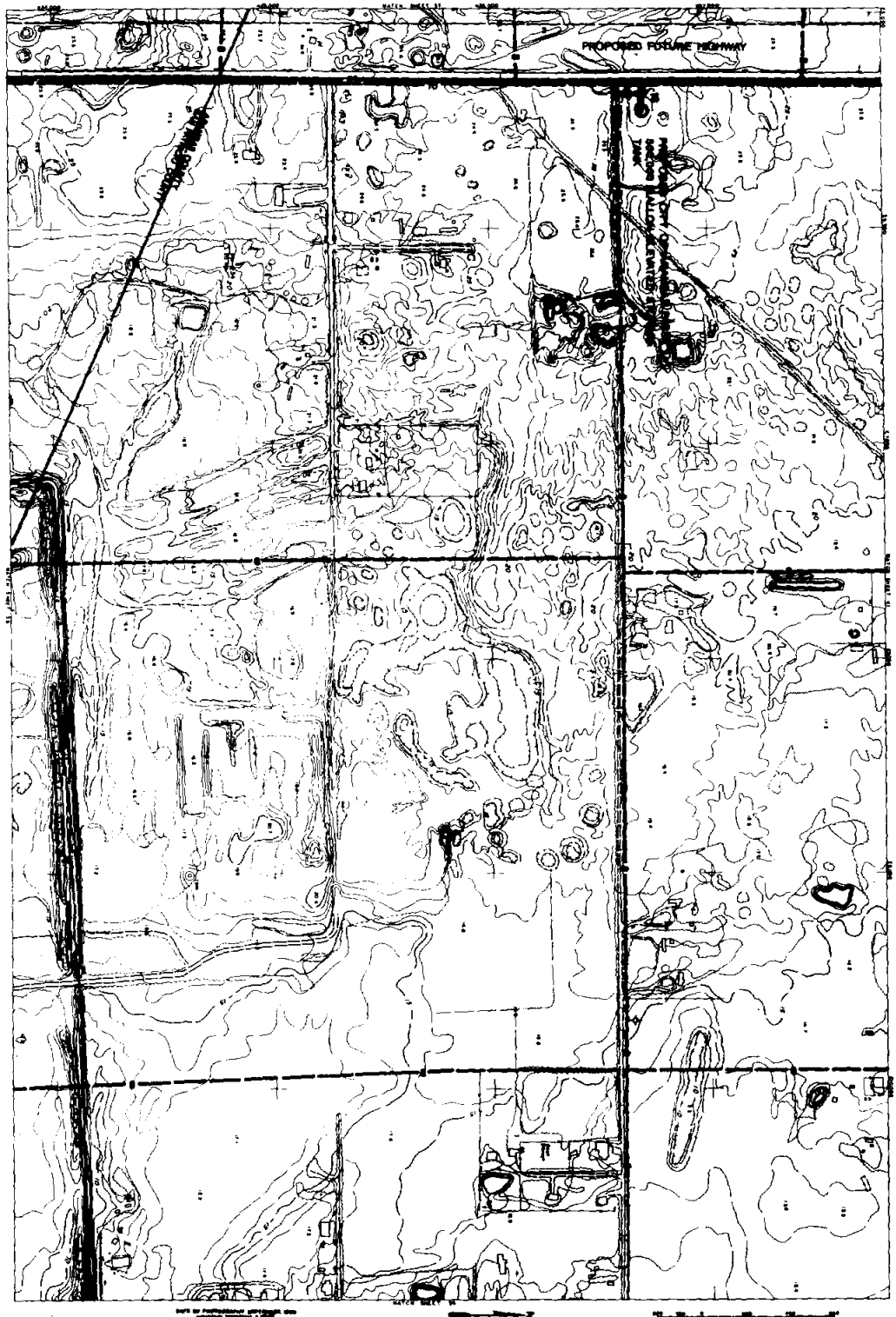
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE OAK PATRICIO COUNTY DRAINAGE DISTRICT.

H - 87



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
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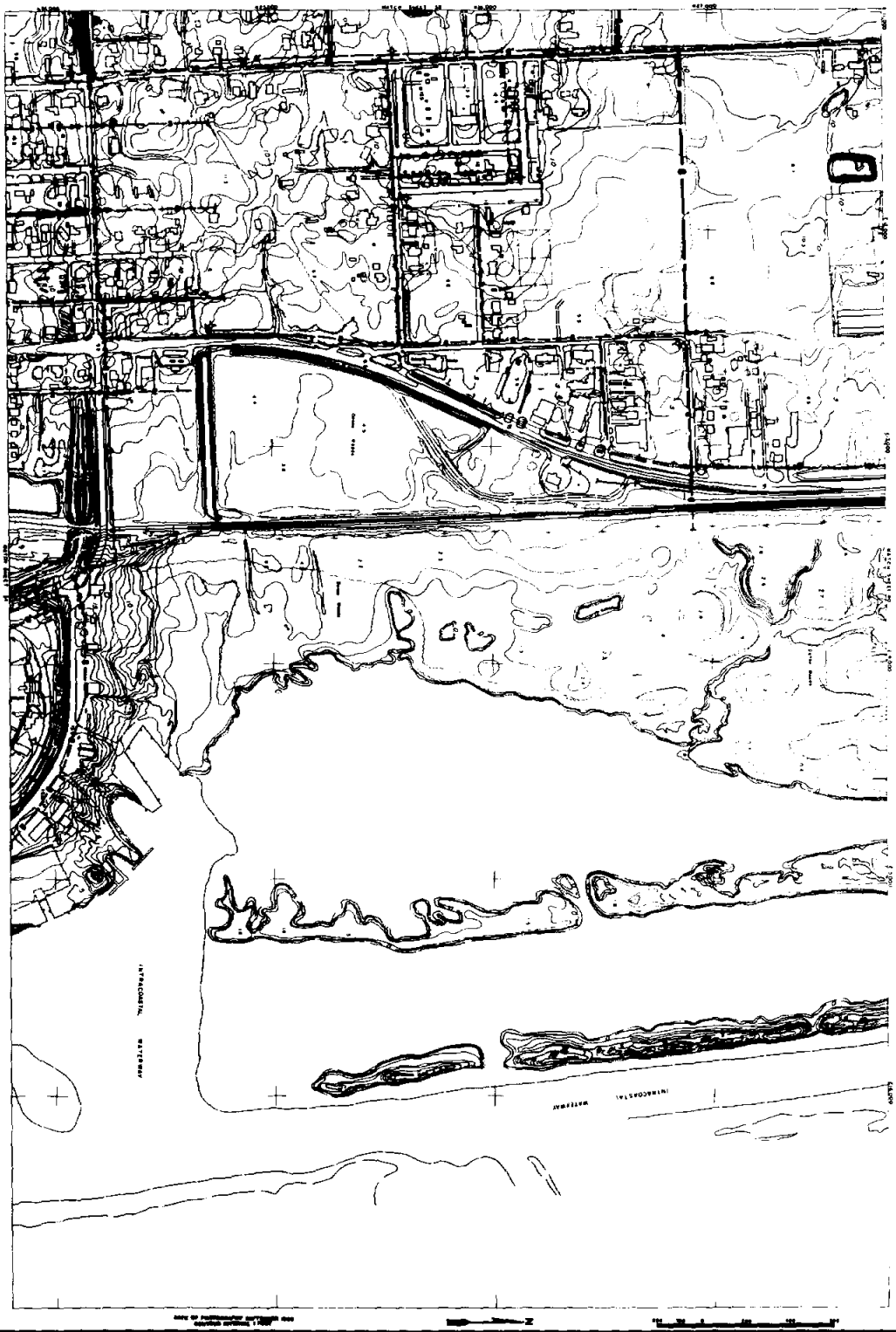
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | 1625-2750

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 38

REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NE-8719

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

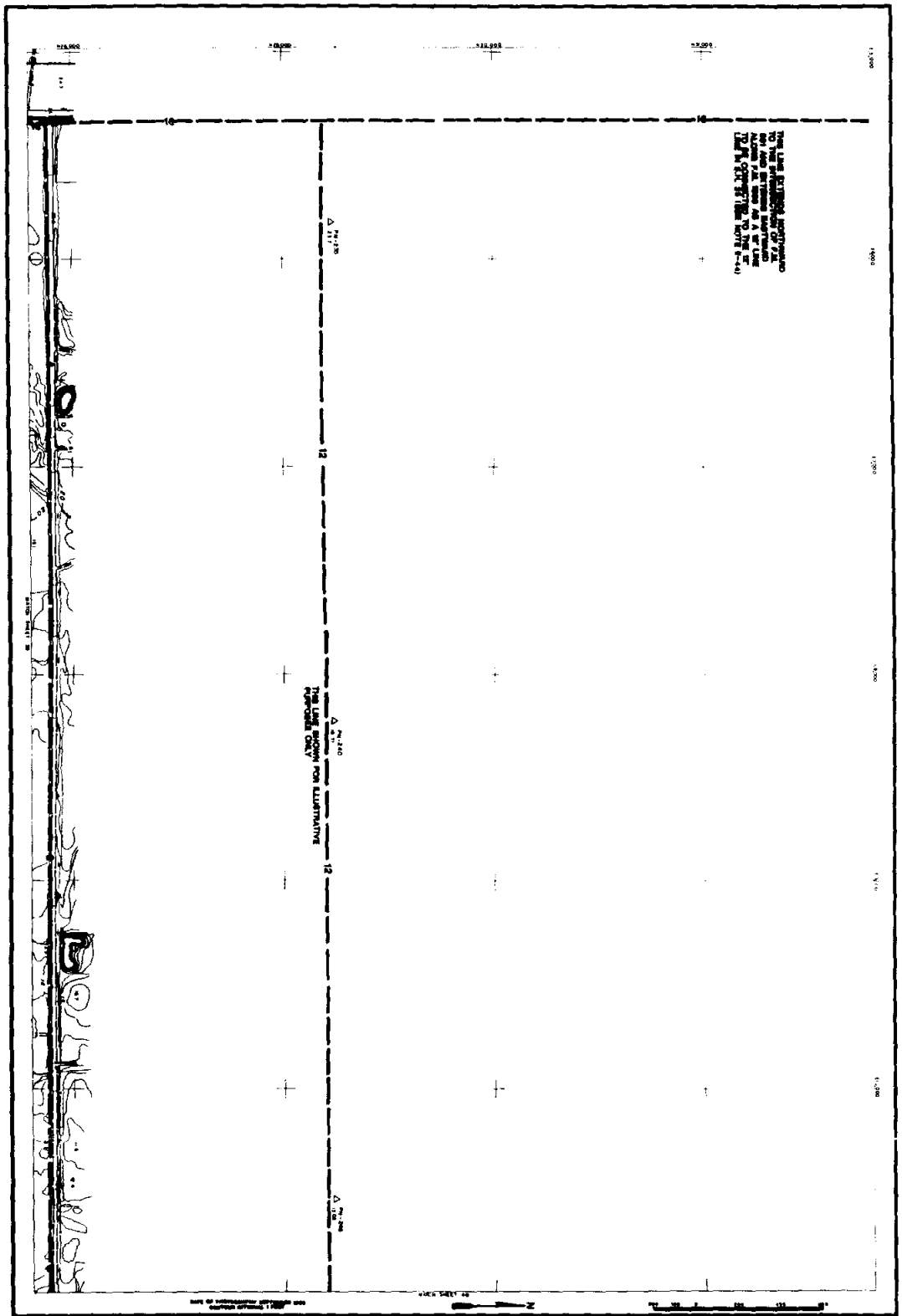
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 40



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAUMETH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980

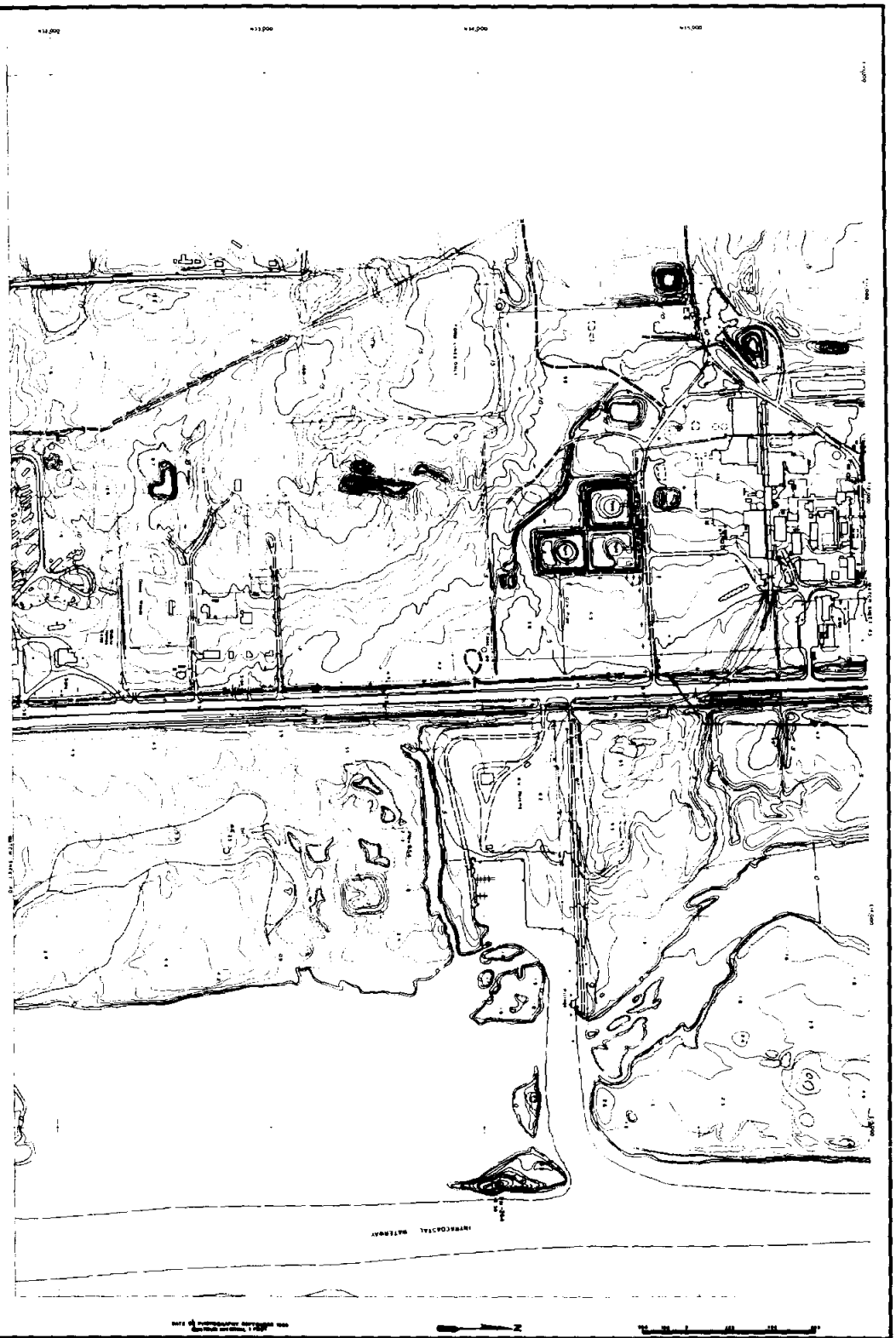
PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1984

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

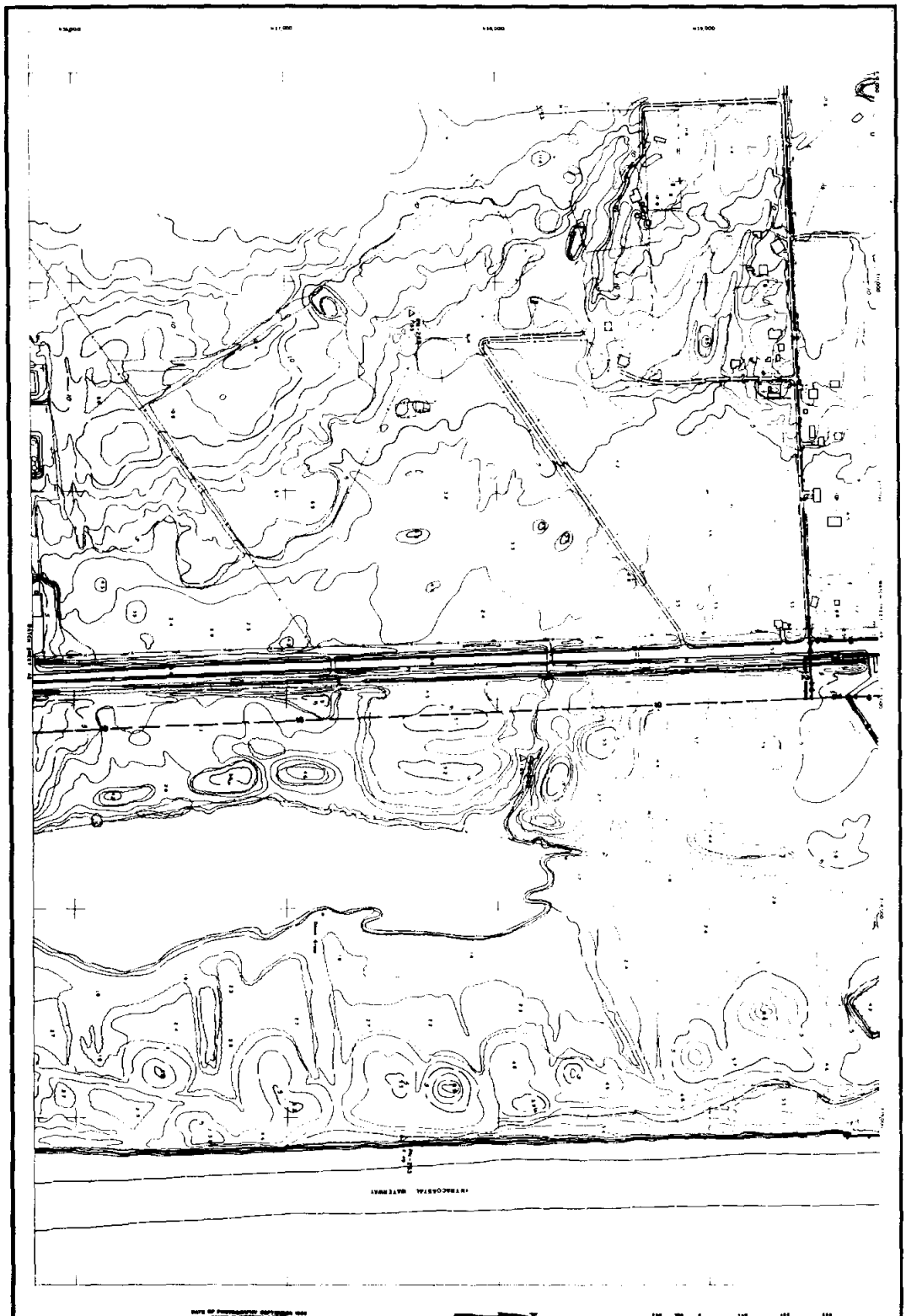
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II-42



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

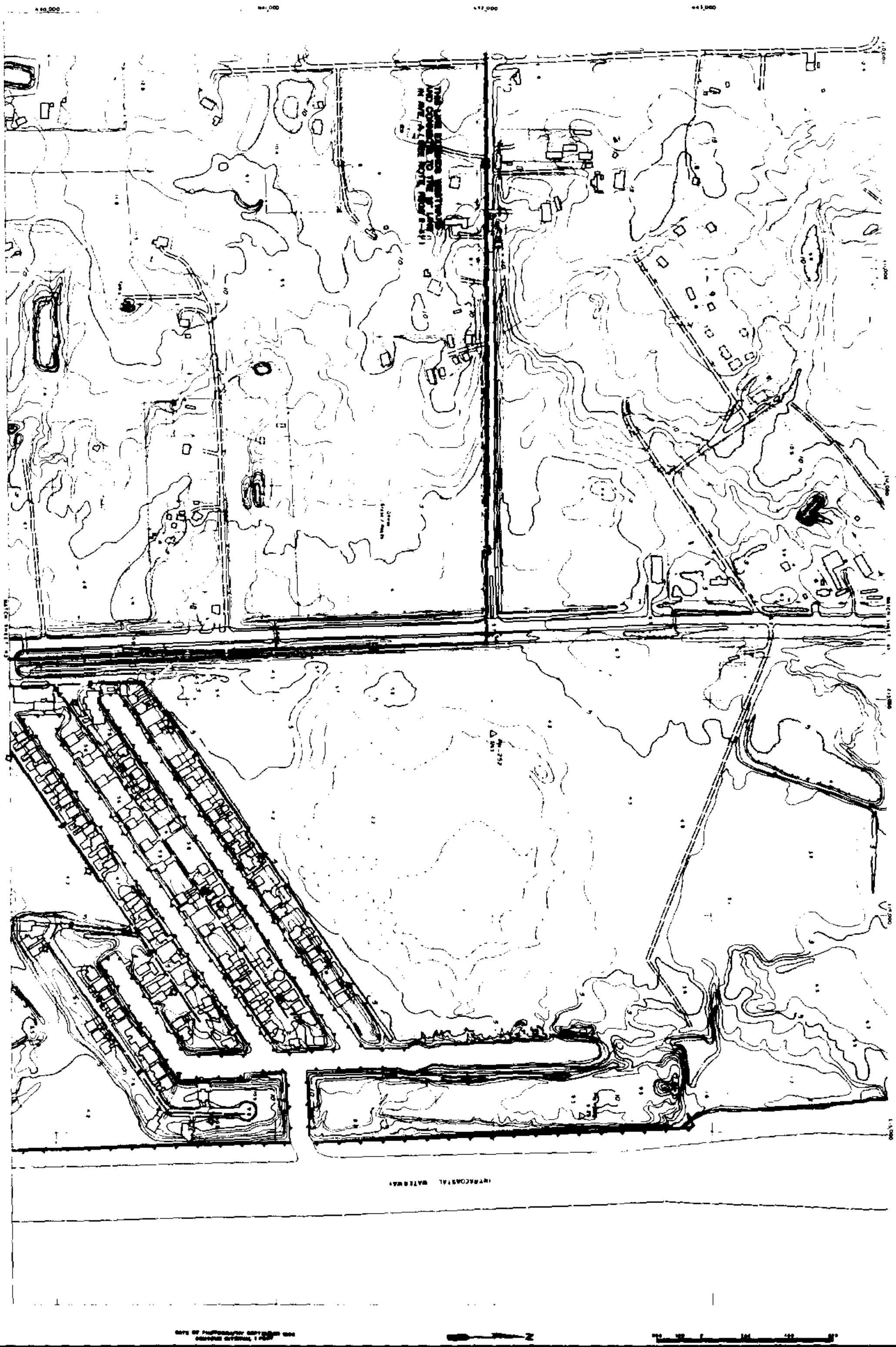
AUG. 1990 | NE#2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1990

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

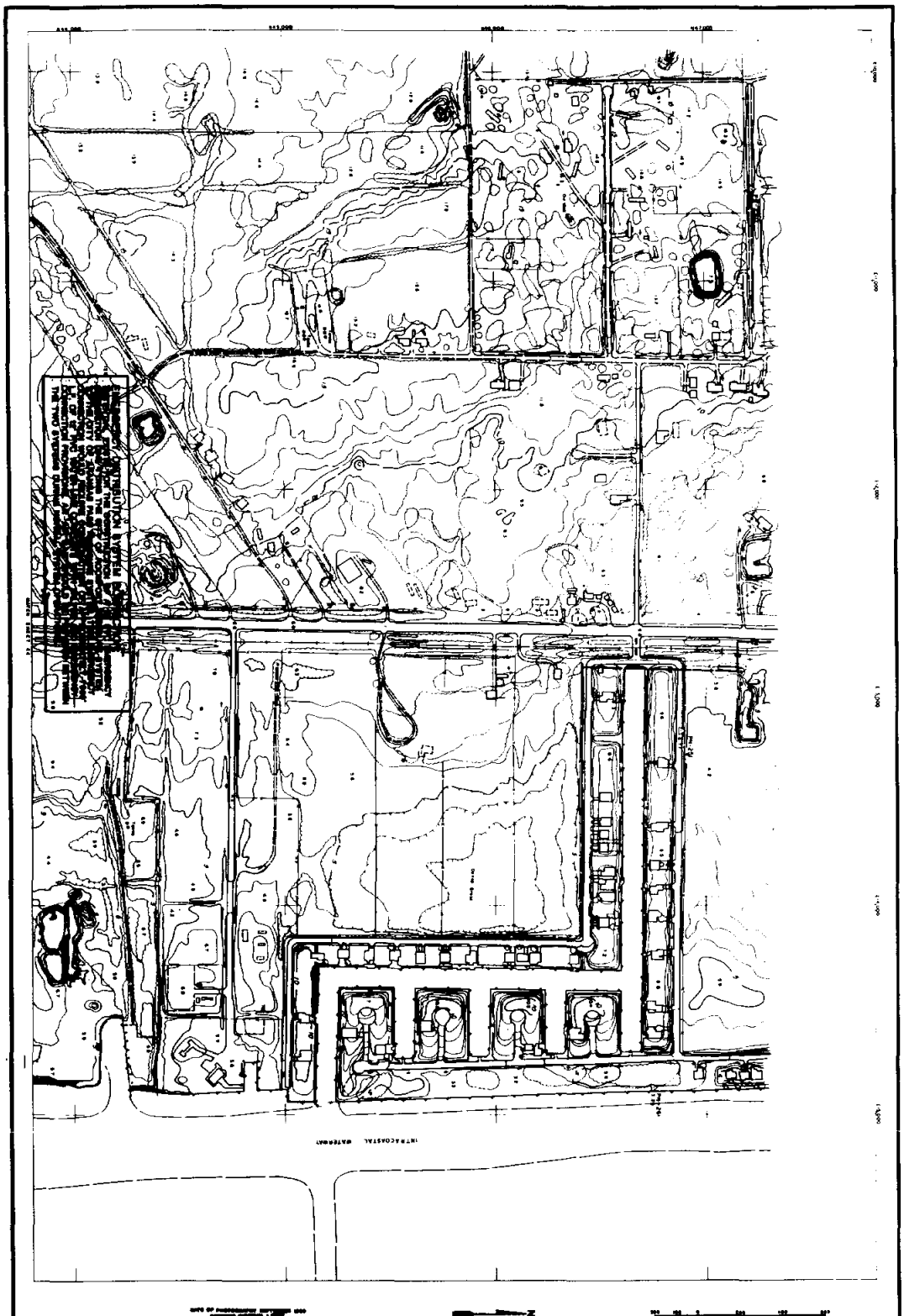
LEGEND

- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

II - 44



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NE-2790

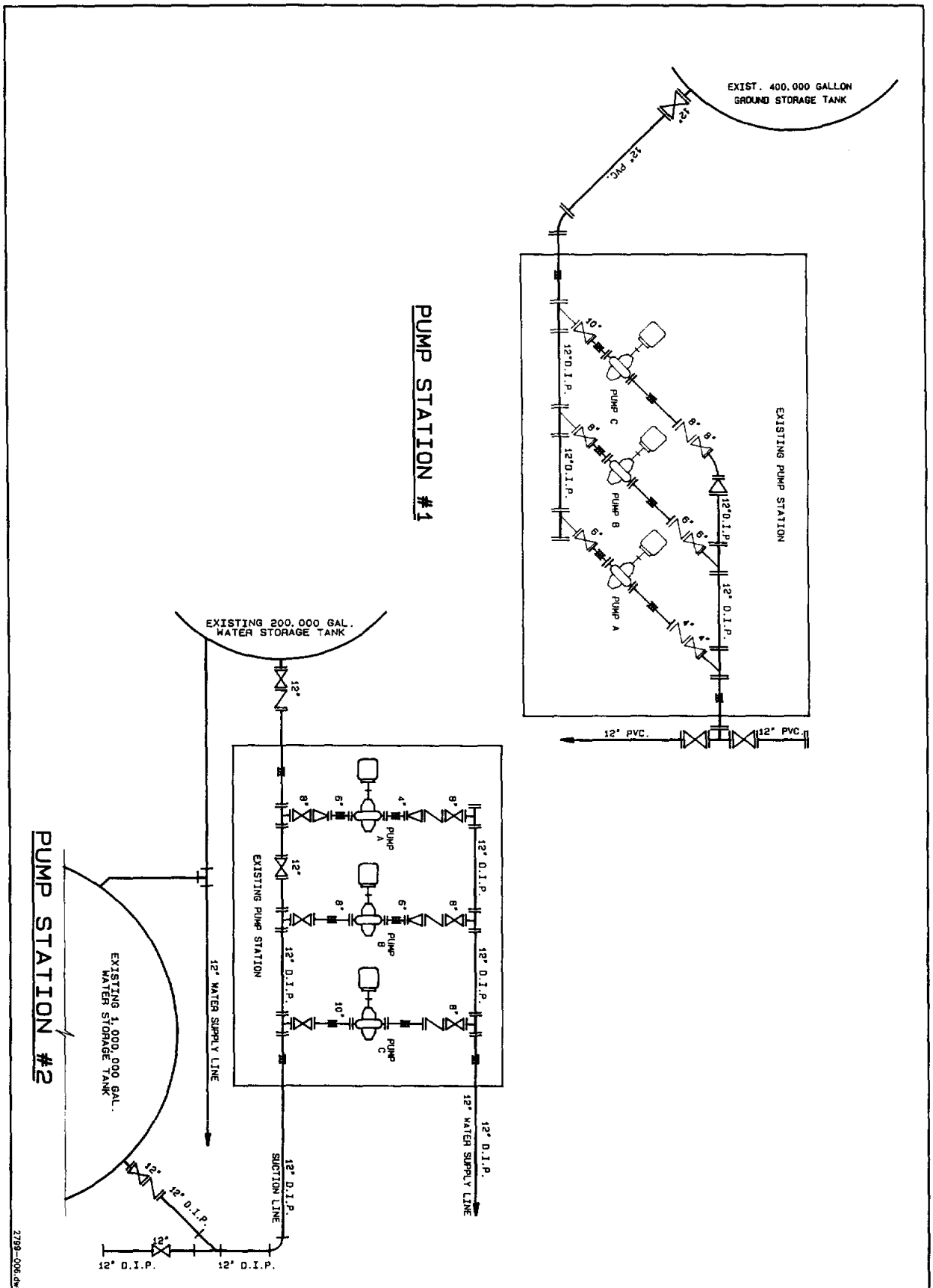
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

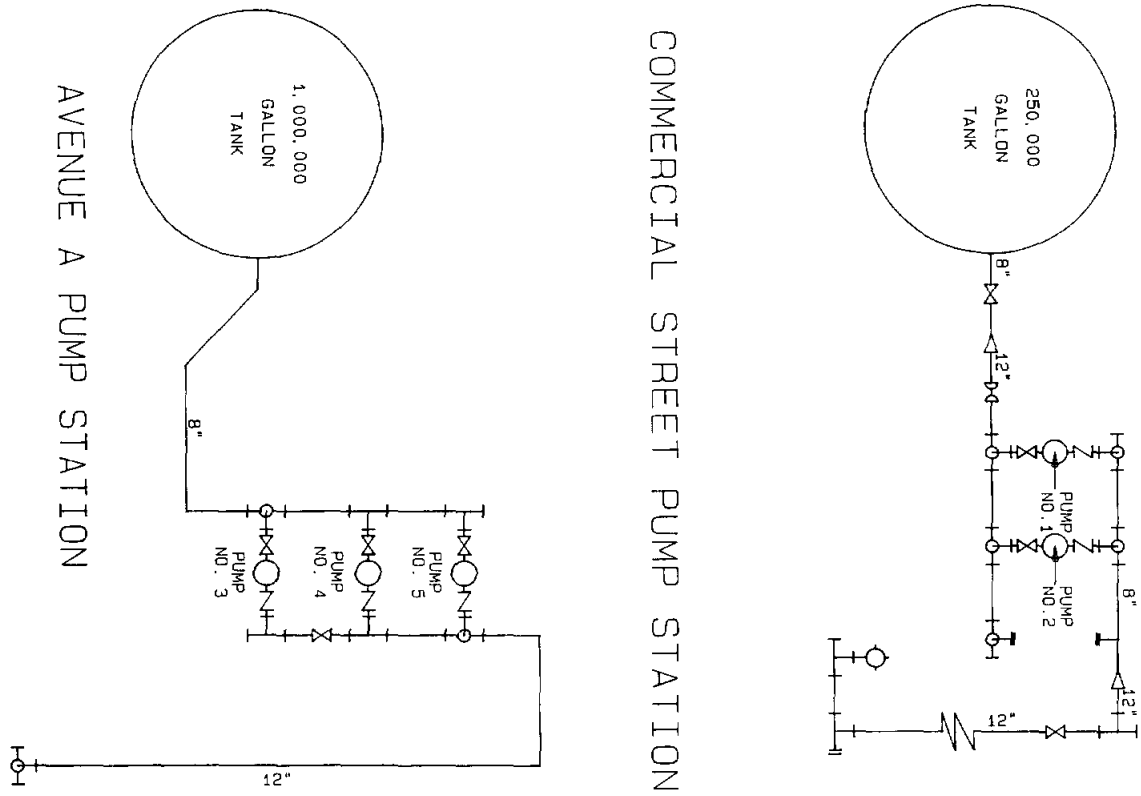
- EXISTING SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- PROPOSED SAN PATRICIO MUNICIPAL WATER DISTRICT TRANSMISSION LINE (SIZE IN INCHES)
- EXISTING WATER LINE (SIZE IN INCHES)
- PROPOSED WATER LINE (SIZE IN INCHES)
- EXISTING WATER VALVE
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT

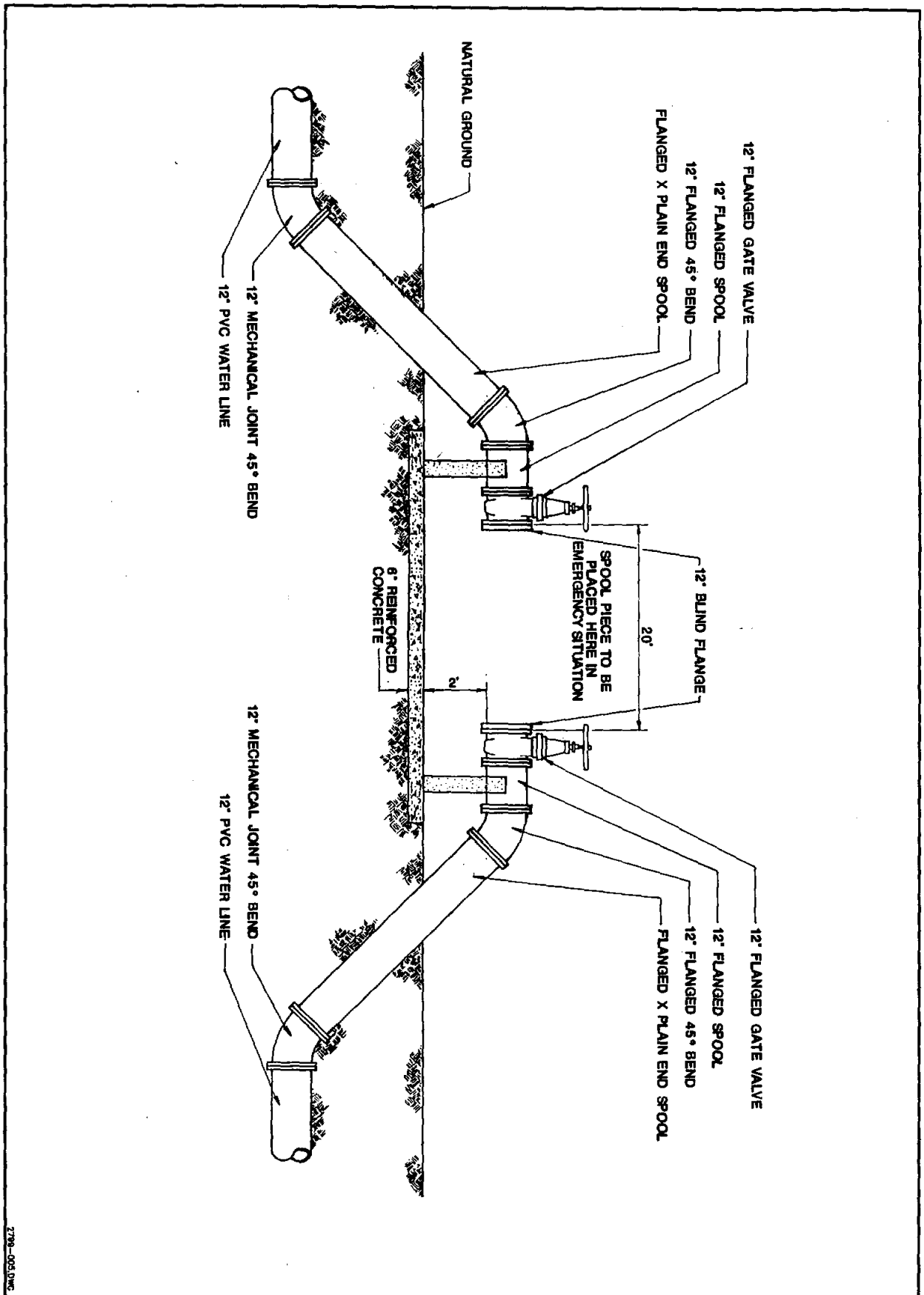


PAGE II-46	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE VIII – SCHEMATIC DIAGRAMS – CITY OF INGLESIDE WATER PUMP STATIONS



2799-006.dwg

PAGE II-47	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE IX – SCHEMATIC DIAGRAMS CITY OF ARANSAS PASS WATER PUMP STATIONS



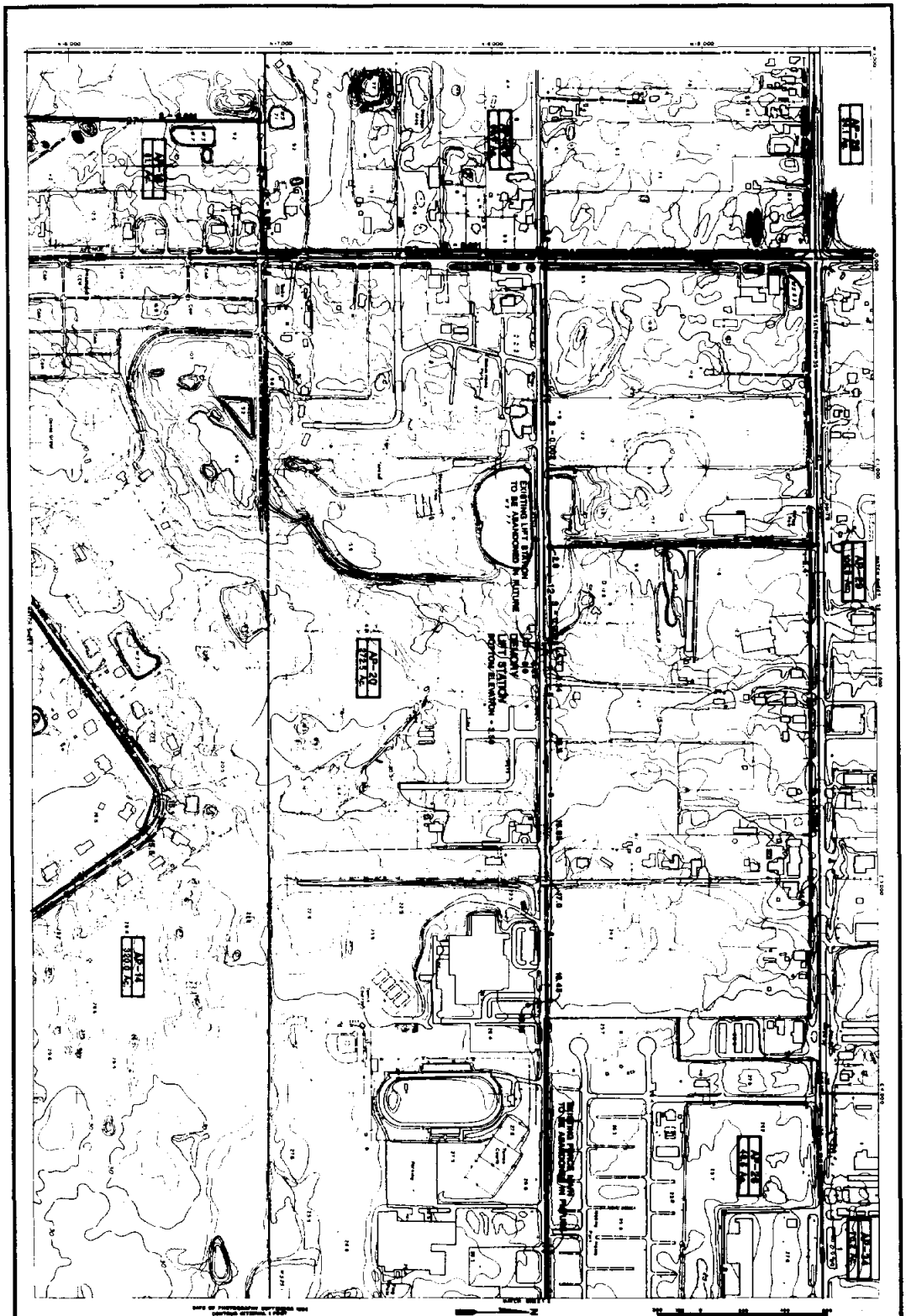
2799-005.DWG

PAGE II-48	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE XV TYPICAL EMERGENCY DISTRIBUTION SYSTEM CONNECTION

REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
SAN PATRICIO COUNTY, TEXAS

SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989

APPENDIX III - MASTER WASTEWATER SYSTEM PLAN



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

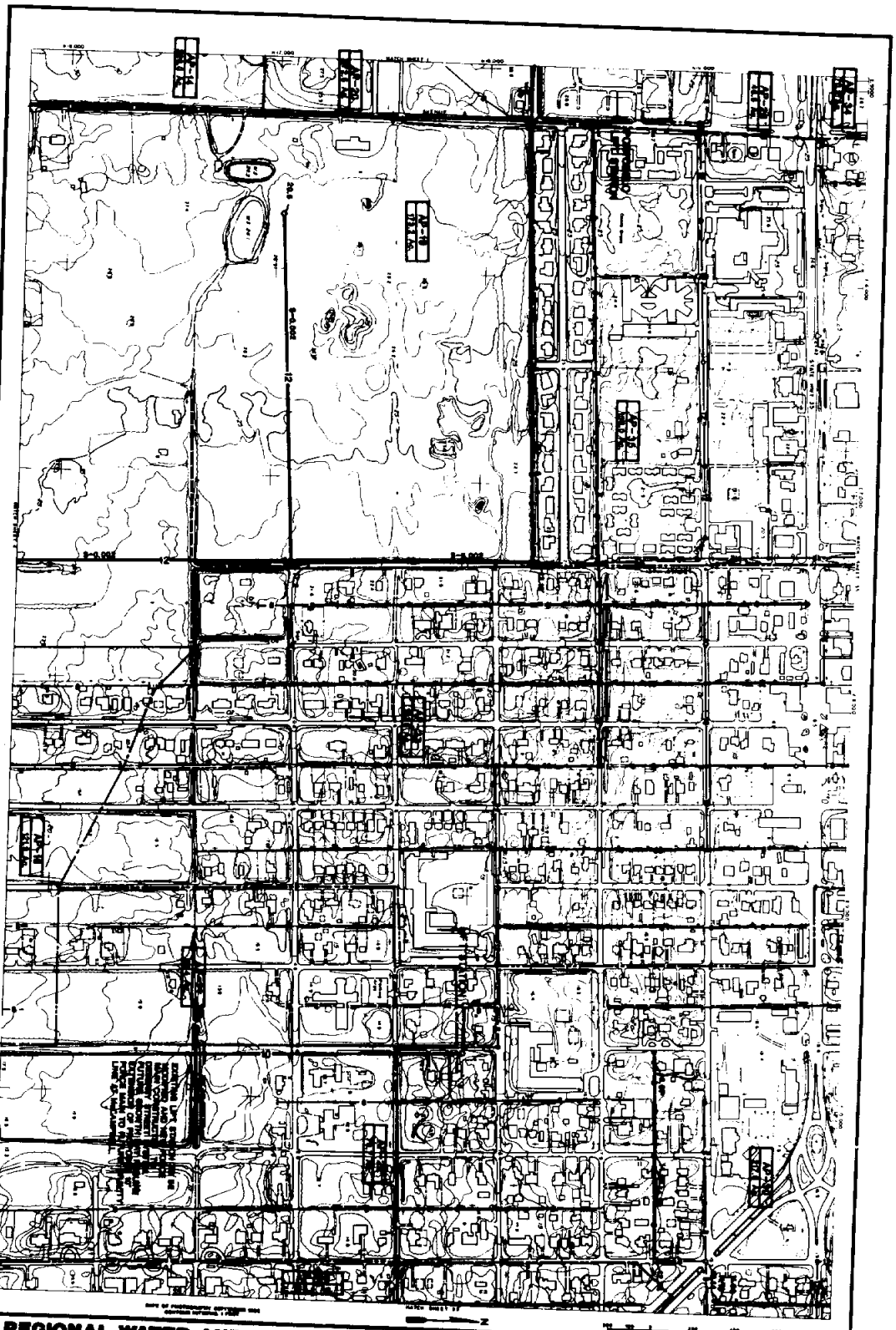
AUG. 1988 | NEI #2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI #7790

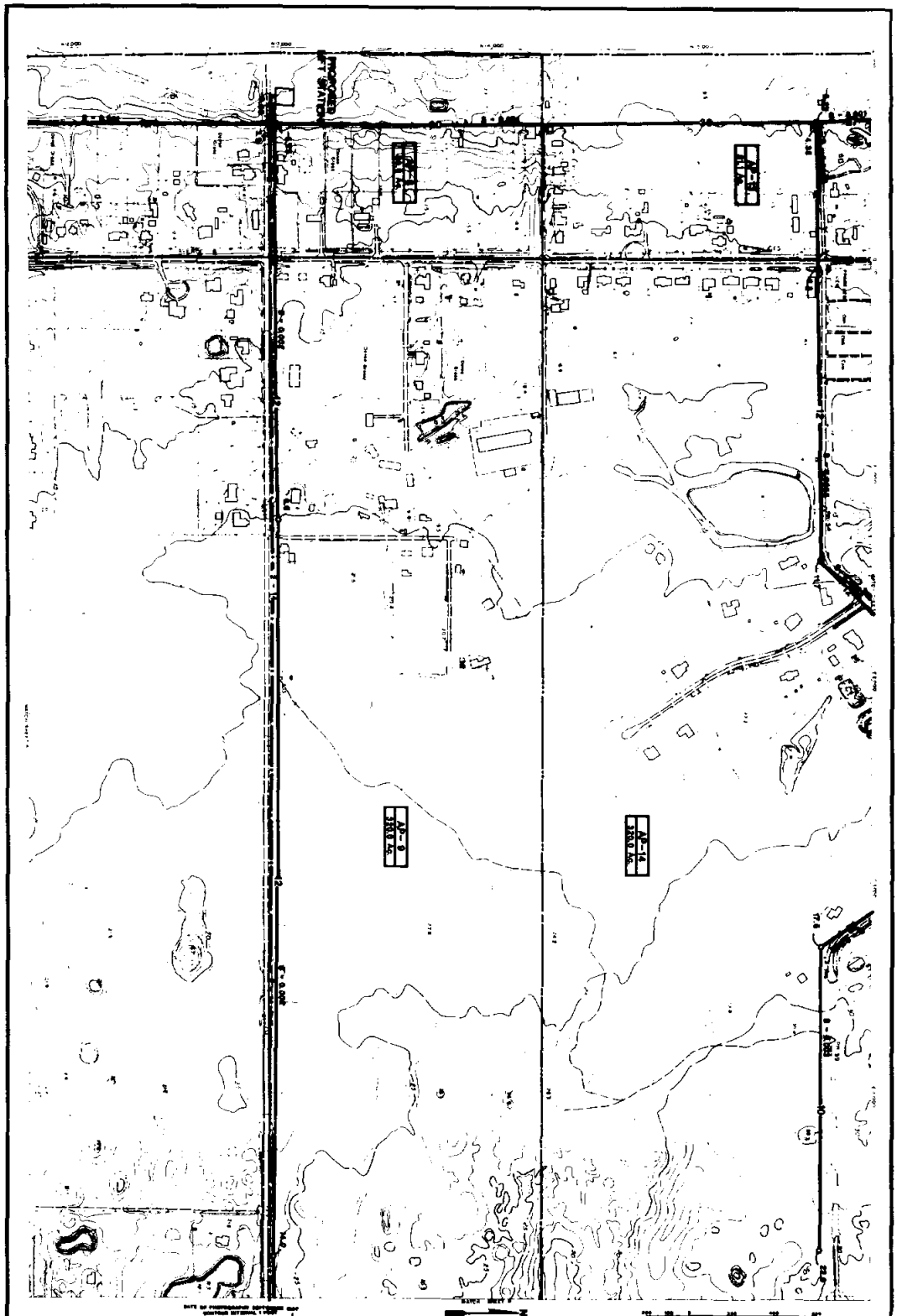
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

LIMITS OF AREA SERVED BY A TRUNK SEWER
EXISTING SEWERS (SIZE IN INCHES)
PROPOSED SEWERS (SIZE IN INCHES)
EXISTING FORCE MAIN (SIZE IN INCHES)
PROPOSED FORCE MAIN (SIZE IN INCHES)
EXISTING MANHOLE INVERT ELEVATION
PROPOSED MANHOLE INVERT ELEVATION
EXISTING LIFT STATION
PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

III - 2



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

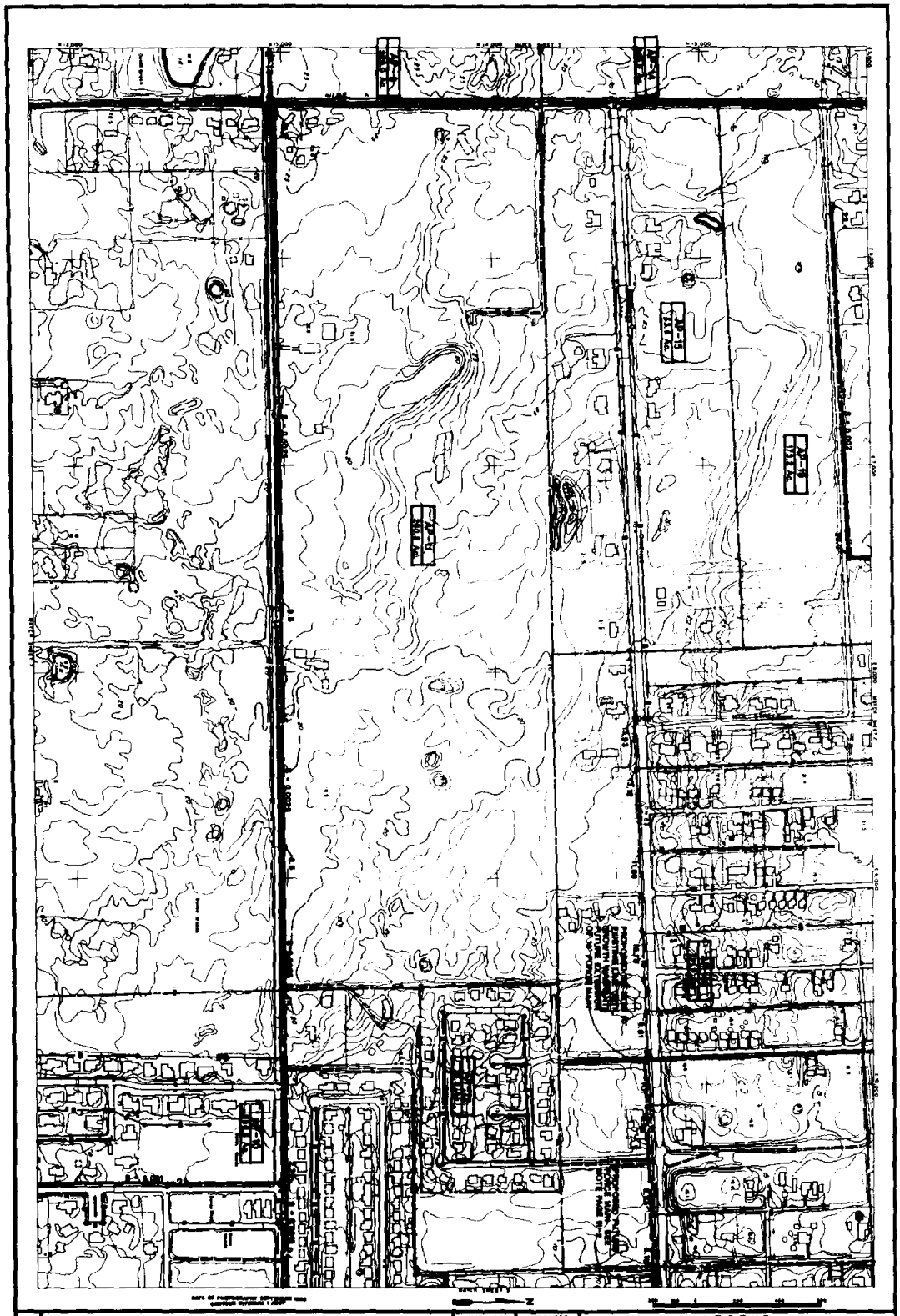
AUG. 1995

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWER (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

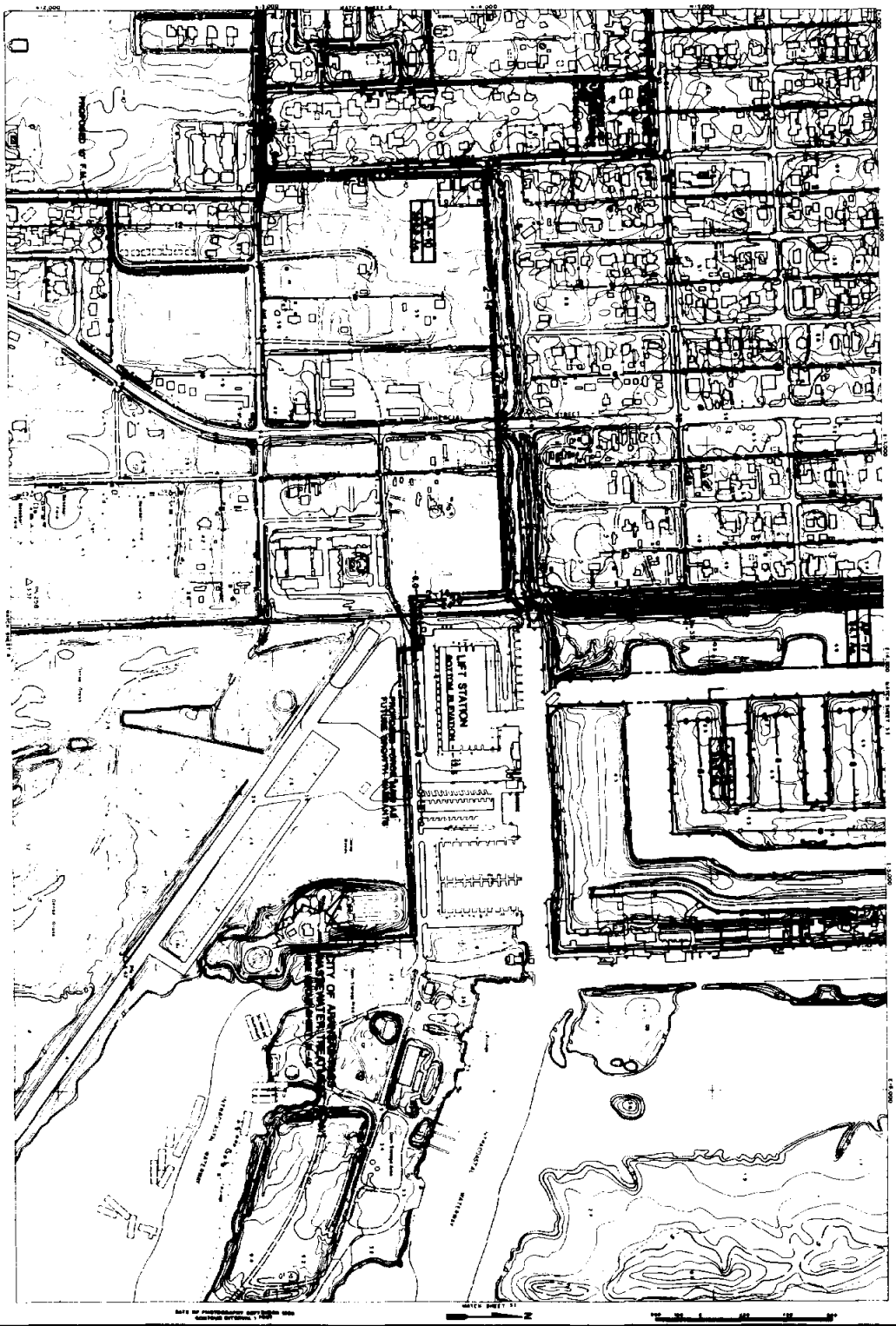
AUG. 1988 | NE87279

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1990 | NE#2790

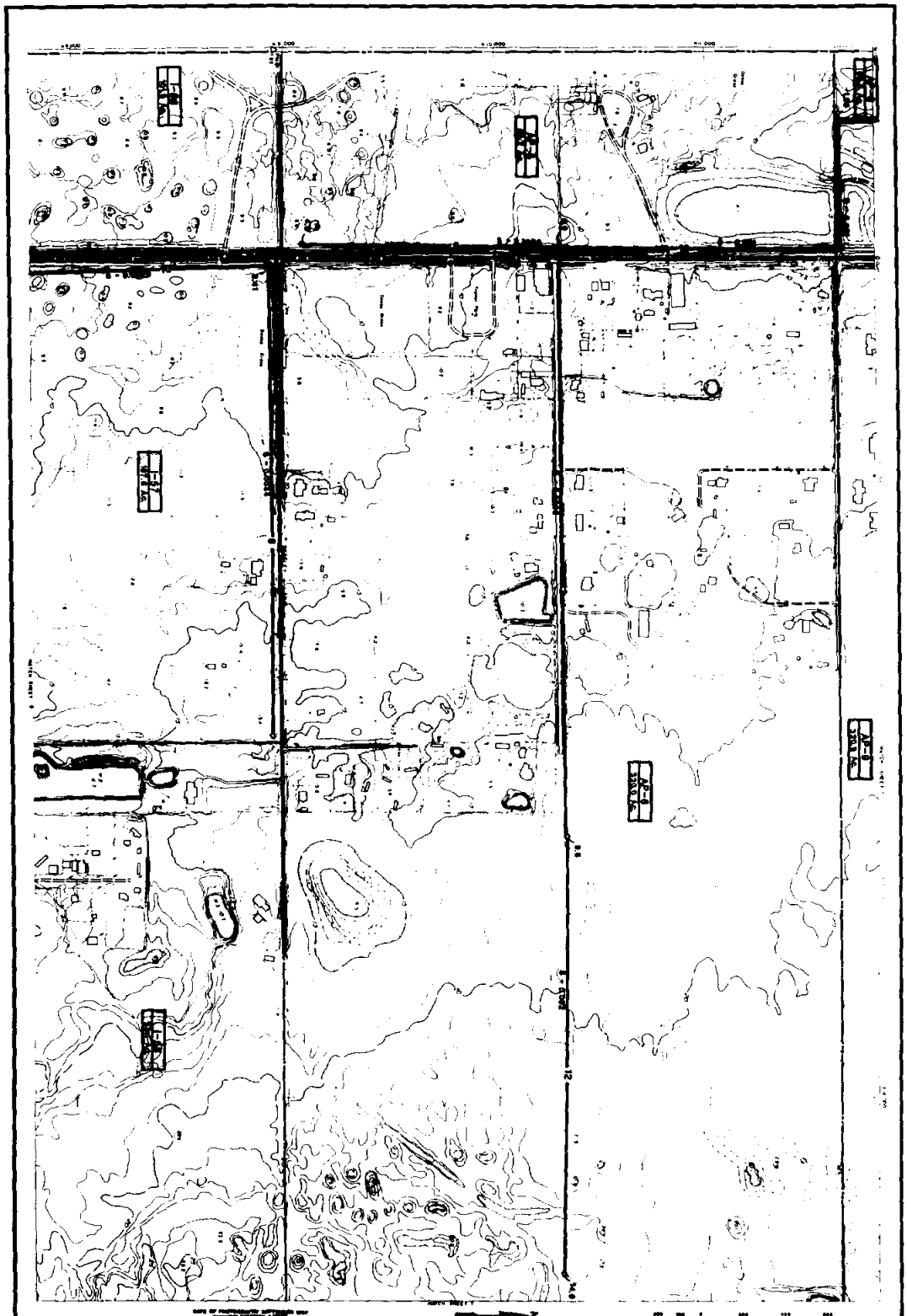
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATIONS)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

III - 5



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

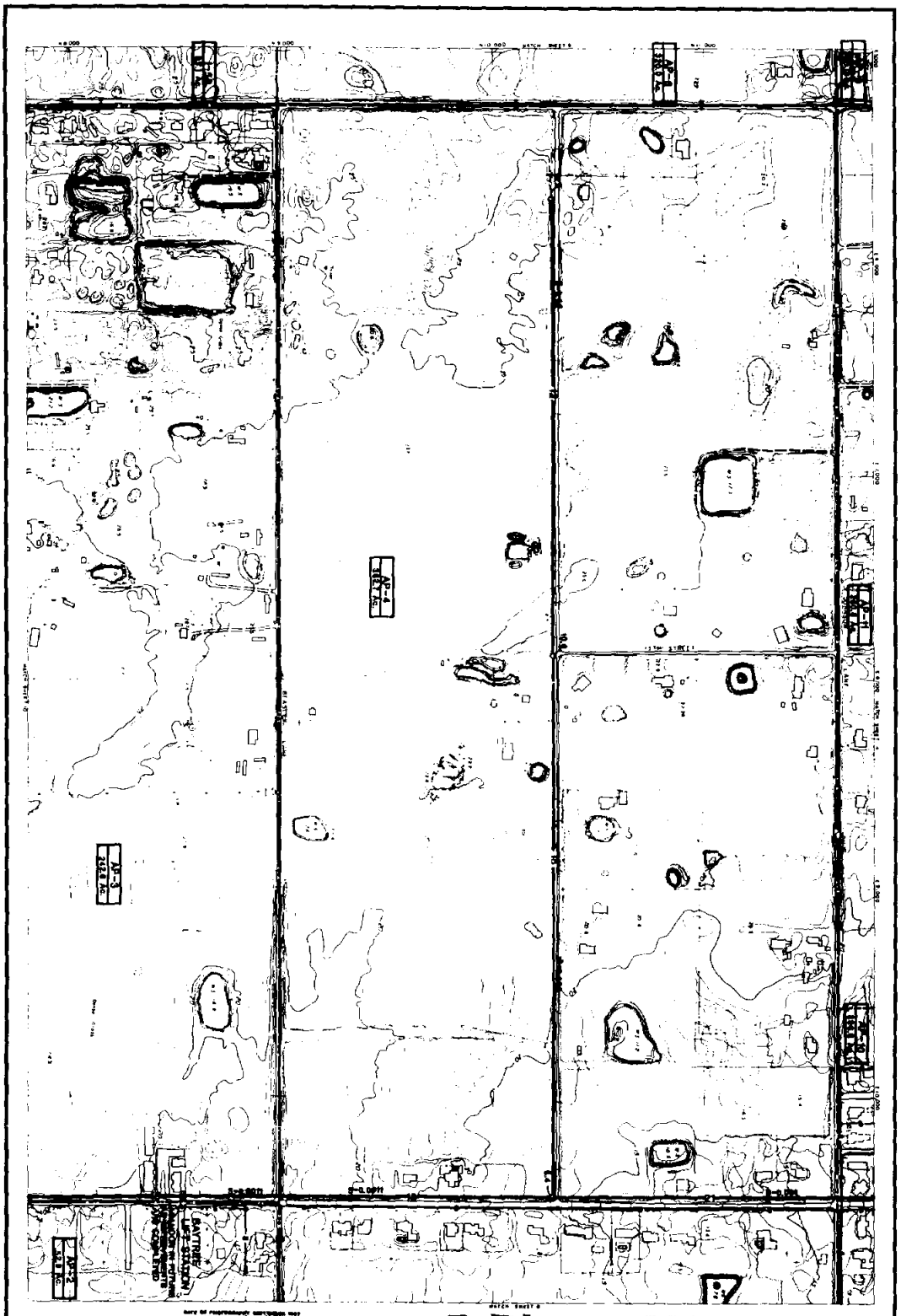
AUG. 1990

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

LIMITS OF AREA SERVED BY A TRUNK SEWER
EXISTING SEWERS (SIZE IN INCHES)
PROPOSED SEWERS (SIZE IN INCHES)
EXISTING FORCE MAIN (SIZE IN INCHES)
PROPOSED FORCE MAINS (SIZE IN INCHES)
EXISTING MANHOLE INVERT ELEVATIONS
PROPOSED MANHOLE INVERT ELEVATIONS
EXISTING LIFT STATION
PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD. MAPPING PURCHASED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NEI #2706

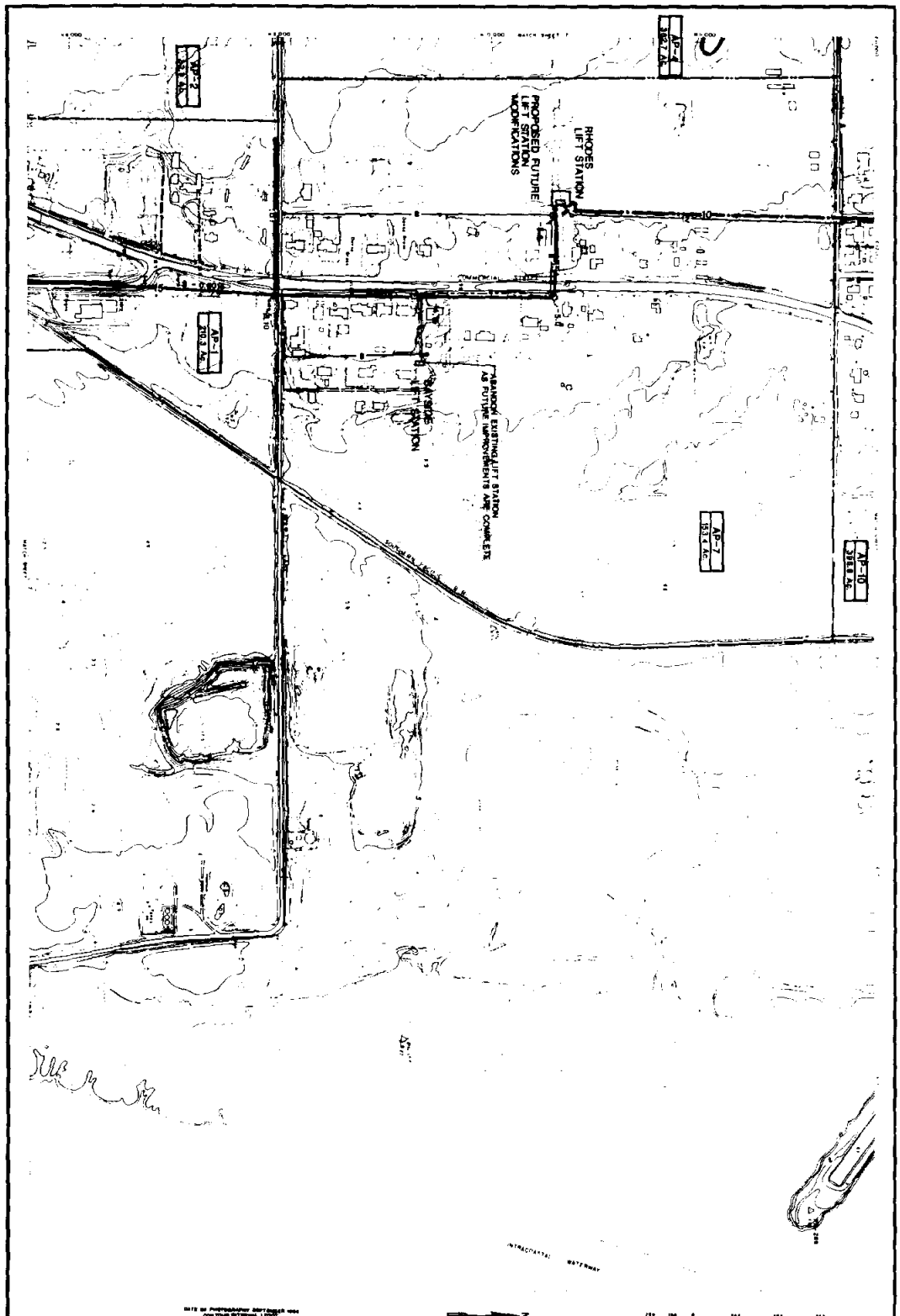
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWERS (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 0.00 EXISTING MANHOLE INVERT ELEVATIONS
- 0.00 PROPOSED MANHOLE INVERT ELEVATIONS
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

III - 7



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

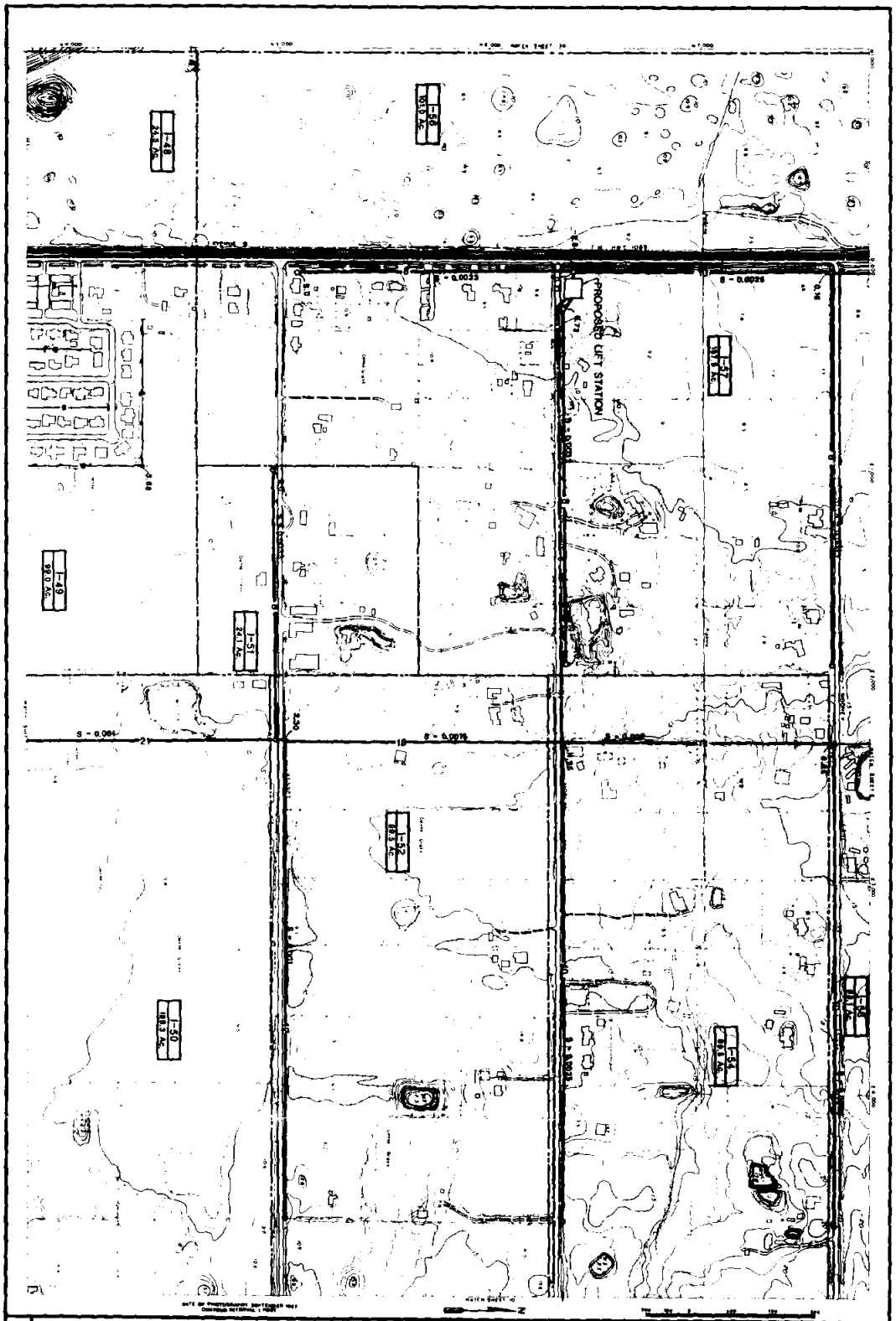
AUG. 1988 | NEI #2788

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

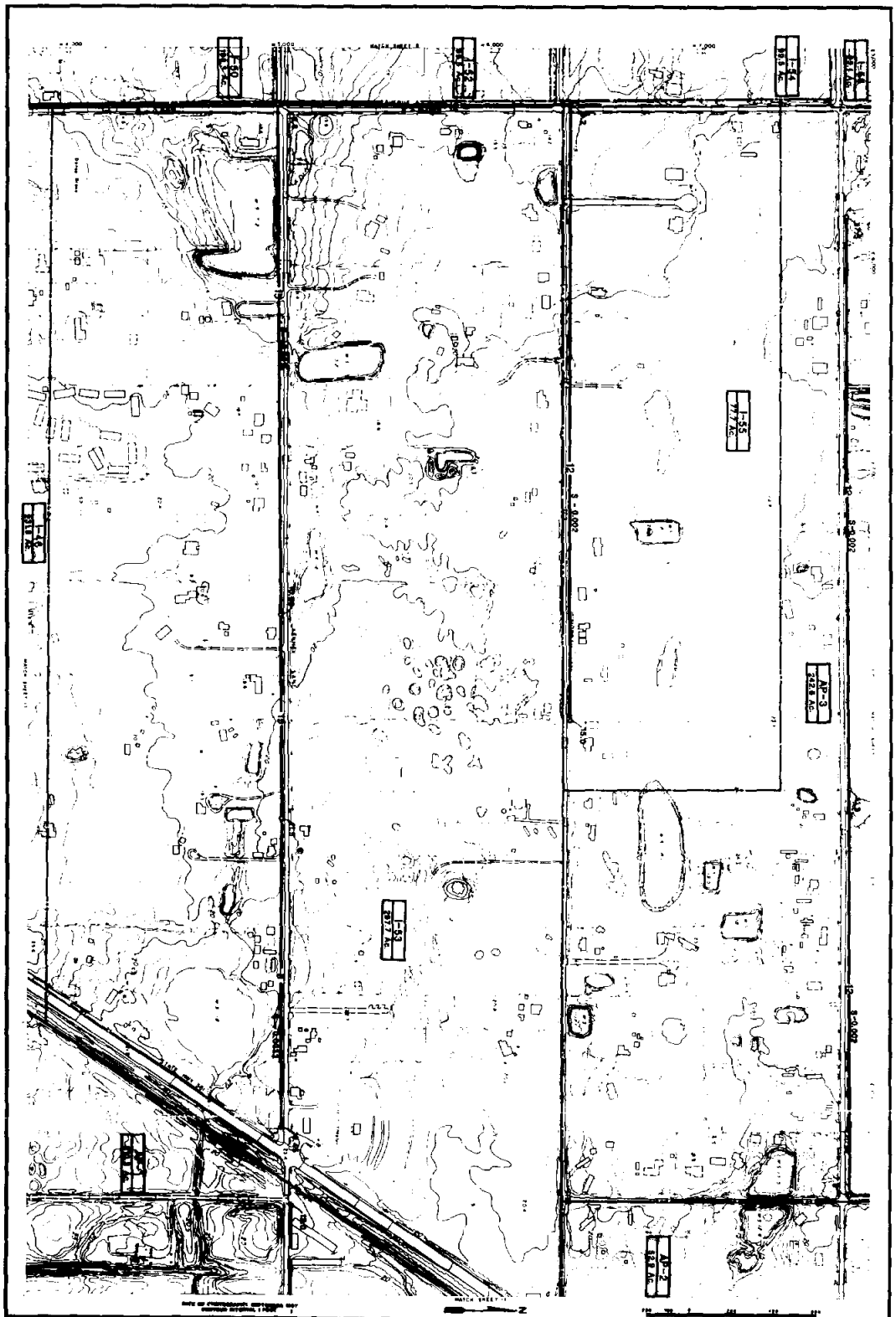
AUG. 1988 | NEI#2795

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

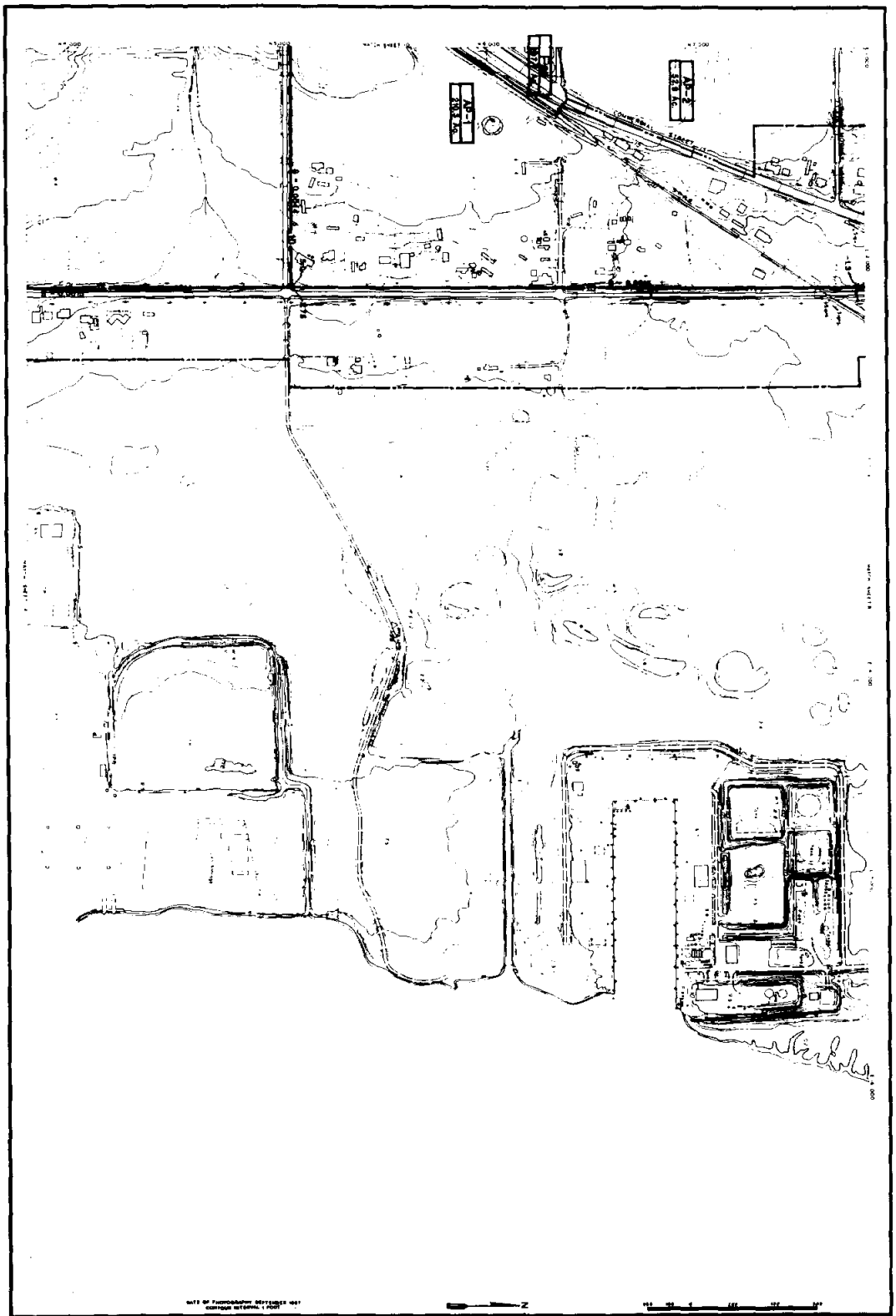
AUG. 1989 | NEI #2709

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

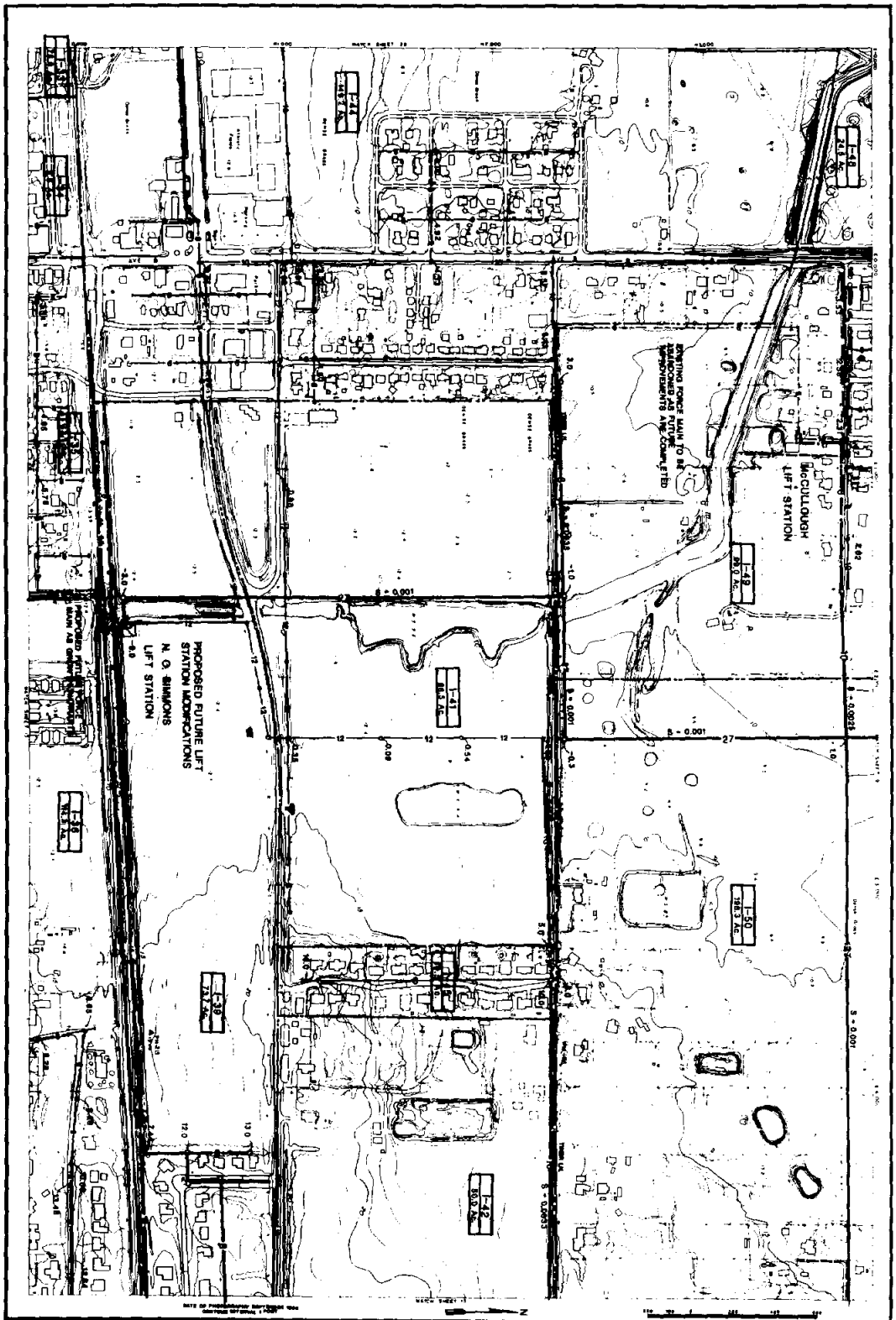
AUG. 1988 | NE/P2790

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 16.55 EXISTING MANHOLE (INVERT ELEVATION)
- 16.55 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

HAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

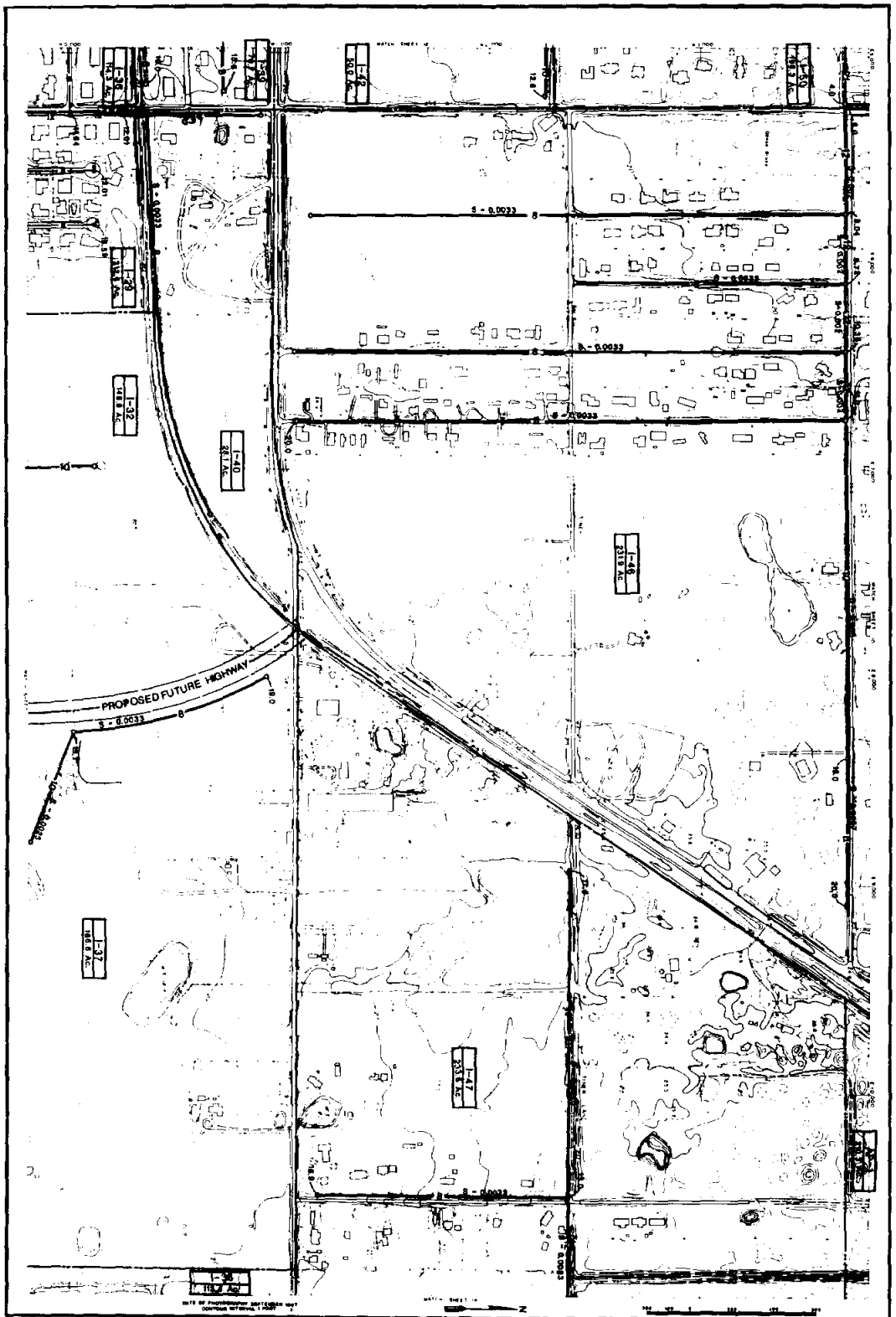
AUG. 1980 | HEI#2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 18 EXISTING SEWERS (SIZE IN INCHES)
- 15 PROPOSED SEWER (SIZE IN INCHES)
- 12 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

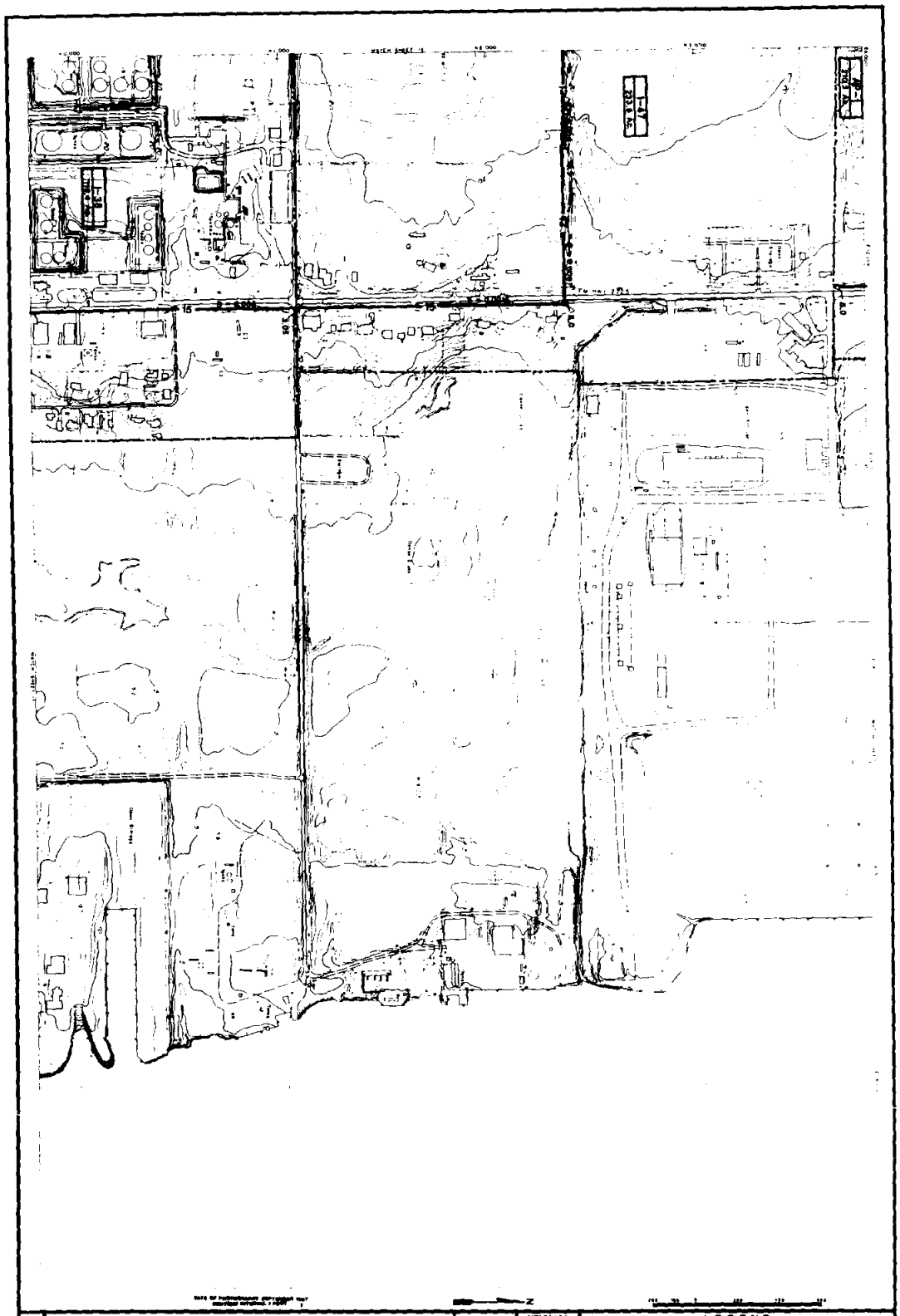
AUG. 1969 | NEI #2799

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

HARWITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

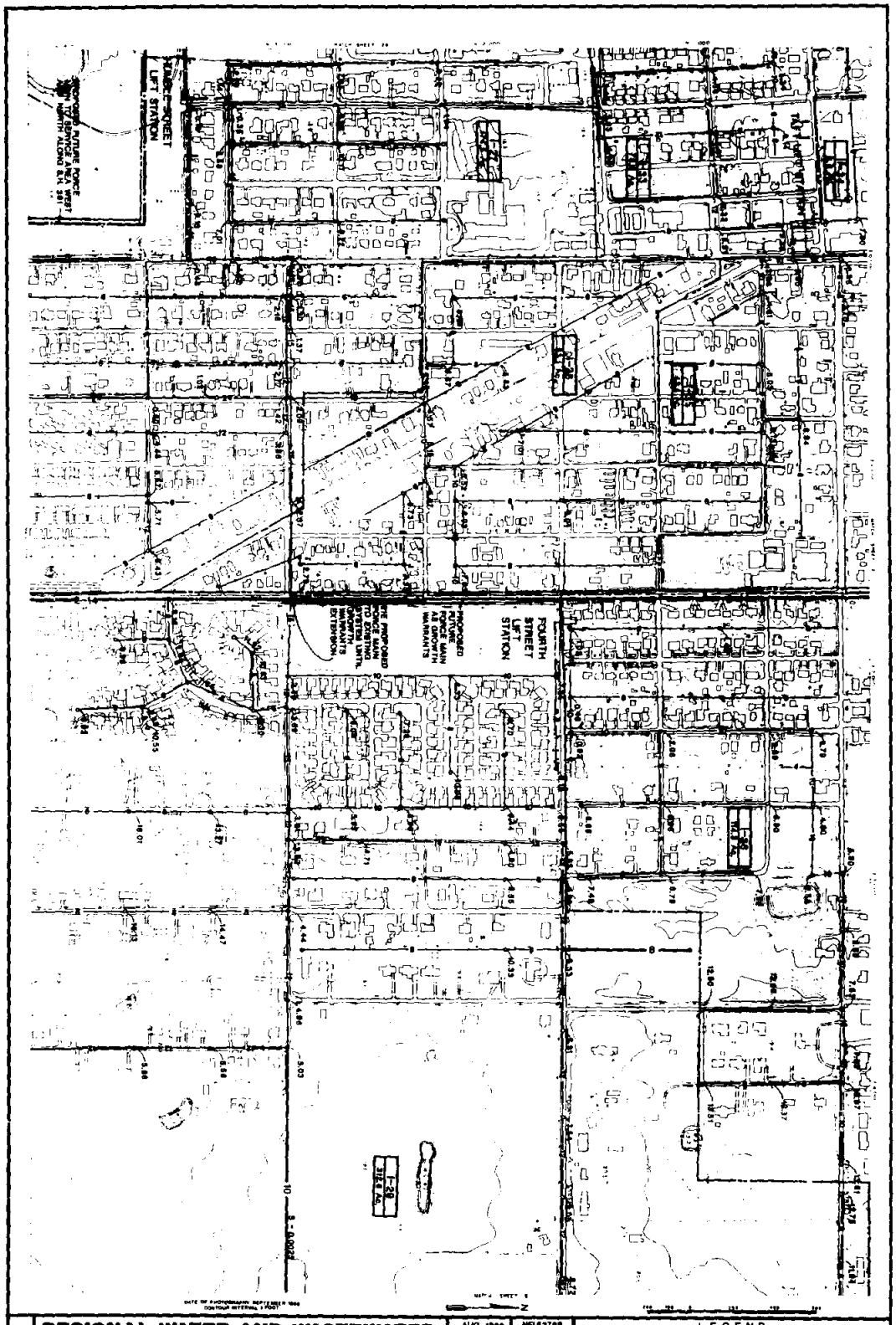
AUG. 1983 | NO. 2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

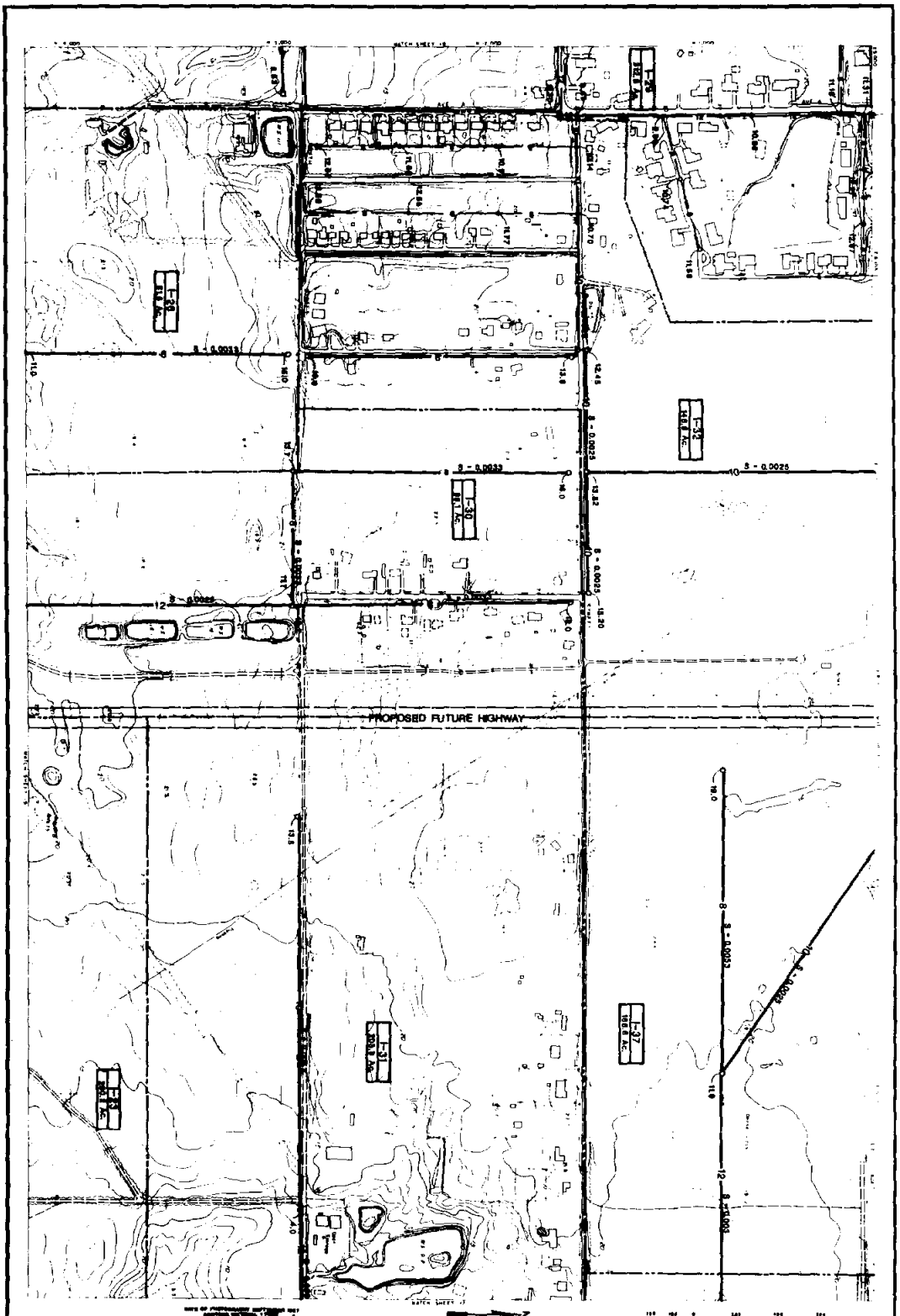
AUG. 1988 | NEI #2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.00 EXISTING MANHOLE (INVERT ELEVATION)
- 10.00 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

HAMMETT ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

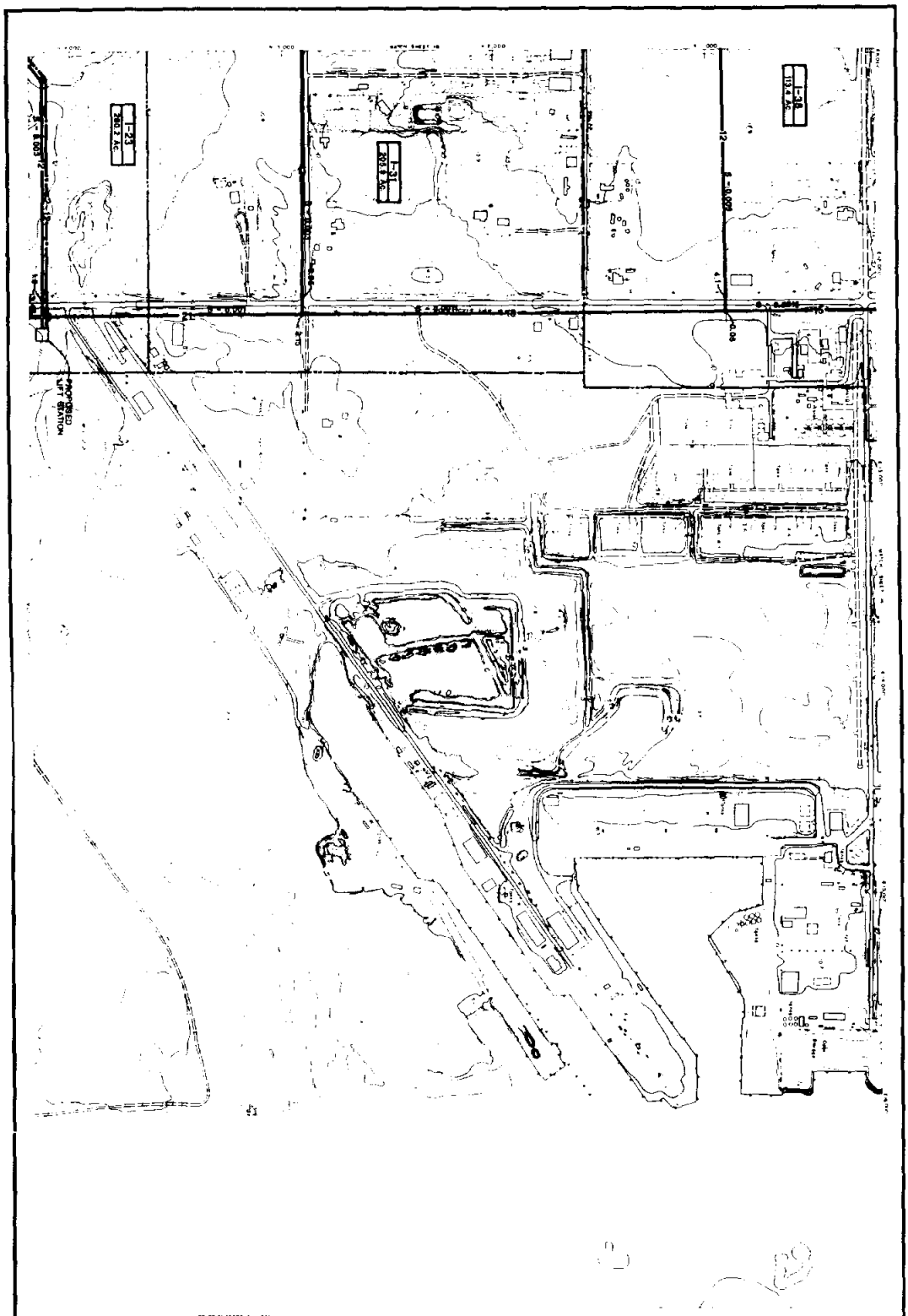
AUG. 1988 | NE#2798

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 15 EXISTING SEWERS (SIZE IN INCHES)
- 15 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.0 EXISTING MANHOLE (INVERT ELEVATION)
- 10.0 PROPOSED MANHOLE INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD. MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

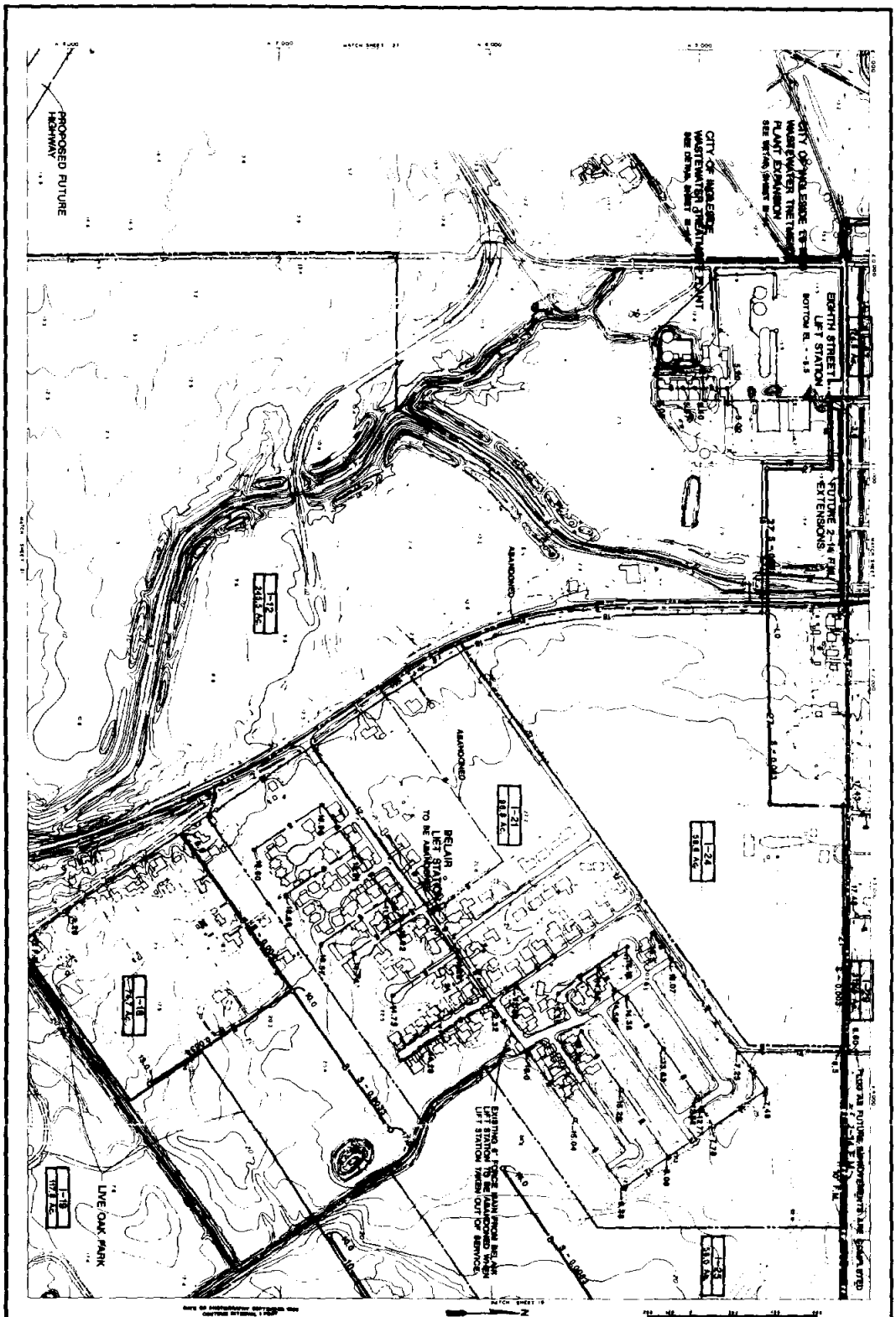
AUG. 1985 | NEI #2799

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 — EXISTING SEWERS (SIZE IN INCHES)
- 10 — PROPOSED SEWER (SIZE IN INCHES)
- 10 — EXISTING FORCE MAIN (SIZE IN INCHES)
- 10-12 — PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- 14.25 — PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION — PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

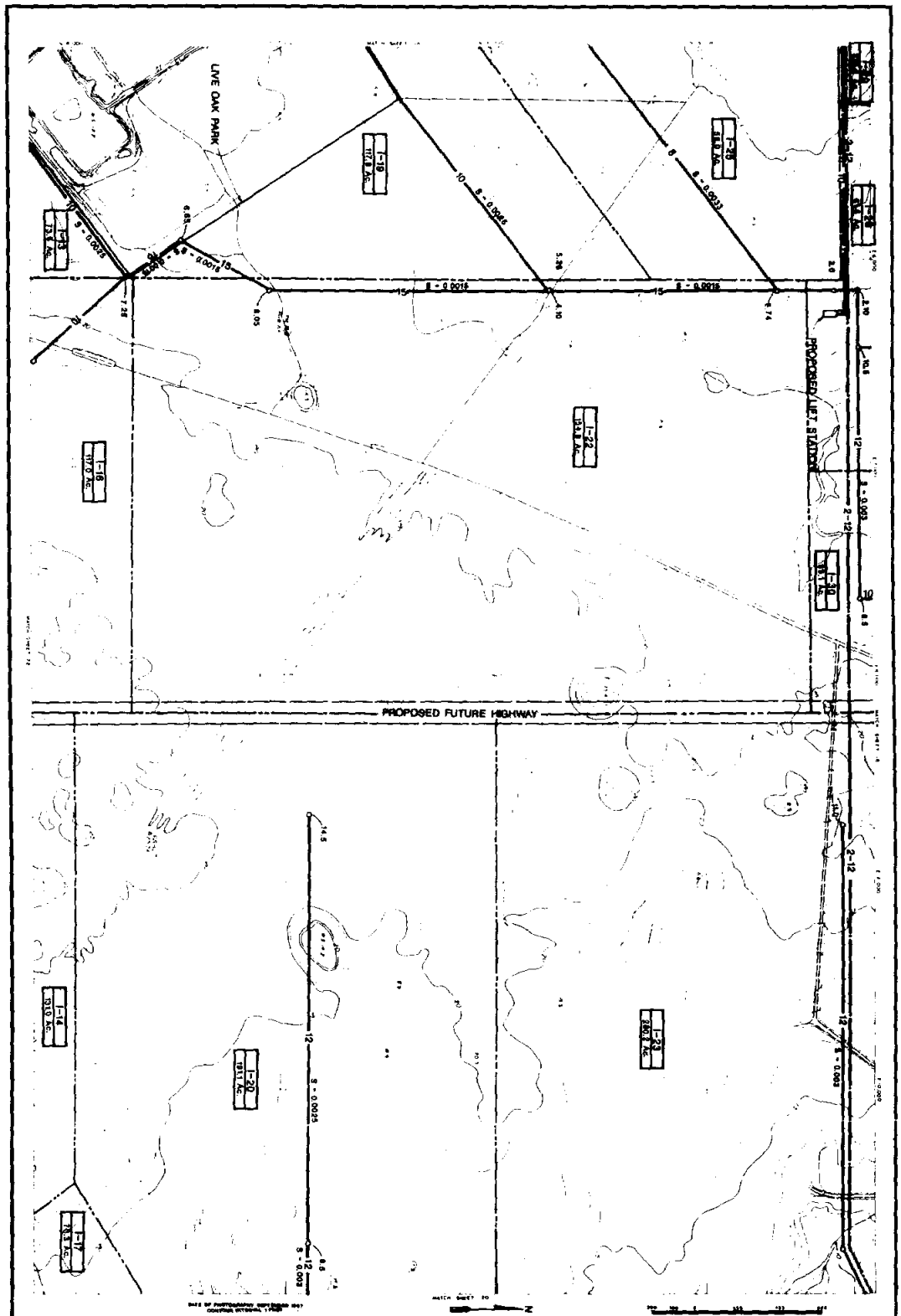
AUG. 1980 | NEI #2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

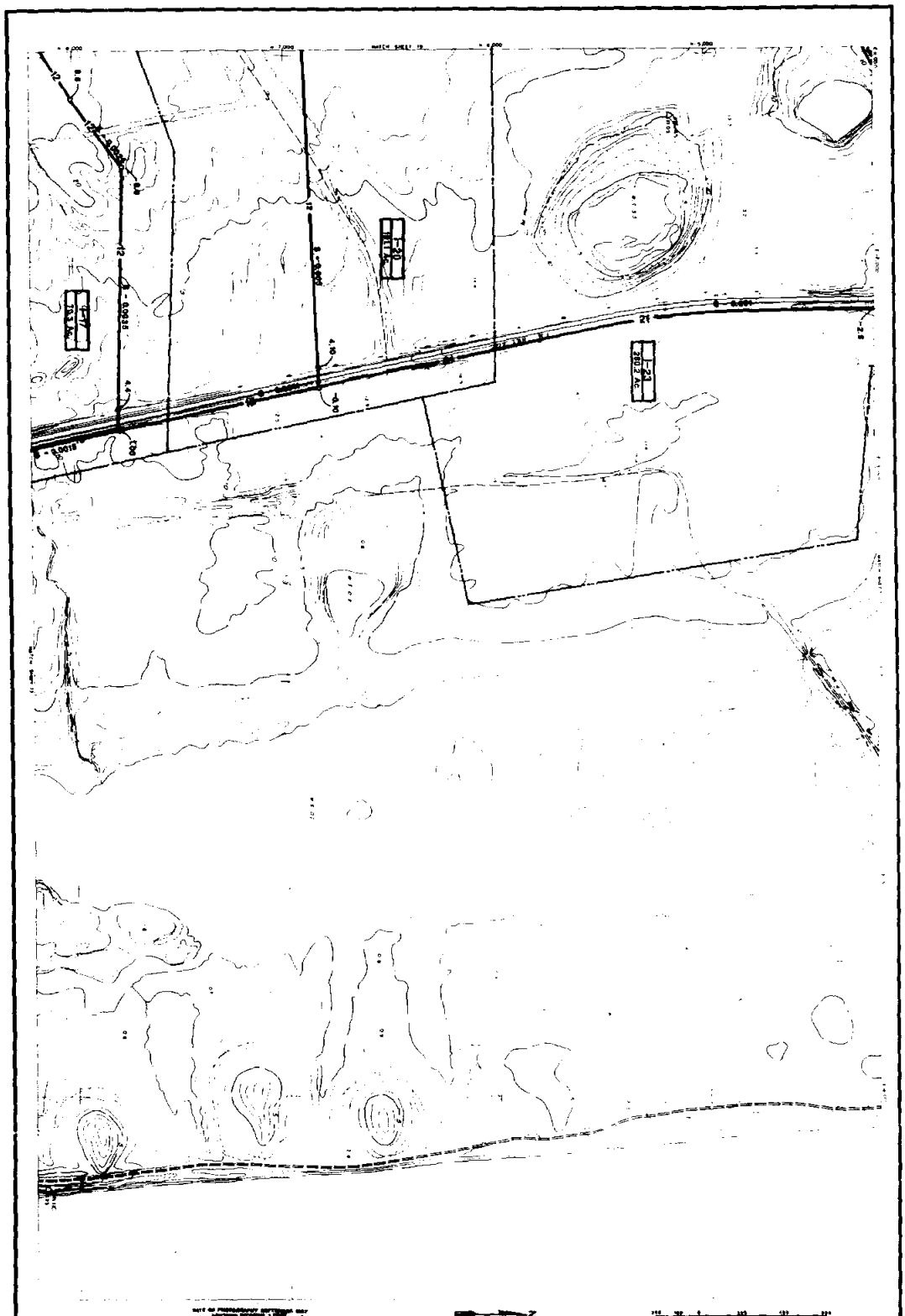
AUG. 1988 | NEI #2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

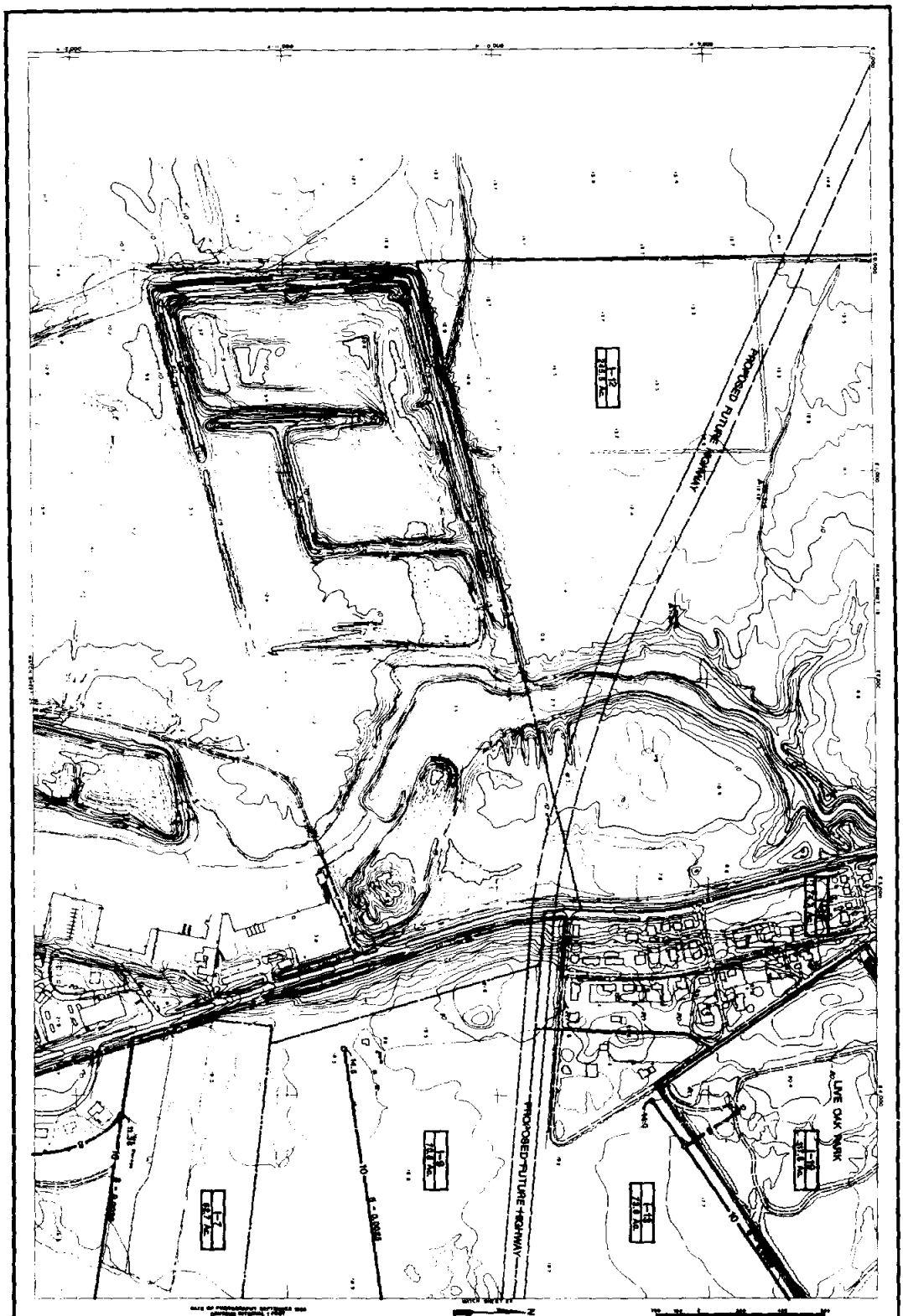
AUG. 1988 | NEI#2788

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING PURCHASED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

HASKELL SMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

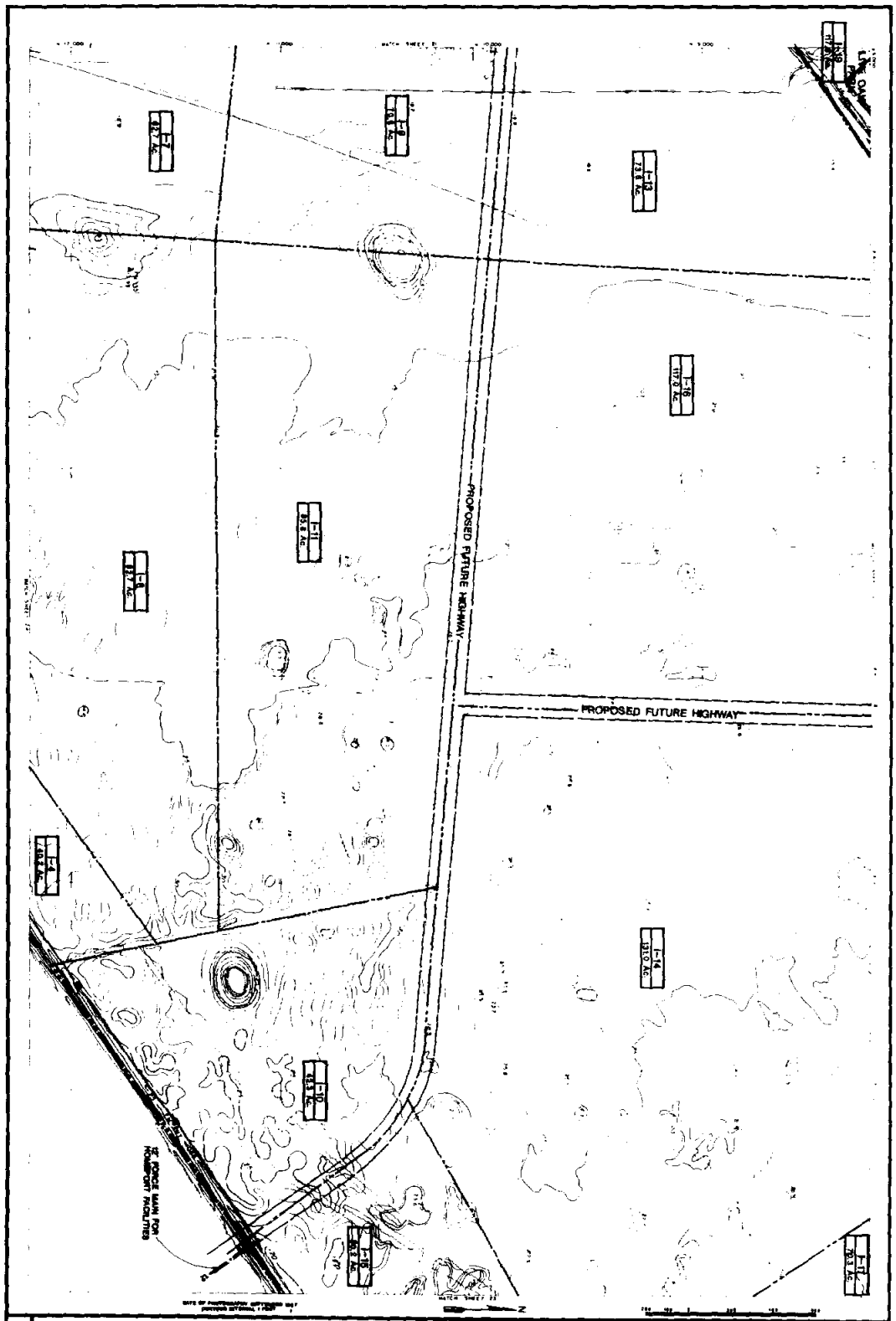
AUG. 1968 | HSI #2708

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE INVERT ELEVATIONS
- PROPOSED MANHOLE INVERT ELEVATIONS
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

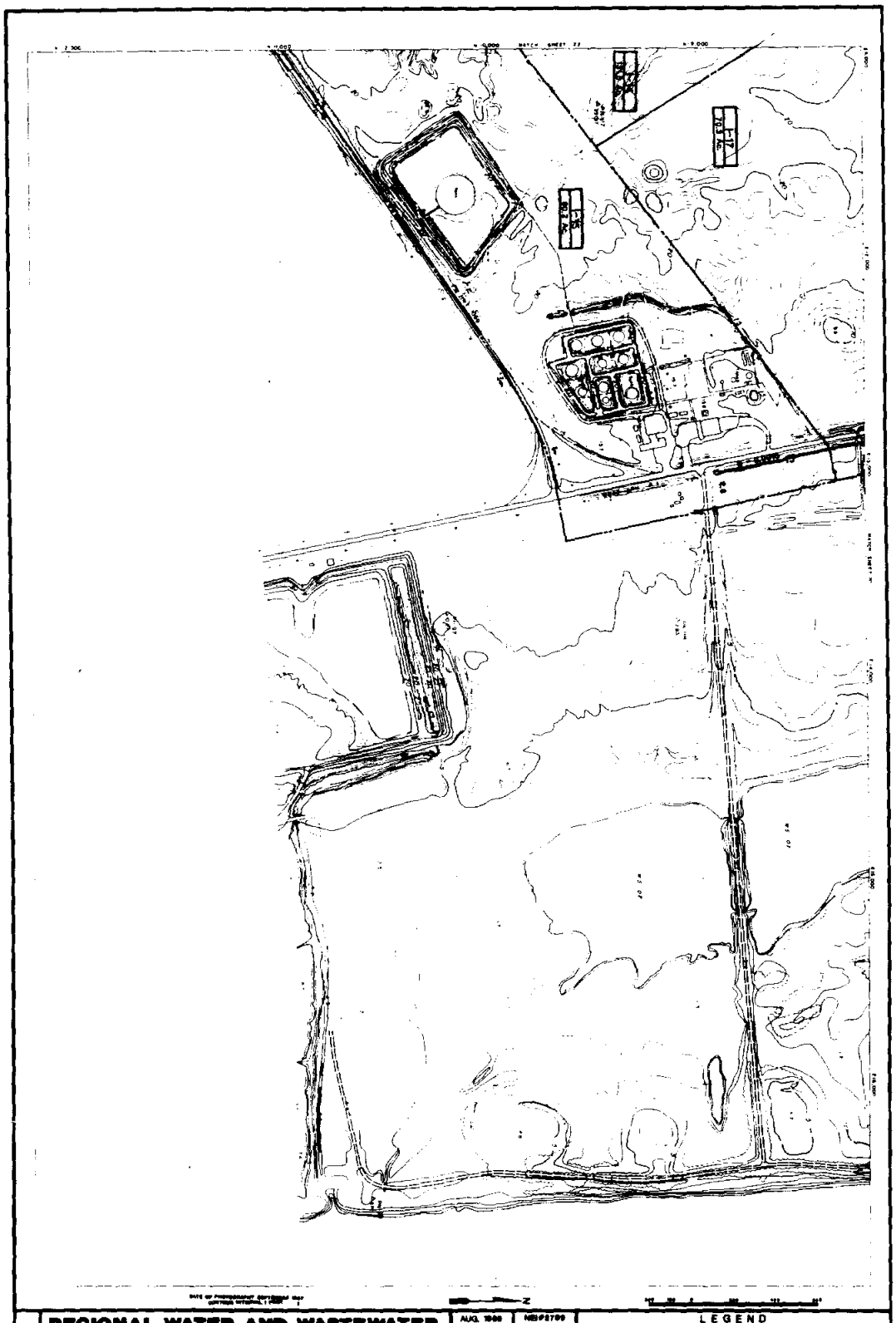
AUG. 1989 | NEI #2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS PERFORMED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

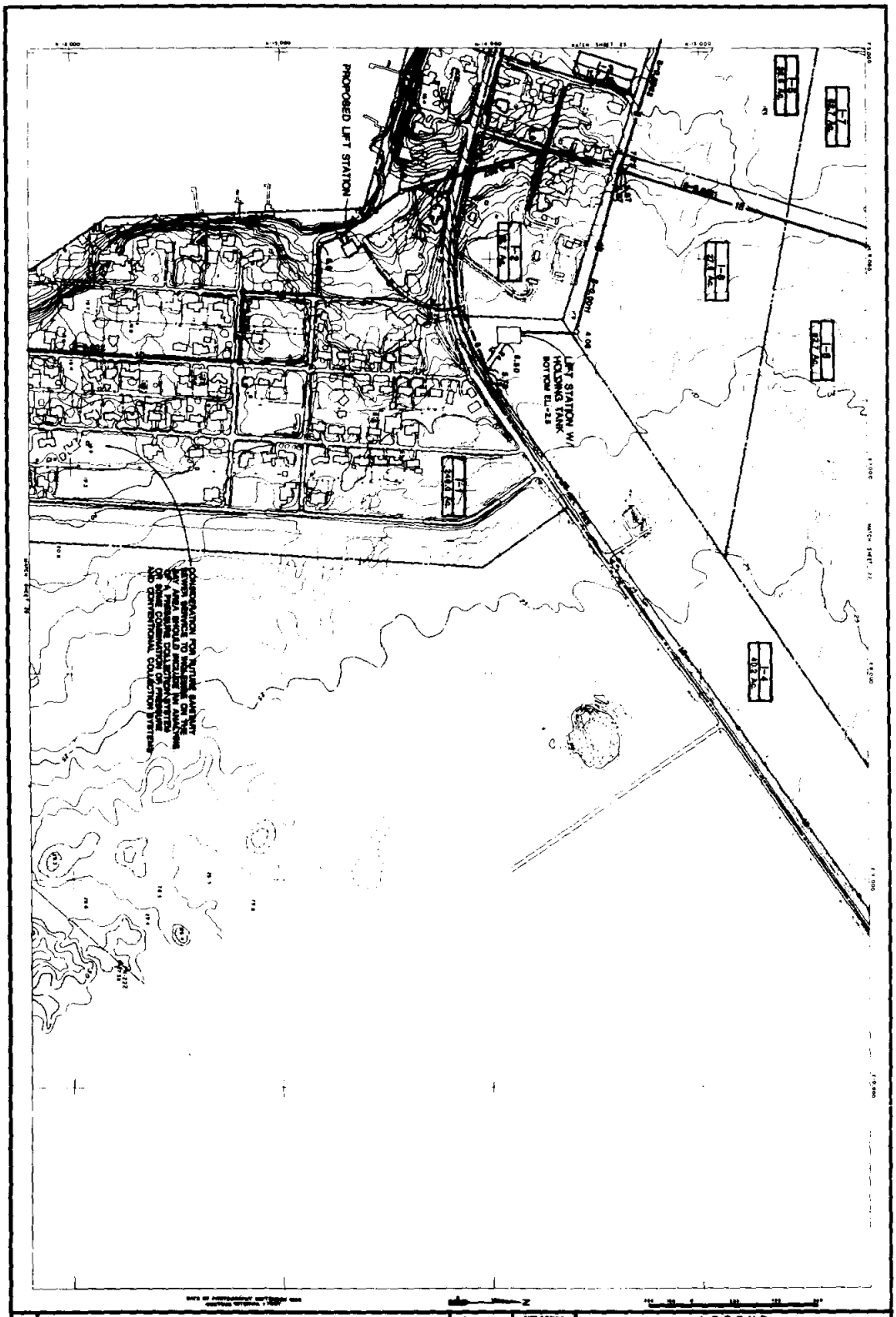
AUG. 1980 | NB#2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 15 EXISTING SEWER (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 99.99 EXISTING MANHOLE (INVERT ELEVATION)
- 99.99 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FINANCED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

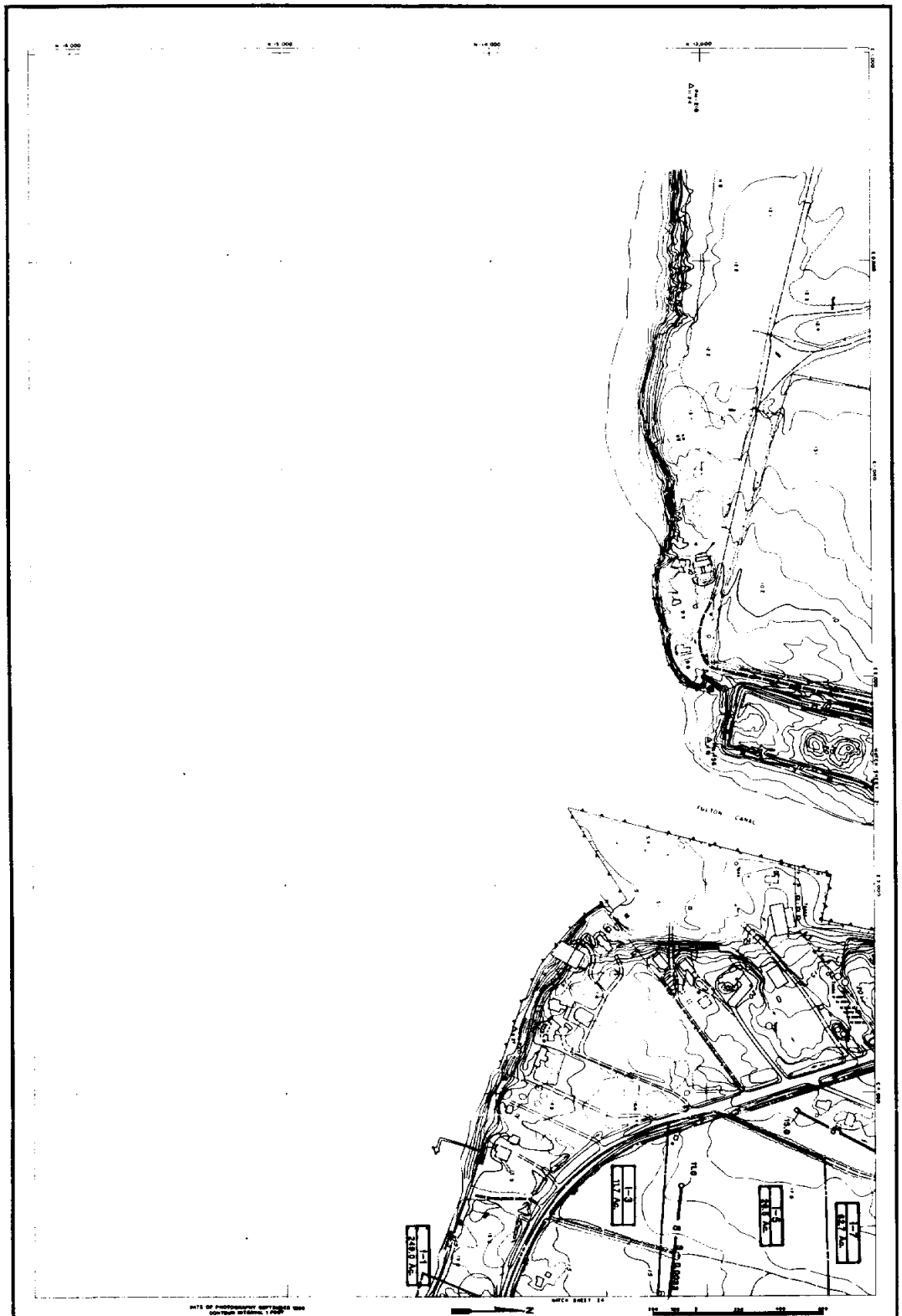
AUG. 1990 | NEI #2790

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATIONS)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

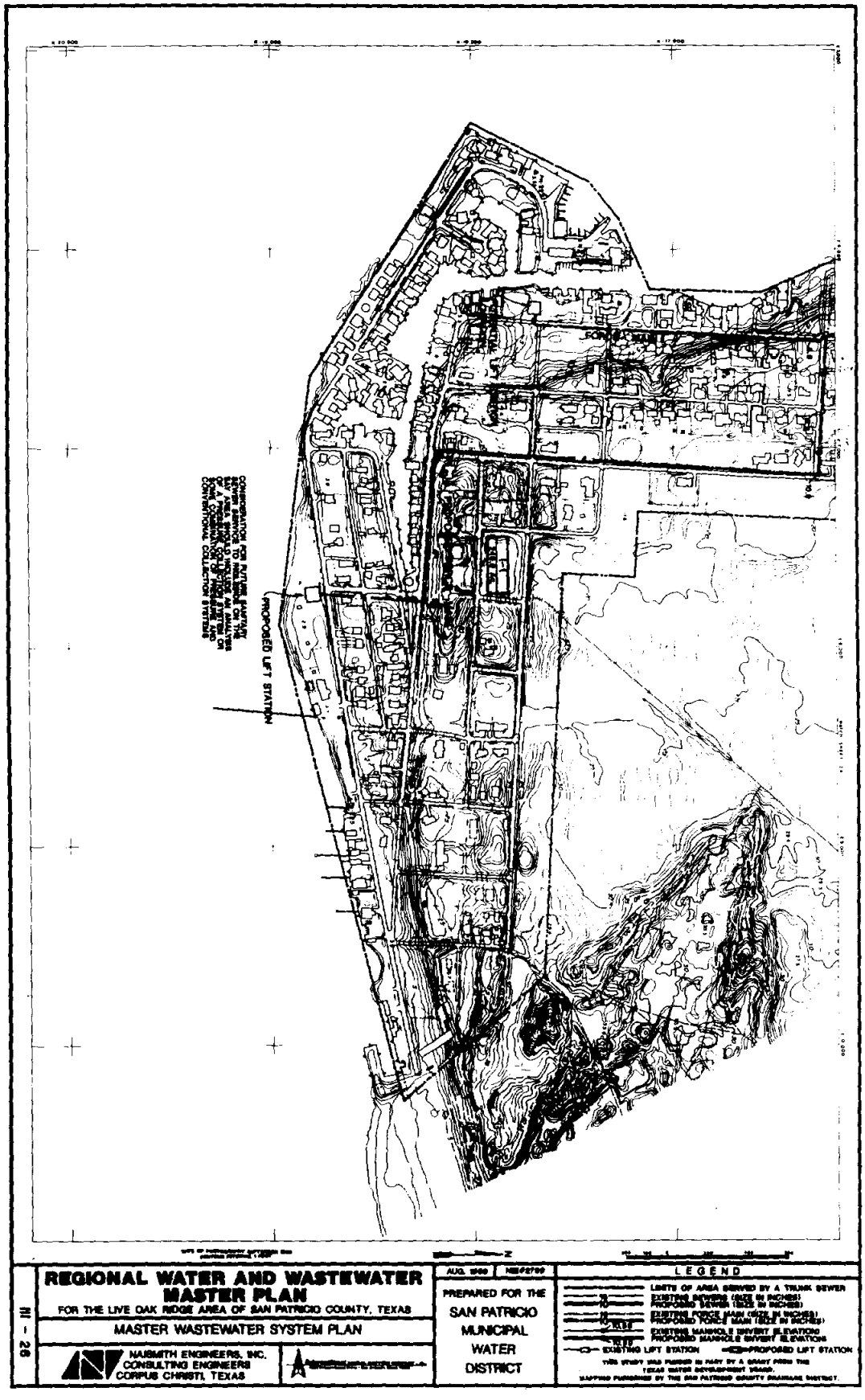
AUG. 1988 | NEI-2706

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

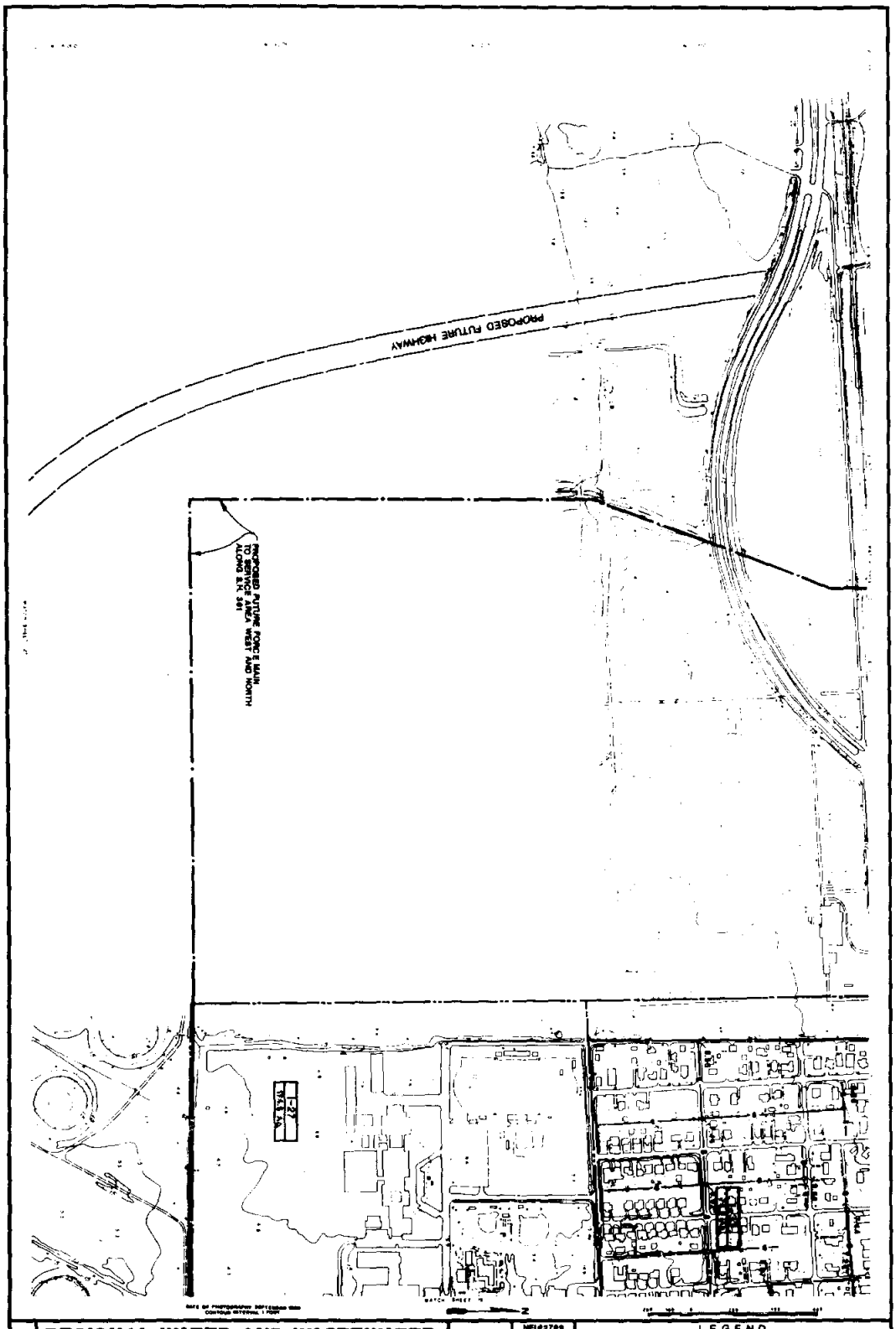
MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1990 | NE#2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

MI - 29



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

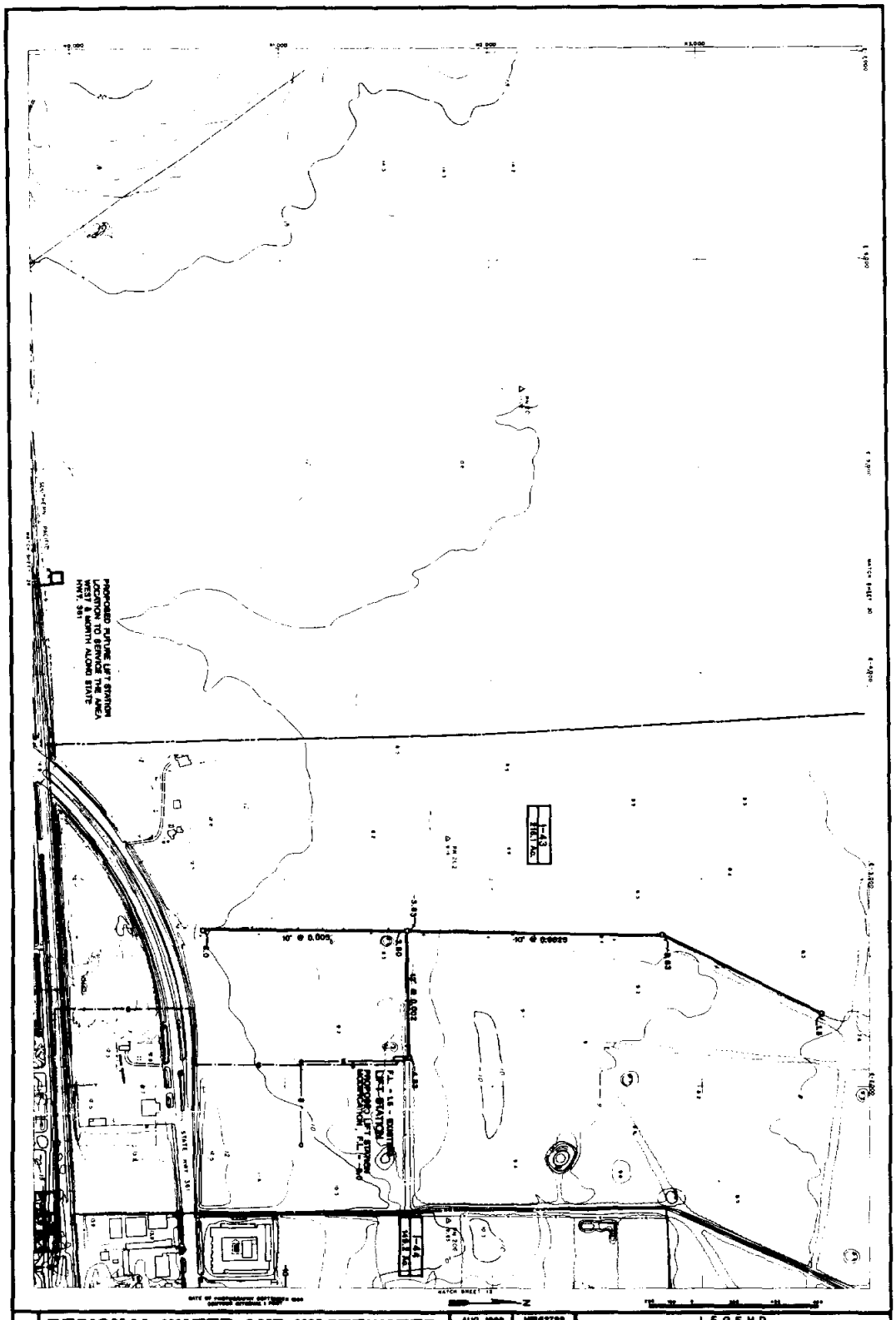
NEI #2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NEI #2709

PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

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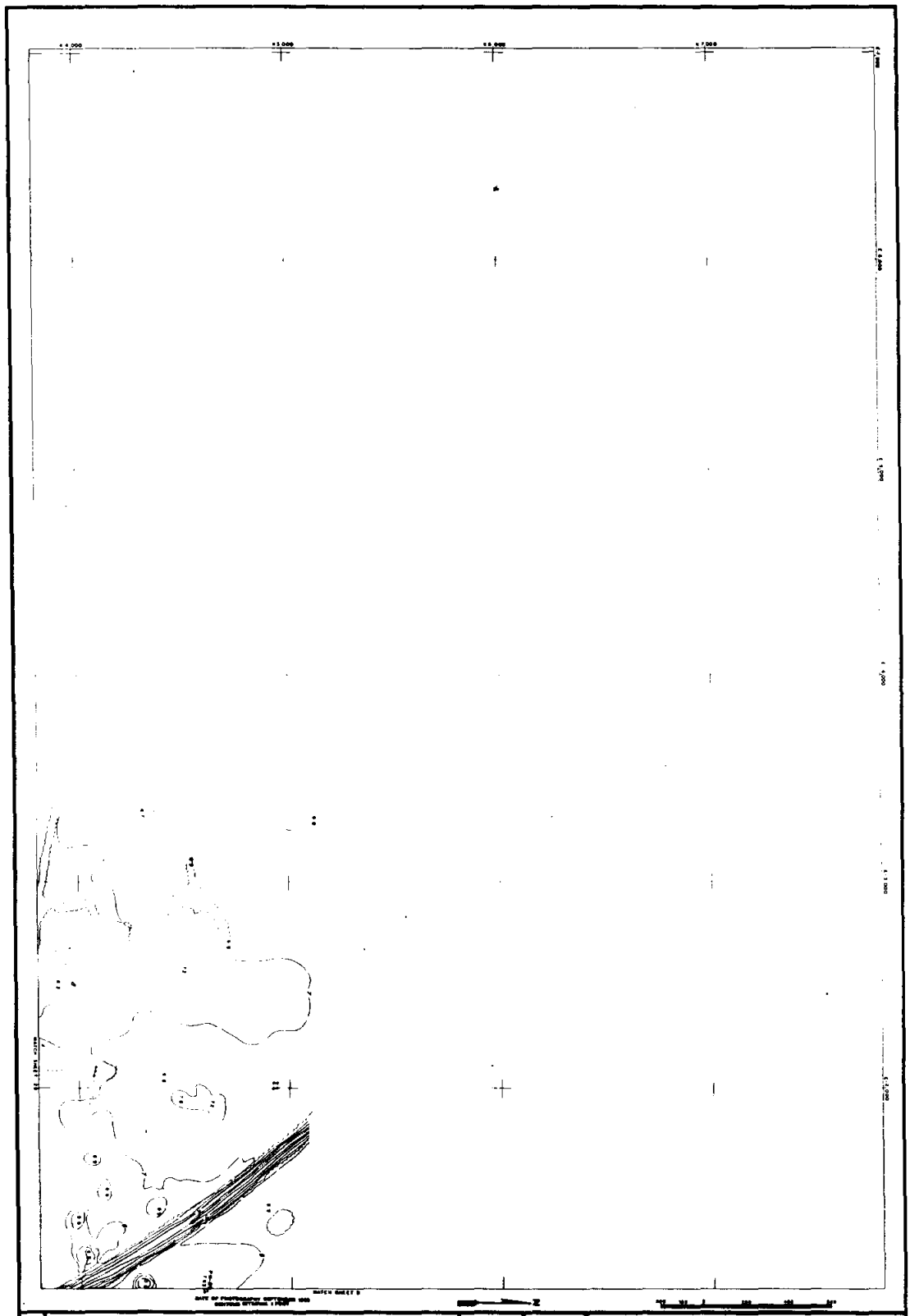
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NEP-2790

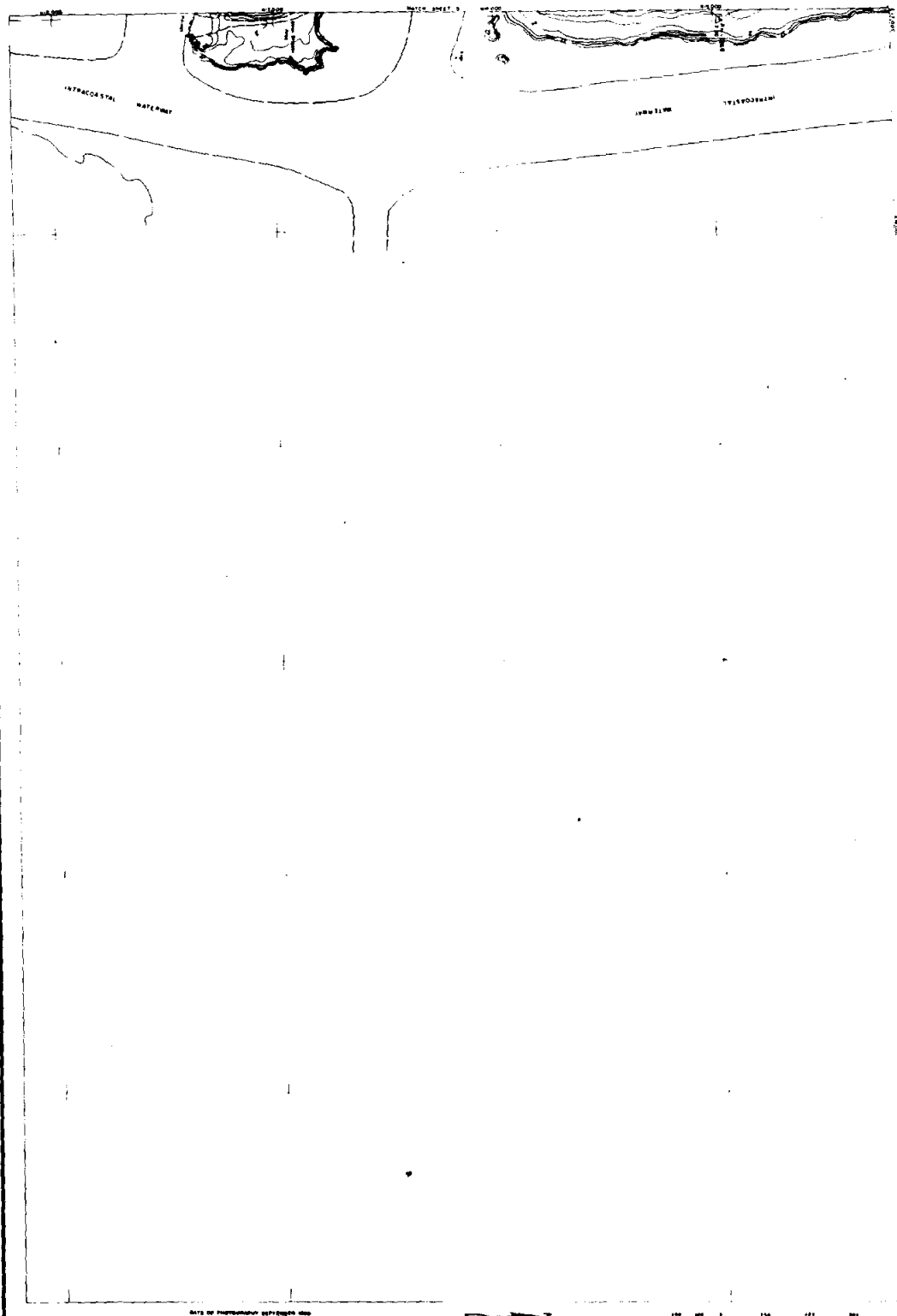
PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

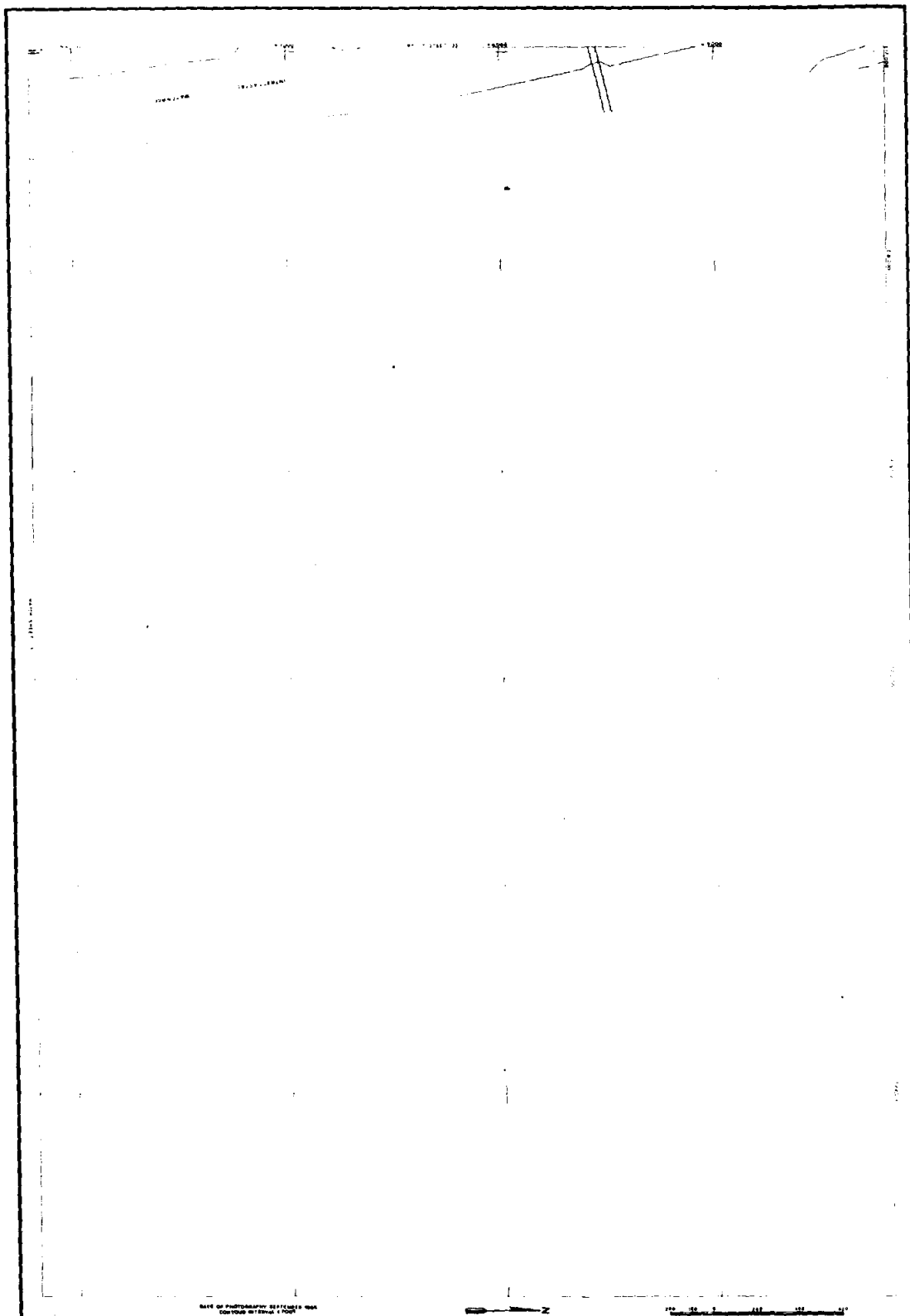
AUG. 1988 | ND#2788

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 16.56 EXISTING MANHOLE (INVERT ELEVATION)
- 16.56 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

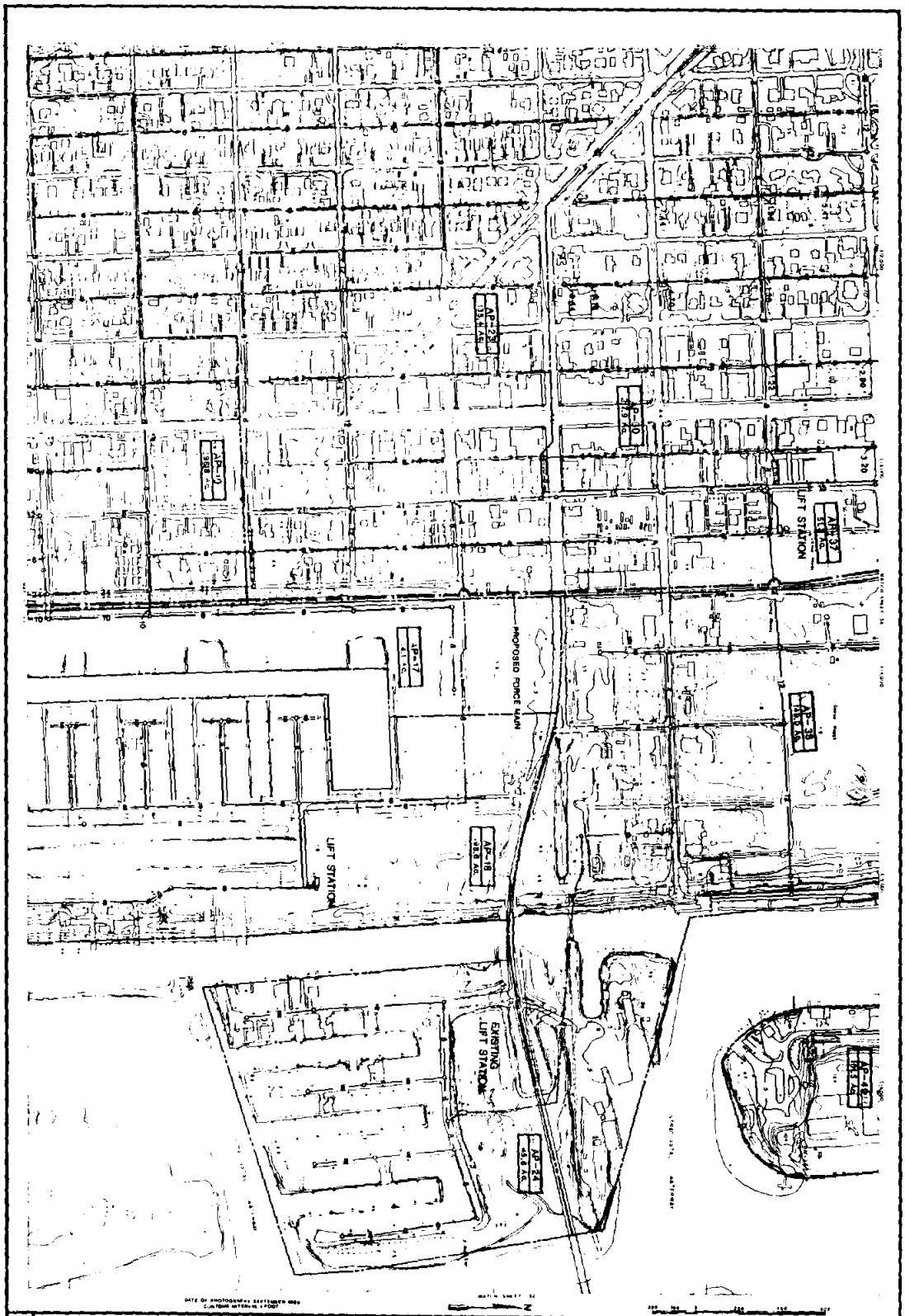
AUG. 1980 | NEI #2788

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 12 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

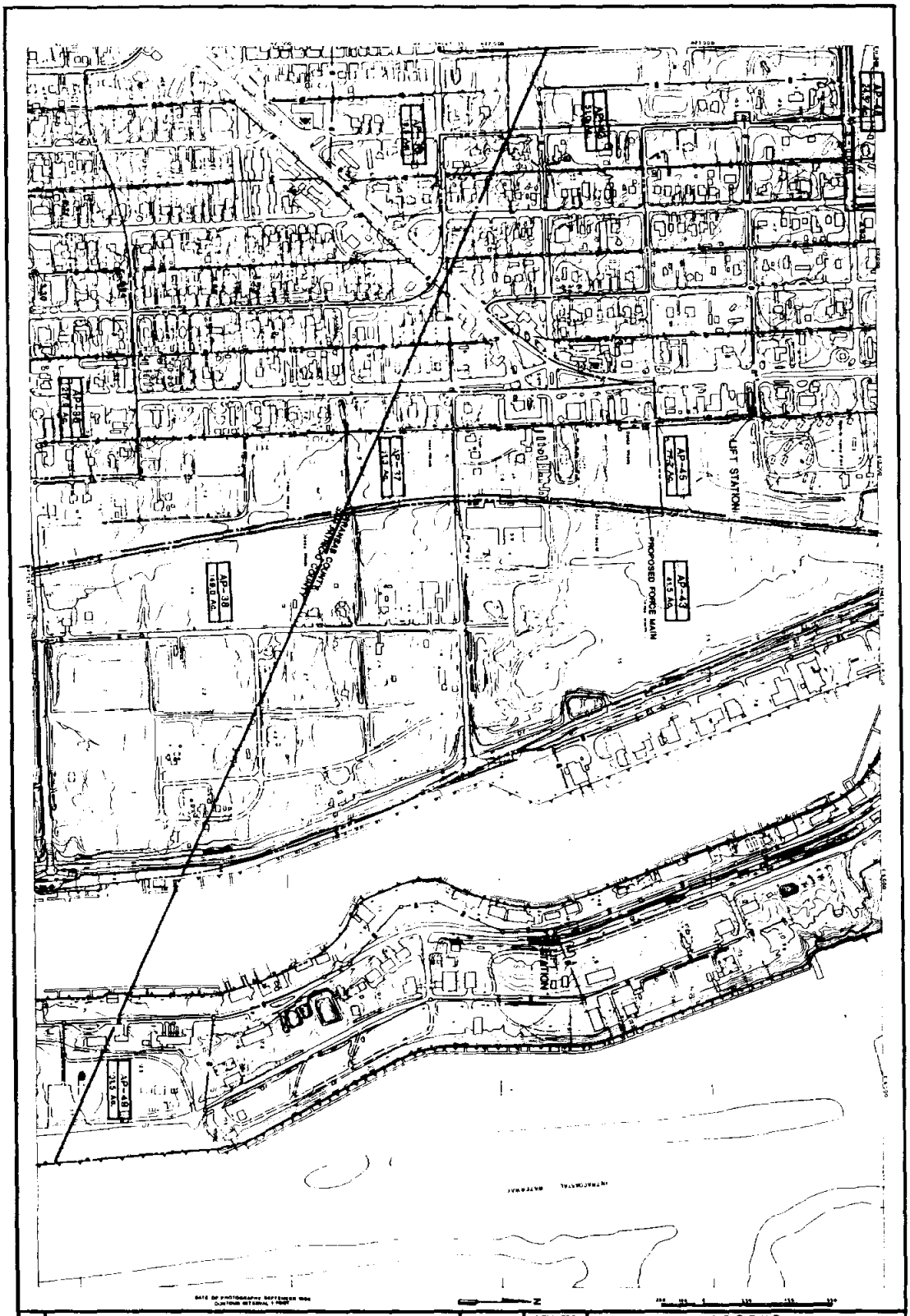
AUG. 1988 | NE#2708

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

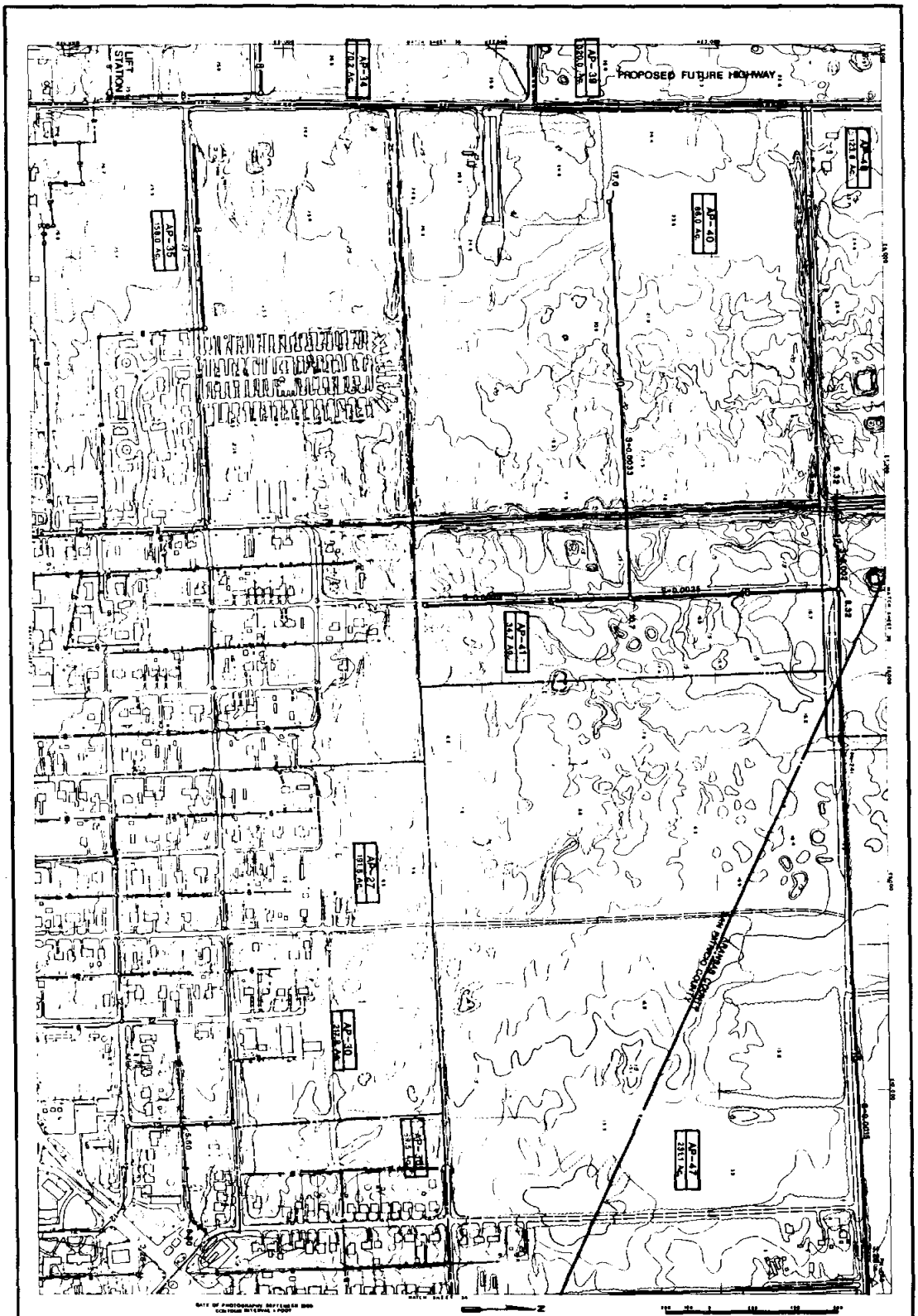
AUG. 1988 | NEI#2788

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

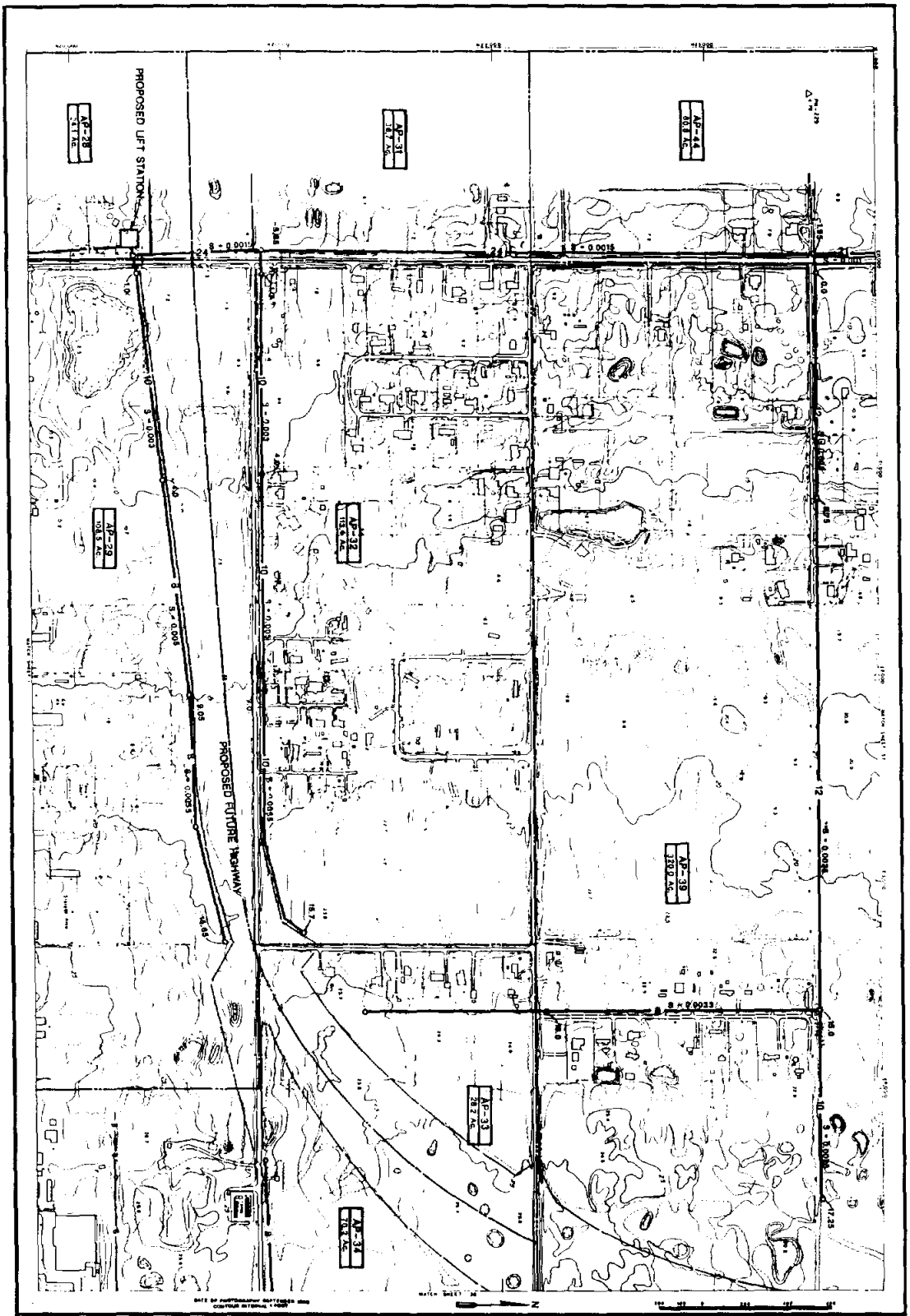
AUG. 1988 | NEI #2796

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZES IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE INVERT ELEVATION
- PROPOSED MANHOLE INVERT ELEVATION
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

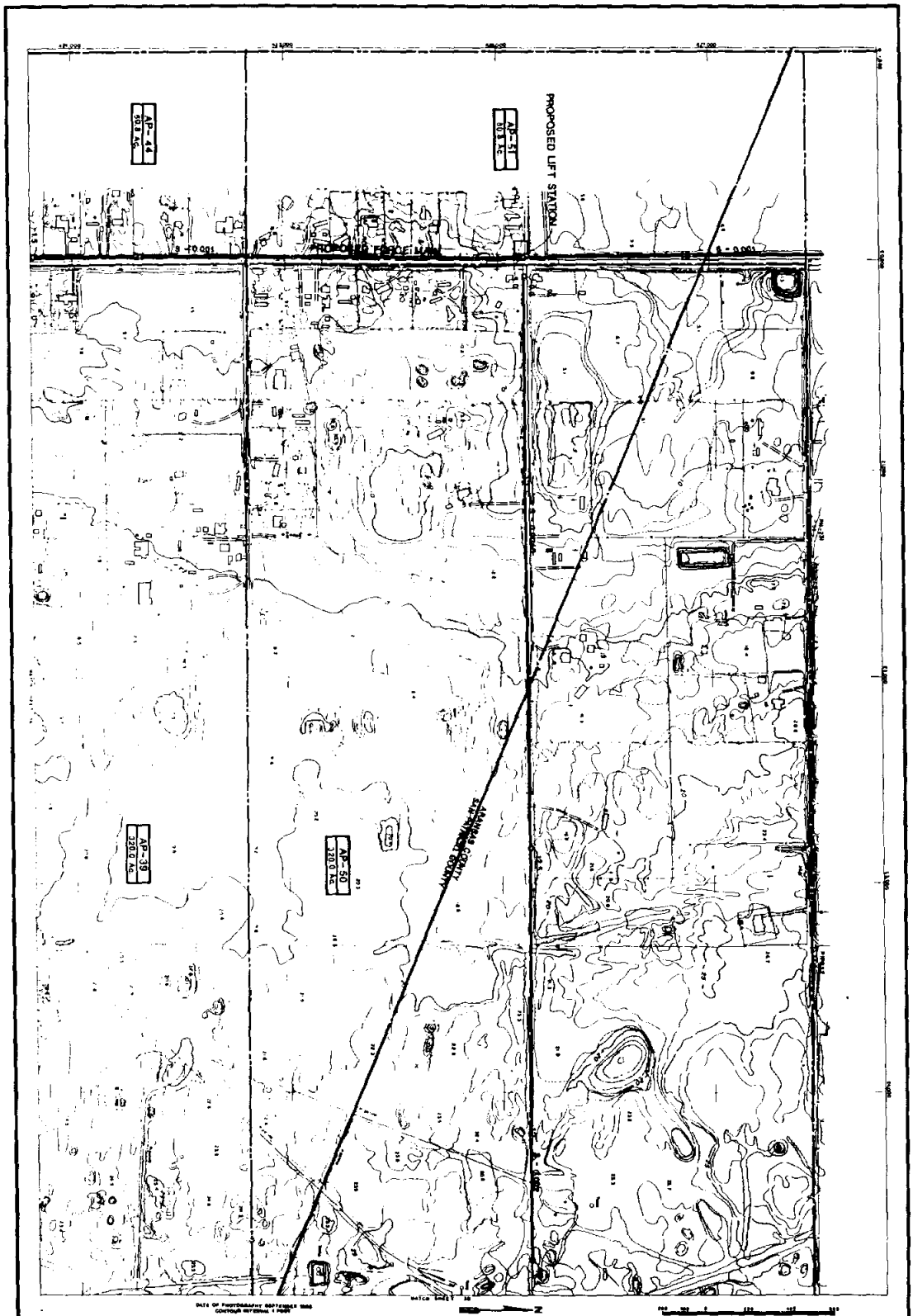
AUG. 1980 | NEI #2709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
- PROPOSED LIFT STATION

THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI#2790

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
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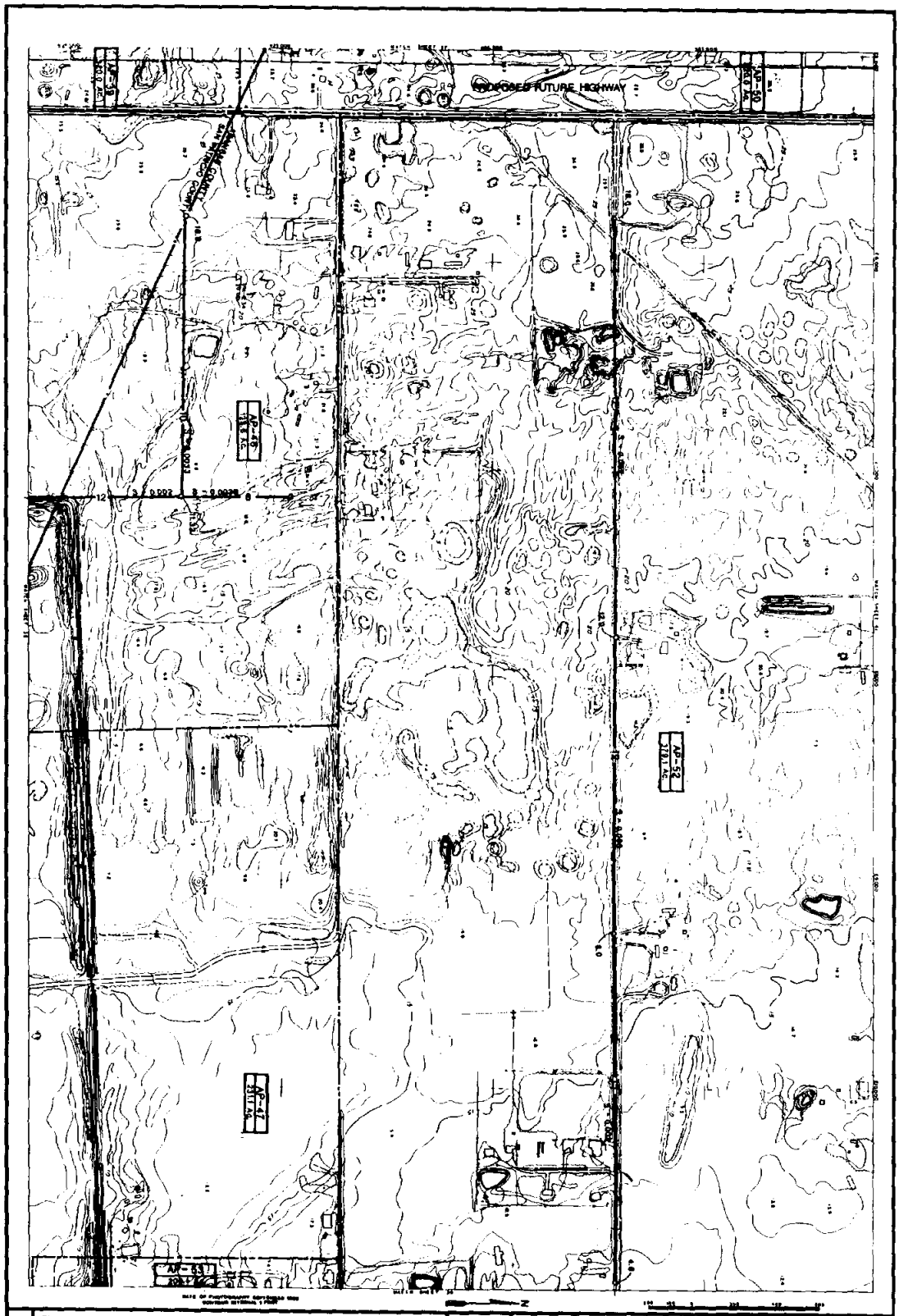

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MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI #1788

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
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- EXISTING MANHOLE INVERT ELEVATION
- PROPOSED MANHOLE INVERT ELEVATION
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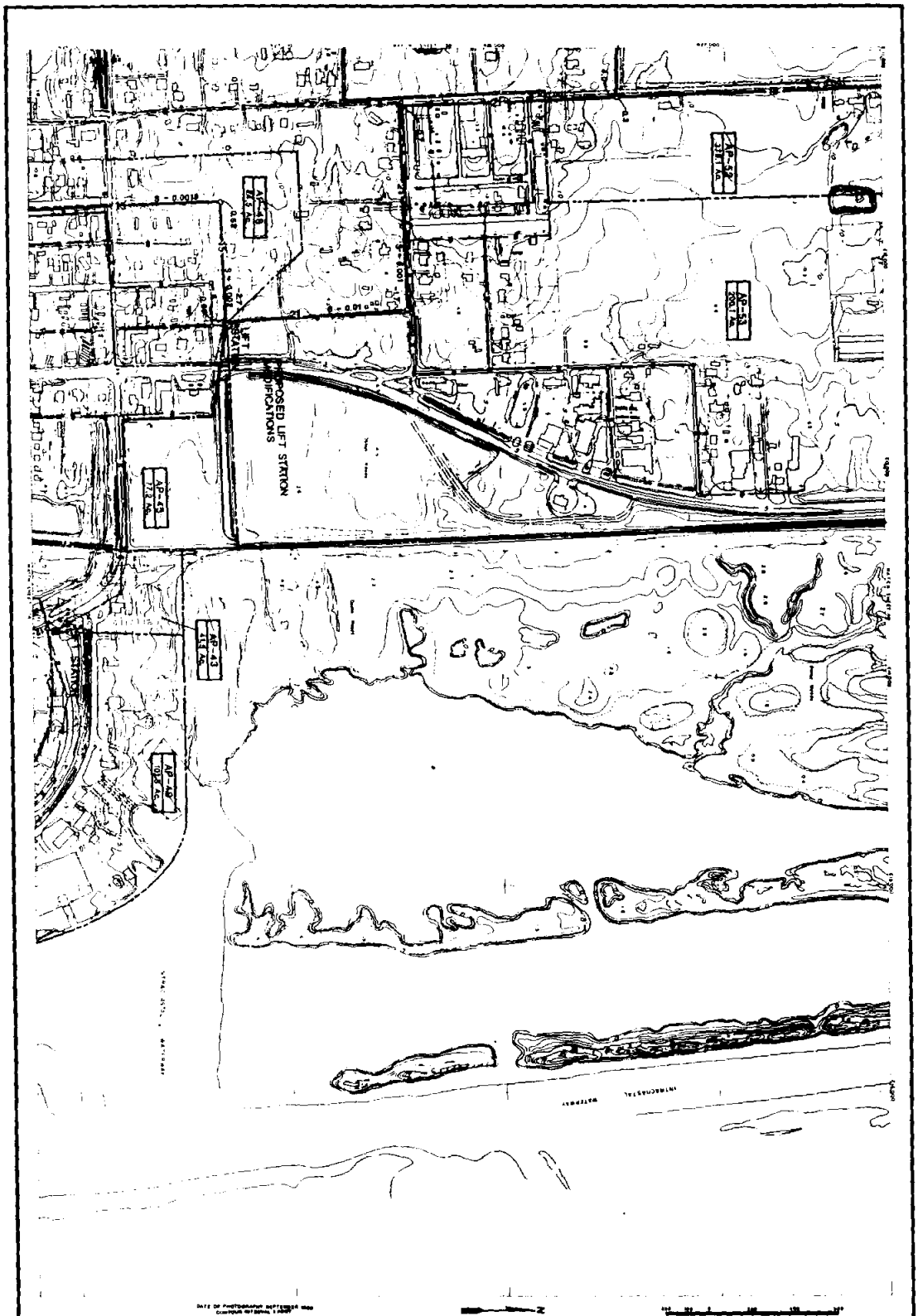

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CORPUS CHRISTI, TEXAS

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MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
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- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAINS (SIZE IN INCHES)
- PROPOSED FORCE MAINS (SIZE IN INCHES)
- EXISTING MANHOLE INVERT ELEVATIONS
- PROPOSED MANHOLE INVERT ELEVATIONS
- EXISTING LIFT STATION
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THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.

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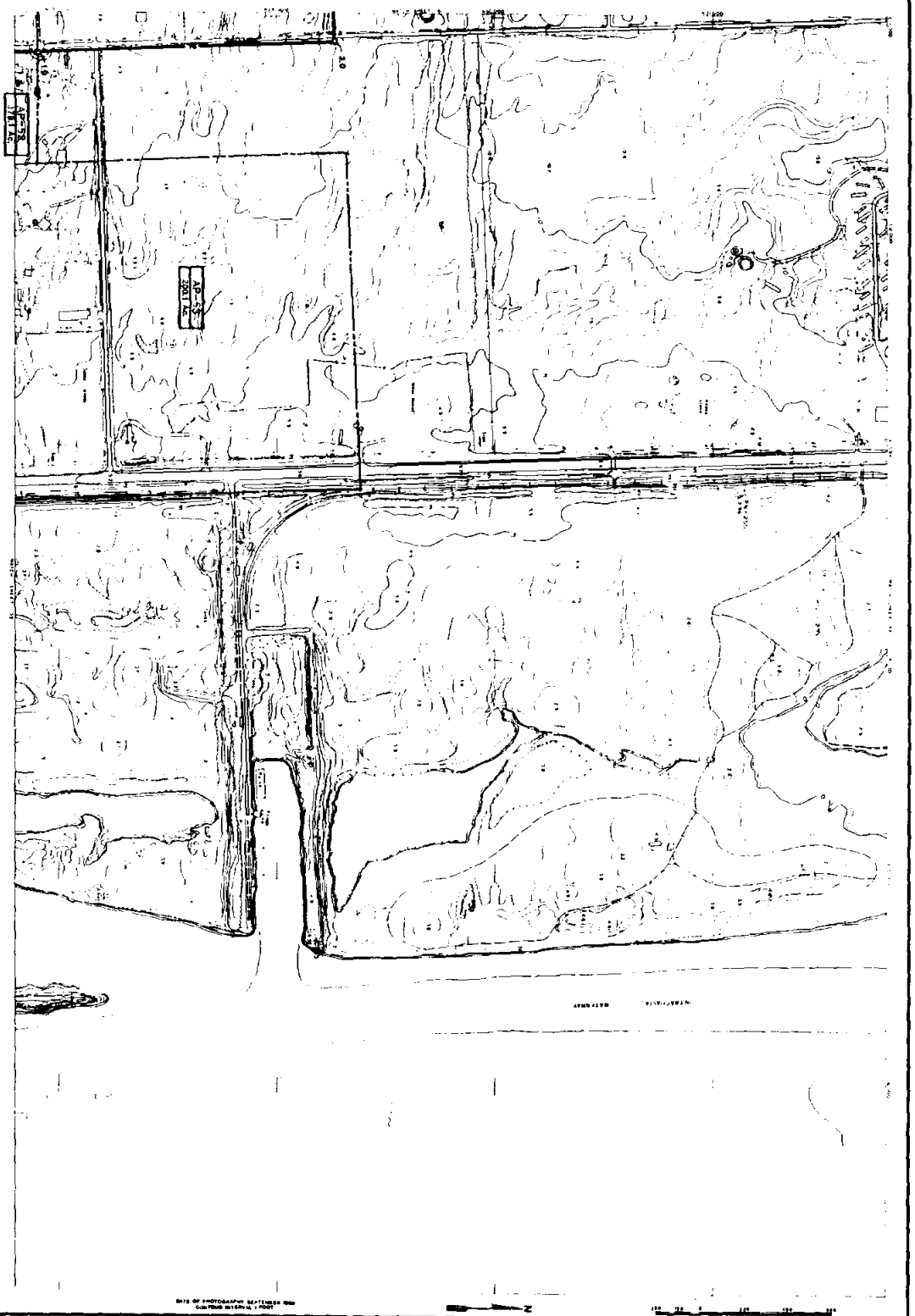

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NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NE#1799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 12 EXISTING SEWER (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
- 10 EXISTING FORCE MAIN (SIZE IN INCHES)
- 10 PROPOSED FORCE MAIN (SIZE IN INCHES)
- 10.50 EXISTING MANHOLE (INVERT ELEVATION)
- 10.50 PROPOSED MANHOLE (INVERT ELEVATION)
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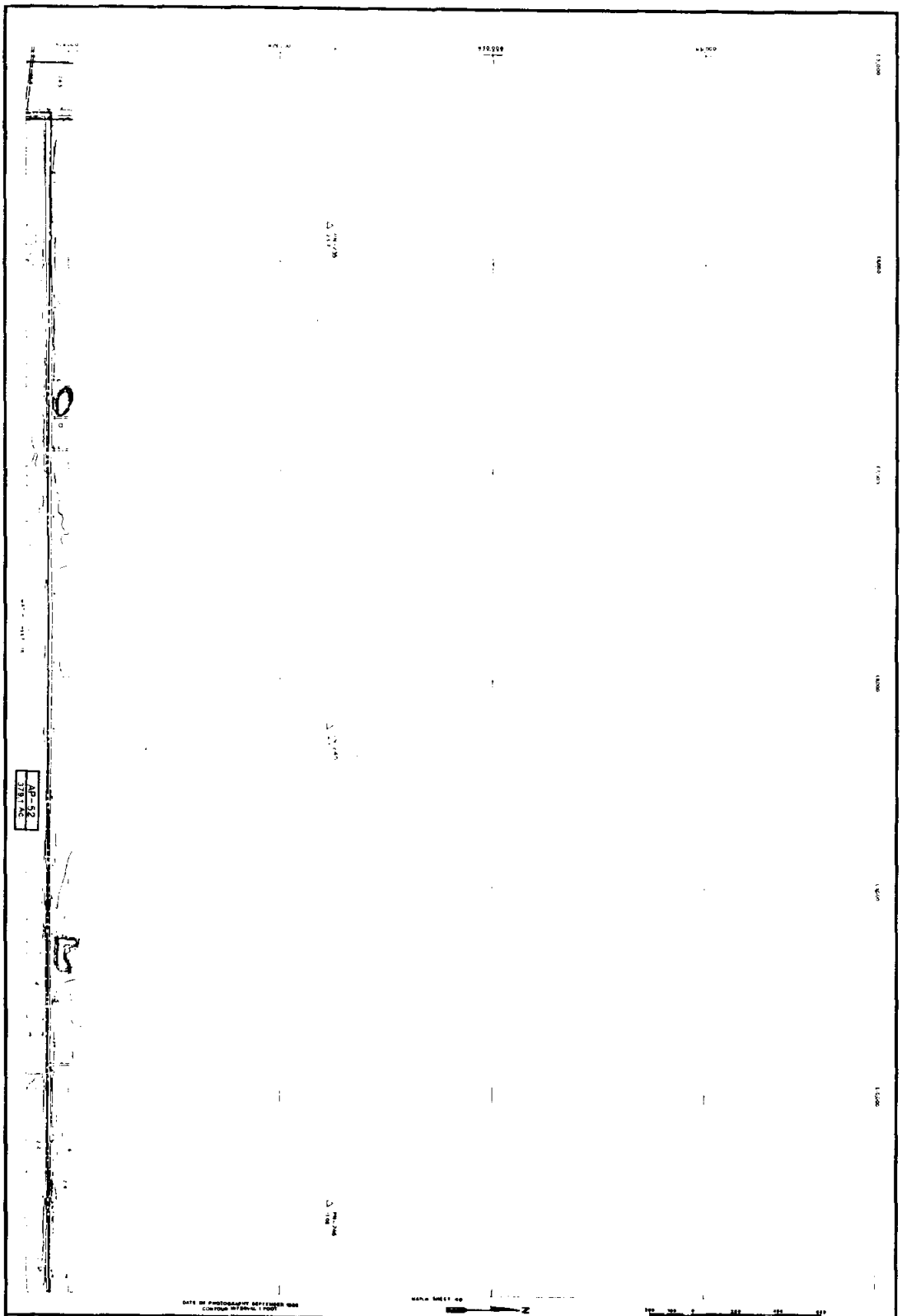

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CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI #2799

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
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LEGEND

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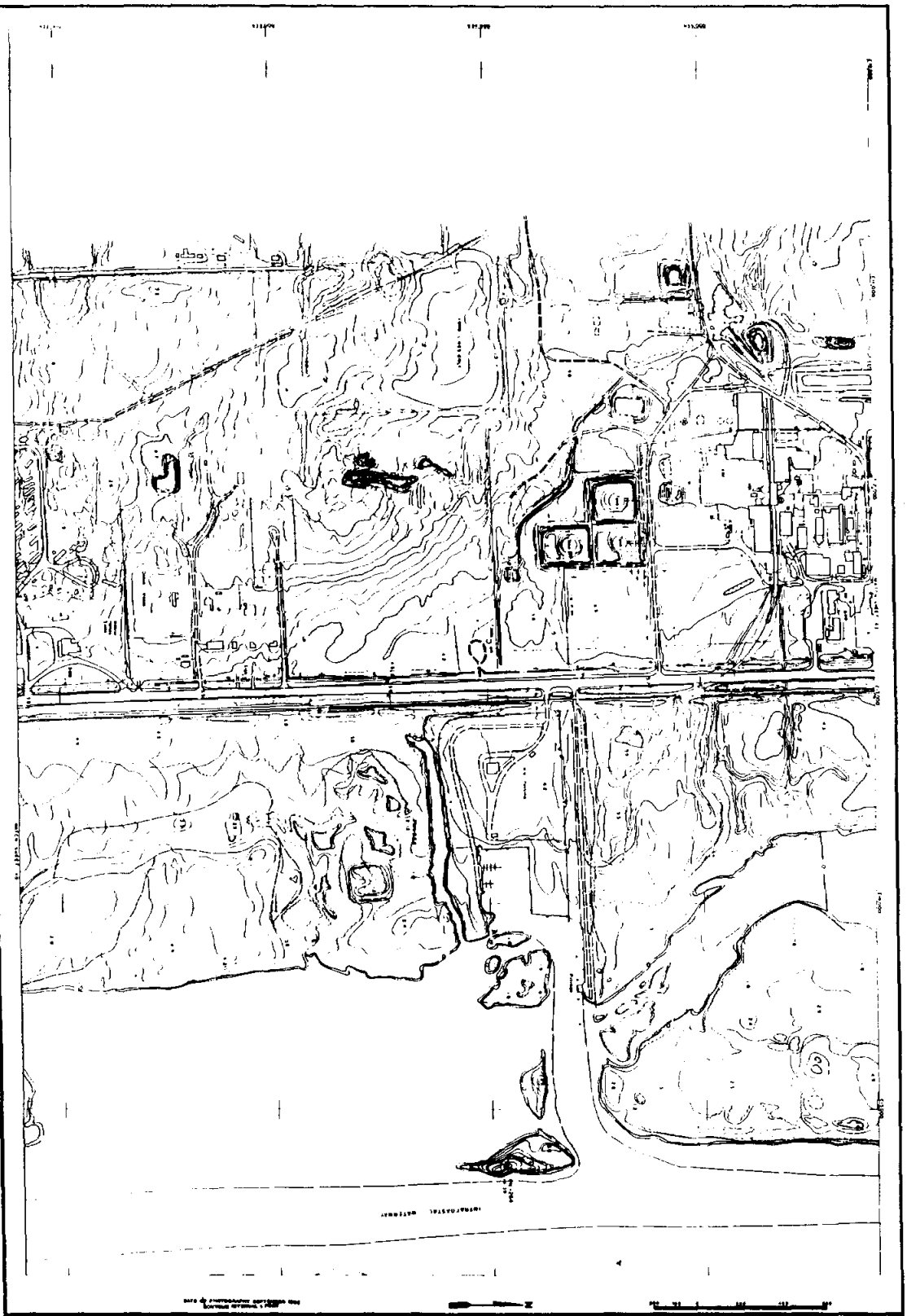

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NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

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- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATION)
- PROPOSED MANHOLE (INVERT ELEVATION)
- EXISTING LIFT STATION
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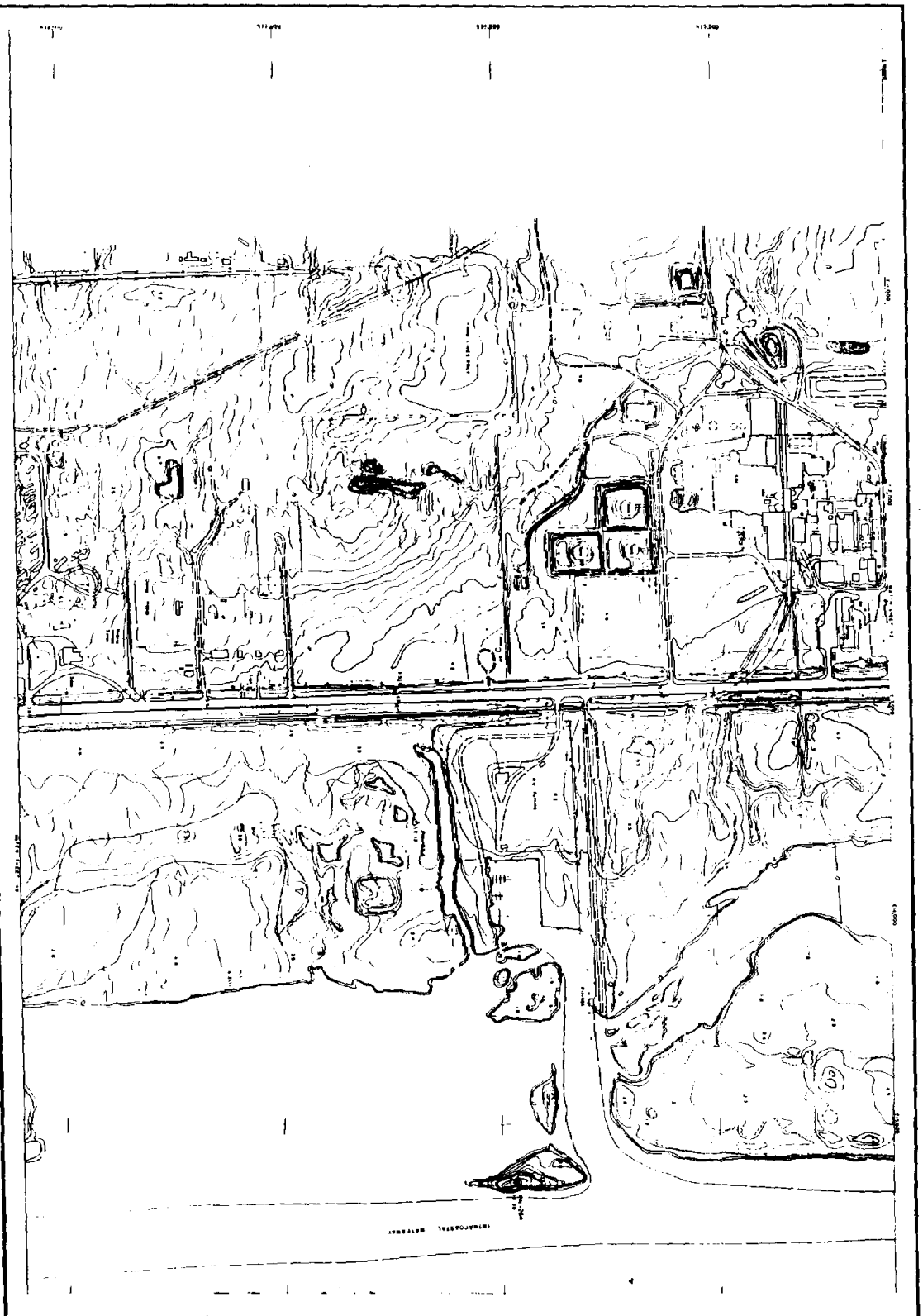

REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1980 | NEI #5705

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
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- EXISTING LIFT STATION
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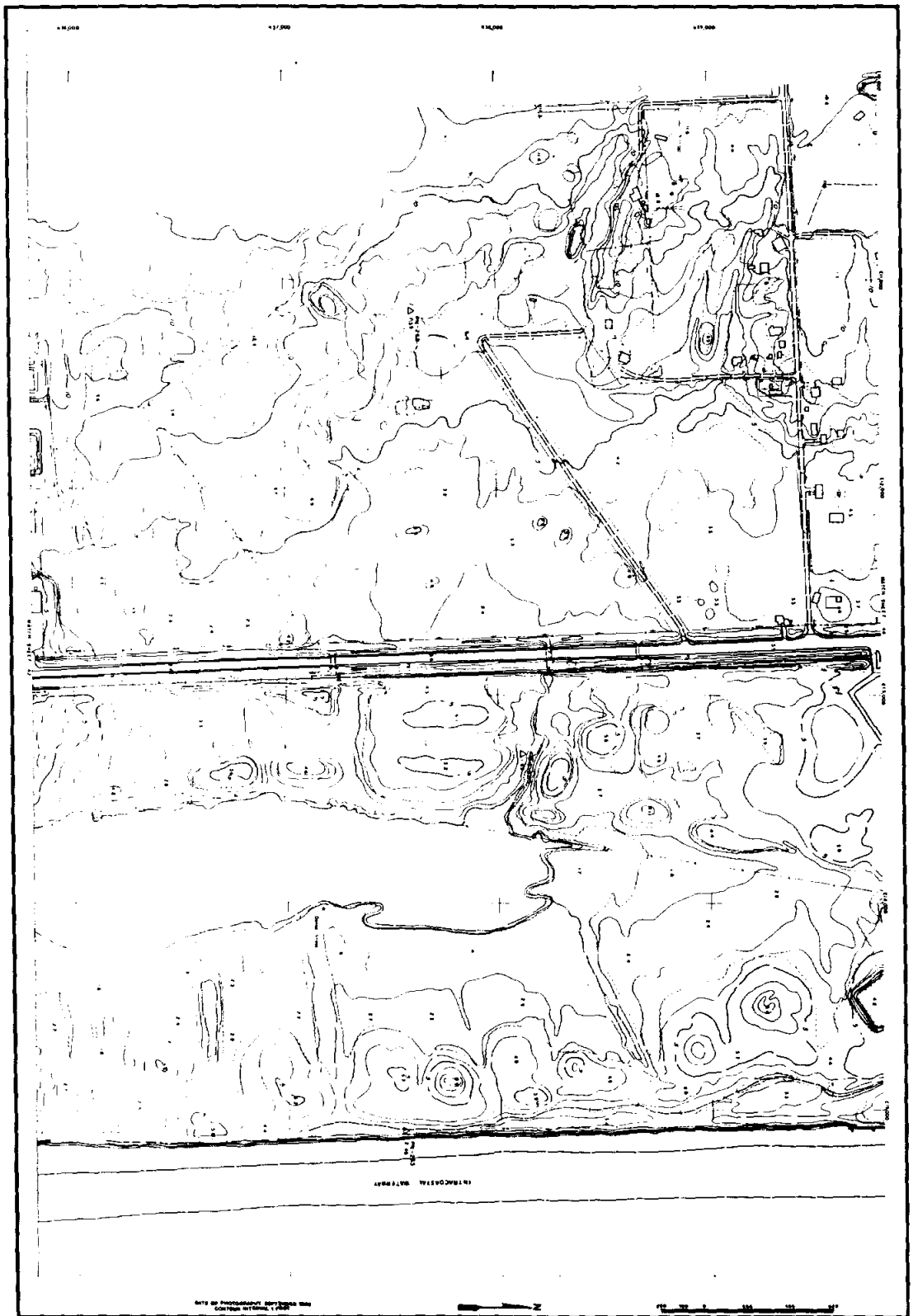
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1986 | NEG2790

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- 10 EXISTING SEWERS (SIZE IN INCHES)
- 10 PROPOSED SEWER (SIZE IN INCHES)
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- 10.00 EXISTING MANHOLE (INVERT ELEVATION)
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THIS STUDY WAS FUNDED IN PART BY A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD.
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

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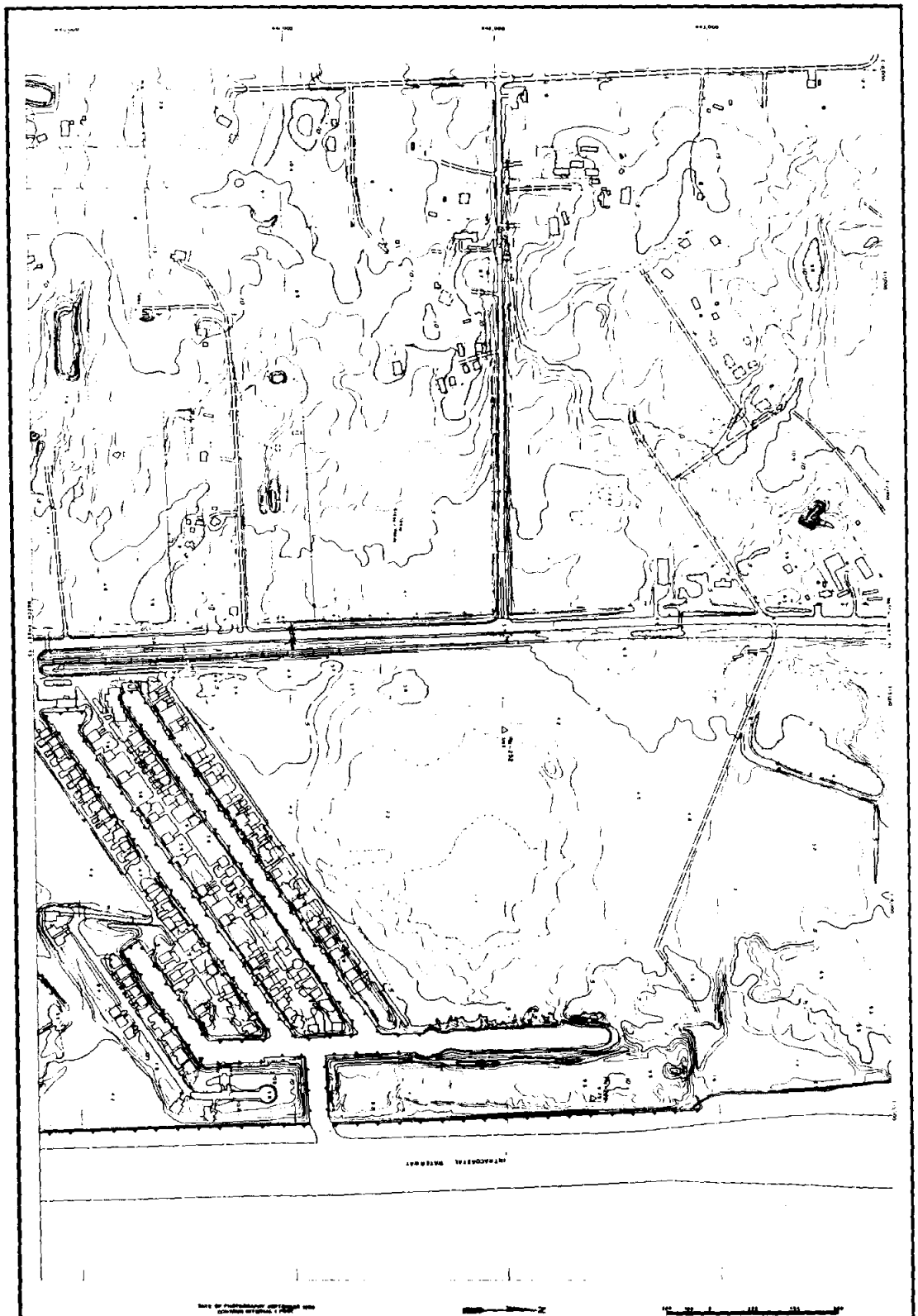

REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NE92709

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWERS (SIZE IN INCHES)
- PROPOSED SEWERS (SIZE IN INCHES)
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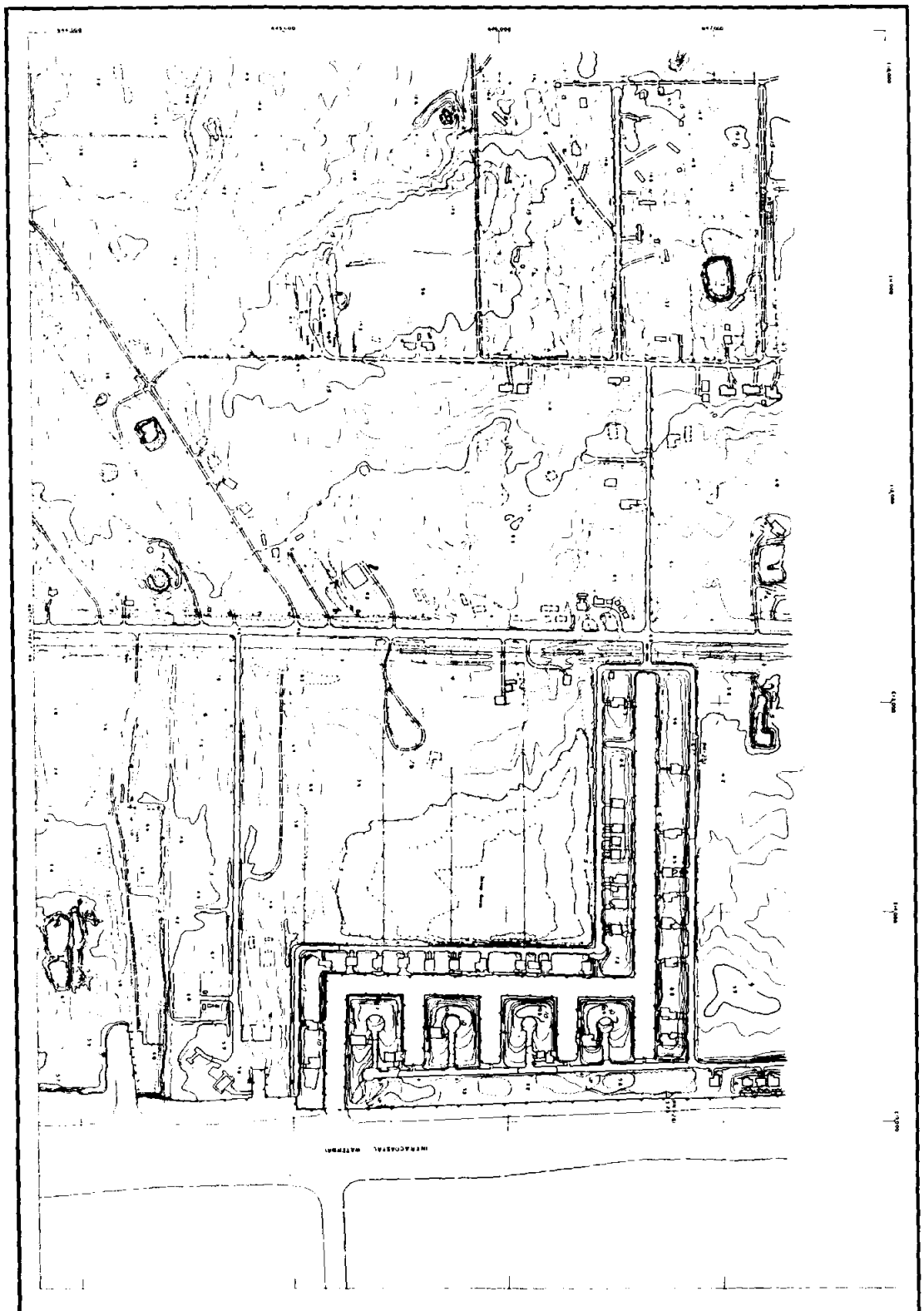
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.

III - 44



REGIONAL WATER AND WASTEWATER MASTER PLAN

FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1988 | NEI #2798

PREPARED FOR THE
SAN PATRICIO
MUNICIPAL
WATER
DISTRICT

LEGEND

- LIMITS OF AREA SERVED BY A TRUNK SEWER
- EXISTING SEWER (SIZE IN INCHES)
- PROPOSED SEWER (SIZE IN INCHES)
- EXISTING FORCE MAIN (SIZE IN INCHES)
- PROPOSED FORCE MAIN (SIZE IN INCHES)
- EXISTING MANHOLE (INVERT ELEVATIONS)
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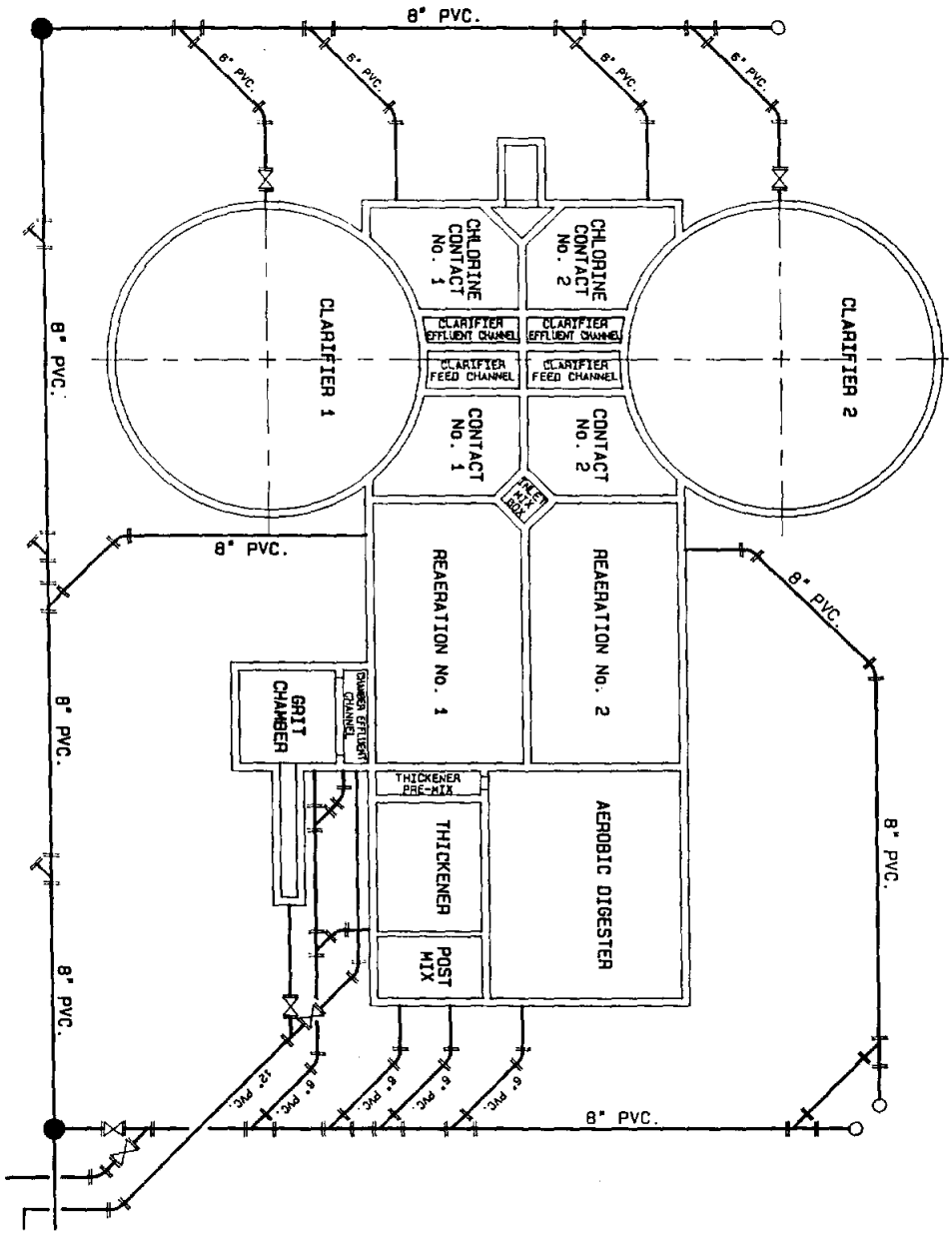
MAPPING FURNISHED BY THE SAN PATRICIO COUNTY DRAINAGE DISTRICT.



2799-010.DWG

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REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

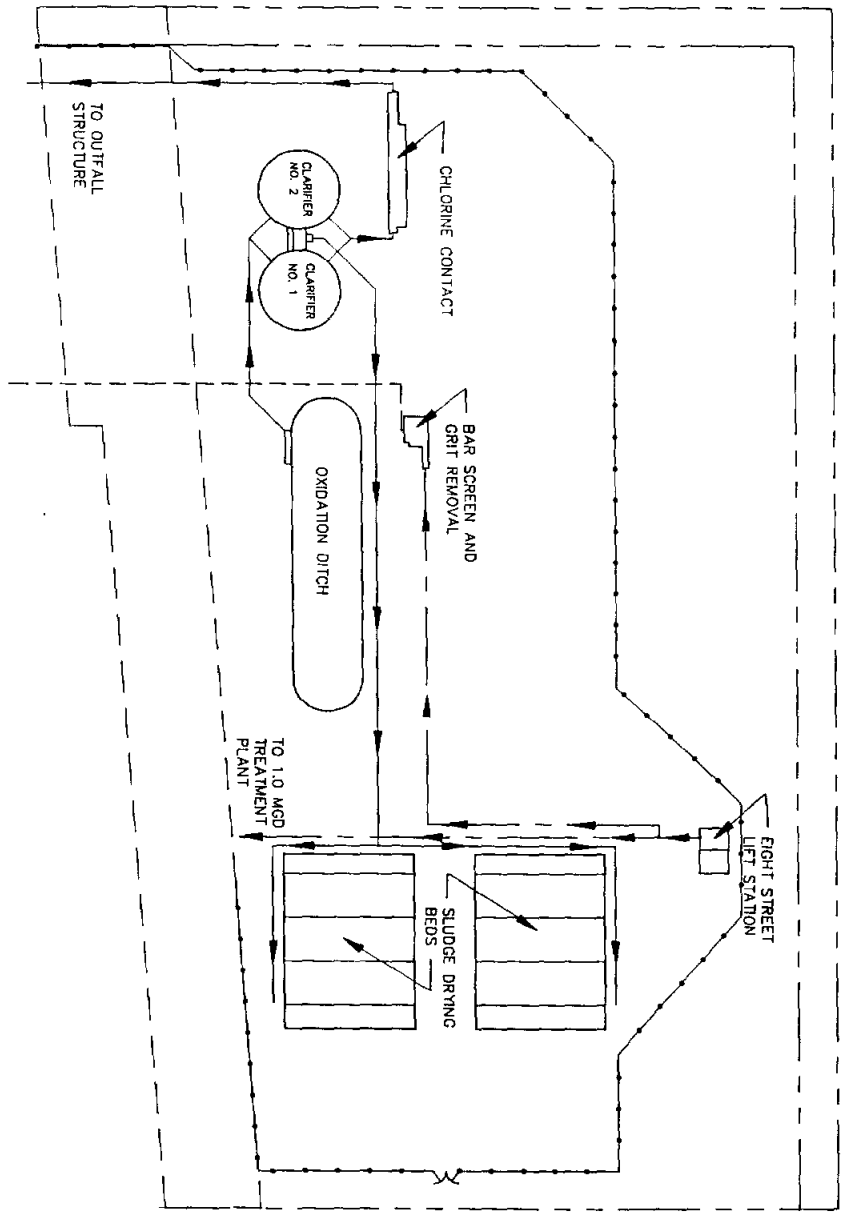
MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI # 2799

PREPARED FOR THE
SAN PATRICIO MUNICIPAL WATER DISTRICT

FIGURE X – SCHEMATIC DIAGRAM 1.0 MGD WASTEWATER TREATMENT PLANT – CITY OF INGLESIDE



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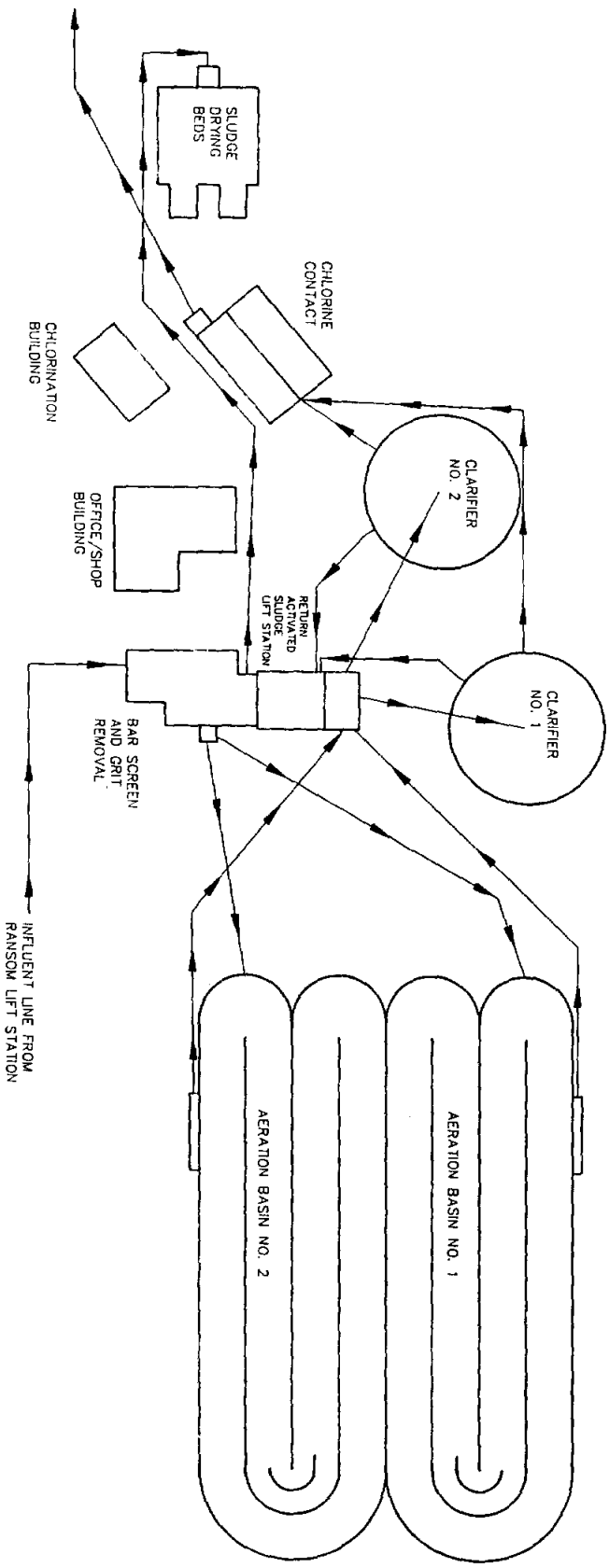
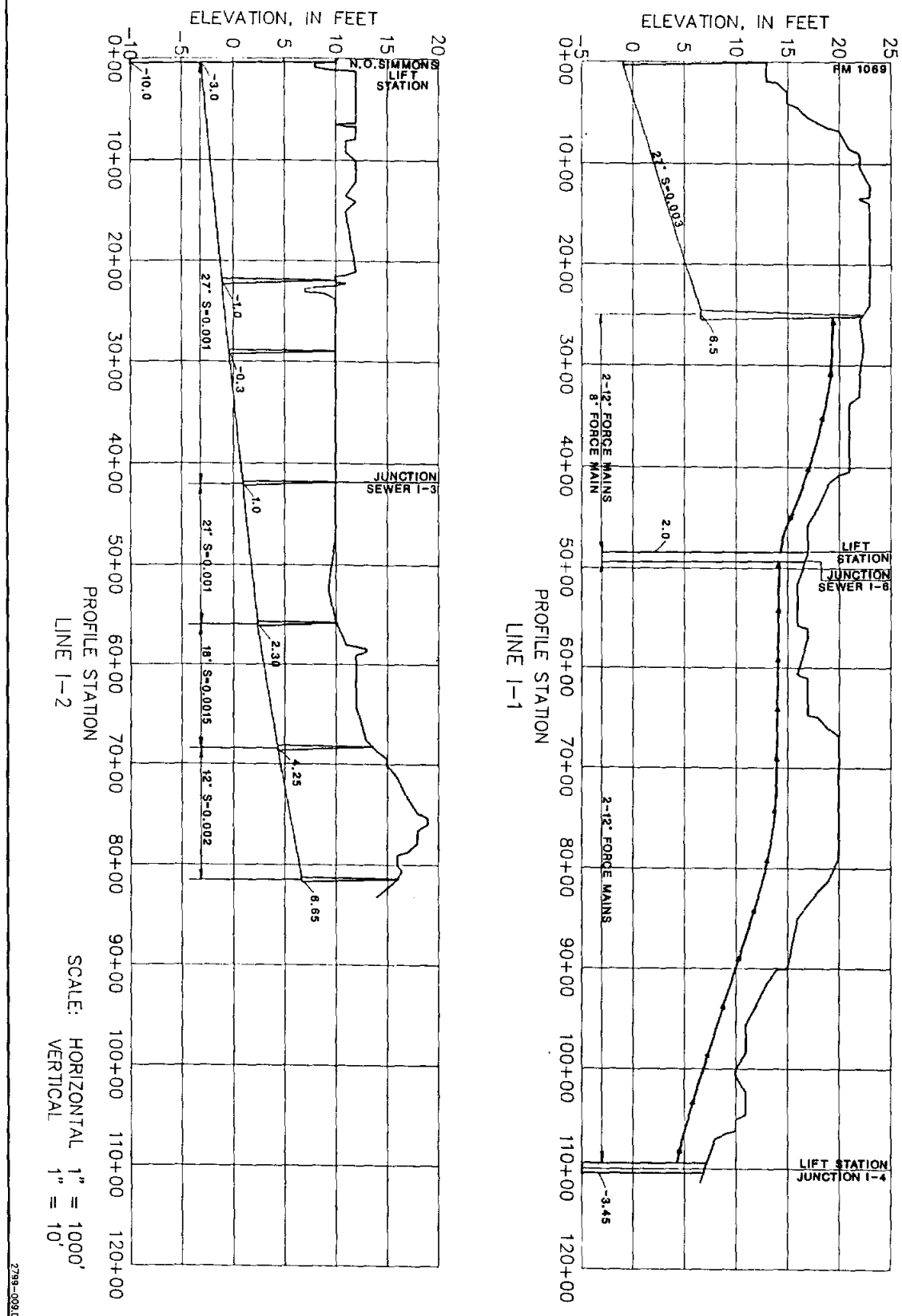
PAGE III-47	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE XI – SCHEMATIC DIAGRAM 1.0 MGD WASTEWATER TREATMENT PLANT EXPANSION



2799-007.DWG

PAGE III-48	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE XII – SCHEMATIC DIAGRAM 1.6 MGD WASTEWATER TREATMENT PLANT – CITY OF ARANSAS PASS



2799-009.DWG

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FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

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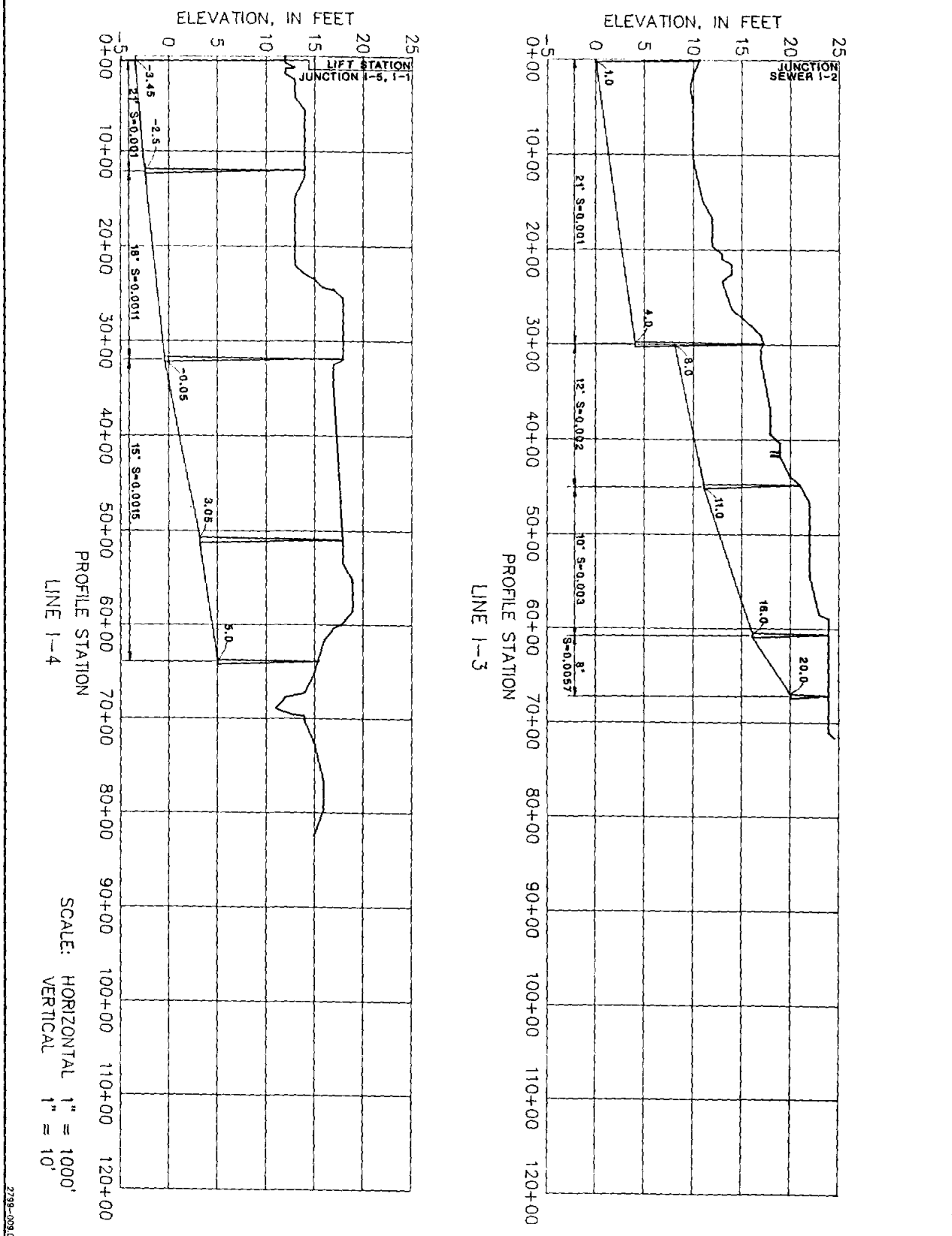
NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI # 2799

PREPARED FOR THE
SAN PATRICIO MUNICIPAL WATER DISTRICT

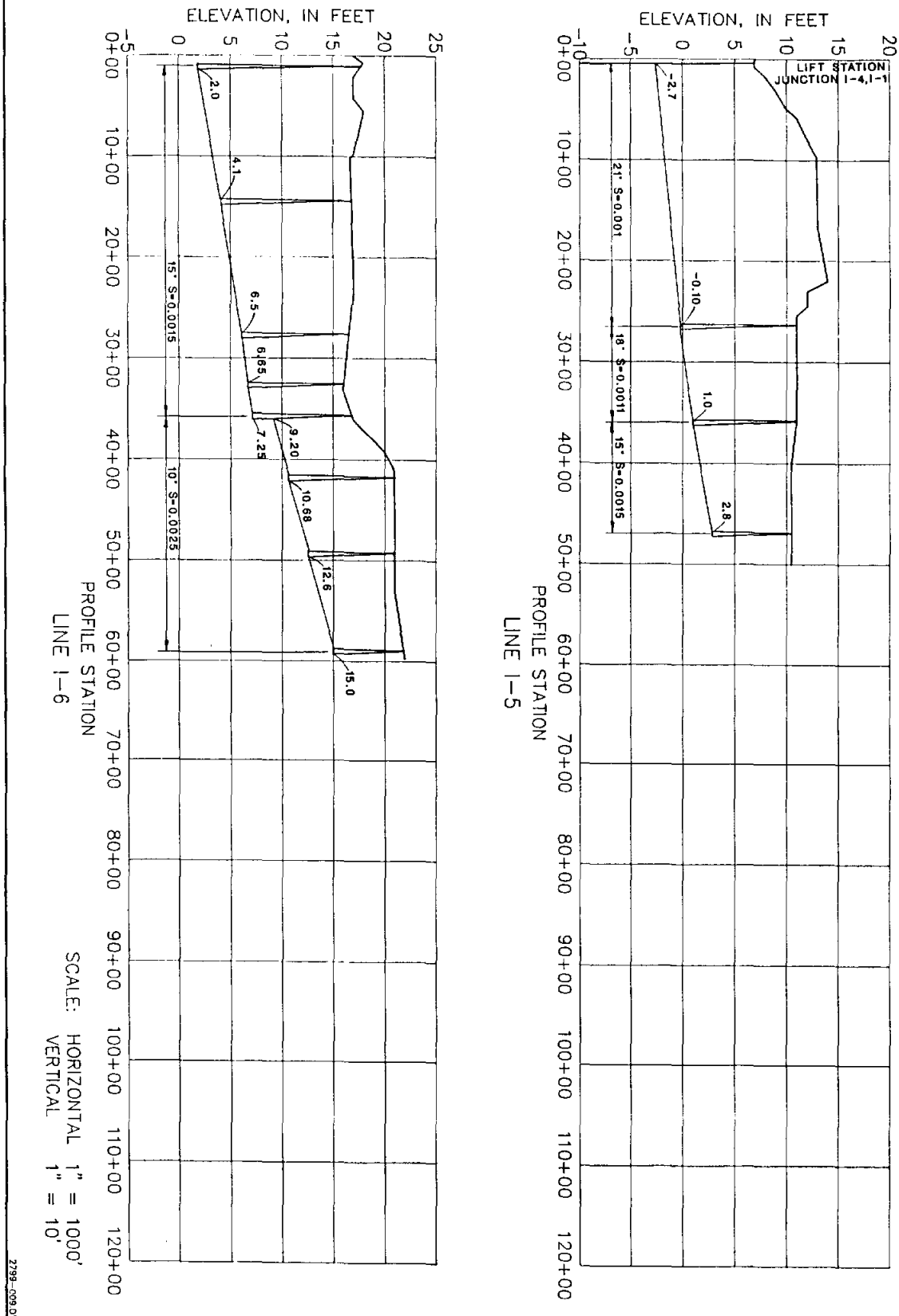
FIGURE XIII – HYDRAULIC PROFILES
RECOMMENDED TRUNK SEWERS
CITY OF INGLESIDE



SCALE: HORIZONTAL 1" = 1000'
VERTICAL 1" = 10'

2799-009.DWG

PAGE III-50	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE XIII – HYDRAULIC PROFILES RECOMMENDED TRUNK SEWERS CITY OF INGLESIDE



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REGIONAL WATER AND WASTEWATER MASTER PLAN
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MASTER WASTEWATER SYSTEM PLAN

NAISMITH ENGINEERS, INC.
CONSULTING ENGINEERS
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI # 2799

PREPARED FOR THE
SAN PATRICIO MUNICIPAL WATER DISTRICT

FIGURE XIII – HYDRAULIC PROFILES
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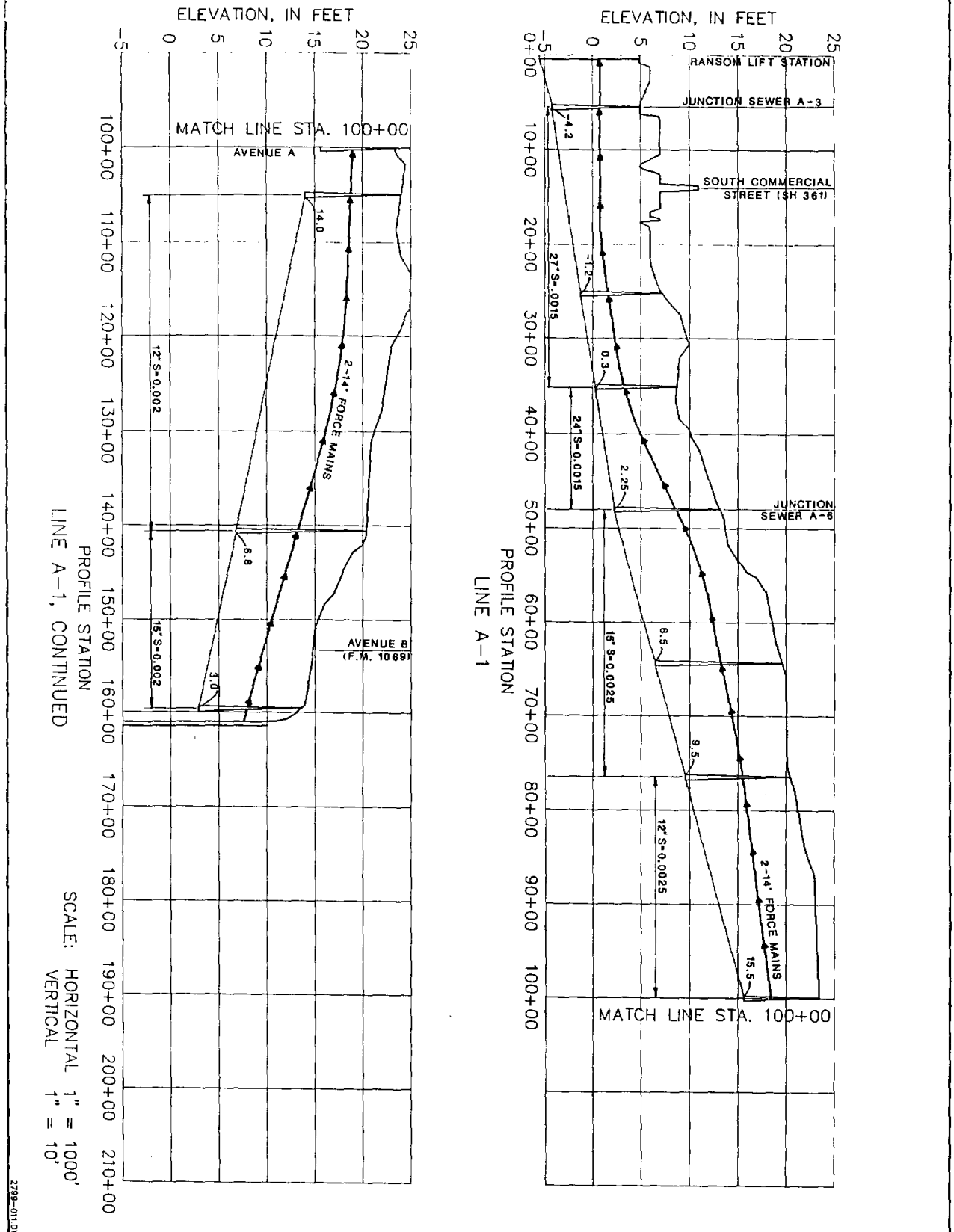
CITY OF INGLESIDE



SCALE: HORIZONTAL 1" = 1000'
VERTICAL 1" = 10'

2799-011.DWG

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REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

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NAISMITH ENGINEERS, INC.
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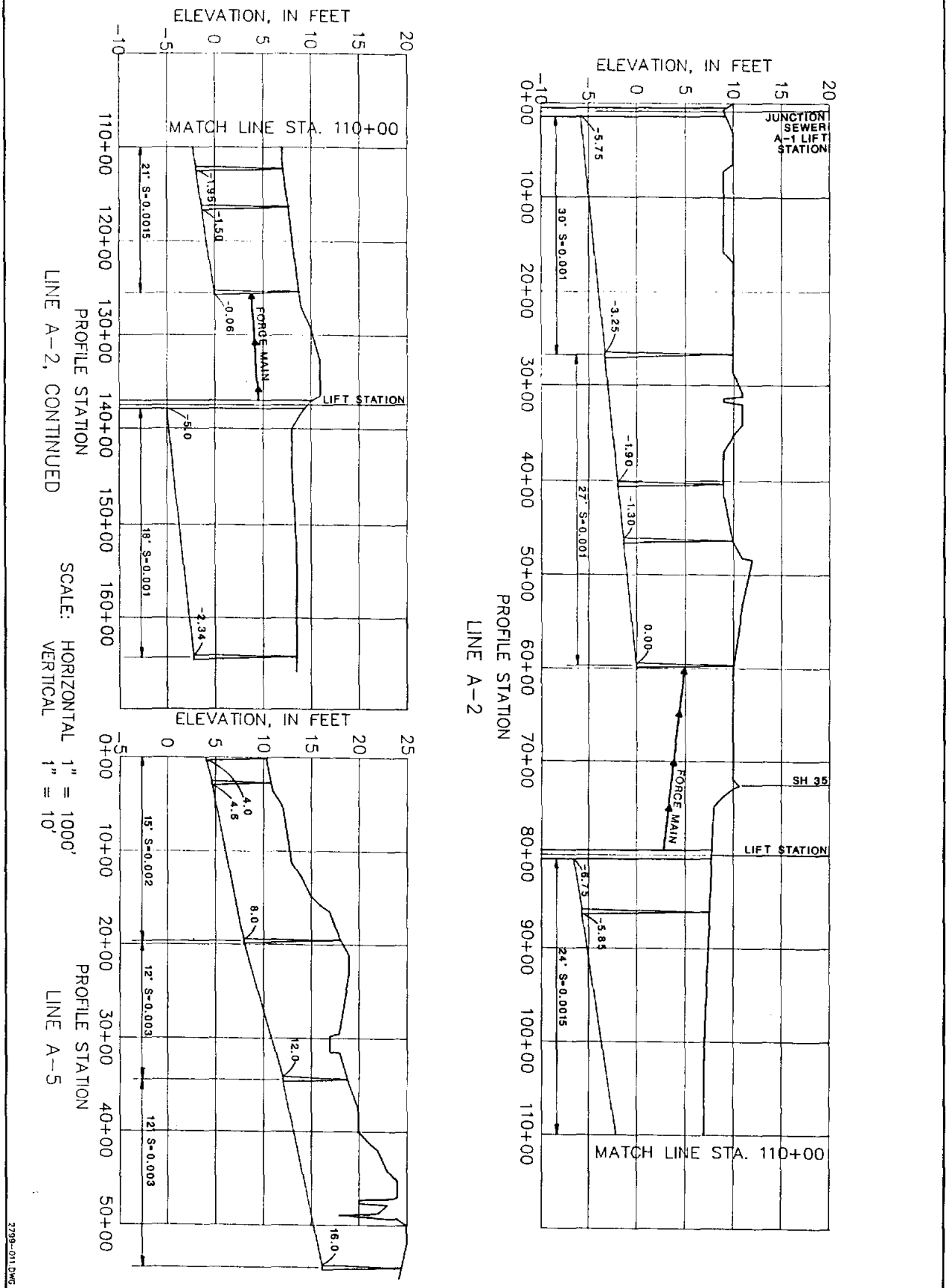
CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI # 2799

PREPARED FOR THE
SAN PATRICIO MUNICIPAL WATER DISTRICT

FIGURE XIV – HYDRAULIC PROFILES
RECOMMENDED TRUNK SEWERS
CITY OF ARANSAS PASS



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SAN PATRICIO MUNICIPAL WATER DISTRICT

FIGURE XIV – HYDRAULIC PROFILES
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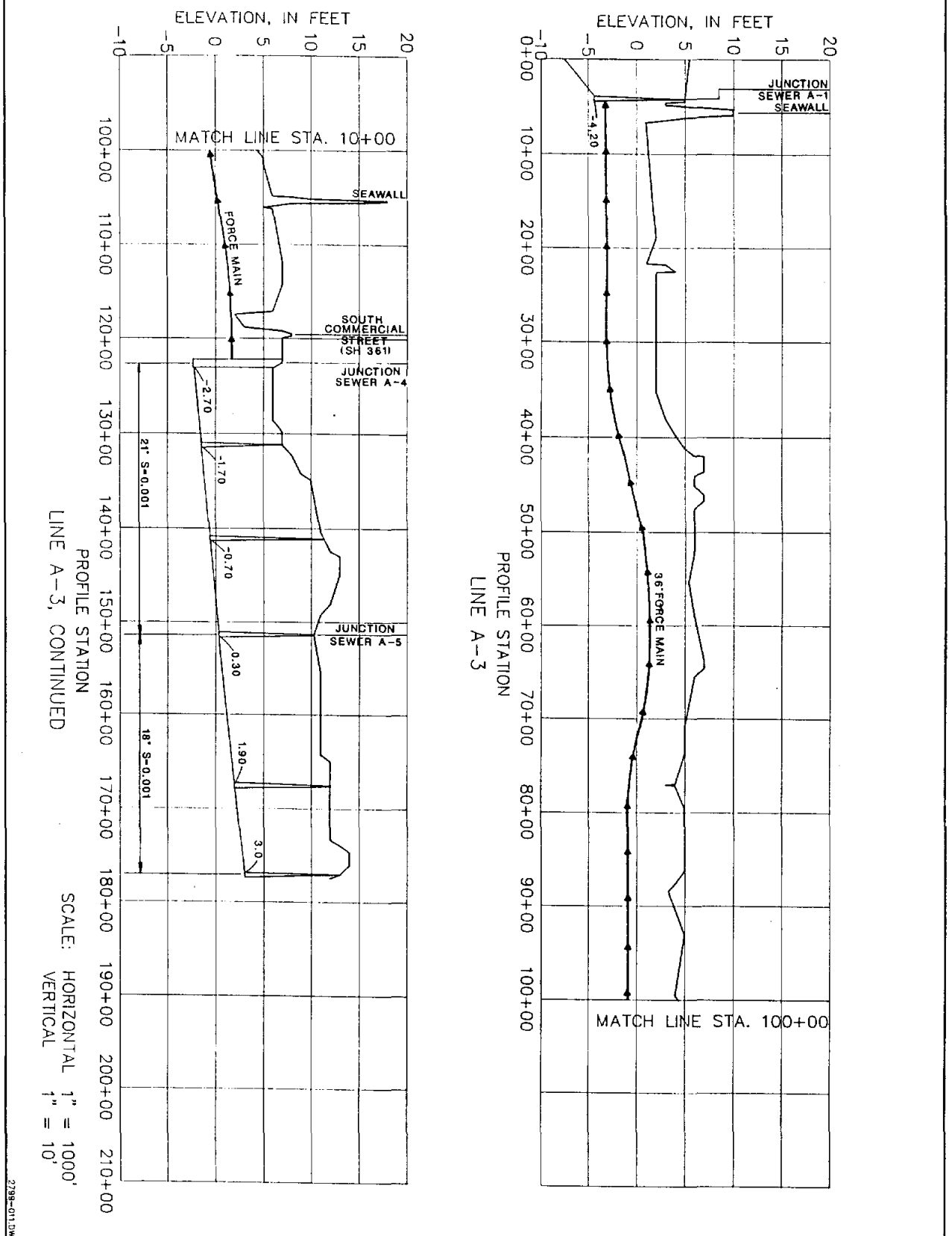
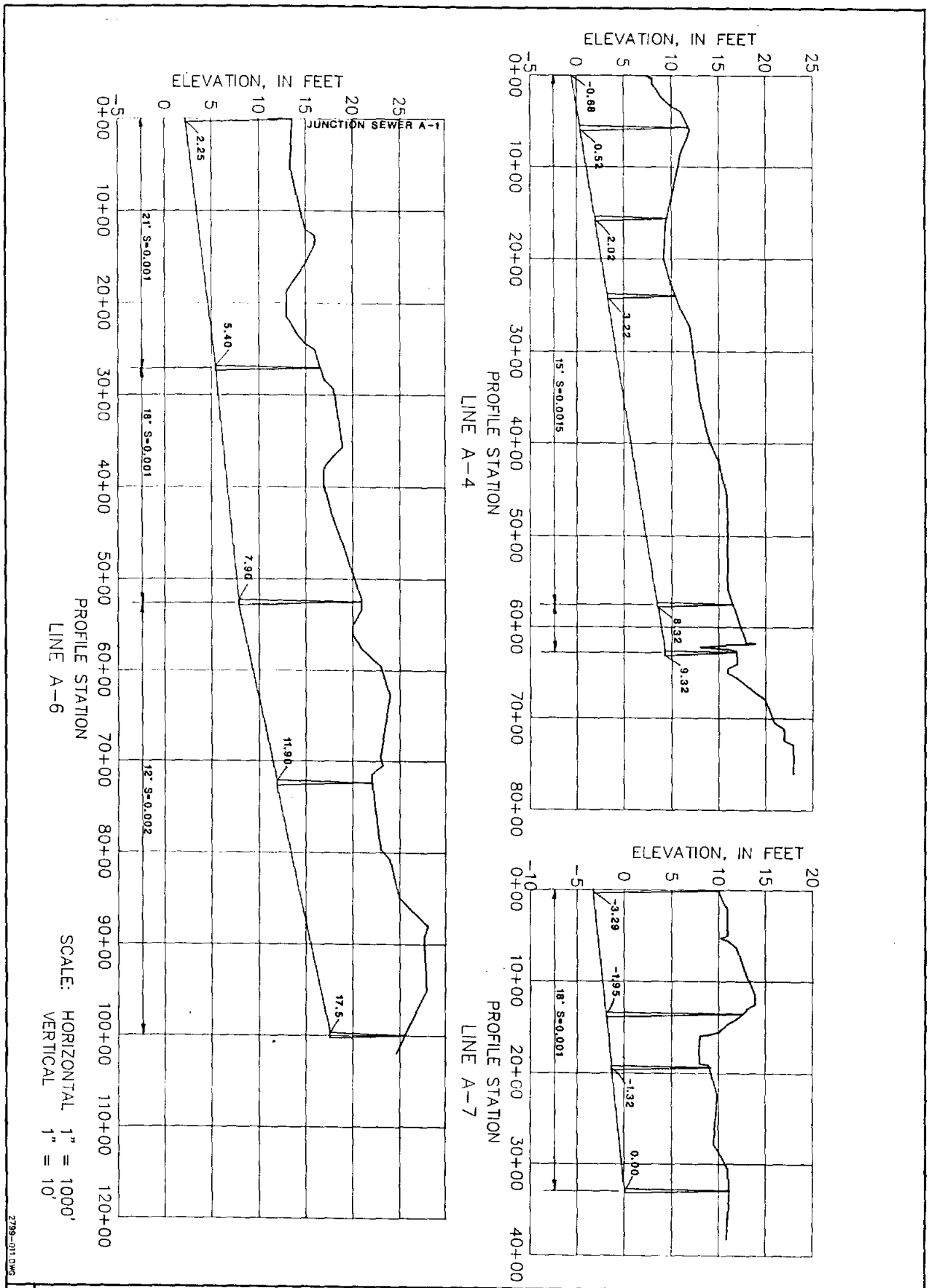


PAGE III-54	REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS MASTER WASTEWATER SYSTEM PLAN NAISMITH ENGINEERS, INC. CONSULTING ENGINEERS CORPUS CHRISTI, TEXAS	AUG. 1989 | NEI # 2799 PREPARED FOR THE SAN PATRICIO MUNICIPAL WATER DISTRICT	FIGURE XIV – HYDRAULIC PROFILES RECOMMENDED TRUNK SEWERS CITY OF ARANSAS PASS



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CORPUS CHRISTI, TEXAS

AUG. 1989 | NEI # 2799

PREPARED FOR THE
SAN PATRICIO MUNICIPAL WATER DISTRICT

FIGURE XIV – HYDRAULIC PROFILES
RECOMMENDED TRUNK SEWERS
CITY OF ARANSAS PASS

REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
SAN PATRICIO COUNTY, TEXAS

SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989

APPENDIX IV - WATER CONSERVATION AND DROUGHT CONTINGENCY PLAN SAN PATRICIO MUNICIPAL WATER DISTRICT

WATER CONSERVATION AND DROUGHT CONTINGENCY PLAN

SAN PATRICIO MUNICIPAL WATER DISTRICT - OWNER

May, 1989

Naismith Engineers, Inc.

Corpus Christi, Texas

SECTION 3039A-045

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WATER CONSERVATION AND DROUGHT CONTINGENCY PLAN

ITEM:

WATER CONSERVATION AND DROUGHT CONTINGENCY PLAN
SAN PATRICIO MUNICIPAL WATER DISTRICT

SECTION I

Basic Water Conservation Plan: The San Patricio Municipal Water District is a Conservation and Reclamation District of the State of Texas created by Act of the Texas Legislature in 1951, Article 8280-145, Vernon's Civil Statutes. The District originally was comprised of the city limits of the cities of Gregory and Ingleside. Later, additions to the District have been the city limits of Odem, Taft, Portland, and Aransas Pass. As it began operation, the District purchased treated water from the Reynolds Metals Company 24" Transmission Line (constructed in 1951 to deliver potable water from the City of Corpus Christi's Cunningham Filtration Plant to the company's aluminum plant near Gregory), and delivered it to the Cities of Ingleside, Gregory, and Odem. Later, Portland, Aransas Pass, and Taft were served as member cities, and the Rockport-Fulton area and the City of Port Aransas were added as customer cities. A 36" diameter untreated water pipeline was constructed in 1964, and water was pumped from the Nueces River Channel Pool upstream from the diversion dam at Calallen to Reynolds Metals Company near Ingleside.

This allowed the District to obtain additional transmission capacity in the treated water line owned by Reynolds. As the demand for treated water increased in the eastern service area, a treatment plant was constructed adjacent to the Reynolds Metals Company property near Ingleside with an initial capacity of 3 mgd. This plant capacity was increased to 6 mgd and then to its present capacity of between 9 and 10 mgd. Water for this plant comes from the untreated water line. E.I. duPont established a large industrial plant adjacent to Reynolds and the District property in 1972, and contracted with the District for untreated water to serve this plant. They use a portion of the water as untreated and treat a portion in their plant for potable and other uses.

All water purchased by the District has been from the City of Corpus Christi who holds the water rights. The Reynolds treated water line was purchased by the City of Corpus Christi following expiration of their original thirty year contract with Reynolds, and it was in turn purchased by the San Patricio Municipal Water District in 1983. At the present time, all water obtained by the District is purchased directly from the City of Corpus Christi, either

as treated water through a meter on the property of the Cunningham Treatment Plant, or as untreated water out of the channel of the Nueces River, and then it is transmitted to District municipal and industrial customers through District facilities. The District has been consistently supportive of the City of Corpus Christi in matters relating to water rights, reservoir construction, water conservation, and drought contingency planning. The District was an active participant with the City of Corpus Christi in the planning sessions required to handle the 1983 - 1984 drought situation. At that time, District customers voluntarily adopted the conservation measures being undertaken by the City of Corpus Christi so that addressing the drought problem was on an area wide basis. A large part of the underground water resource which is relied on as an emergency backup to the Corpus Christi Area water supply is in the westerly and northerly portions of San Patricio County.

The City of Corpus Christi published a Water Conservation and Drought Contingency Plan in September of 1986. This Plan has been reviewed and accepted by the Texas Water Development Board and will form the basis of the water

conservation and drought contingency plan for the San Patricio Municipal Water District. This has been discussed with the water superintendent of the City of Corpus Christi, and it is agreed that this is the most reasonable approach, as the entities are under contractural obligation to one another, depend on the same basic resource, use the same media for communication with the consumer public, and recognize that water conservation and handling of the drought situation works best when everybody "plays by the same rules".

The Corpus Christi plan is adopted by the San Patricio Municipal Water District for its use and the use of its member and customer cities and industrial customers, subject to certain modifications and clarifications which are noted in following sections.

Section 1.1 Education and Information. The District and the City of Corpus Christi will continue to work cooperatively in development and dissemination of information promoting water conservation. The District has only a very limited number of direct residential customers (services resulting from agreements between Reynolds Metals

Company and property owners across whose land the pipeline was laid) and was not accepting additional individual customers for several years. Therefore, its primary function will be to make available to its member cities, other communities which it serves, and customer industries the information available with encouragement of its use and adoption. For the year 1988, approximately forty-four percent of the total water sold by the District was untreated water sold to industrial customers. These industries already have extensive water conservation programs, driven not only by the cost of water, but also by the necessity of reducing waste treatment and discharge to the minimum levels possible. At the end of this section is attached a news media list as updated by the public information section of the City of Corpus Christi. Appended to this list are additional media available to and used by the San Patricio County Area.

Section 1.2. Plumbing Code and Retrofit Programs. Use of water saving plumbing fixtures in the District's service area is influenced by its proximity to the City of Corpus Christi. Each of the member and customer municipalities of the District has its own plumbing code.

The District will continue to encourage these municipalities to adopt or modify their codes in the interest of water conservation.

Section 1.3. Water Rate Structures. District contracts with industries for untreated water contain a basic charge adequate to recover costs for installing the necessary delivery facilities and deliver a base amount of water, and then have a flat charge per thousand gallons for water delivered over the basic amount. There is no decrease in water rate for demands beyond the base demand. Municipal customers are charged a flat rate per thousand gallons for all water taken. This is currently $0.75 per thousand gallons for communities in the westerly portion of the District, served from the 24" treated water line, and $0.85 per thousand gallons for communities in the easterly portion of the District, served from the District's water treatment plant. Growth in the District's municipal customer demand has been primarily in the easterly portion of the District, and expenditures have been required to meet this growing demand, whereas the demand in the westerly portion of the District has been relatively constant.

Each individual municipality served by the District sets its own rates.

Section 1.4. Metering and Meter Repair. Each of the District's municipal customers has its own meter installation and repair policy. Residential, commercial, and industrial customers are all metered. Some municipal uses of water, such as fire fighting, park irrigation, and "City Hall" service are unmetered.

The District's own metering program consists of purchase of all water through calibrated and routinely tested meters owned by the District and calibrated by the City of Corpus Christi. Untreated water is purchased through a calibrated flow tube and orifice plate meters, and totalizers installed at the Nueces River Pump Station, and treated water is purchased through a turbine-type meter with mechanical totalizer installed at the Cunningham Filtration Plant Site. Sale of untreated water is through calibrated flow tubes and flow totalizers, and sale of treated water is through calibrated turbine meters with mechanical totalizers. During the last full year of operation by the

District (1988), the District purchased a total of 5,334,433 M gallons of combined untreated and treated water and sold a total of 5,347,171 M gallons. This indicates a theoretical "gain" of 12,738 M gallons for the year or 0.24 percent. This is well within the accuracy limits of the installed meters and indicates the effectiveness of the District's program.

Section 1.5. Water Conserving Landscaping. The District will distribute and encourage the use of the excellent material contained in the City of Corpus Christi Plan.

Section 1.6. Leak Detection, Repair, and Pressure Control. Because of the nature of the District's transmission system, leak detection tends to be simple, as leaks are large and readily observed. Continuity of service to its customers requires that the District immediately repair any leaks or breaks. Water loss is indeed minimal, as indicated by the difference between indicated water purchases and sales in Section 1.5.

The District's transmission system is operated at the

lowest possible pressure level compatible with health concerns, this is in the interest of minimizing the electric power requirement for pumping.

Section 1.7. Recycling and Reuse. Customers, cities, and industries of the District currently have extensive recycling and reuse programs in their service areas.

The District collects all filter backwash water from its treatment plant and recycles the supernatant back to the head of the plant. Sludge removal from its clarifiers is on a twice yearly basis with disposal on the plant site. Under normal operations there is no loss of water from the plant site resulting from the treatment operation. Again, this is reflected by the water purchase/sales balance indicated in Section 1.5.

Section 1.8. Implementation and Enforcement. As noted in the Corpus Christi Plan, water supply contracts between the City of Corpus Christi and the District require that during periods of drought, the District and its receiving customer cities and industries restrict use of water in the same degree that the retail customers of the City of Corpus

Christi are required to conserve. Experience has indicated that this is best implemented during drought circumstances by joint actions originating from a control group having area-wide representation. Voluntary cooperation has been and will continue to be far more effective than attempts to enforce contractural obligations. Managing implementation of conservation measures during a drought is an "extremely" delicate matter, and it requires daily attention by all cooperating entities.

SECTION II

BASIC DROUGHT CONTINGENCY PLAN: As with the water conservation plan, the San Patricio Municipal Water District is, by contractural agreement, one of the participants in implementation of the City of Corpus Christi Drought Contingency Plan. This Plan calls for steps to be taken by water consumers when it appears the existing surface water supply may not be sufficient to meet all needs without some type of restrictions on the water use.

The Drought Contingency Plan recognizes four condition levels as noted below:

Condition I - Drought Possibility: Condition I exists when the combined water supply in the two reservoirs is estimated to be a two year demand without rationing, conservation, or storm water runoff.

Condition II - Drought Watch: Condition II exists when the combined water supply in the two reservoirs is estimated to be less than 130,000 acre feet.

Condition III - Drought Warning: Condition III exists when the combined water supply in the two surface reservoirs is estimated to be less than 100,000 acre feet.

Condition IV - Drought Emergency: Condition IV exists when the water supply in the two reservoirs is estimated to be less 65,000 acre feet.

Under **Condition I- Drought Possibility,** the District will take the following actions:

1. Stay in weekly touch with the City of Corpus Christi Water Division regarding lake levels and status of City Drought Contingency Plan.
2. Check operability of wells or other backup supply which District member cities, customer cities, or industries served may have available.
3. Discuss water conservation and rationing possibilities with all member and customer cities and industries served by the District.
4. Request voluntary conservation of water by all users served by the District's system.
5. Require member and customer cities to implement odd/even address user yard watering or other similar measures to begin water conservation and to call attention of the using public for the need to conserve.
6. Cooperate with the City of Corpus Christi in inventory and investigation of alternative water sources available.
7. Verify with member and customer cities that water leak reduction programs are fully implemented.

During the 1982-84 drought period, the City of Corpus Christi joined with other area municipalities and industrial representatives, both at the staff level and at the Adhoc Water Advisory Commission level to monitor planning and implementation

of water conservation and drought contingency measures. This effort was extremely effective and was a key to keeping the various municipalities and industries on uniform levels of effort for water conservation. It will be the District's policy to cooperate fully with such volunteer efforts addressing future water conservation - drought contingency needs. The "bottom line" for water conservation measures will be the degree to which use may be reduced during critical periods. It will be the District's policy to assure that its member cities and customer cities implement either the same measures for water conservation indicated in the Corpus Christi Plan or other measures which have an equal or better effect in reducing water consumption.

Under **Condition II - Drought Watch**, the District will implement the following additional measures:

8. Meet with representatives of member cities and customer cities to address the following specific items:

   a. Restriction of outdoor use of water such as car washing, dust control, exterior building, sidewalk, and driveway washing.

   b. Restrict use of fire hydrants for uses other than fire fighting.

   c. Establishment of local committees of governmental, health, industrial, and private citizens to review policies and issue exemptions within each city.

9. Meet with industrial customers to determine allocations.

Under **Condition III - Drought Warning,** the District will implement the following additional measures:

10. Meet with member and customer cities to address the following:

    a. Prohibition of new connections to distribution systems where others supply service is available.

    b. Mandatory reduction of normal water use by industrial and commercial customers.

    c. Limitation of residential customer use without rate penalty (also review existing rate schedules and prepare to modify as needed to discourage overuse).

Under **Condition IV - Drought Emergency,** the District will implement the following additional measures:

11. Meet with representatives of member and customer cities to address the following:

    a. Prohibition of new connections to member and customer cities' distribution systems.

    b. Establish maximum monthly use for residential meters respecting the amount of alternative water supply available.

    c. Discuss municipalities taking such other action as may be needed if it appears the water supply may become depleted. The goal will be for all municipalities to take the same steps at the same time.

12. Meet with representatives of industrial customers and allocate available water.

APPENDIX

NEWS MEDIA LIST
November 1988

Print Media

Corpus Christi Caller-Times (Daily)
Publisher: Steve Sullivan
President: Steve Sullivan (886-3666)
Exec. Editor: Larry Rose (886-3607)
Managing Editor: Norma Sosa (886-3608)
Caller & Times City Editor: Nick Jimenez (886-3611)
Asst. City Editor: Tom Whitehurst (886-3662)
Community Life Editor: Kevin Kerrigan (884-2011)
Weekend Magazine: Nita Peterson (884-2011, ext. 236)
P.O. Box 9136 78469
820 Lower North Broadway
Central Telephone Number: 884-2011

Flour Bluff Sun (weekly)
Editor: Marie Speer
P.O. Box 18268 78418
1935 Flour Bluff Dr. #7 78418
937-4584 or 939-7893

Corpus Christi Business Journal
Publisher: Ron Lammert
723 N. Upper Broadway, Suite 301
Corpus Christi, TX 78401
884-9311

Gray Gazette (monthly)
Editor: Becky Barker
P.O. Box 363
Taft, Texas
364-1439

Island News (weekly)
Editor: Raymond M. Cushing
P.O. Box 159
Pt. Aransas, TX 78373
749-6088

TODAY & La Voz Latina
Editor: Dan Burgess
4701 Ayers, Suite 600-3
Corpus Christi, TX 78415
854-2772

Western Star (weekly)
Gen. Mgr.: Sam Keach
Editor: Bill Defries
P.O. Box 1192
Robstown, TX 78380
387-8880 or 387-4511

Radio Media

KBCB-FM (K-99)
(See KRYS)

KCCT (1150KC)
Format/Market: Young Hispanic Adult
News Director: Leo Luna
PSA Director: Maria Villagomez
Gen. Mgr.: Manuel Davila Jr.
P.O. Box 5278 78405
701 Benys Road 78408
289-0999 or 289-0990

KEYS (1440KC)
Format/Market: Oldies & Goodies
News Director: Bud Lockhart
Gen. Mgr.: Pryce Taylor
P.O. Box 9917 78469
2117 Leopard 78408
882-7411

KLTG (96.5MC)
Format/Market: Easy Listening
News Director: Tony Tinsel
PSA Director: John Spofford
Gen. Mgr.: Steve De Walt
P.O. Box 31274 78404
1608 S. Brownlee 78404
882-4394

Radio Media

KDAE (1590KC)
Format/Market: Hits of Yesteryear
(see KIOU)

KBNJ (91.9MC)
Format/Market: Educational, non-denominational religious; Eng. & Span.
Mgr.: David Throndson
Adm. Asst.: Herb Kinard
P.O. Box 9940 78469
3105 Leopard 78403
888-9292

KLUX-FM (89.5FM)
Operations Mgr.: Cathy Graves
Catholic Telecommunications Center
1200 Lantana 78407
289-6437 or 387-6221

KNCN-FM (101.3MC)
Format/Market: Rock & Roll
PSA Director: Alice St. John
Gen. Mgr.: John Marin
P.O. Box 9781 78469
5544 Leopard 78408
289-1000

KOUL-FM (105MC)
Format/Market: Town & Country
News Director: Jim Wilkens
PSA Director: Jan Kullman
Gen. Mgr.: Bob Trask
P.O. Box 898 78403
1300 Antelope 78401
Station: 883-0927; Studio: 883-1600

KROB-AM/FM (1510KC/99.9MC)
Format/Market: Country Western
Gen. Manager: Jeanette Gossage
P.O. Box 752, Robstown 78380
387-1510

KZFM (95.5MC)
Format/Market: Rock & Roll
(see KEYS)

KJKC (105MC)
Format/Market: Rock & Roll
News Director: Harry Sherwood
Gen. Mgr.: Jonathan Cohen
711 N. Carancahua, Suite 1620 78475
888-8555

KKED-FM (90.3MC)
Format/Market: Classical
(see KEDT-TV)

KRYS (1360KC)
Format/Market: Country western
News Director:
PSA Director: Lisa Richardson
Gen. Mgr.: Jim Whiteaker
702 McBride Lane 78408
289-0111

KSIX (1230KC)
(see KZTV-TV)

KSTE-FM (93.9MC)
Format/Market: Adult
PSA Director: Rene Hernandez
Station Mgr.: D'Ann Davis
Program Dir.: Jim Thomas
1 Gaslight Square 78404
883-5576

KUNO (1400KC)
Format/Market: Trad. Hispanic
News/PSA Director: Victor Lara
Gen. Manager: Luis Munoz
P.O. Box 4722 78469
1301 Horne Rd. 78416
851-1414

KKHQ (95.5MC)
Format/Market: Modern
Gen. Manager: Lynn Poynter
PSA Director: Francelia Gutierrez
4718 Leopard 78408
887-9836

TV MEDIA

KEDT-TV (PBS) Channel 16
News Director: Jeff Felts
PSA Director: Laura Elliott
Gen. Manager: Terrell Cass
P.O. Box 416 78403
4455 S. Padre Is. Dr., suite 38 78411
855-2213

KIII-TV (ABC) Channel 3
News Director: Rob Dean
Assignments Editor: Charlie Rose
3 Magazine: Kathryn Childers &
Kathy Welsh
PSA Director: Lori Bodine
Gen. Manager: Max Sklower
P.O. Box 6669 78411
4750 So. Padre Is. Dr. 78466
854-4733; News 853-0330

KORO-TV (SIN) Channel 28
News Director: Roberto Perez
Production Manager: Rene Pantoja
Gen. Manager: Servando Caballero
102 N. Mesquite 78401
883-2823

KRIS-TV (NBC) Channel 6
News Director: Fred Jordan
Assignment Editor: Dot Pettersen
PSA Director: Norma Cavazos
Gen. Mgr.: T. Frank Smith
P.O. Box 840 78403
409 S. Staples 78401
883-6511; News 884-6666

KZTV-TV (CBS) Channel 10
News Director: Walter Furley
Assignments Editor: W. Furley
PSA Director: Alice Bentson
Gen. Mgr.: Vann Kennedy
P.O. Box TV-10 78403
301 Artesian 78401
883-7070

TCI Cablevision of Texas, Inc.
Gen. Mgr.: Randy Grimes
Access Coordinator: John Bowles
Bulletin Board: Robert Hughes
P.O. Box 6607
4060 So. Padre Island Dr. 78411
857-5059

ADDITIONAL NEWS MEDIA
SAN PATRICIO COUNTY - ARANSAS COUNTY
MAY, 1989

Media in San Patricio County

San Patricio County New
Editor: Jim Tracy
P.O. Drawer "B"
Sinton, Texas 78387
364-1270

Odem-Edroy Times
Editor: Lillian Harris
P.O. Drawer "B"
Sinton, Texas 78387
364-1270

Taft Tribune
Editor: George Rigotti
P.O. Box 8
Taft, Texas 78390

Mathis News
Editor: Charles E. Sullivan
P.O. Box 38
Mathis, Texas 78368
547-3274

Portland News
Editor: Donner J. Strong
1 Cedar Place, Suite G
Portland, Texas 78374
643-1566

Media in Aransas County

Rockport Pilot
Editor: Mike Probst
P.O. Box 730
Rockport, Texas 78382
729-9900

REGIONAL WATER AND WASTEWATER MASTER PLAN
FOR THE LIVE OAK RIDGE AREA OF
SAN PATRICIO COUNTY, TEXAS

SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989

APPENDIX V - DISTRIBUTION SYSTEM PUMP DATA

CITY OF ARANSAS PASS
PUMP NAMEPLATE DATA

SOUTH COMMERCIAL STREET PUMP STATION

Pumps No. 1 and No. 2 (Identical)

Mfg: Allis Chalmers - Cinn., Ohio
Type: 8000 Mfg. Code: Al-Al-Al config. 300
Size: 6 x 4 x 14S Ser. No. 831-48554-01-2
G/A H7-471-111-133-940 500 gpm @ 150 ft.
Imp. Dia. = 12.6 1770 rpm
Frame: F20-C2

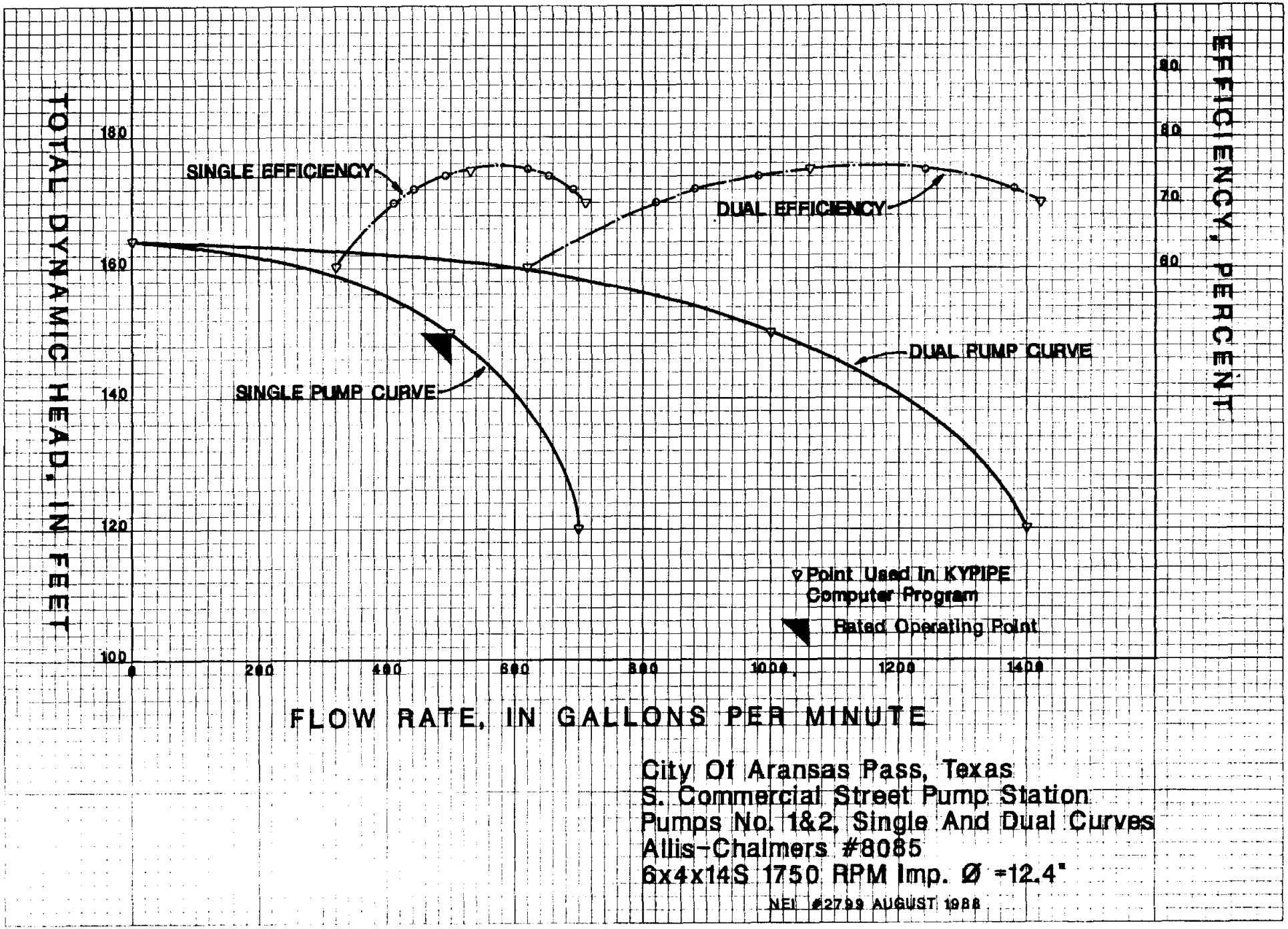
AVENUE A PUMP STATION

Pump No. 3

Mfg: Allis Chalmers - Cinn., Ohio
Type: 8000 Mfg. Code: Al-Al-Al config. 150
Size: 6 x 4 x 14S Ser. No. 871-60058-01-1
G/A 00-471-111-133-940
Imp. Dia. = 12.9 1770 rpm

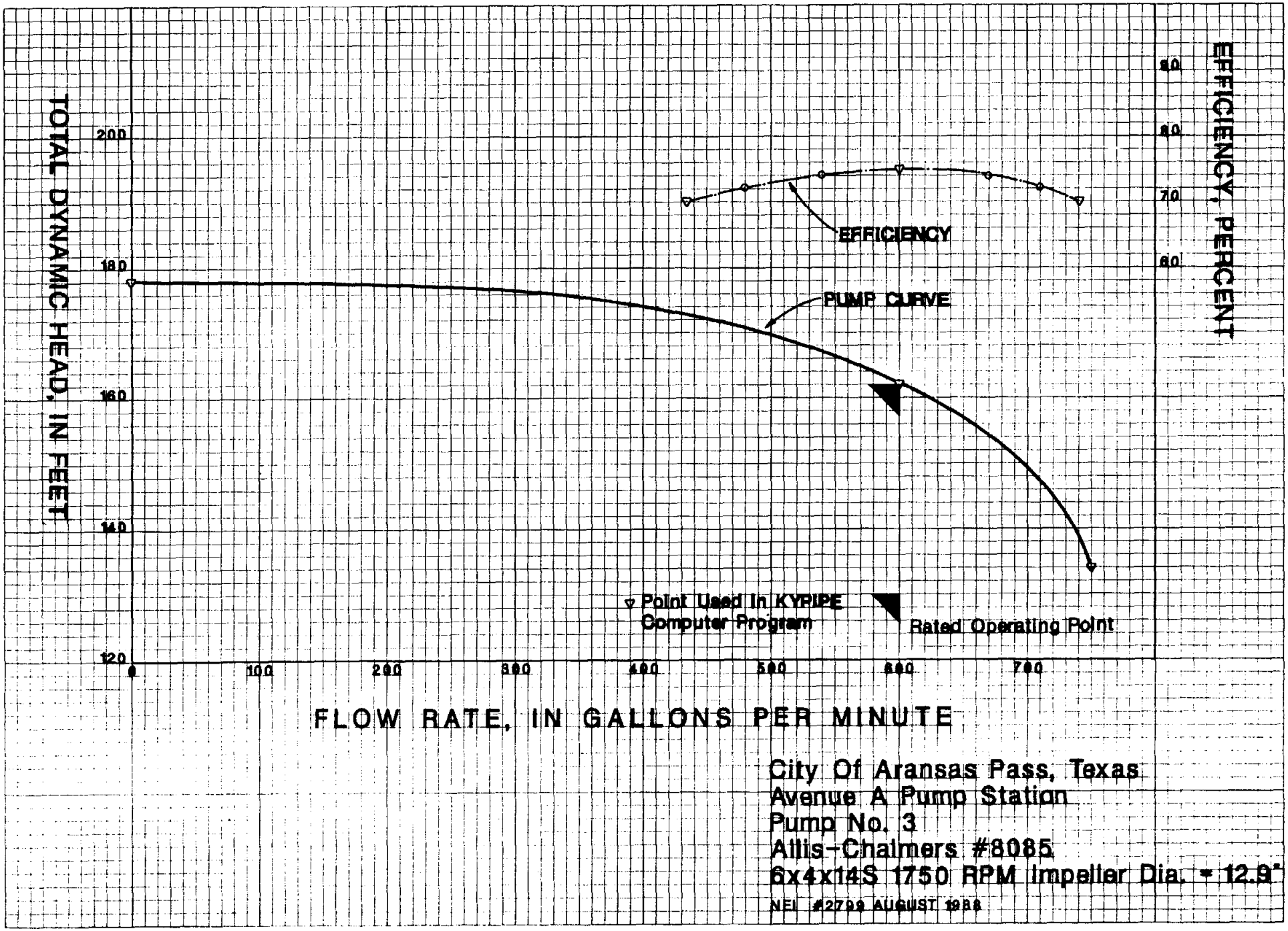
Pumps No. 4 and No. 5 (Identical)

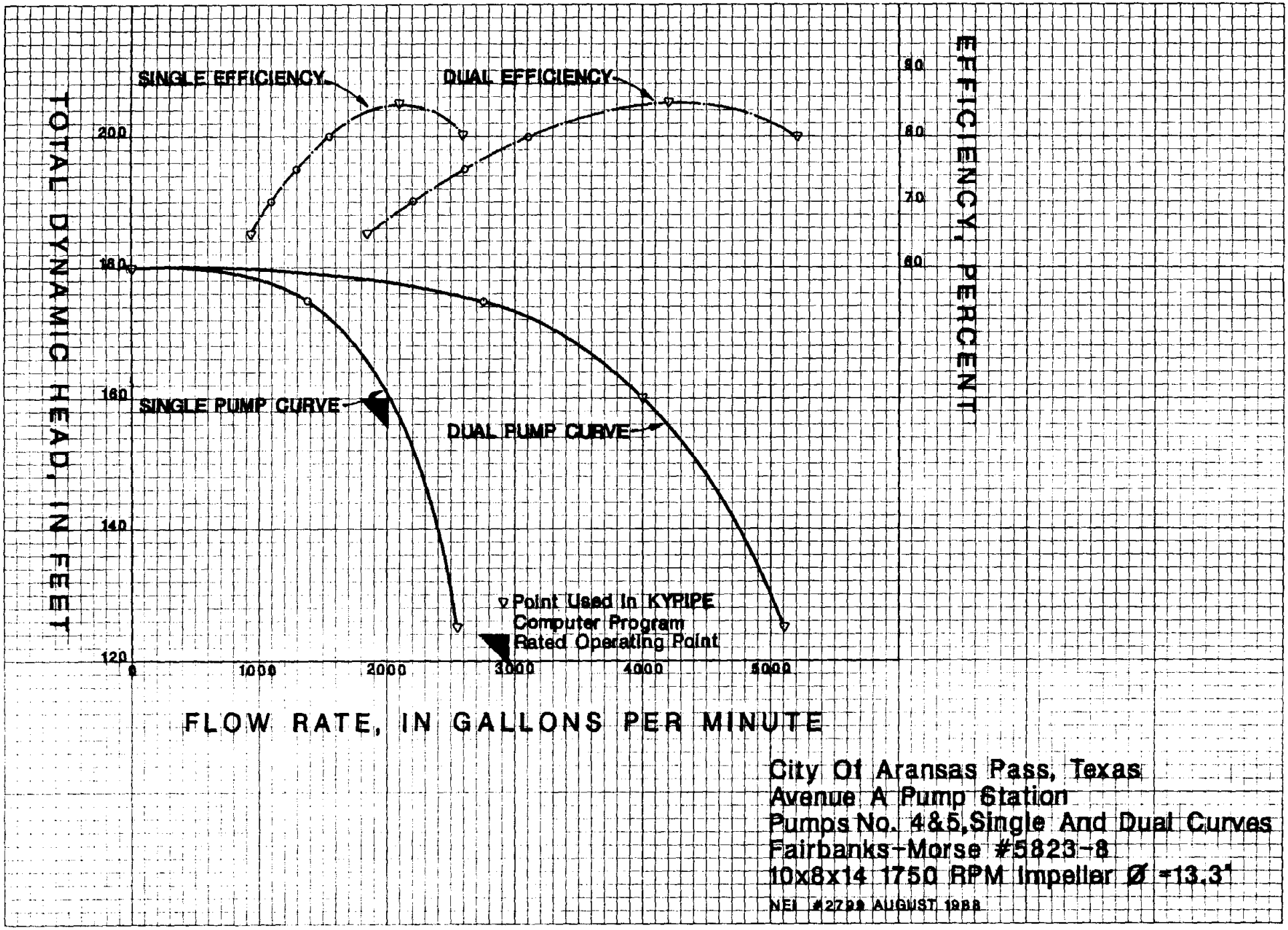
Mfg: Colt Industries (Fairbanks-Morse)
Model D8A2 Size: 8 Total Head: 160 Q=2000 gpm
Imp. Dia. = 13.378 Ser. No. K2R1061539-1



City Of Aransas Pass, Texas
S. Commercial Street Pump Station
Pumps No. 1&2, Single And Dual Curves
Allis-Chalmers #8085
6x4x14S 1750 RPM Imp. Ø =12.4"

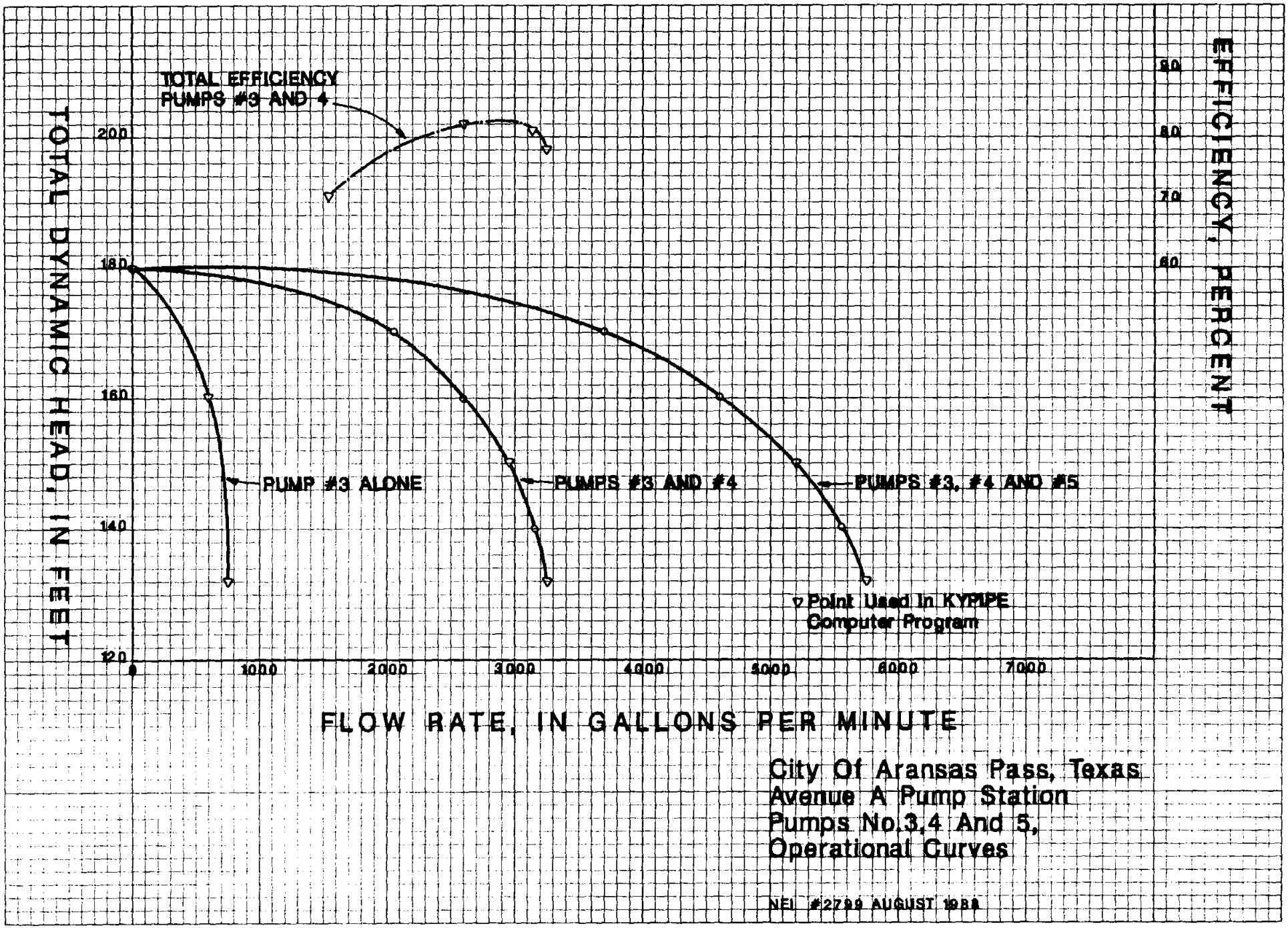
NEI #2799 AUGUST 1988


TOTAL DYNAMIC HEAD, IN FEET
200
180
160
140
120
EFFICIENCY, PERCENT
90
80
70
60
EFFICIENCY
PUMP CURVE
Point Used In KYPIPE Computer Program
Rated Operating Point
0
100
200
300
400
500
600
700
FLOW RATE, IN GALLONS PER MINUTE
City Of Aransas Pass, Texas
Avenue A Pump Station
Pump No. 3
Allis-Chalmers #8085
6x4x14S 1750 RPM Impeller Dia. = 12.9"
NEI #2799 AUGUST 1988



City Of Aransas Pass, Texas
Avenue A Pump Station
Pumps No. 4&5, Single And Dual Curves
Fairbanks-Morse #5823-8
10x8x14 1750 RPM Impeller Ø =13.3"

NEI #2799 AUGUST 1988



City Of Aransas Pass, Texas
Avenue A Pump Station
Pumps No.3,4 And 5,
Operational Curves

NEI #2799 AUGUST 1988

CITY OF INGLESIDE
PUMP NAMEPLATE DATA

PUMP STATION NO. 1

Pump A

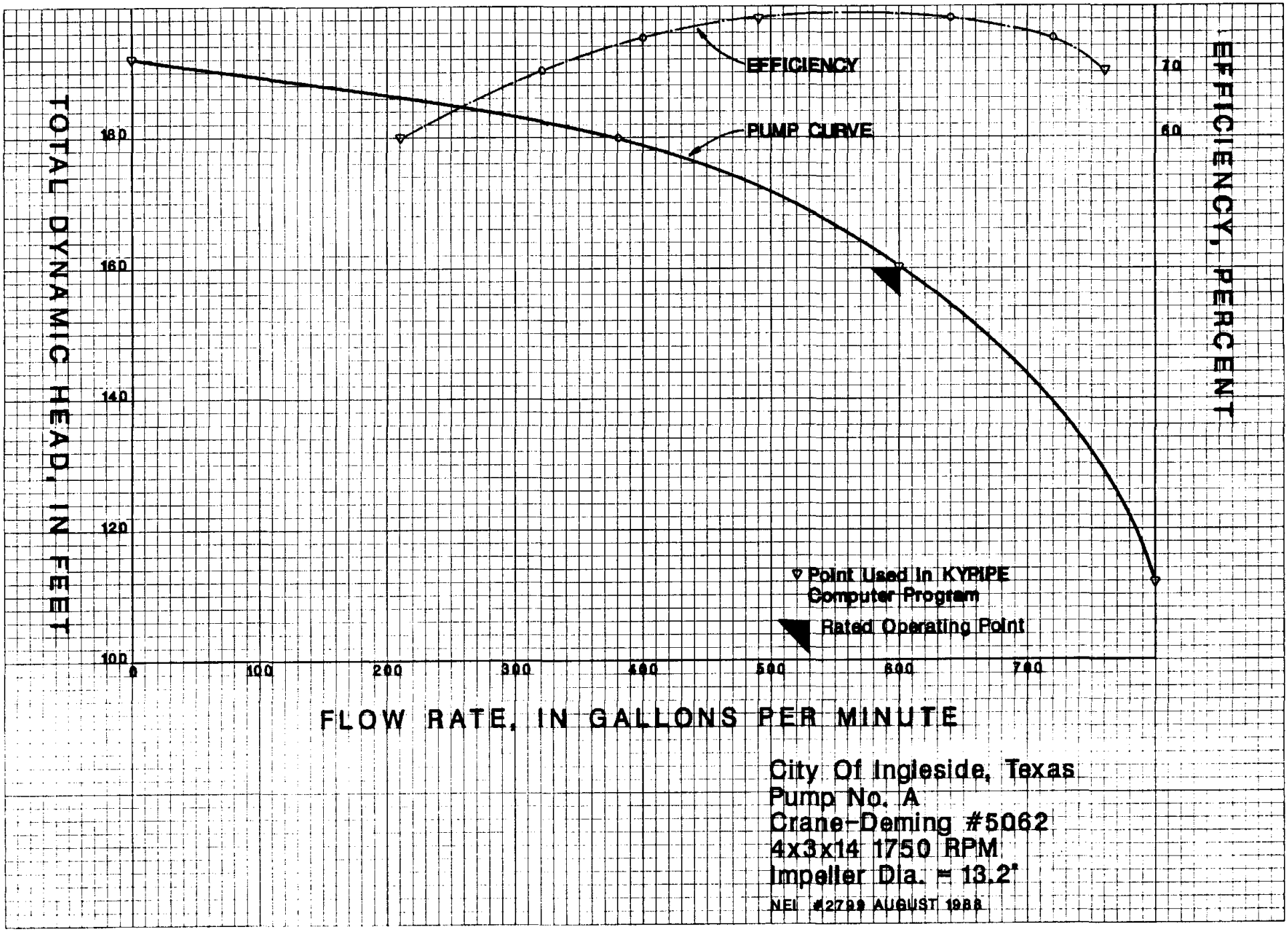
Mfg: Crane-Deming Model: 5062
Size: 4 x 3 x 14 Ser. No.
600 gpm @ 160 ft. Imp. Dia. = 13.2 1750 rpm

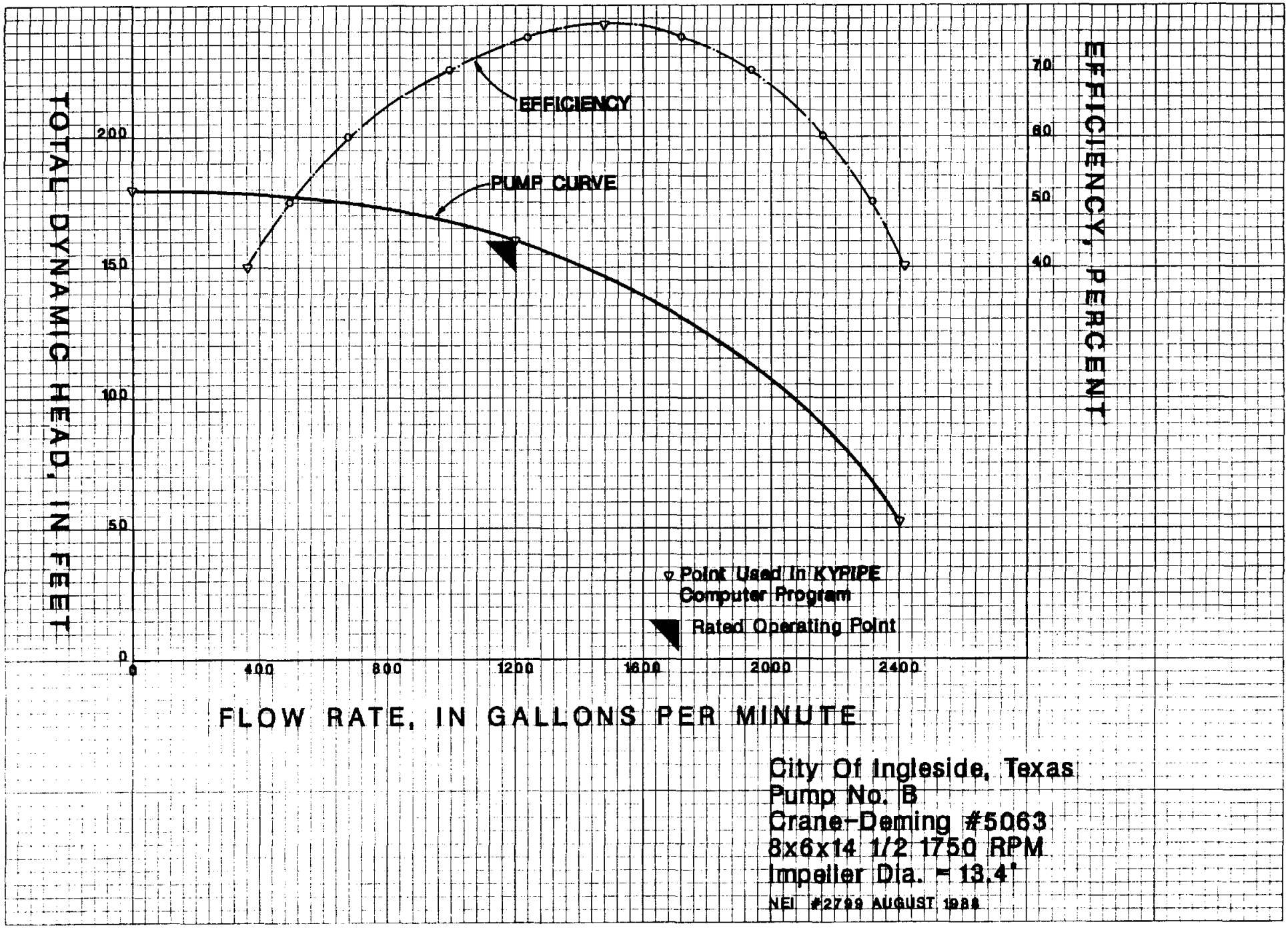
Pump B

Mfg: Crane-Deming Model: 5063
Size: 8 x 6 x 14 Ser. No.
1200 gpm @ 160 ft. Imp. Dia. = 13.4 1750 rpm

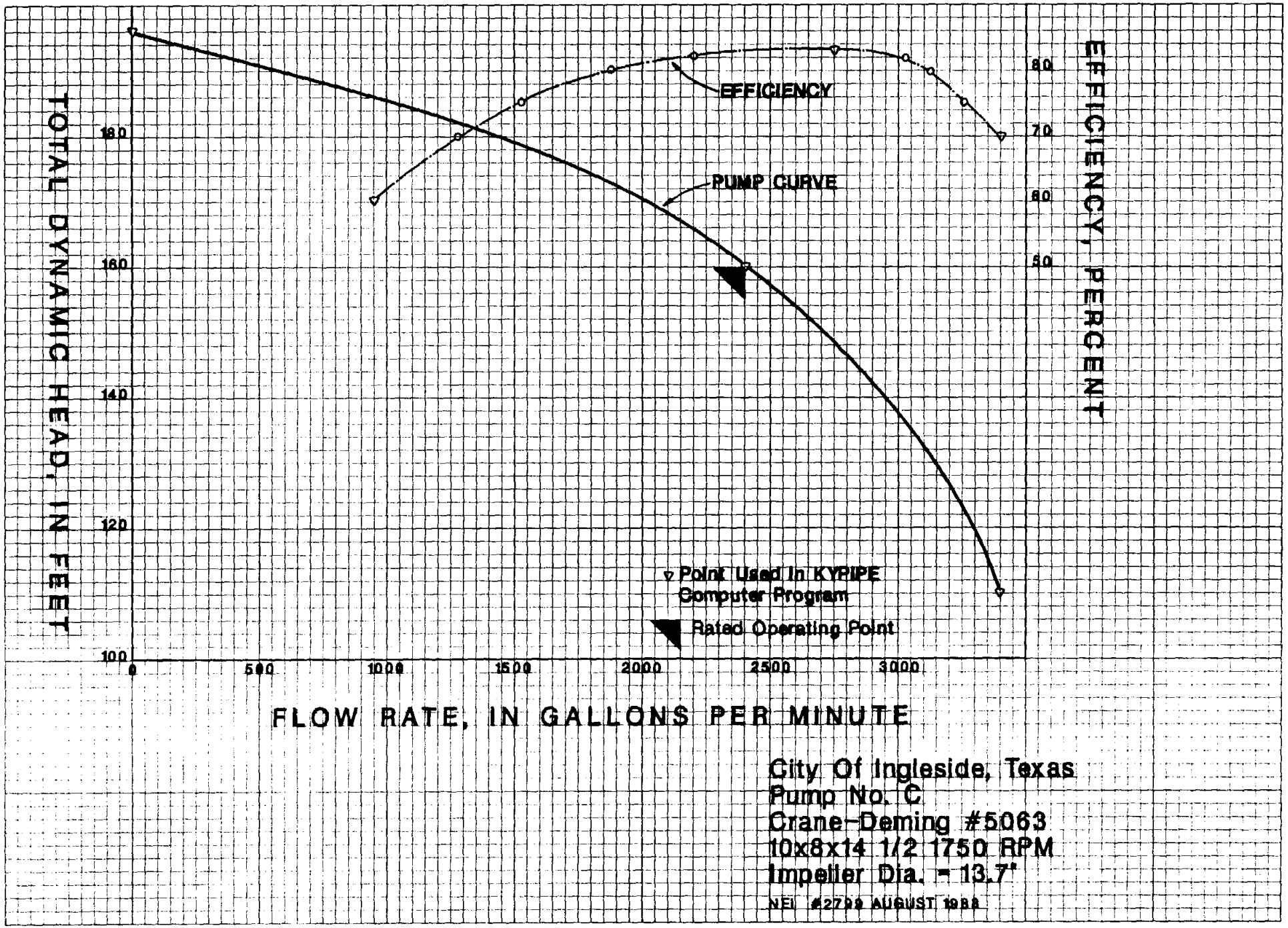
Pump C

Mfg: Crane-Deming Model: 5063
Size: 10 x 8 x 14-1/2 Ser. No.
2400 gpm @ 160 ft. Imp. Dia. = 13.7 1750 rpm


EFFICIENCY
PUMP CURVE
TOTAL DYNAMIC HEAD, IN FEET
EFFICIENCY, PERCENT
180
160
140
120
100
70
60
0
100
200
300
400
500
600
700
▽ Point Used In KYPIPE Computer Program
Rated Operating Point
FLOW RATE, IN GALLONS PER MINUTE
City Of Ingleside, Texas
Pump No. A
Crane-Deming #5062
4x3x14 1750 RPM
Impeller Dia. = 13.2"
NEI #2799 AUGUST 1988



City Of Ingleside, Texas
Pump No. B
Crane-Deming #5063
8x6x14 1/2 1750 RPM
Impeller Dia. = 13.4"
NEI #2799 AUGUST 1988



City Of Ingleside, Texas
Pump No. C
Crane-Deming #5063
10x8x14 1/2 1750 RPM
Impeller Dia. = 13.7"

NEI #2709 AUGUST 1988

REGIONAL WATER AND WASTEWATER MASTER PLAN FOR THE LIVE OAK RIDGE AREA OF SAN PATRICIO COUNTY, TEXAS

SAN PATRICIO MUNICIPAL WATER DISTRICT
AUGUST 1989

APPENDIX VI - SAMPLE COMPUTER PROGRAM OUTPUT

148	10.83	12	58.84
82	39.27	11	58.84
84	39.57	16	58.72
142	40.38	13	58.51

SWITCH OCCURS FOR PIPE # 191 NEXT SWITCH GRADE = 146

EPS SIMULATION - TIME = 1 HOURS
**** THE RESULTS FOR THIS SIMULATION FOLLOW ****

NO. OF TRIALS = 13 - ACCURACY ATTAINED = .0002

PIPE NO.	NODE #1	NODE #2	FLOW RATE	HEAD LOSS	MINOR LOSS	PUMP HEAD	LINE VELOCITY	HL 1000
1	149	1	835.83	0.59	0.09	0.00	2.37	2.96
2	1	102	646.89	0.04	0.11	0.00	2.64	3.75
3	102	103	176.93	0.42	0.04	0.00	1.13	1.01
4	103	142	145.79	0.91	0.03	0.00	0.93	0.70
5	142	84	133.04	3.27	0.07	0.00	1.51	2.41
6	84	82	84.10	1.01	0.03	0.00	0.95	1.03
7	82	86	63.25	1.00	0.01	0.00	0.72	0.61
8	86	83	35.35	0.27	0.00	0.00	0.40	0.21
9	83	60	19.45	0.31	0.00	0.00	0.22	0.07
10	60	59	-18.20	0.02	0.00	0.00	0.21	0.06
11	59	57	-22.73	0.03	0.00	0.00	0.26	0.09
12	57	58	16.20	0.13	0.00	0.00	0.18	0.05
13	57	56	-54.38	0.20	0.01	0.00	0.35	0.11
14	56	2	9.90	0.00	0.00	0.00	0.03	0.00
15	147	2	0.00	0.00	0.00	0.00	0.00	0.00
16	56	143	-75.16	0.02	0.00	0.00	0.21	0.03
17	143	55	6.63	0.01	0.00	0.00	0.08	0.01
18	143	53	-73.18	0.02	0.00	0.00	0.21	0.03
19	143	54	-17.79	0.03	0.00	0.00	0.20	0.06
20	53	54	-15.78	0.01	0.00	0.00	0.18	0.05
21	54	71	-40.65	0.25	0.01	0.00	0.46	0.27
22	53	51	-60.34	0.01	0.00	0.00	0.17	0.02
23	51	52	14.16	0.10	0.00	0.00	0.16	0.04
24	71	70	-14.55	0.01	0.00	0.00	0.17	0.04
25	70	69	9.12	0.00	0.00	0.00	0.10	0.02
26	69	67	3.18	0.00	0.00	0.00	0.04	0.00
27	67	68	-1.90	0.00	0.00	0.00	0.02	0.00
28	67	66	0.62	0.00	0.00	0.00	0.01	0.00
29	66	65	-1.12	0.00	0.00	0.00	0.01	0.00
30	65	69	-2.19	0.00	0.00	0.00	0.02	0.00
31	59	62	1.98	0.00	0.00	0.00	0.02	0.00
32	60	61	22.65	0.13	0.00	0.00	0.26	0.09
33	63	72	-1.50	0.00	0.00	0.00	0.02	0.00
34	63	64	0.15	0.00	0.00	0.00	0.00	0.00
35	64	72	-1.83	0.00	0.00	0.00	0.02	0.00
36	72	73	-8.02	0.00	0.00	0.00	0.09	0.01
37	70	73	-25.02	0.07	0.01	0.00	0.28	0.11
38	71	74	-32.38	0.33	0.01	0.00	0.37	0.18
39	144	77	-65.13	0.03	0.01	0.00	0.42	0.16
40	73	144	-34.84	0.25	0.01	0.00	0.40	0.20
41	68	69	-4.99	0.00	0.00	0.00	0.06	0.01
42	78	146	7.64	0.00	0.00	0.00	0.05	0.00
43	77	78	-54.64	0.08	0.01	0.00	0.35	0.11
44	78	79	-69.58	0.17	0.01	0.00	0.44	0.18
45	144	76	20.20	0.01	0.00	0.00	0.18	0.03
46	76	74	26.40	0.01	0.00	0.00	0.17	0.03

167	122	121	-90.08	0.28	0.02	0.00	0.57	0.29
168	122	123	13.42	0.00	0.00	0.00	0.09	0.01
169	124	132	6.57	0.02	0.00	0.00	0.07	0.01
170	126	131	33.84	0.01	0.00	0.00	0.10	0.01
171	127	130	6.69	0.02	0.00	0.00	0.08	0.01
172	131	132	10.59	0.01	0.00	0.00	0.12	0.02
173	132	133	11.61	0.02	0.00	0.00	0.13	0.03
174	131	134	20.59	0.00	0.00	0.00	0.06	0.00
175	134	135	18.83	0.09	0.00	0.00	0.21	0.06
176	135	129	11.39	0.01	0.00	0.00	0.07	0.01
177	135	141	-9.21	0.03	0.00	0.00	0.10	0.02
178	134	136	62.16	0.02	0.00	0.00	0.18	0.02
179	136	137	10.43	0.03	0.00	0.00	0.12	0.02
180	136	138	39.05	0.01	0.00	0.00	0.11	0.01
181	138	139	27.78	0.01	0.00	0.00	0.08	0.00
182	139	140	23.99	0.00	0.00	0.00	0.13	0.02
183	140	141	19.17	0.00	0.00	0.00	0.05	0.00
184	23	24	2.12	0.00	0.00	0.00	0.01	0.00
185	145	51	79.42	0.04	0.00	0.00	0.23	0.03
LINE NO. 186 IS SHUT OFF								
LINE NO. 187 IS SHUT OFF								
188	0	148	0.00	0.00	0.00	0.00	0.00	0.00
LINE NO. 189 IS SHUT OFF								
LINE NO. 190 IS SHUT OFF								
--- THE PUMP IN LINE 191 IS OUT OF RANGE ---								
191	150	149	835.83	1.07	2.21	107.09	5.33	21.30
192	0	150	835.83	2.13	2.21	0.00	5.33	21.30

JUNCTION NO.	ELEVATION (FT.)	DEMAND	PRESSURE (PSI)	HYDRAULIC GRADE
1	27.0	3.8	52.8	148.8
2	10.0	9.9	57.0	141.5
3	6.5	1.2	59.0	142.7
4	7.0	2.3	58.8	142.7
5	6.0	1.7	59.1	142.5
6	6.0	2.0	59.2	142.6
7	7.0	3.8	58.8	142.6
8	10.0	4.5	57.5	142.6
9	5.0	5.5	59.6	142.6
10	6.0	13.7	59.2	142.5
11	5.0	7.5	59.6	142.5
12	5.0	7.1	59.6	142.5
13	5.0	7.0	59.6	142.5
14	10.0	12.1	57.3	142.3
15	10.0	4.9	57.3	142.3
16	4.5	3.1	59.8	142.5
17	6.0	5.7	59.1	142.5
18	6.5	6.1	58.9	142.5
19	7.0	2.1	58.7	142.5
20	10.0	23.3	57.3	142.2
21	5.0	1.2	59.4	142.1
22	9.0	1.5	57.7	142.1
23	10.5	3.9	57.0	142.1
24	6.0	4.1	59.0	142.1
25	10.0	5.1	57.3	142.1
26	15.0	1.8	55.1	142.1
27	11.0	3.8	56.3	142.1
28	14.0	3.9	55.5	142.1
29	10.0	1.9	57.3	142.1
30	13.0	13.3	56.0	142.2

THE NET SYSTEM DEMAND = 1047.54
SUMMARY OF INFLOWS(+) AND OUTFLOWS(-)

PIPE NO.	FLOW
121	211.71
188	0.00
192	835.83

SUMMARY OF PUMP OPERATION

PIPE NO.	PUMP TYPE	PUMP FLOW	PUMP HEAD	USEFUL POWER	EFFIC-IENCY	TOTAL KWH
PUMP IN LINE NO. 186	IS OFF					
PUMP IN LINE NO. 187	IS OFF					
PUMP IN LINE NO. 189	IS OFF					
PUMP IN LINE NO. 190	IS OFF					
191	2	835.83	107.09	22.62	0.62	0.00

THE TOTAL POWER USED TO THIS TIME = 0 KWH

SUMMARY OF MINIMUM AND MAXIMUM VELOCITIES

MINIMUMS		MAXIMUMS	
34	0.00	192	5.33
150	0.01	2	2.64
28	0.01	1	2.37
87	0.01	110	1.94
155	0.01	112	1.73

SUMMARY OF MINIMUM AND MAXIMUM HL/1000

MINIMUMS		MAXIMUMS	
34	0.00	192	21.30
150	0.00	2	3.75
87	0.00	112	3.09
28	0.00	1	2.96
155	0.00	115	2.85

SUMMARY OF MINIMUM AND MAXIMUM PRESSURES

MINIMUMS		MAXIMUMS	
150	8.09	31	60.44
146	10.83	140	60.35
82	48.91	139	59.92
84	49.58	141	59.92
83	50.52	16	59.80

--- TANK STATUS REPORT ---

PIPE NO.	PIPE Q	EXT. Q	ELEVATION	PROJ. EL.
192	-835.8	0.0	50.0	49.0
188	0.0	0.0	35.0	35.0
121	-211.7	0.0	142.8	142.4

THE FOLLOWING CHANGES ARE MADE

JUNCT. NO.	DEMAND
14	500

EPS SIMULATION - TIME = 1.5 HOURS