WATER DISTRIBUTION STUDY

March 2023

City of Friona, Texas

3/16/23

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F-4174

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SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

An adequate and reliable water system is essential for the operation, growth and well-being of a city. Sufficient water source quantity and a flexible delivery system are necessary to meet this requirement. The City of Friona desires its water production capabilities and delivery system be evaluated to identify deficiencies and future needs. Recommendations to correct the deficiencies and meet future needs are requested.

Scope

- Collect available reports, drawings, maps, operating reports, population data and other information to perform the study and evaluation.
- Assess the City's water demand. Review historic consumption data and population data. Determine peak day demand and average day demand. Project future peak day demands.
- Assess the City's water supply. Determine current production rate and project future production rate of each well. Make recommendations concerning improvement to existing wells and acquisition of water rights.
- Future water supply assessment. Compare projected peak day demands with future production of existing wells. Determine additional production capacity required to meet future demands. Make recommendations on acquisition of water production capacity.
- Assess the capabilities of the existing transmission system delivering water from the well field to the City. Make recommendations on improvements.
- Assess the distribution system. Evaluate distribution system including major water mains, ground storage, elevated storage and pump stations. Make recommendations to improve deficiencies in available volume and pressure. Make recommendations on improvements to accommodate future growth of the City.
- Prepare a written report containing results of the study. Prepare a prioritized list of recommended improvements.

SECTION 2.0

POPULATION

2.0 POPULATION

Population and changes in population tend to have the greatest effect on a city's water consumption. Projection of a city's future population is a basis for projecting the future water demand for a city. City of Friona population since 1980 has been consistently stable with the City increases and decreases in population in each 10-year census. Table 2.1 shows the population of the City since 1980. Average annual population increase between 1980 and 2020 was approximately .17% per year.

Table 2.1 Historic Populations

Census Year	Census Population	Average Growth Rate per Year from Previous Census	Percentage Change from Previous Census
1980	3,809	698	22.4%
1990	3,688	-121	-3.2%
2000	3,854	166	4.5%
2010	4,123	268	7.0%
2020	4,174	51	1.2%

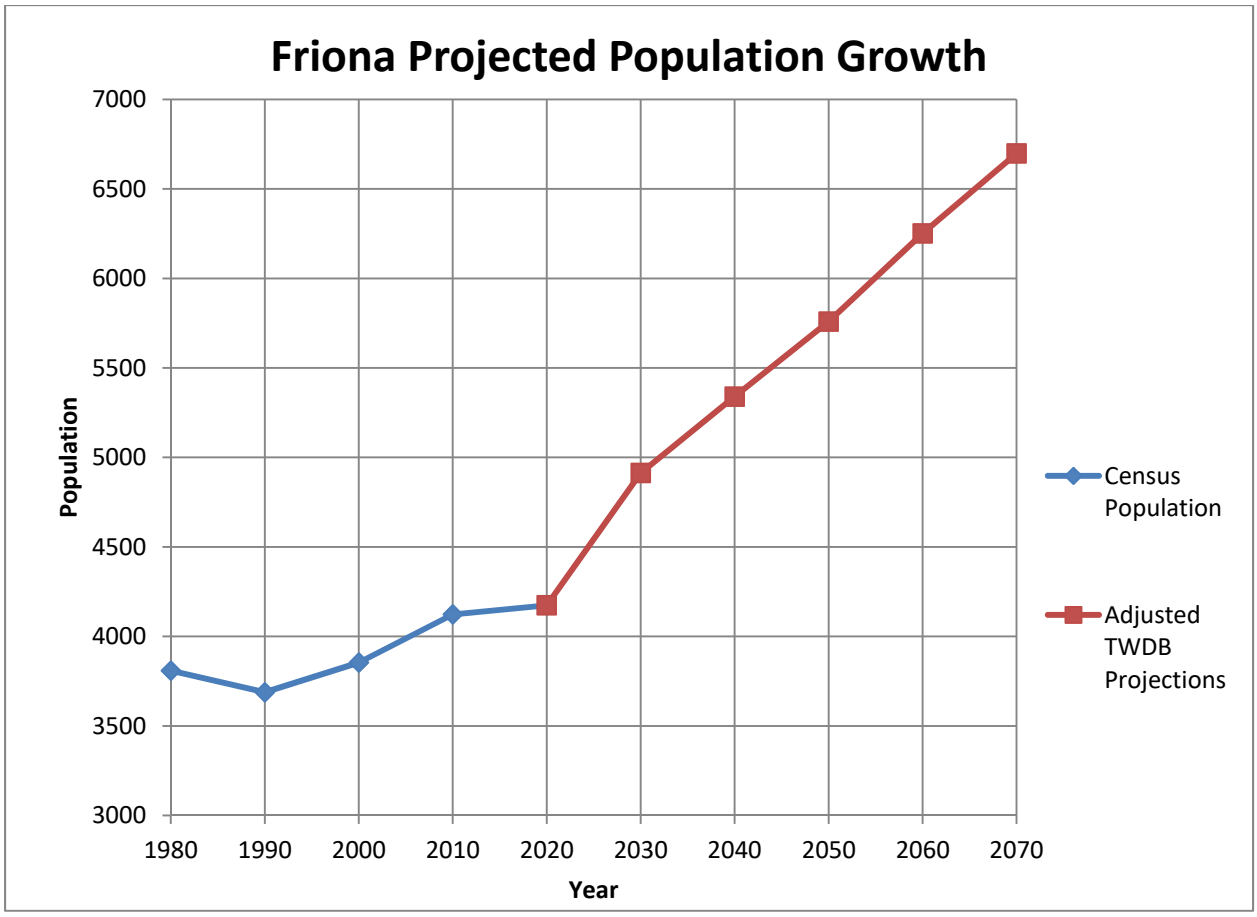
The Texas Water Development Board (TWDB) has prepared population projections for cities in the State of Texas. These projections are utilized by the Regional Water Planning Groups in the preparation of the regional water plans. Table 2.2 shows the TWDB projected population growth, for the City, from 2030 through 2070. The average annual population increase from 2030 to 2070 is approximately 0.53% per year.

Table 2.2 TWDB Projected Populations

Year	Projected Population	Average Growth Rate per Year From Previous Decade	Percent Change From Previous Decade
2030	4,913	73.9	15.0%
2040	5,340	42.7	8.0%
2050	5,759	41.9	7.3%
2060	6,251	49.2	7.8%
2070	6,698	44.7	6.7%

Figure 2.1 is a graphical representation of the historical projected populations for the City.

Figure 2.1



Population Distribution

The population distribution throughout the City will directly affect the water demands used in the water distribution model. Areas with greater population densities will have greater demands.

The 2020 Census data will be used as the basis for population distribution. The U.S. Census Bureau breaks down census data by city blocks. A census block is usually defined by the streets that encircle the block's perimeter. A copy of the 2020 Census Block Map for the City is enclosed in Attachment 1. For the purpose of this study the 2020 population of the

existing census blocks will be assumed to remain the same for each successive 10-year time period. Growth in population will occur in undeveloped areas on the edge of the City.

In order to assess the effect of population growth on the City's water distribution system the projected population growth must be distributed in some manner. Discussion with City personnel indicate that growth and development are occurring on the edge of the City in the northwest portion of the City and growth is anticipated to continue in these areas in the future. For purposes of population distribution, the populations of the developed portions of the City as of 2020 are assumed to remain the same and the increase in population occurring in the growth areas.

Projected population growth areas are shown in Figures 2-1 through 2-3 for census years 2030, 2040 and 2050 respectively. Census blocks where population growth is anticipated are highlighted showing the previous and future populations of each area.

SECTION 3.0

WATER CONSUMPTION

3.0 WATER CONSUMPTION

Water consumption in a community is affected by a variety of conditions and combinations of conditions. Examples of conditions are the season of the year, recent and current weather conditions and day of the week. During a 24-hour period, water consumption can be affected by the day of the week, time of day, current weather conditions and unique events such as firefighting. A water distribution system must be constructed and maintained with sufficient infrastructure to meet all water consumption demands. To assess the capabilities of the distribution system, three consumption scenarios are used:

- Peak Day Consumption
- Peak Hour Consumption
- Peak Hour Consumption with Additional Fire Fighting Demand

Peak Day Consumption is the projected maximum volume of water used in the City in a 24-hour period. A city should have adequate supply and production capabilities to meet the peak day consumption demand without depleting water stored in water distribution ground storage tanks and elevated storage tanks.

Peak Hour Consumption is the projected maximum volume of water used by the City in a one hour period. A city should have adequate ground storage, elevated storage and pumping capacity to meet the peak hour demand and maintain a minimum 35 psi pressure throughout the distribution system.

Peak Hour Consumption with Additional Fire Fighting Demand is the total projected maximum volume of water used in a one hour period and the volume of water used for firefighting purposes during that same hour. The fire flow demand is assumed to be constant. A city should have adequate ground storage, elevated storage and pumping capacity to meet the total demand and maintain a minimum pressure of 20 psi at the location of the fire demand.

Projected annual consumption is used as the basis for calculating average day consumption volume. The TWDB has projected City of Friona annual water consumption volumes for 2020 through 2070. The rates are given in acre feet.

Projected peak daily consumption is derived by multiplying the projected daily average consumption volume by the historically highest peak day factor. The peak day factor for each year is derived from the TCEQ Water Watch database by dividing the largest one day consumption in a year by the average daily consumption. For this study, consumption data from the TCEQ Water Watch was used to derive a peaking factor of 1.35.

The projected peak hour volume is calculated by multiplying the projected peak day volume by a peak hour factor. The TCEQ states that in the absence of historical data, peak hourly demand means 1.25 times the maximum daily demand. There is no data to indicate this ratio should be altered; therefore, the peak hour factor of 1.25 was used for this study.

Results of projected water consumption calculations are shown in Table 3.1.

Table 3.1 Projected Water Consumption

Year	Projected Population	Projected Annual Consumption (Million Gallons)	Projected Average Daily Consumption MGD (GPM)	Projected Peak Day Consumption MGD (GPM)	Projected Peak Hour Consumption MGD (GPM)
2030	4,913	281.5	0.77 (540)	1.04 (725)	1.30 (900)
2040	5,340	300.4	0.82 (570)	1.10 (770)	1.38 (955)
2050	5,759	320.9	0.88 (610)	1.19 (825)	1.49 (1,030)
2060	6,251	347.7	0.95 (660)	1.28 (890)	1.60 (1,110)
2070	6,698	372.4	1.02 (710)	1.38 (955)	1.73 (1,200)

Peak Hour Consumption with Additional Fire Fighting Demand assumes a fire event occurs during the peak hour of consumption. A city should have adequate storage and pumping capacities to meet the demand and maintain a minimum 20 psi pressure at the location of

the fire demand. Fire demand was evaluated at several locations. The fire demand used for each site was 1,500 gallons per minute.

SECTION 4.0

WATER SUPPLY

4.0 WATER SUPPLY

The City of Friona source of water is the Ogallala Aquifer. The Ogallala Aquifer lies under much of the Texas Panhandle Region.

The City owns and operates 3 well fields that produce water from the Ogallala Aquifer and convey the water to 3 separate pump stations: The North Well Field, The South Well Field and The West Well Field. Water production from these well fields is regulated by the High Plains Groundwater Conservation District.

Currently, all three well fields produce water to the City's distribution system. A majority of the water is produced by the North Well Field and is conveyed to the North Plant pump station. A 12-inch diameter transmission pipeline conveys the water production from North Well Field to the City.

The wells in the South Well Field are in service and pump directly to the South Plant pump station prior to distribution.

There are two wells in the West Well Field and are currently in service. The wells pump to the West Plant pump station prior to distribution.

The well fields and transmission pipelines are shown on Figure 2.1. Table 4.1 shows the estimated pumping rates of each of the wells.

Table 4.1 Estimated Well Pumping Rates

North Well Field								
Well No.	12	14	15	17	18	21	22	Total
Pumping Rate (GPM)	200	220	-	180	180	250	250	1280

South Well Field						
Well No.	5	6	9	10	19	Total
Pumping Rate (GPM)	150	170	240	175	35	770

West Well Field			
Well No.	20	23	Total
Pumping Rate (GPM)	60	70	130

The North Well Field and the 12-inch diameter transmission pipeline were constructed in the 1970s. The North Well Field consists of seven wells, a collection system, a chlorination facility and a one million gallon ground storage tank.

The South Well Field and transmission line were constructed in as early as the 1950s. The South Well Field consists of five wells, a collection system, a chlorination facility and a 500 thousand gallon ground storage tank.

The West Well Field and transmission line were constructed in the 2000s. The West Well Field consists of two wells, a collection system, a chlorination facility and a 150 thousand gallon ground storage tank.

The Ogallala Aquifer is a major source of water for the entire Texas Panhandle Region. Agricultural, municipal and industrial entities pump water from the Ogallala. The amount of water withdrawn from the Ogallala is much greater than recharge; therefore, the aquifer is being depleted. Depletion is evident by the reduction in saturated thickness of the aquifer. As the saturated thickness diminishes around a well, the production capacity from the well will decrease. The decrease in well production is cumulative in the well field as each well is affected by the aquifer depletion.

The need to manage the depletion of the ground water has been recognized by the State of Texas through the TWDB and by the High Plains Groundwater Conservation District. The State has been divided into groundwater management areas to locally establish goals for preservation of the ground water. Most of the South Plains Region, including Parmer

County, is in Groundwater Management Area 2 (GMA2). GMA2 has established the following goals for groundwater preservation:

- Ogallala Aquifer: a GMA 2-wide average drawdown of 28 feet between 2013 and 2080

Table 4.2 shows the modeled available groundwater in the Ogallala aquifer in Parmer County.

Table 4.2 Projected Available Water in Parmer County

Year	2020	2030	2040	2050	2060	2070
Available water (Acre-feet per year)	144,423	92,025	63,568	46,835	37,743	32,290

As noted in Section 3.0, water demand is projected to increase with an increase in population. In its current state the City's production capacity is more than the peak demand which occurred in 2014. This will continue to be the case until 2040. Beyond 2040, if water consumption continues to trend upward, the groundwater availability goals will not be met. The projected average demand in acre-feet per year shown in Table 4.3 Water Demand by Friona.

Table 4.3 Water Demand by Friona

Year	2020	2030	2040	2050	2060	2070
Average Water Demand (Acre-feet per year)	36,643	48,338	51,584	55,104	59,706	63,947

TCEQ Regulations Compliance

The Texas Commission on Environmental Quality regulation 290.45(a) (2) requires additional supply if the system's maximum daily demand exceeds its total production and treatment capacity. The total current production of all operable City wells is estimated to be 2,180

gpm. Table 4.4 compares the Projected Well Production with Projected Peak Day Demand based on historical data.

Table 4.4 Water Production Requirements

Year	Projected Average Daily Consumption MGD (GPM)	Projected Peak Day Consumption MGD (GPM)	Projected Day Well Production MGD (GPM)
2030	0.77 (540)	1.04 (725)	2.68 (1,860)
2040	0.82 (570)	1.10 (770)	2.37 (1,648)
2050	0.88 (610)	1.19 (825)	2.09 (1,455)
2060	0.95 (660)	1.28 (890)	1.82 (1,261)
2070	1.02 (710)	1.38 (955)	1.56 (1,082)

Table 4.4 makes the assumption that no additional wells are developed and production decreases linearly. The well drawdown was assumed to be 1.2 feet per year based on historical drawdown data from the TWDB (see attachment Figure 4-1).

Figure 4-1 below shows the relationship between the projected existing well production, the projected peak day demands, and average day demand. The projected peak day demand exceeds the existing production capacity.

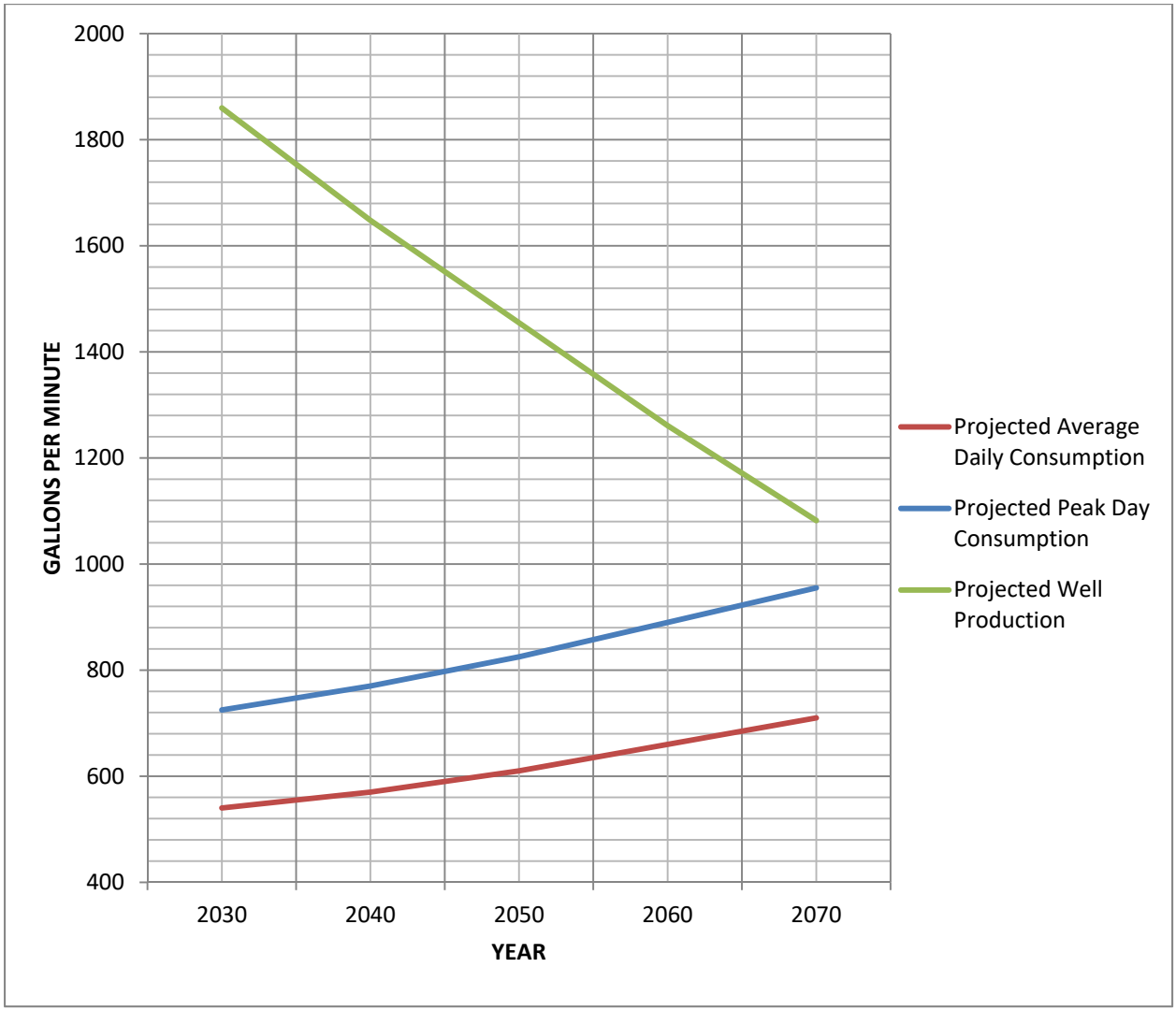


Figure 4.1 Projected Demands vs. Well Production

SECTION 5.0

EXISTING FACILITIES

5.0 EXISTING FACILITIES

The City of Friona Water Distribution System consists of the following:

- Distribution piping from 2-inch to 12-inch nominal diameter
- One elevated storage tank with a capacity of 200,000 gallons located at Pierce Ave and 15th Street
- North Plant Pump Station, located on County Road 19 north of Friona, Texas
    - 1,000,000 gallon ground storage tank
    - 2 – 1,000 gpm pumps
- South Plant Pump Station, located at Grand Avenue and 6th Street
    - 1 – 500,000 gallon ground storage tanks
    - 2 – 1,000 gpm pumps
- West Plant Pump Station, located on Crockett Avenue west of Friona, Texas
    - 1 – 150,000 gallon tanks
    - 1 – 800 gpm

See Figure 5-1 in the attachments for an elevation schematic of the storage tanks.

Data on storage tanks and pumps is from TCEQ records.

NORTH PLANT PUMP STATION

The North Plant Pump Station serves to collect water from the North Well Field (Wells #12, #14, #15, #17, #18, #21, and #22) at the ground storage tank and delivers water to the distribution system. The booster pumps, building and the piping are currently in service and in fair condition. The facility has an on-site generator with an automatic transfer switch.

The tank at the North Plant Station appear to be structurally sound and in good condition. The tank will need to be recoated and upgraded to current TCEQ standards in approximately 10-15 years.

A 12-inch transmission line conveys the water supply from the North Plant Pump Station to the distribution system at Sixteenth Street and State Highway 214.

SOUTH PLANT PUMP STATION

The South Plant Pump Station serves to collect water from the South Well Field (Wells #5, #6, #9, #10, and #19) at the ground storage tank and delivers water to the distribution system. The booster pumps, building and the piping are currently in service and in fair condition. The pump station pumps directly into the distribution system. The facility has an on-site generator with an automatic transfer switch.

The tank at the South Plant Station appear to be structurally sound and in fair condition. The tank is in need of maintenance to recoat the interior and exterior surfaces, and upgraded to current TCEQ standards.

WEST PLANT PUMP STATION

The West Plant Pump Station serves to collect water from the West Well Field (Wells #20, and #23) at the ground storage tank and delivers water to the distribution system. The booster pumps, building and the piping are currently in service and in good condition. The pump station pumps directly into the distribution system. The facility has an on-site generator with an automatic transfer switch.

The tank at the West Plant Station appear to be structurally sound and in good condition. The tank will need regularly scheduled maintenance to comply with TCEQ standards.

WATER STORAGE TANKS

The Texas Commission on Environmental Quality regulation 290.45(b)(1)(D) establishes minimum requirements for community water systems that serve over 250 connections. City of Friona records show the City has 1,553 connections as of 2023. Tables 5.1 and 5.2 show

the City's future compliance with this regulation. Compliance assumes the regulation will remain the same in the future.

Table 5.1 Total Storage Requirement §290.45(b)(1)(D)(ii)

Year	2030	2040	2050	2060	2070
Projected Population	4,913	5,340	5,759	6,251	6,698
Estimated Water Connections	1,638	1,780	1,920	2,084	2,233
Total Storage Required (200 Gals/Connection)	328,000	356,000	384,000	417,000	447,000
Current Total Storage In Service (Gallons)	1,650,000	1,650,000	1,650,000	1,650,000	1,650,000

Table 5.2 Total Elevated Storage Requirement §290.45(b)(1)(D)(iv)

Year	2030	2040	2050	2060	2070
Projected Population	4,913	5,340	5,759	6,251	6,698
Estimated Connections	1,638	1,780	1,920	2,084	2,233
Total Storage Required (100 Gallons/Connection)	164,000	178,000	192,000	209,000	224,000
Current Total Storage In Service (Gallons)	200,000	200,000	200,000	200,000	200,000
Elevated Capacity per Connection	122	112	104	96	90

SERVICE PUMPS

Table 5.3 shows the TCEQ pumping requirements for the City's distribution system if the elevated storage is less than 200 gallons per connection. If no additional elevated storage is added as the population increases, the City must meet the TCEQ pumping requirements.

This requirement can be met until the number of service connections reaches up to 2,000 (estimated population of 5,700). When the number of connections exceed 2,000, either service pumps or additional elevated storage is required. Pumps are also required if the system cannot maintain the minimum TCEQ requirement of 35 psi during peak demand conditions.

Table 5.3 Total Service Pumping Requirement §290.45(b)(1)(D)(iii)

Year	2030	2040	2050	2060	2070
Projected Population	4,913	5,340	5,759	6,251	6,698
Estimated Connections	1,638	1,780	1,920	2,084	2,233
Total Pumping Capacity Required (2 GPM/Connection)*	3,275	3,560	3,839	4,167	4,465

* Pumping capacity required if elevated storage is less than 200 gallons per connections

SECTION 6.0

ANALYSIS DESCRIPTION

6.0 ANALYSIS DESCRIPTION

Distribution Analysis

The City of Friona Water Distribution System was analyzed using computer model software, EPANET 2.2 by the United States Environmental Protection Agency. The model is a skeletonized version of the City Water Distribution System including ground storage tanks, elevated storage tank and distribution mains 2-inches in diameter and larger. Water mains less than 6-inches in diameter were included in the model to eliminate a dead end by completing a loop line. The majority of the distribution system is 6-inch in diameter. There is an 8-inch and 10-inch arterial line loop line that is connected to the elevated storage tank and the North Plant and South Plant booster pump stations. The computer model was used to analyze the distribution system under different demand conditions and to test the effectiveness of proposed water infrastructure.

Operation of the City's three pump stations has not been necessary to maintain adequate pressure within the distribution system. The bottom elevation of the elevated tank controls the operation of the water system.

In the computer model, the water mains are drawn to scale and identify the length of pipe between intersections with other mains. Each pipe segment is assigned a unique attributes including pipe diameter, length, and estimated roughness factor based on available distribution system information. Flow rate and pressure loss across each pipe segment are calculated by the computer model program based on specified operating conditions and are part of the program output.

At both ends of each pipe segment is a node. The node can be the connection point for two or more pipes or can define the termination of a dead end pipe. Each node is assigned a unique coded designation and is assigned attributes including elevation, and coordinate location based on available system information. Demand flows are assigned to the nodes

based on projected population distribution and projected water consumption conditions. Water pressure at each node is calculated by the computer model program based on specified operating conditions and displayed in the program output.

Consumption Allocation

As noted in Section 2.0 Population, the census blocks generally coincide with City Blocks (census block maps are enclosed in Attachment 1). By combining the Census Block Map with the water distribution map, the population distribution of each Census Block can be assigned to a node in close proximity to the Census Block. Census Blocks, served by mains smaller than 6-inch, are combined at their nearest model node. Population of Census Blocks served by more than one main or pipe node were divided among the affected nodes based on housing unit distribution as shown in aerial photographs. Future population growth as identified and allocated in Section 2.0 is assigned to the nearest possible node. The distribution of demand for peak day and peak hour flow rates in the model for 2030, 2040, 2050, 2060 and 2070 projections are included in Figures 2-1, 2-2, and 2-3. The peak day demand distribution for each node is calculated by multiplying the ratio of node population to total population by the total peak day demand divided by 1,440 minutes per day yielding a value in gallons per minute. The peak hour demand distribution for each node is calculated by multiplying the peak day demand by a factor of 1.35. Not every node will have a demand flow rate because there may be no population in the area around the node.

Demand Scenarios

Multiple demand scenarios were tested by the computer model to predict the demand effects on the distribution system. Scenarios were tested in steady state analysis. Steady state analysis yields a single moment view of the system. Key output parameters from the model software include the flow rate in each pipe, pressure at each node and water levels in

all tanks. Output from the model was used to identify existing and anticipated low pressure areas within the distribution system.

The following water demand scenarios were evaluated for 2030, 2040, 2050, 2060 and 2070:

- Peak Hour Demand and
- Peak Hour Demand with Fire Flows

Each scenario assumes automated operations at the stated control settings. It is noted that the water system operators can override system control settings to meet unique demand situations and best serve the water customers.

Cargill Plant Demand Evaluation

The estimated demand by Cargill Plant is set to be 2 million gallons per week. This converts into 198.41 gallons per minute (gpm). This number was rounded up to 200 gpm for conservative estimates. Google Earth was used to measure the distance and change in elevation between the city's distribution system and Cargill. The distance from the City's distribution system to Cargill was measured to be approximately 17,500 feet and the change in elevation was approximately 93 feet. As the ground elevation at Cargill is significantly higher than that of the City it was determined that the City's water distribution system will not be able to deliver water to Cargill at the minimum 35 psi
pressure required for water distribution.

This Cargill demand of 200 gpm was modeled during the peak flow conditions to evaluate the worst case scenarios. Based on the model, it was determined that the city's distribution system will be able to convey 200 gpm approximately 5,000 feet (26.6 feet in elevation difference) towards the Cargill plant before the pressure drops below the required 35 psi. A pressure boosting pump would be necessary to provide the water to the Cargill plant at the minimum pressure of 35 psi.

Should the City opt to serve Cargill with a demand of 200 gpm, the distribution system and water supply system can support it. The demand projections show that the existing system could support Cargill until 2040. Beyond the 2040 projections, the City will need to expand the well field to meet the projected water demands. This is to be considered prior to entering into a long term agreement for water service as it may trigger the need for large capital improvement projects. See Figure 6-2 in the attachments for the proposed project layout.

SECTION 7.0

SYSTEM VULNERABILITIES

7.0 SYSTEM VULNERABILITES

Review of the City's distribution infrastructure reveals vulnerabilities in the system. Specifically, there are pipeline segments and storage tanks in the system having no back-up or redundancy such that if the vulnerable pipe segment or tank is removed from service due to a leak, equipment failure, or maintenance, the City will not be able to maintain its normal level of service. The following are identified as vulnerable components of the distribution system:

7.1 12-inch discharge pipeline from the North Plant Pump Station to distribution system.

Failure of this pipeline would result in the shutdown of the North Plant Pump Station and 1.0 MG Ground Storage Tank because there is no alternate discharge pipe from the pump station. This would result in the loss of water supply from North Plant Wellfields.

7.2 Elevated Storage Tank

Removal of tank from service for maintenance or in an emergency would result in the loss of system pressure for the entirety of the City of Friona. Without the storage tank to provide system pressure, the City of Friona will rely on the booster pumps to provide water. The booster pumps are not currently equipped with variable frequency drives, allowing for low pump rates to provide directly pressure to the system.

7.3 6-inch distribution lines crossing Highway 60.

The existing distribution lines that cross Highway 60 interconnect the distribution system. The distribution system loop line provides capacity and pressure throughout the entire city with the use of interconnecting pipelines. The failure of one of the distribution lines crossing Highway 60 will result in reduced

pressures and capacities in the immediate surrounding area. The replacement of utilities within the TxDOT Right-of-Way can result in lengthy construction timelines. The surrounding areas to a pipe failure will result in low pressure, possibly below the TCEQ minimum of 35 psi.

7.4 2-inch distribution lines in the north east quadrant of Friona.

The north east quadrant of Friona between Pierce Avenue through Maple Avenue and between Twelfth Street through Fourteenth Street is served by various 2-inch distribution mains. The 2-inch water lines serve more than the TCEQ allowable 10 connections. If fire flow is necessary within this region, the connections served by the 2-inch water lines drop in pressure, possibly below the TCEQ minimum of 35 psi.

Other items to take into consideration as the population increases are shown below:

- The capacity of the wastewater treatment plant
- The capacity of sewer collection mains
- Utility rate study to ensure sustainability of utility growth
- Increase in emergency services
- Increase in public education facilities
- Potential industrial users are to be evaluated prior to providing utility services

SECTION 8.0

CONCLUSIONS AND RECOMMENDATIONS

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on modeling results, the distribution system is capable of meeting the various demand conditions described in this study. This conclusion assumes supply sources are available at the volumes required and the operational and physical conditions of existing facilities remain in their current or better state.

The adequacy of the system to meet minimum pressure requirements during fire demands has reached its limits north east portion of the system. Specifically, any of the homes that are served with 2-inch water lines. The City has begun to address these potential pressure problems with the ongoing planning and construction of the 10-inch loop line. Continued growth of the City, especially on the west and north edges of the City, will necessitate the construction of additional distribution pipelines and elevated storage to meet the projected demands.

Infrastructure redundancy in the system is important in order to avoid interrupted service or temporarily limited capacity of service. Some of the recommended improvements address redundancy issues.

As the population continues to grow and groundwater levels are depleted, it will become necessary to develop more wells. The groundwater levels of the surrounding area were evaluated for a recommendation of water right acquisition.

The following recommendations are intended to maintain the integrity of the system and address potential future problems:

1. Continue replacing under sized and deteriorated water mains as needed with properly sized mains.
2. Plan and construct the recommended water improvement projects.

Recommended Improvements

The locations of recommended improvements are shown on Figures 8-1 through 8-6.

Project 1 – Upsizing of 2-inch Distribution Lines

In order to provide adequate water supply and pressure to all service connections, the water system is to have adequate sized distribution lines. Several of the existing 2-inch distribution lines exceed the TCEQ maximum allowable connections. This causes low water availability and pressures, specifically during fire flow demands. It is recommended that the existing 2-inch mains be replaced with 6-inch water mains.

Project 1 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 45,000.00	$ 45,000.00
2	PVC Water Main	5,180	LF	$ 160.00	$ 828,800.00
3	Erosion Controls	1	LS	$ 10,000.00	$ 10,000.00
4	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 893,800.00
				Contingencies	$ 89,380.00
				Survey/Gather Data	$ 19,670.00
				Basic Engineering	$ 88,490.00
				Construction Testing	$ 4,920.00
				TOTAL	**$ 1,096,260.00**

Project 2 – 12-inch Redundant Transmission Line from North Plant to Distribution System

It is recommended that a redundant pipeline be constructed between the North Plant to the city distribution system. A large portion of the water supply comes from the North Plant. There is a single 12-inch transmission line from the North plant to the distribution system. If the 12-inch transmission line were to be in need of service, the water supply would be greatly affected. It is recommended that a redundant 12-inch transmission line be constructed to bolster the resiliency of the system.

Project 2 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 123,000.00	$ 123,000.00
2	12-inch PVC Transmission Line	11,500	LF	$ 200.00	$ 2,300,000.00
3	Erosion Controls	1	LS	$ 20,000.00	$ 20,000.00
4	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 2,453,000.00
				Contingencies	$ 245,300.00
				Survey/Gather Data	$ 53,970.00
				Basic Engineering	$ 242,850.00
				Construction Testing	$ 13,500.00
				TOTAL	**$ 3,008,620.00**

Project 3 – Replacement of Distribution Lines across Highway 60

It is recommended that the existing distribution lines that cross Highway 60 be replaced and encased. It is also recommended that more connections be made across the highway to achieve more even distribution of capacity and pressure. The replacement of the water mains will avoid future maintenance issues underneath Highway 60.

Project 3 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 38,000.00	$ 38,000.00
2	PVC Water Mains	1,440	LF	$ 160.00	$ 230,400.00
3	Steel Casing	990	LF	$ 350.00	$ 346,500.00
4	Pavement Repair	1,080	SF	$ 100.00	$ 108,000.00
5	Erosion Controls	1	LS	$ 10,000.00	$ 20,000.00
6	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 752,900.00
				Contingencies	$ 75,290.00
				Survey/Gather Data	$ 16,570.00
				Basic Engineering	$ 74,540.00
				Construction Testing	$ 4,150.00
				TOTAL	**$ 923,450.00**

Project 4 – Construction of a New Elevated Tank

It is recommended that a new elevated tank be constructed as the population continues to increase. As additional service connections are added to the system, the TCEQ will require the construction of elevated storage. The existing abandoned elevated tank is to be demolished and the new tank to be constructed in its place.

Project 4 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 76,000.00	$ 76,000.00
2	250K Gallon Elevated Tank	1	LS	$1,000,000.00	$ 1,000,000.00
3	Demolition of Existing Tank	1	LS	$ 300,000.00	$ 300,000.00
4	Yard Piping	1	LS	$ 100,000.00	$ 100,000.00
5	Erosion Controls	1	LS	$ 10,000.00	$ 20,000.00
6	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 1,506,000.00
				Contingencies	$ 150,600.00
				Survey/Gather Data	$ 33,140.00
				Basic Engineering	$ 149,100.00
				Construction Testing	$ 8,290.00
				TOTAL	**$ 1,847,130.00**

Project 5 – Variable Frequency Drives for Pump Stations

It is recommended that variable frequency drives be installed on the booster pump station pumps. The use of variable frequency drives extends the life of the pump and allows for pressure service to be provided to the distribution system without the use of an elevated tank.

Project 5 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 13,000.00	$ 13,000.00
2	North Plant Drives	1	LS	$ 100,000.00	$ 100,000.00
3	South Plant Drives	1	LS	$ 100,000.00	$ 100,000.00
4	Erosion Controls	1	LS	$ 10,000.00	$ 20,000.00
5	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 243,000.00
				Contingencies	$ 24,300.00
				Survey/Gather Data	$ 5,350.00
				Basic Engineering	$ 24,060.00
				Construction Testing	$ 1,340.00
				TOTAL	**$ 298,050.00**

Project 6 – Acquisition of Water Rights and Construction of Additional Municipal Water Wells

It is recommended that additional water rights be acquired for the development of additional wells. As the population grows individual wells can be drilled. It is a proposed that several wells transmission lines be constructed to meet future demand needs. The construction of the transmission lines will allow for more wells to be drilled even further into the future. The recommendation is for several transmission lines and wells. The transmission lines can be constructed individually as needed.

Project 6 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 251,000.00	$ 251,000.00
2	Transmission Line	20,535	LF	$ 180.00	$ 3,696,300.00
3	Water Well	3	EA	$ 350,000.00	$ 1,050,000.00
4	Erosion Controls	1	LS	$ 10,000.00	$ 20,000.00
5	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 5,027,300.00
				Contingencies	$ 502,730.00
				Water Rights Acquisition	$ 7,044,000.00
				Survey/Gather Data	$ 110,610.00
				Basic Engineering	$ 497,710.00
				Construction Testing	$ 27,660.00
				TOTAL	**$ 13,210,010.00**

Project 7 – Extension of Water Service to Cargill

The extension of water service to Cargill will require the construction of a new distribution main to the plant. The difference in elevation will require a booster pump to boost pressure above the TCEQ required minimum of 35 psi. The distribution line will cross the railroad Right-of-Way. Cargill is responsible for their own storage and pumping facilities.

Project 7 – Opinion of Probable Cost

	Item Description	Est. Quantity	Unit	Unit Price	Ext. Amount
1	Mobilization/demobilization	1	LS	$ 207,000.00	$ 207,000.00
2	Distribution Line	18,345	LF	$ 200.00	$ 3,669,000.00
3	Booster Pump	1	EA	$ 100,000.00	$ 100,000.00
4	Railroad ROW Crossing	1	EA	$ 125,000.00	$ 125,000.00
5	Erosion Controls	1	LS	$ 10,000.00	$ 20,000.00
6	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
				Construction	$ 4,131,000.00
				Contingencies	$ 413,100.00
				Survey/Gather Data	$ 90,890.00
				Basic Engineering	$ 408,970.00
				Construction Testing	$ 22,730.00
				TOTAL	**$ 5,066,690.00**

ATTACHMENTS

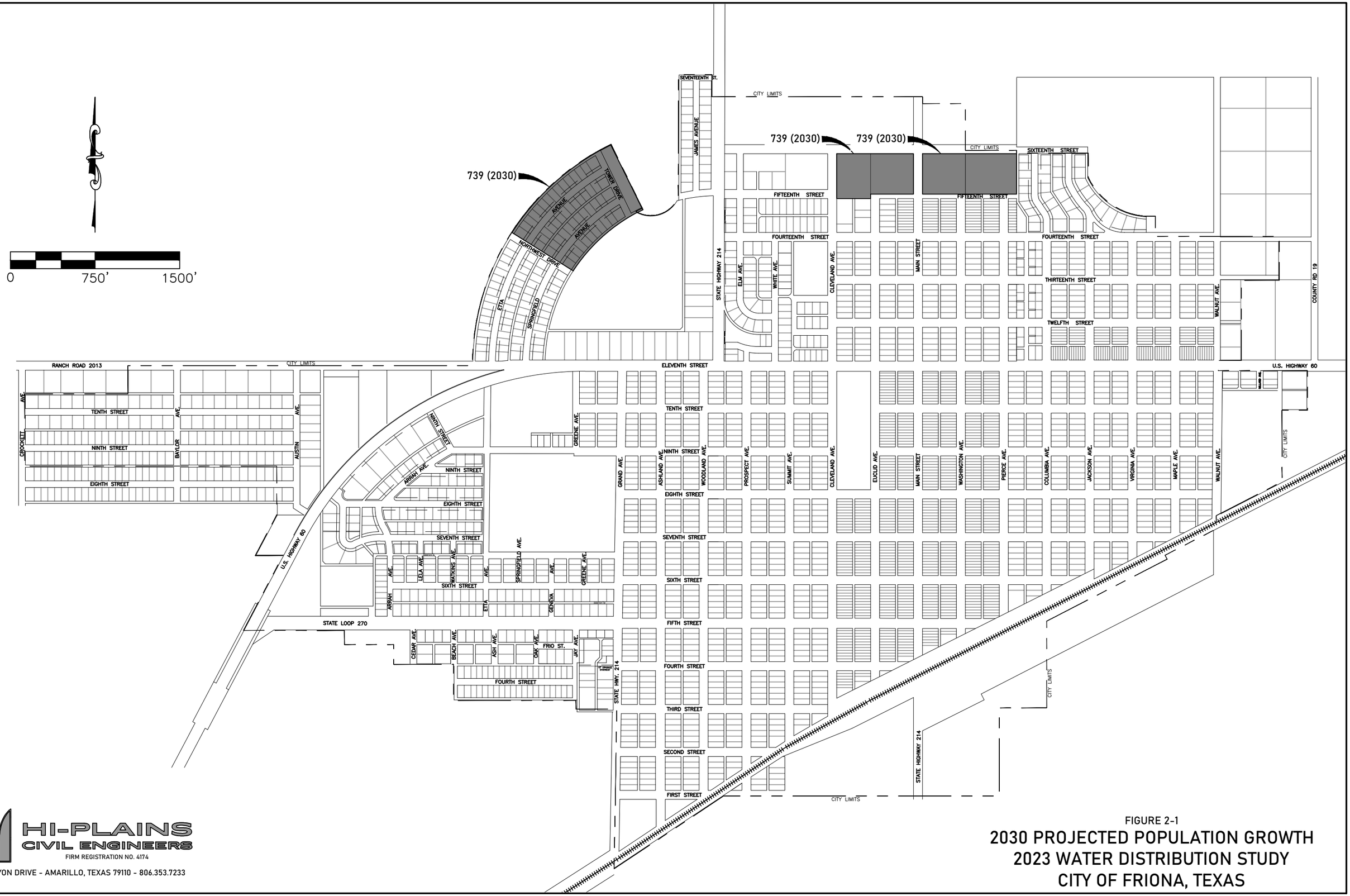


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FIGURE 2-1
2030 PROJECTED POPULATION GROWTH
2023 WATER DISTRIBUTION STUDY
CITY OF FRIONA, TEXAS

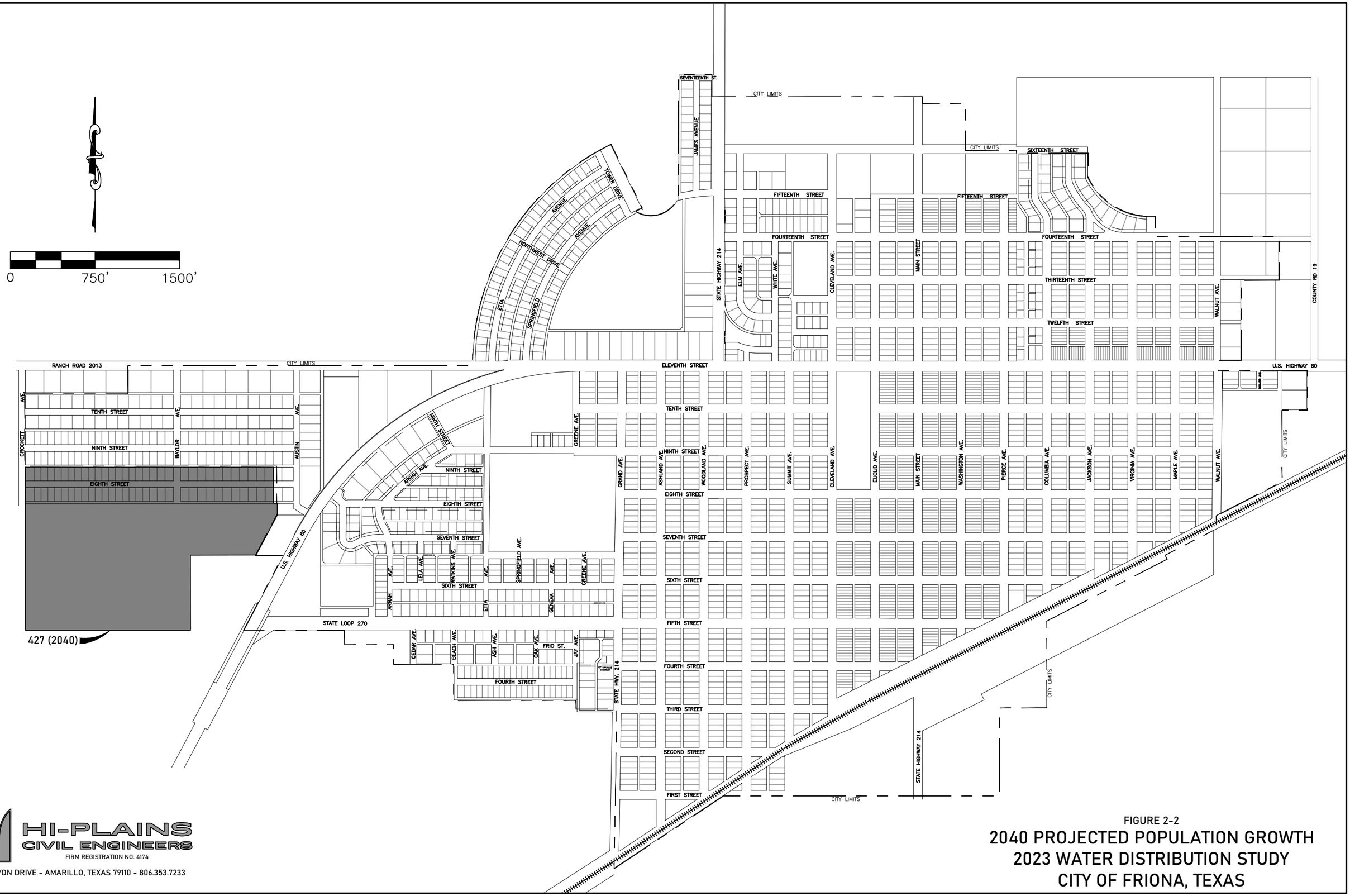

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FIGURE 2-2

2040 PROJECTED POPULATION GROWTH
2023 WATER DISTRIBUTION STUDY
CITY OF FRIONA, TEXAS

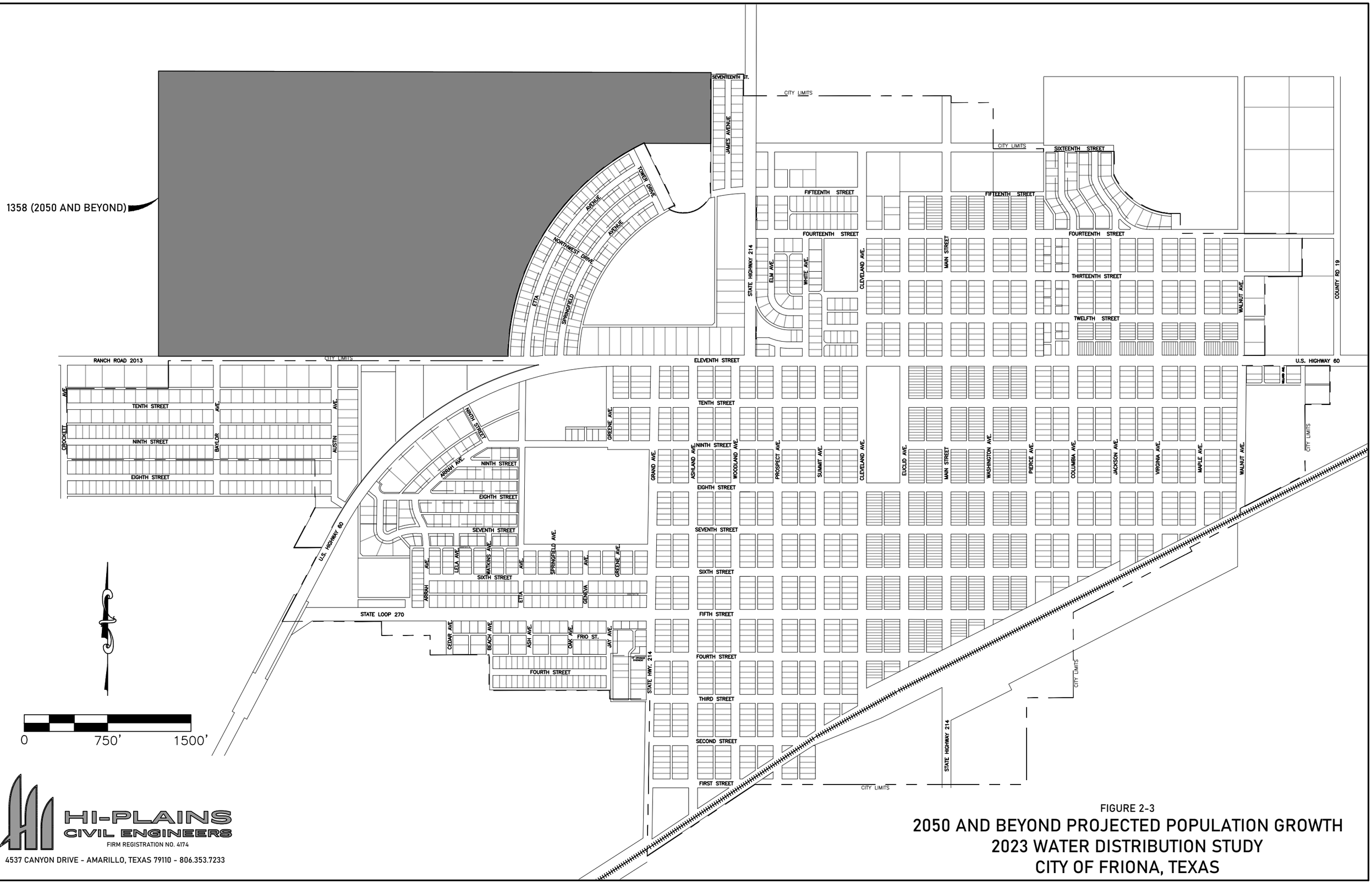

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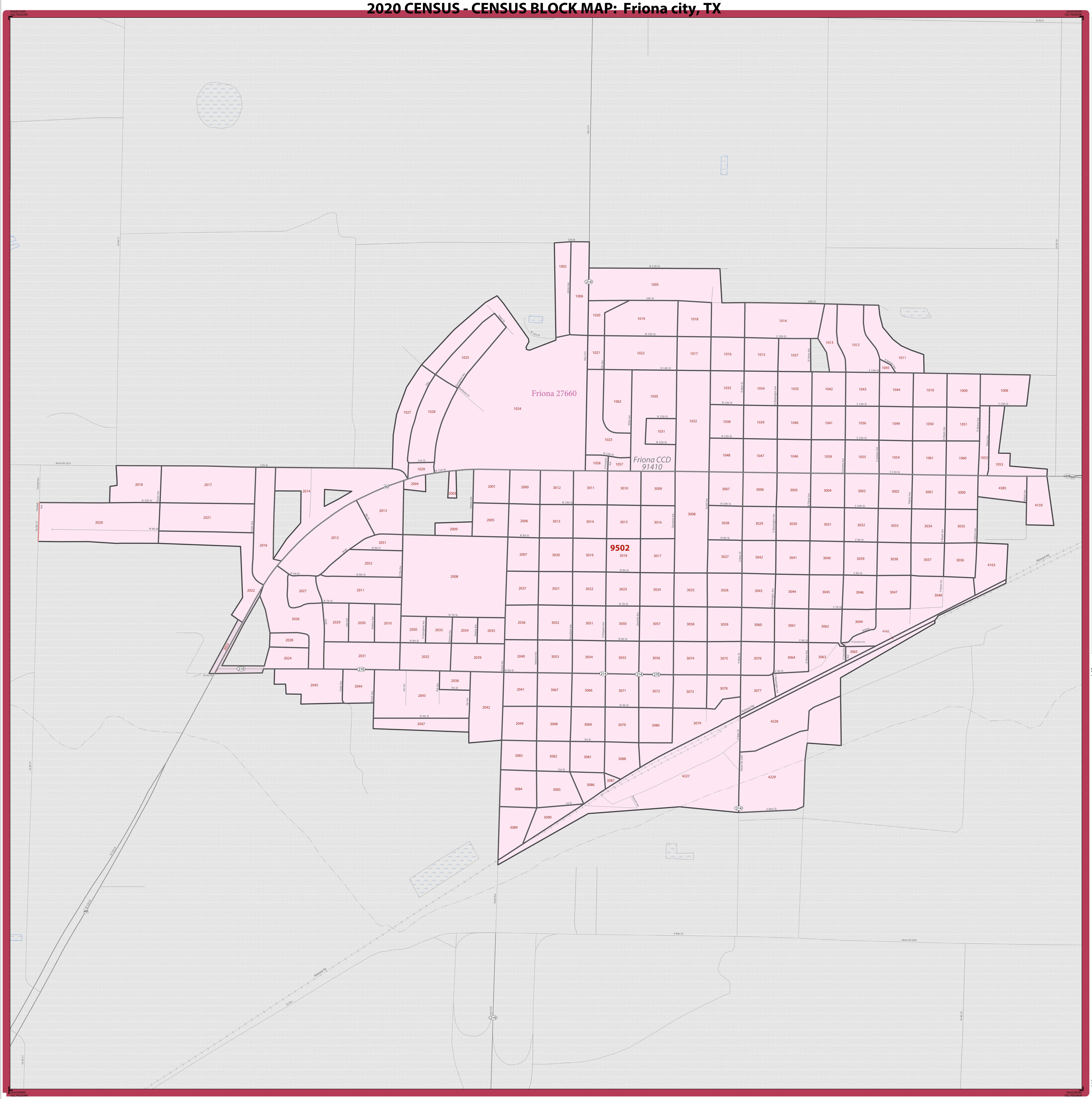
FIGURE 2-3
2050 AND BEYOND PROJECTED POPULATION GROWTH
2023 WATER DISTRIBUTION STUDY
CITY OF FRIONA, TEXAS

2020 CENSUS - CENSUS BLOCK MAP: Friona city, TX



LEGEND

SYMBOL DESCRIPTION	LABEL STYLE
International or State Water Limit	CANADA
Federal American Indian Reservation	L'ANSE RESVN 1880
Off-Reservation Trust Land or Hawaiian Home Land	T1880
Oklahoma Tribal Statistical Area, Alaska Native Village Statistical Area, or Tribal Designated Statistical Area	KAW OTSA 5690
American Indian Tribal Subdivision	EAGLE NEST DIST 200
State American Indian Reservation	Tama Resvn 9400
State Designated Tribal Statistical Area	Lumbee SDTSA 9815
Alaska Native Regional Corporation	NANA ANRC 52120
State (or statistically equivalent entity)	NEW YORK 36
County (or statistically equivalent entity)	MONTGOMERY 031
Minor Civil Division (MCD) 1	Bristol town 07485
Census County Division (CCD), Census Subarea (CSA), or Unorganized Territory (UT)	Hanna CCD 91650
Consolidated City	MILFORD 47500
Incorporated Place 1,2	Davis 18100
Census Designated Place (CDP) 2	Incline Village 35100
Census Tract 3	33.07
Census Block 4	3012

DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL
Interstate		Geographic Offset or Corridor	
U.S. Highway		Water Body	Pleasant Lake
State Highway		Swamp, Marsh, Gravel Pit, or Quarry	
Other Road		Glacier	Bering Glacier
Cul-de-sac		Military	Fort Belvoir
Circle		National or State Park, Forest, or Recreation Area	Yosemite Natl Pk
4WD Trail, Stairway, Alley, Walkway, or Ferry		College or University	Brown Univ
Railroad		Prison or Juvenile Detention Center	Baxter County Jail
Pipeline or Power Line		Airport, Airfield, or Helicopter Landing Pad	
Ridge or Fence		Selected Mountain Peaks	Mt Shasta
Perennial Stream			
Intermittent Stream	Piney Cr		
Island Name	DEER IS		
Nonvisible Boundary or Feature Not Elsewhere Classified			
Inset Area	A	Outside Subject Area	

Where international, state, county, and/or MCD/CCD boundaries coincide, the map shows the boundary symbol for only the highest-ranking of these boundaries. Where American Indian reservation and American Indian tribal subdivision boundaries coincide, the map shows only the American Indian reservation boundaries. Where Oklahoma tribal statistical area boundaries and American Indian tribal subdivision boundaries coincide, the map shows only the Oklahoma tribal statistical area boundaries.

Geographic area names are followed by either their FIPS or census code.

1 A '°' following an MCD name denotes a false MCD. A '°' following a place name indicates that a false MCD exists that is coextensive with the place and has the same name and FIPS code as the place; the false MCD label is not shown.

2 Place label color corresponds to the place fill color.

3 Census tracts are identified by an up to four-digit integer number and may have an optional two-digit suffix; for example 23 or 1457.02. The census tract codes consist of six digits with an implied decimal between the fourth and fifth digit corresponding to the basic census tract number, but with leading zeros, and trailing zeros for census tracts without a suffix. The tract number examples above would have codes of 002300 and 145702, respectively.

4 A '*' following a block number indicates that the block number is repeated elsewhere in the block.

Due to space limitations, some areas and features such as water bodies, colleges, prisons, and roads may not be labeled.

SUBJECT AREA COUNTIES ON MAP SHEET
48369 Parmer

Sheet 1 of 1 PARENT sheets
Total Sheets: 1 (Index 0; Parent 1; Inset 0)

All legal boundaries and names are as of January 1, 2020. The boundaries shown on this map are for Census Bureau statistical data collection and tabulation purposes only; their depiction and designation for statistical purposes does not constitute a determination of jurisdictional authority or rights of ownership or entitlement.

Geographic Vintage: 2020 Census (reference date: January 1, 2020)
Data Source: U.S. Census Bureau's MAF/TIGER database (TAB20)
Map Created by Geography Division: April 13, 2021

U.S. DEPARTMENT OF COMMERCE U.S. Census Bureau

Projection: Albers Equal Area Conic
Datum: NAD 83
Spheroid: GRS 80
1st Standard Parallel: 27 36 51
2nd Standard Parallel: 34 43 24
Central Meridian: -100 04 35
Latitude of Projection's Origin: 25 50 13
False Easting: 0
False Northing: 0

0 0.1 0.2 0.3 0.4 0.5 Kilometers
0 0.1 0.2 0.3 0.4 0.5 Miles
SCALE 1:5,027

N S W E

United States® Census 2020

NAME: Friona city (27660)
ENTITY TYPE: Incorporated Place
ST: Texas (48)
CO: Parmer (369)

Geographic Unit (GU) Block Map Series
2020 CENSUS BLOCK MAP (PARENT) - Sheet ID: 26004827660001

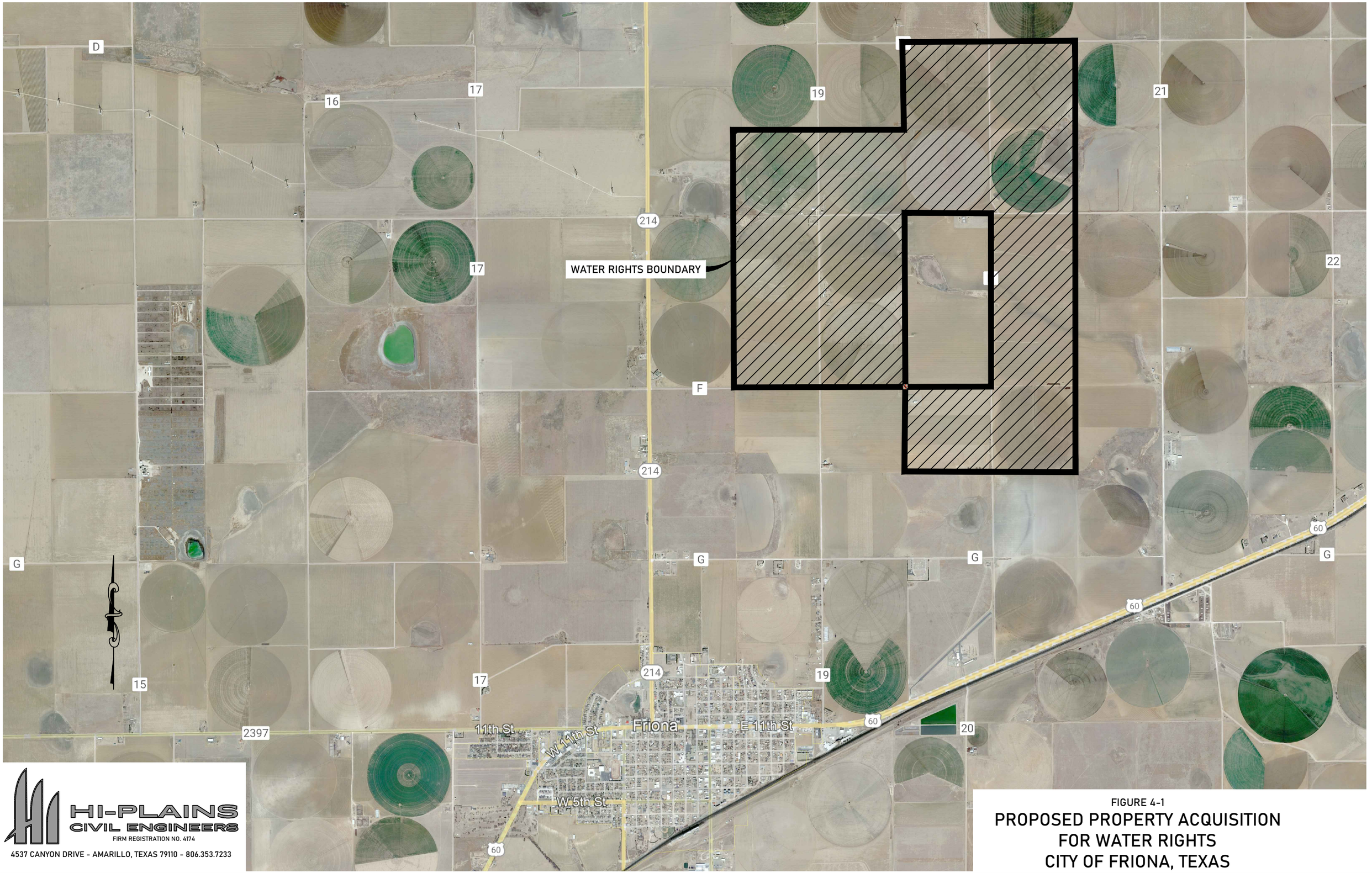


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FIGURE 4-1

PROPOSED PROPERTY ACQUISITION FOR WATER RIGHTS CITY OF FRIONA, TEXAS

Groundwater Saturated Thickness

March 15, 2023

Polygon Graphics

- User drawn polygons
- HPWD Boundary
- HPWD Counties
- Saturated Thickness 2022

1:36,112

0 0.425 0.85 1.7 mi

0 0.5 1 2 km

Jed Leibbrandt
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

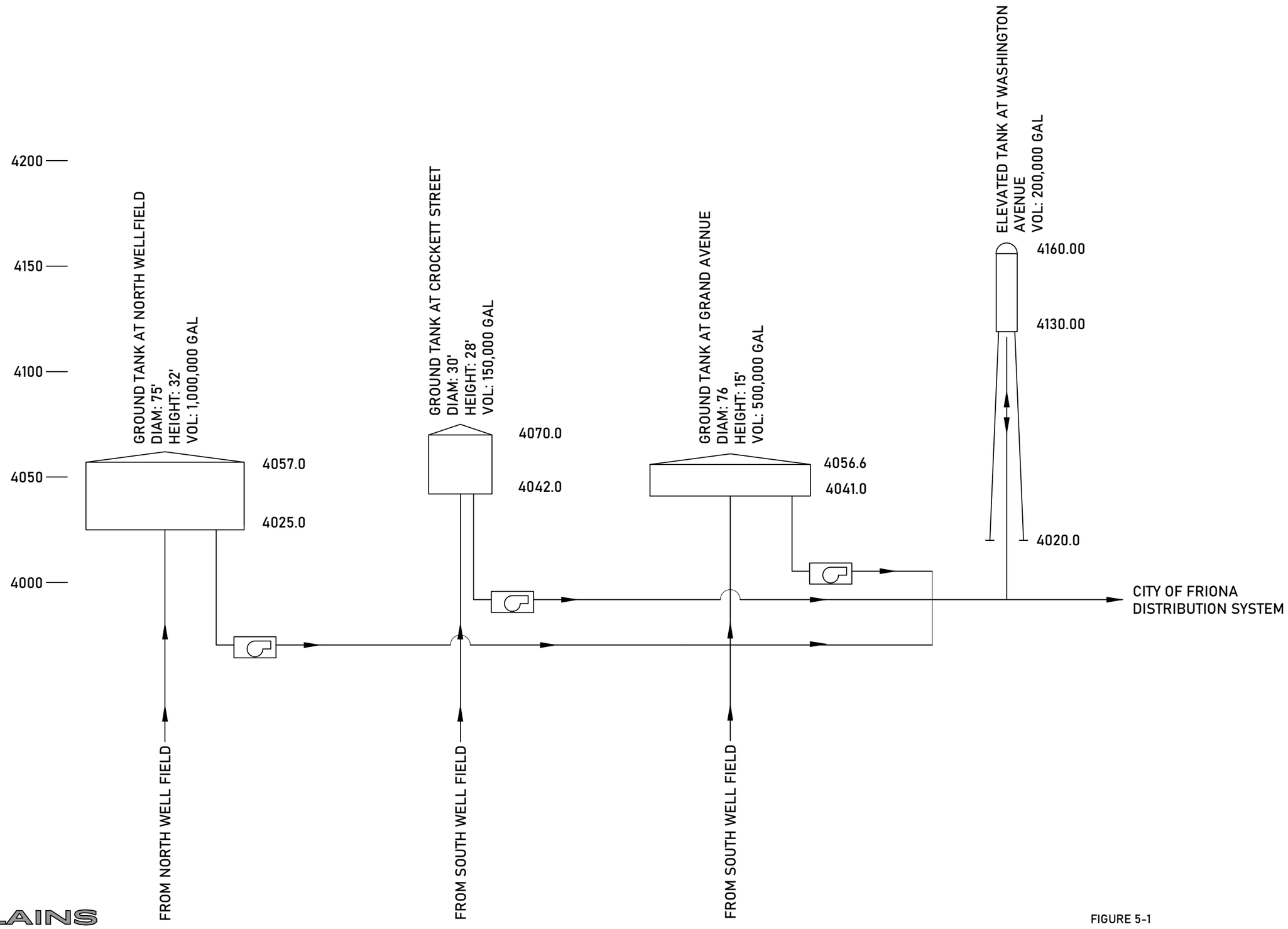

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FIGURE 5-1
DISTRIBUTION SYSTEM SCHEMATIC
CITY OF FRIONA, TEXAS

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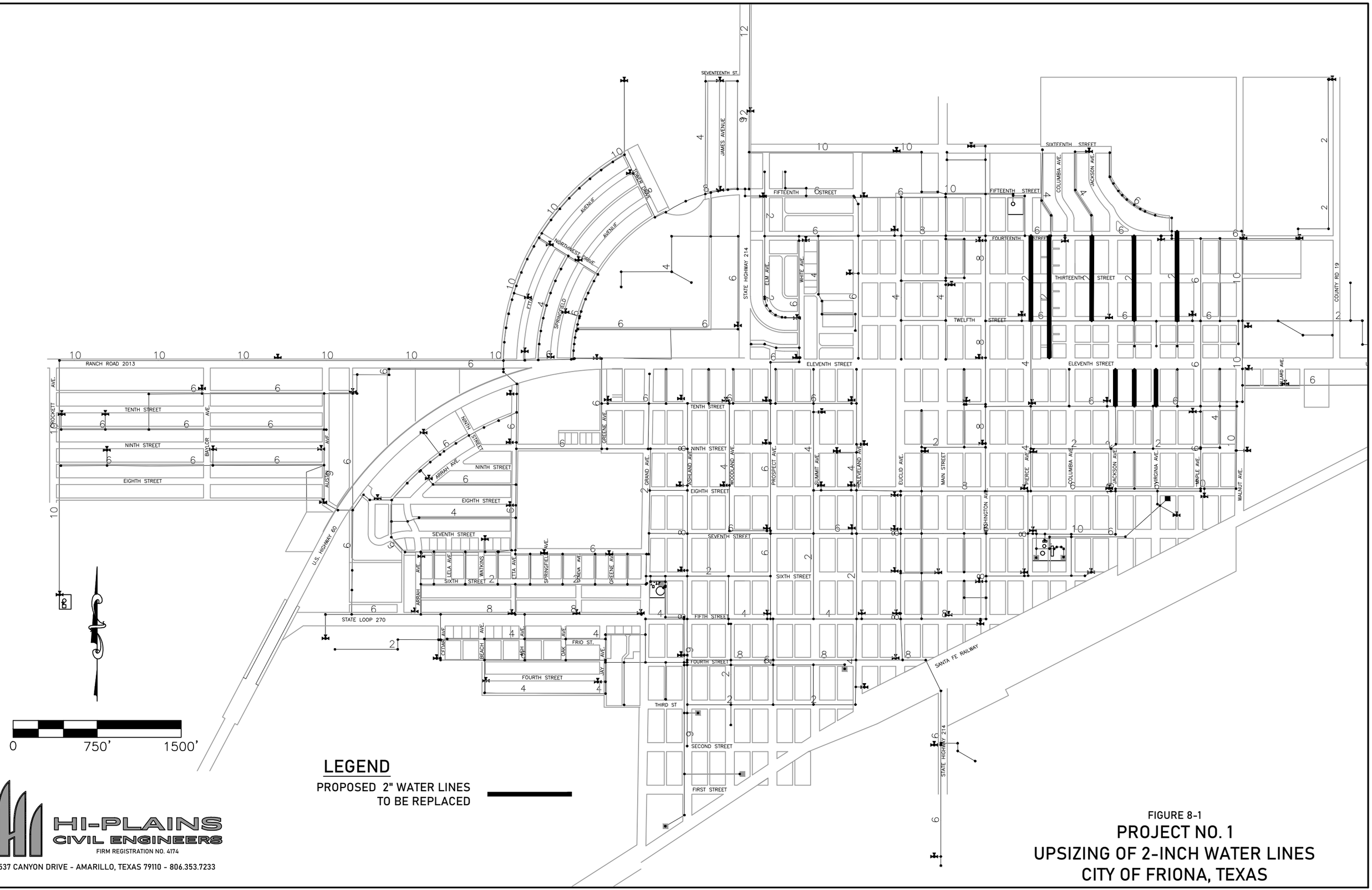
FIGURE 6-1
CARGILL PLANT
WATER UTILITY EXTENSION
CITY OF FRIONA, TEXAS



LEGEND

PROPOSED 2" WATER LINES
TO BE REPLACED

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FIGURE 8-1

PROJECT NO. 1
UPSIZING OF 2-INCH WATER LINES
CITY OF FRIONA, TEXAS

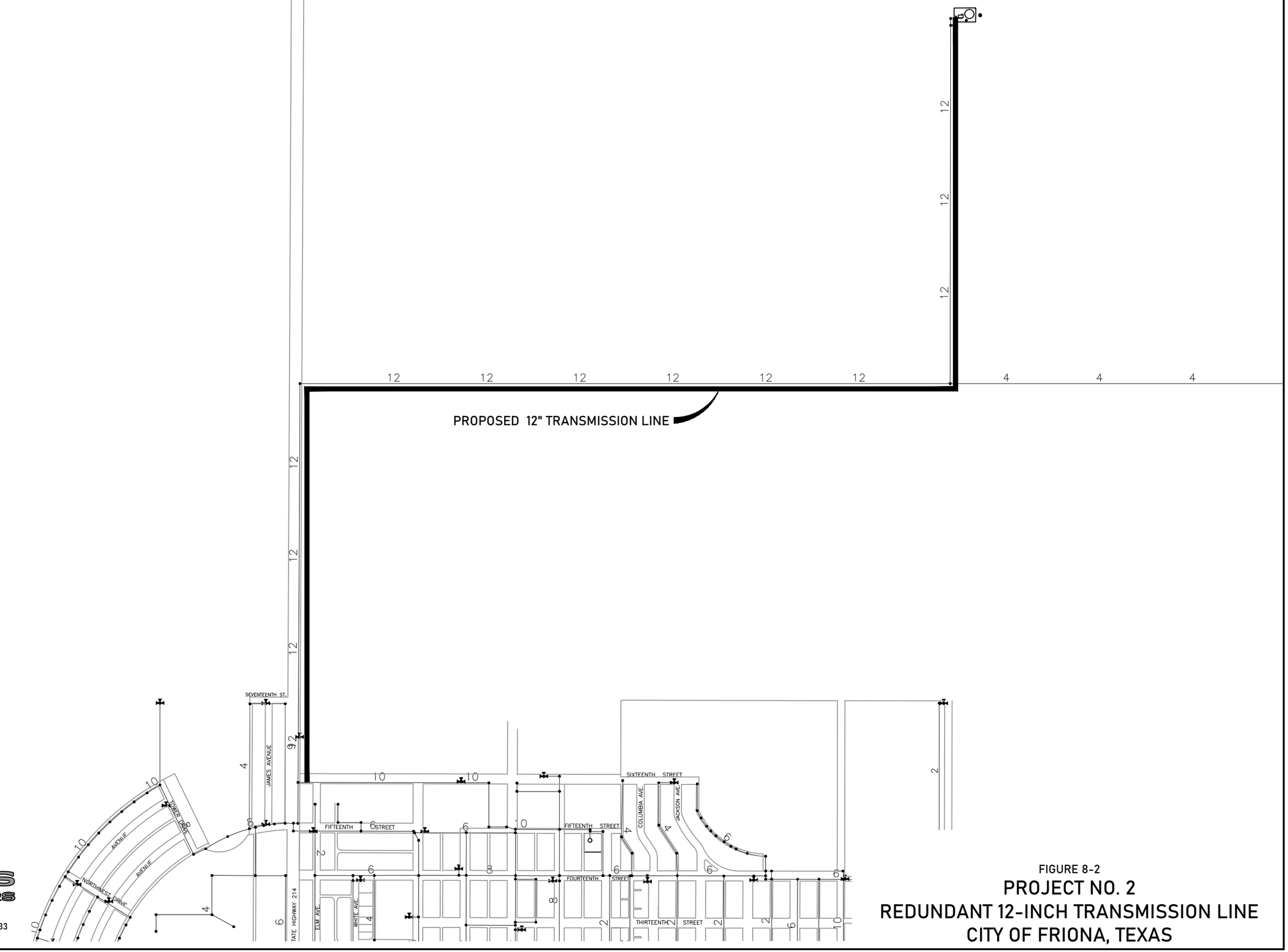

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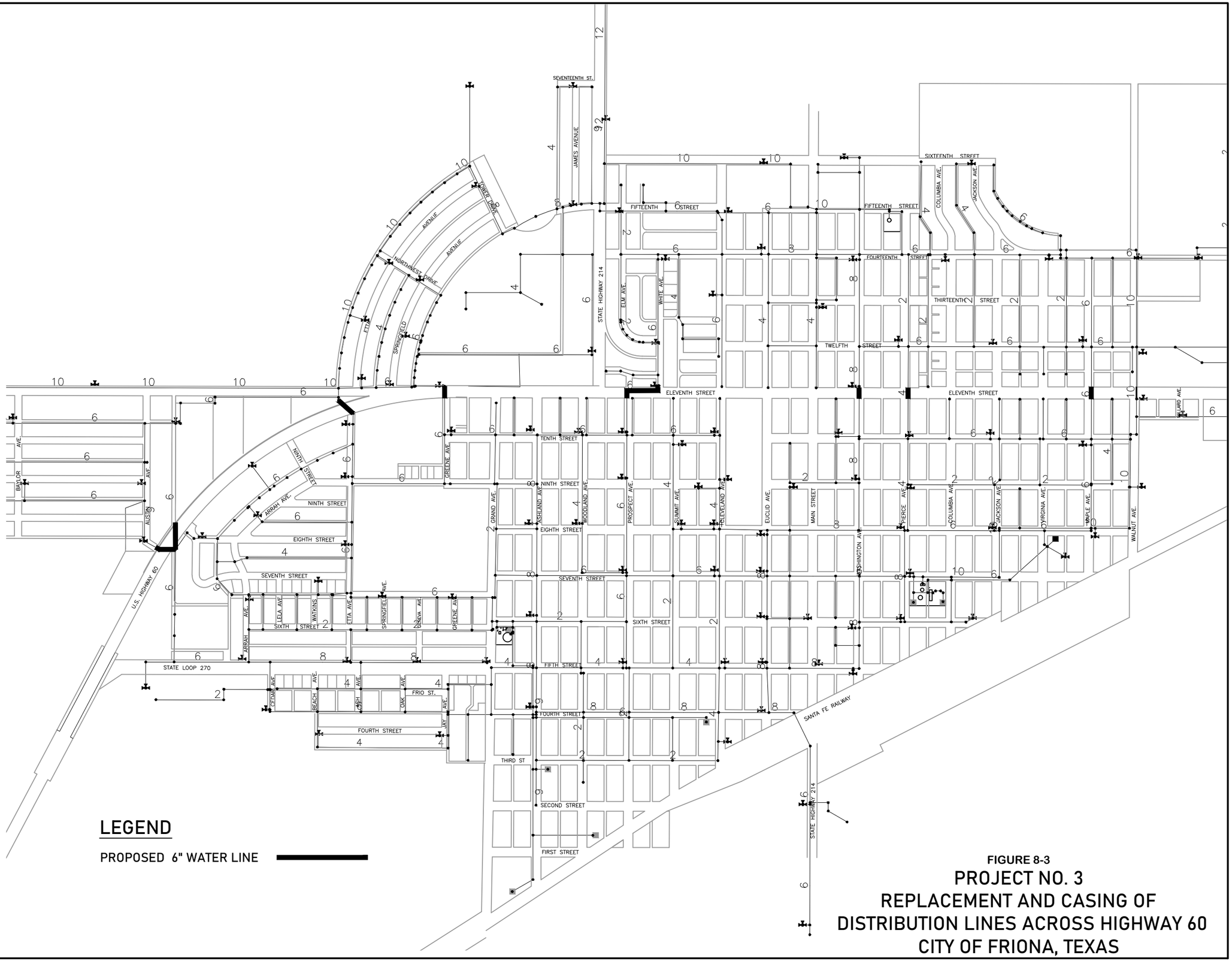
FIGURE 8-2
PROJECT NO. 2
REDUNDANT 12-INCH TRANSMISSION LINE
CITY OF FRIONA, TEXAS



0 750’ 1500’

LEGEND

PROPOSED 6" WATER LINE

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FIGURE 8-3

PROJECT NO. 3
REPLACEMENT AND CASING OF DISTRIBUTION LINES ACROSS HIGHWAY 60
CITY OF FRIONA, TEXAS

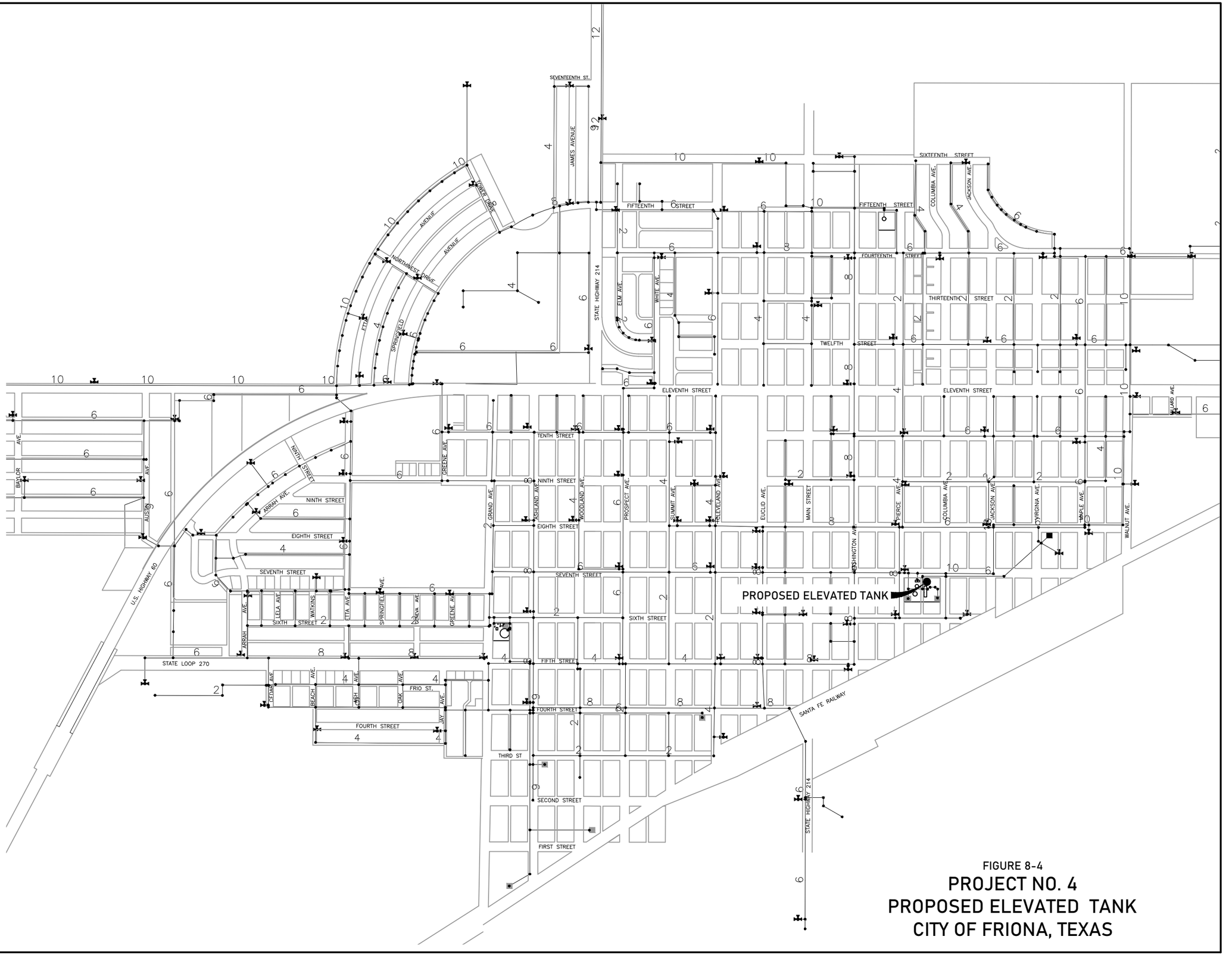

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FIGURE 8-4
PROJECT NO. 4
PROPOSED ELEVATED TANK
CITY OF FRIONA, TEXAS

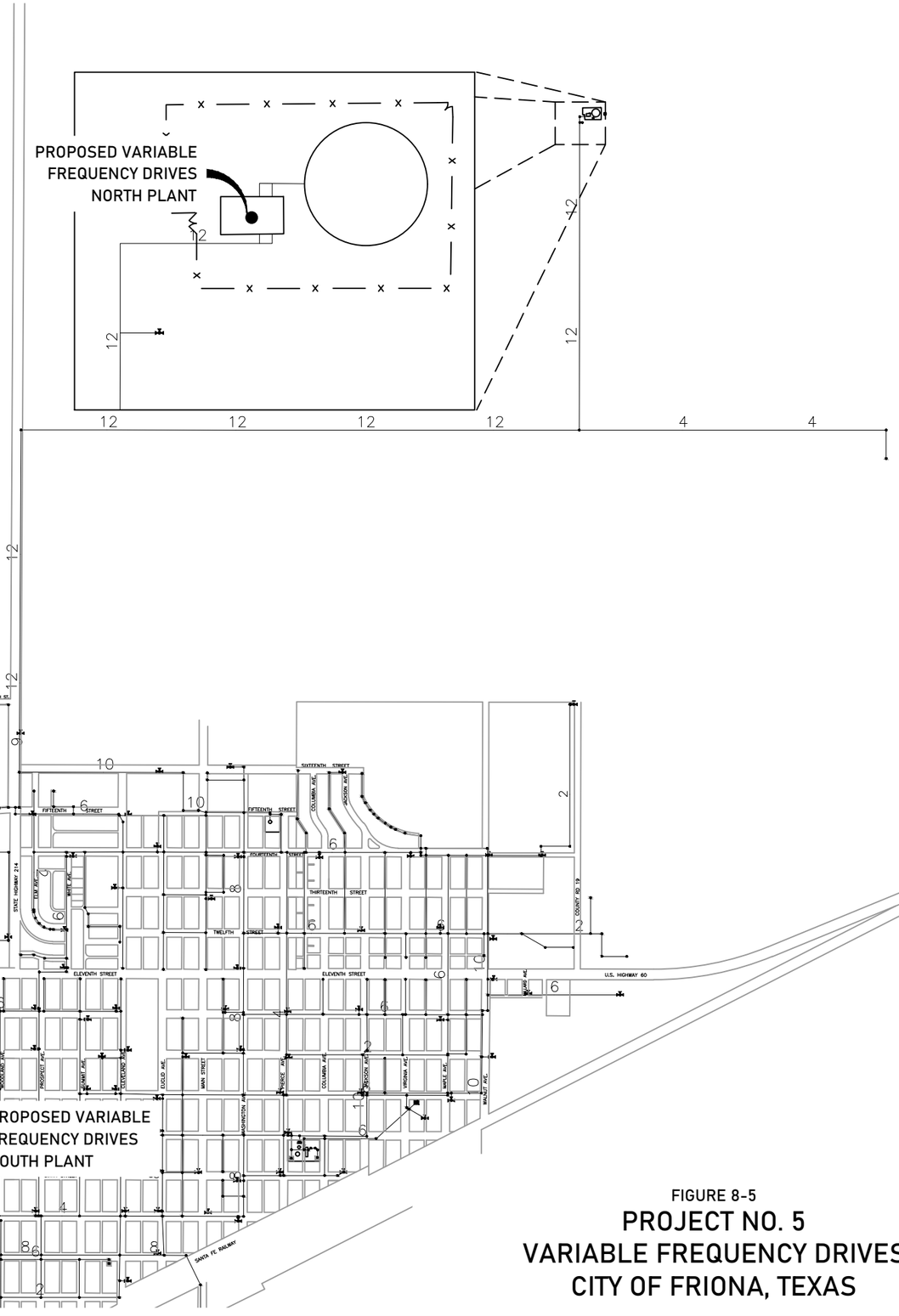

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FIGURE 8-5

PROJECT NO. 5
VARIABLE FREQUENCY DRIVES
CITY OF FRIONA, TEXAS

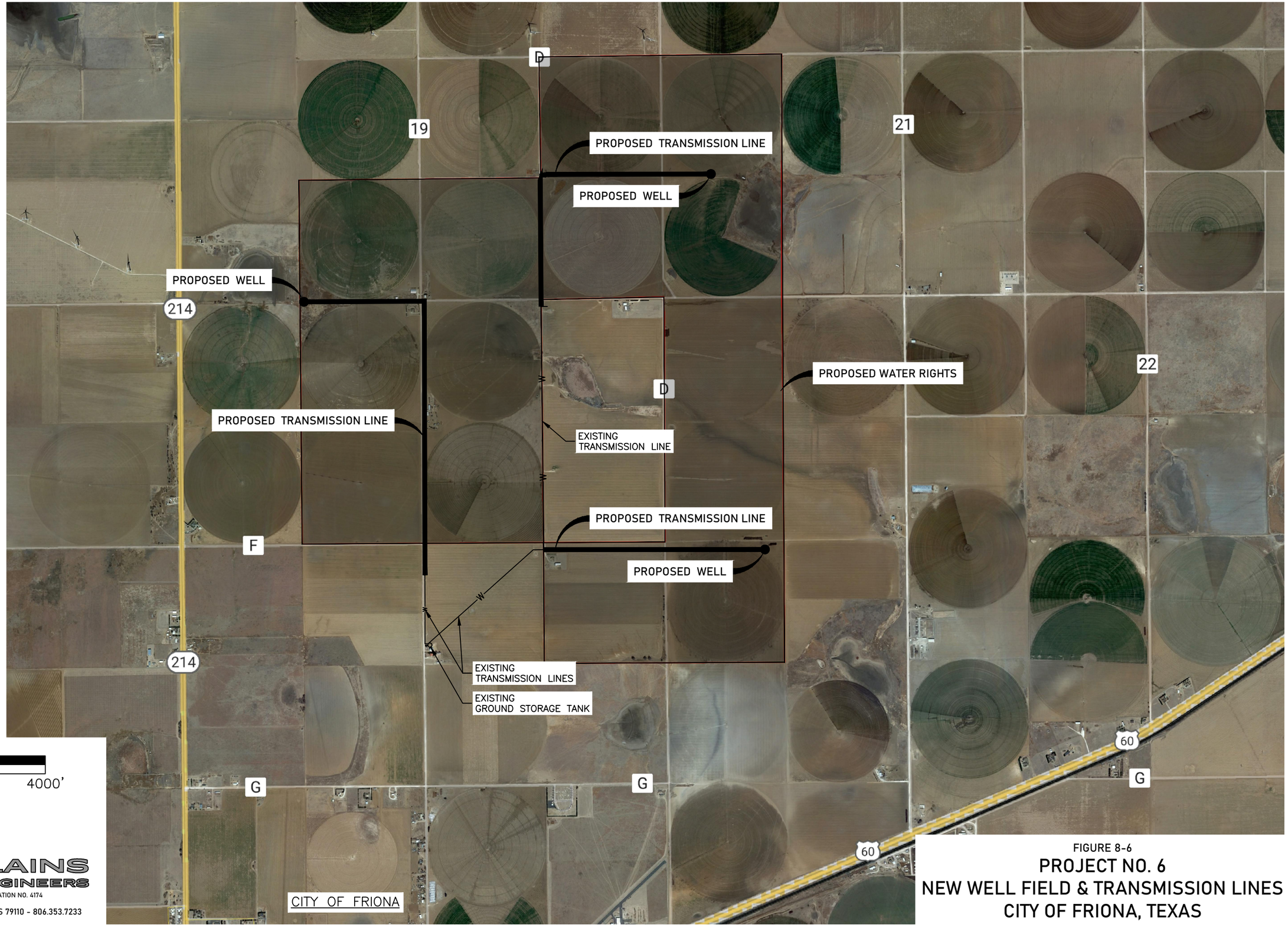

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FIGURE 8-6

PROJECT NO. 6
NEW WELL FIELD & TRANSMISSION LINES
CITY OF FRIONA, TEXAS