AGENDA ITEM SUMMARY FORM

MEETING DATE: January 13, 2026

PREPARED BY: Gaudalupe Valdez

AGENDA CONTENT: Utility Master Plan Update

AGENDA ITEM SECTION: Regular Agenda

BUDGETED AMOUNT: **FUNDS REQUESTED:**

FUND:

EXECUTIVE SUMMARY:
Discussion and possible action accepting the Utility Master Plan.

HDR presented the Utility master plan to Council on October 14, 2025. Council requested a modification to the water supply plan to reflect that the City will meet future water demands with additional water well capacity. As the City continues to grow and the demand from the aquifers increases in Brazoria County, the City can supplement its water demands with additional surface water purchase.

RECOMMENDATION:

Council to accept the Utility Master Plan and direct HDR to bring a proposal for creating a City Wide Impact Fee.

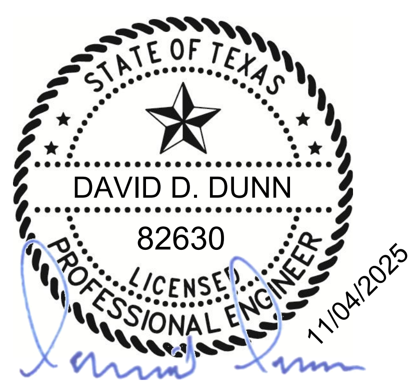
City of Angleton Utility Master Plan

Angleton, Texas

HDR Engineering, Inc.
Project No. 10388364

September 30, 2025

Updated November 4, 2025



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Acronyms/Abbreviations

ac-ft/yr	acre-feet per year
ADF	average daily flows
BWA	Brazosport Water Authority
CIP	Capital Improvement Plan
City	City of Angleton
DMR	discharge monitoring reports
DWF	dry weather flows
gal	gallons
gpm	gallons per minute
GW	groundwater
HDR	HDR Engineering, Inc.
I&I	inflow and infiltration
kWh	kilowatt-hour
max-day	Maximum-day
MFR	multi-family residential
mgd	million gallons per day
NOAA	National Oceanic and Atmospheric Administration
OPCC	Opinion of Probable Construction Cost
PVC	polyvinyl chloride
SFR	single family residential
SSO	sanitary sewer overflow
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
UMP	Utility Master Plan
WWTP	wastewater treatment plant

Executive Summary

The City of Angleton is preparing for growth in all areas that are currently not served by its utility water distribution and wastewater collection system. This water and wastewater master plan identifies capital improvement projects necessary to serve this growth effectively, while also maintaining and improving existing infrastructure.

Growth projections were developed and used to project future water demand and wastewater flows, based on information provided by City staff regarding current and future land use, and anticipated future growth in specific areas. These projections anticipate an additional 15,700 service connections over the next 30 years, in addition to the City's current 7,547 metered connections in August 2024.

Hydraulic models of the City's water distribution system and wastewater collection system were updated from previous efforts by incorporating infrastructure improvements added since the last utility master plan (UMP) in 2019[1], and calibration to recently observed water system operational data and wastewater flows. The future water demands and wastewater flows (dry and wet weather) were incorporated into the updated water and wastewater models, under current, near-term (2033), and long-term (2053) conditions. The capabilities of the existing systems were evaluated under these three demand scenarios to identify improvements necessary to serve the existing and future demands.

Deficiencies in the water system were identified as the inability to maintain system pressures above 35 pounds per square inch (psi) during maximum-day demands or pipe velocities exceeding six (6) feet per second. Deficiencies in the wastewater collection system were identified as surcharges in pipes exceeding 3 feet below ground elevation, which indicates areas of high risk for potential sanitary sewer overflows (SSOs). The current system storage, pumping, and supply capacities were also compared to State of Texas requirements for public water systems (30 TAC §290.45) to identify any additional water system deficiencies.

Capital Improvement Plans (CIPs) were developed consisting of projects identified that, when constructed, will alleviate the system deficiencies for the near-term (10-year, 2033) and long-term (30-year, 2053) conditions. Note that only those projects needed to meet 2033 demands are considered eligible for impact fee assessment, because impact fees can only be assessed for projects needed within a 10-year period (Texas Local Government Code §395.014). The City of Angleton has not yet adopted an impact fee ordinance.

In addition to developing CIPs for the water distribution and wastewater collection systems, future water demands were projected through year 2073, and a water supply plan was developed to recommend strategies to meet the City's future water supply needs.

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[1] HDR Engineering, Inc., "Utility Master Plan," City of Angleton, March 2019.

<u>Summary of Water Master Plan</u>

The City's water distribution system is comprised of about 144 miles of water distribution mains ranging in diameter from 1-inch to18 inches, with over 56 percent either 6 inches or 8 inches. The system includes four ground storage tanks totaling 2.47 million gallons (mg). Three booster pump stations (11 total pumps) draw water from the ground storage tanks and pressurize the system with a total pumping capacity of 9,150 gallons per minute (gpm). When the pumps are not running, system pressures are maintained with two elevated storage tanks totaling 1.25 mg.

The City is supplied through a contract with the Brazosport Water Authority (BWA) for 2.3 million gallons per day (mgd) and five active groundwater wells with a total production capacity of 4.7 mgd. The City's total supply capacity is 7.0 mgd to supply water under maximum-day demand conditions.

The CIP to provide the necessary infrastructure to meet the near-term and long-term system demands is shown in Tables ES-1, ES-2, and ES-3.

Table ES-1. Near-Term (10-year) Water Line CIPs

Recommended CIP	Pipe Diameter (in)	Pipe Length (LF)	OPCC (2025 dollars)	% of Cost Impact Fee Eligible (portion of capacity used within 10 years)
North East Expansion	8	8,600	$3,920,000	50%
	16	2,000		
CR 44 Extension	12	9,000	$3,334,000	25%
HWY 288 & FM 523	12	2,500	$1,089,000	100%
Henderson to CR 44	12	9,000	$3,920,000	25%
FM 523 Interconnect	12	2,300	$1,002,000	25%
E Phillips Rd & CR 220 Interconnect	12	6,400	$2,788,000	25%
S Velasco St Loop	8	1,600	$421,000	25%
Henderson Transmission Line	12	9,400	$4,095,000	50%
N Chenango St and Wilkins	16	550	$294,000	50%

Table ES-2. Long-Term (30-year) Water Line CIPs

Recommended CIP	Pipe Diameter (in)	Pipe Length (LF)	OPCC (2025 dollars)
CR 428 & S Downing Rd Interconnect	8	2,700	$711,000
CR 428 WL	8	4,800	$1,263,000
CR 220 Loop	8	8,900	$2,342,000
HWY 288 NB WL Extension	8	2,300	$605,000
Coale Rd and HWY 288 Loop	12	13,100	$5,706,000
CR 219 WL	16	7,100	$3,802,000
Coale Rd and HWY 288B Loop	8	14,400	$3,790,000
CR 288 WL Extension	8	4,400	$1,158,000
BWA Transmission Line	12	39,600	$17,250,000

Table ES-3. Pumping and Storage Improvements (Long-Term)

Recommended CIP	Additional capacity	OPCC[1] (2025 dollars)
Chenango Pump Station Improvements	750 gpm	$980,000
Henderson Distribution Pump Improvements	850 gpm	$1,116,000
EST 3*	1.0 mg	$10,890,000

*EST 3 should be completed within 10 years, as only 400 connections can be added to the system in excess of those projected as "Near-Term" before this additional storage will be needed.

<u>Summary of Water Supply Plan</u>

In addition to providing sufficient pumping and transmission capacity internal to the water distribution system, the City must have sufficient water supplies available to meet annual and maximum-day water demands. Annual water demands are equivalent to average-day demands, but are expressed as volumes in acre-feet per year (ac-ft/yr). Based on the City's current water use characteristics (average-day use per connection and maximum-day peaking factor), future water demands were compared to the City's existing water supplies through year 2073, which is 20 years beyond the long-term time period of the water distribution system master plan. This is because major water supply projects can often take a decade or longer to develop and require a longer time period for planning. Consequently, water demand projections were developed based on current (2023) demands, the near-term growth (2033), the long-term growth (2053), and 50-year growth (2073). The resulting water demand projections are shown in Table ES-4.

Table ES-4. Water Demands

Year	Average-Day Demand) (ac-ft/yr)	Maximum-Day Demand (mgd)
2023	1,873	3.35
2028	2,413	4.31
2033	3,108	5.55
2043	4,115	7.35
2053	5,449	9.73
2073	7,229	12.91

Assuming the groundwater wells are pumped at full capacity, the City of Angleton has a total combined annual supply of 5,077 ac-ft/yr and a maximum-day capacity of 7.0 mgd across the entire planning period.

It is a possibility that the City's groundwater withdrawals will be limited in the future by subsidence-related regulations, due to the large growth expected in the Brazoria County area. Therefore, for the purpose of this water supply plan, a scenario where the City uses only half of the annual groundwater supply capacity is also considered. Assuming the groundwater wells are used primarily to meet maximum-day demands, resulting in utilization of about half of their annual supply, the City of Angleton has a total combined annual supply of 3,827 ac-ft/yr.

Projected annual demands, supplies and needs are shown in Table ES-5 and Figure ES-1. Maximum-Day demands, supplies, and needs are shown in Table ES-6 and Figure ES-2.

Table ES-5. Annual Demand, Supply, and Need (acre-feet per year)

Year	Ave-Day Demand	BWA Surface Water Supply	Annual Well Supply		Total Annual Supply		Annual Surplus/(Need)	
			100% GW Capacity	*50% GW Capacity*	*100% GW Capacity*	*50% GW Capacity*	*100% GW Capacity*	*50% GW Capacity*
2023	1,873	2,576	2,501	1,251	5,077	3,827	3,204	1,954
2028	2,413	2,576	2,501	1,251	5,077	3,827	2,664	1,414
2033	3,108	2,576	2,501	1,251	5,077	3,827	1,969	719
2043	4,115	2,576	2,501	1,251	5,077	3,827	962	(289)
2053	5,449	2,576	2,501	1,251	5,077	3,827	(372)	(1,622)
2073	7,229	2,576	2,501	1,251	5,077	3,827	(2,152)	(3,403)

Figure ES-1. Comparison of Annual Supplies and Demands (2020-2073)

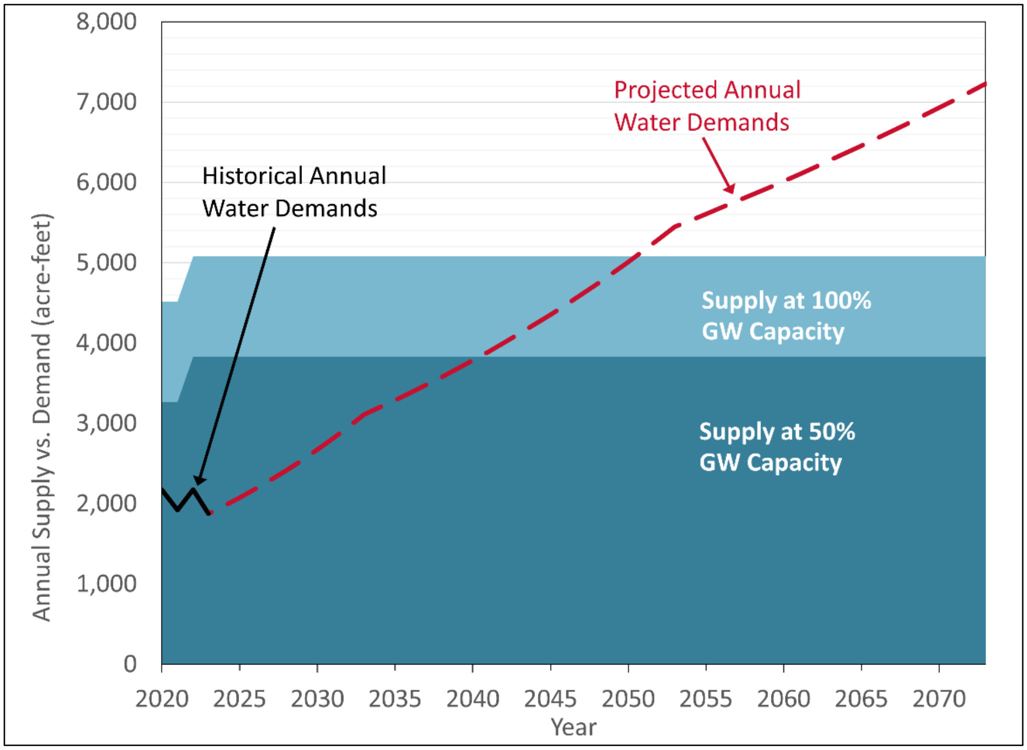
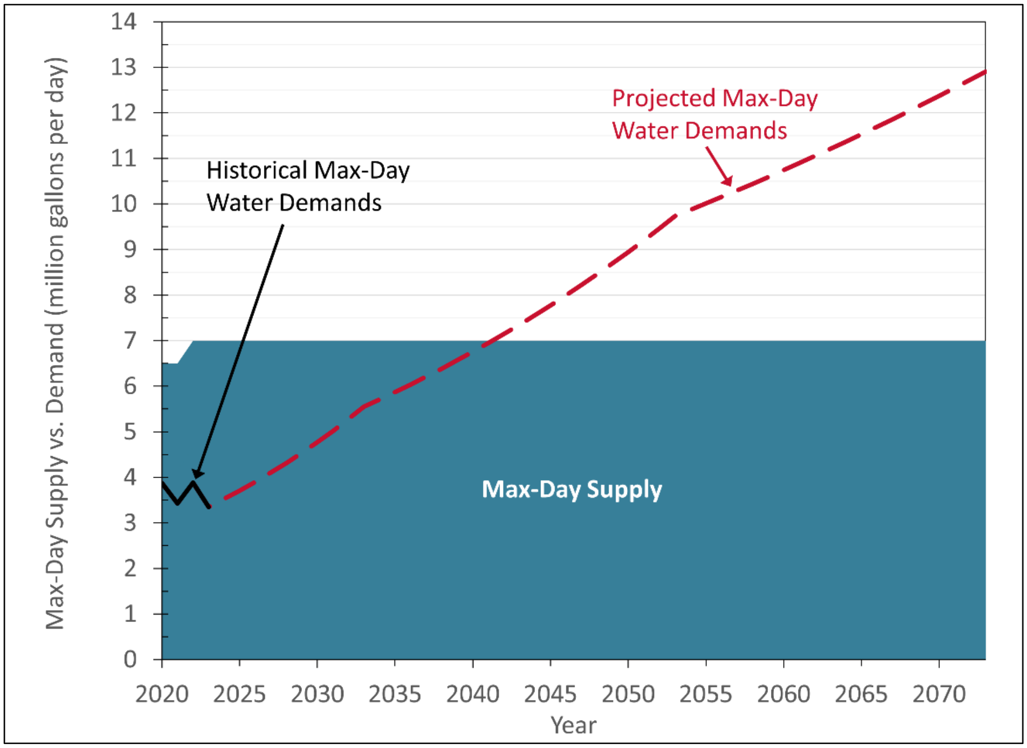


Table ES-6. Maximum-Day Demand, Capacity, and Need (million gallons per day)

Year	Maximum-Day Demands	BWA Surface Water Supply Capacity	Well Capacity	Total Capacity	Maximum-Day Surplus/ (Need)
2023	3.35	2.30	4.70	7.00	3.65
2028	4.31	2.30	4.70	7.00	2.69
2033	5.55	2.30	4.70	7.00	1.45
2043	7.35	2.30	4.70	7.00	(0.35)
2053	9.73	2.30	4.70	7.00	(2.73)
2073	12.91	2.30	4.70	7.00	(5.91)

Figure ES-2. Comparison of Maximum-Day Capacity and Demands (2020-2073)



Two primary water supply strategies were identified and evaluated for this water supply plan:

1. Additional City-owned groundwater wells, and
2. Additional supply from BWA.

Both of these supply strategies will be needed to meet future annual and maximum-day demands through the 50-year water supply planning period.

Two alternative options were considered, differing only in the timing of when specific components are implemented.

- Water Supply Option A. Obtain the additional BWA supplies first, and
- Water Supply Option B. Develop the additional groundwater first.

With either option, when the two water management strategies are fully implemented, the City will have an additional 6,461 ac-ft/yr of annual supplies and an additional 5.95 mgd of maximum-day capacity, as shown in Table ES-7 and ES-8.

Option A was the water supply plan recommended originally and Option B was not presented originally in this report. However, during the City Council meeting of October 14, 2025, the Council requested that Option B be added as the Council's preferred path forward to delay expenditure on the additional BWA supply as long as possible.

The implementation plan for Option B to develop additional annual and maximum-day supplies is shown in Table ES-7 and Figures ES-3 and ES-4 (annual supplies), and Table ES-8 and Figure ES-5 (maximum-day supplies).

As shown in the tables and figures, the critical factor is the need to provide sufficient maximum-day capacity at appropriate times in the future.

To meet the projected maximum-day demands later in the planning period, the City will need to rely on 100% of the City's current groundwater maximum-day capacity alongside both water management strategies (additional BWA supply and additional groundwater wells).

Table ES-7. Strategy Implementation to Supply Annual Demands (ac-ft/yr) – Water Supply Option B

Demand / Supply / Strategy	2028	2033	2043	2073
Current System				
Projected Average-Day Demand	2,413	3,108	4,115	7,229
Current Supply at 50% Groundwater Capacity	3,827	3,827	3,827	3,827
Current Supply at 100% Groundwater Capacity	5,077	5,077	5,077	5,077
Surplus/(Need) at 50% Groundwater Capacity	1,414	719	(289)	(3,403)
Surplus/(Need) at 100% Groundwater Capacity	2,664	1,969	962	(2,152)
Recommended Water Management Strategies				
Development of Additional City Groundwater	0	0	862	4,310
Additional BWA Surface Water Supplies	0	0	0	2,151
Total Future System				
Supply from Recommended Strategies	0	0	862	6,461
Total Supplies at 50% Current Groundwater Capacity	3,827	3,827	4,689	10,288
Total Supplies at 100% Current Groundwater Capacity	5,077	5,077	5,939	11,538
Surplus/(Need) at 50% Current Groundwater Capacity	1,414	719	574	3,059
Surplus/(Need) at 100% Current Groundwater Capacity	2,664	1,969	1,824	4,309

Figure ES-3. Strategy Implementation Timeline: Annual Supplies with Current Groundwater Supply Operated at 50% Annual Capacity – Water Supply Option B

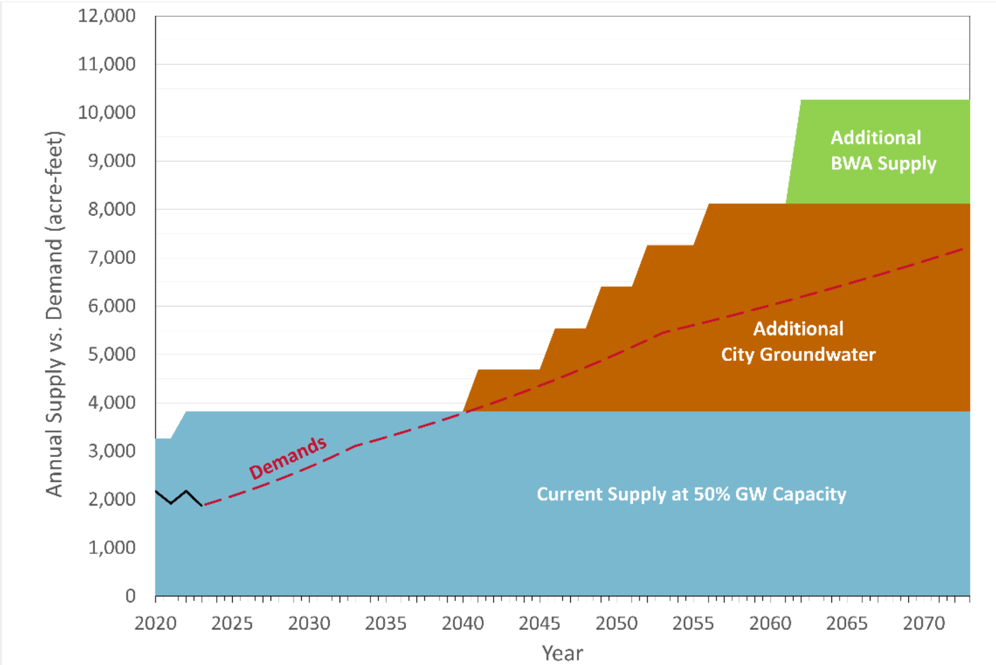


Figure ES-4. Strategy Implementation Timeline: Annual Supplies with Current Groundwater Supply Operated at 100% Capacity – Water Supply Option B

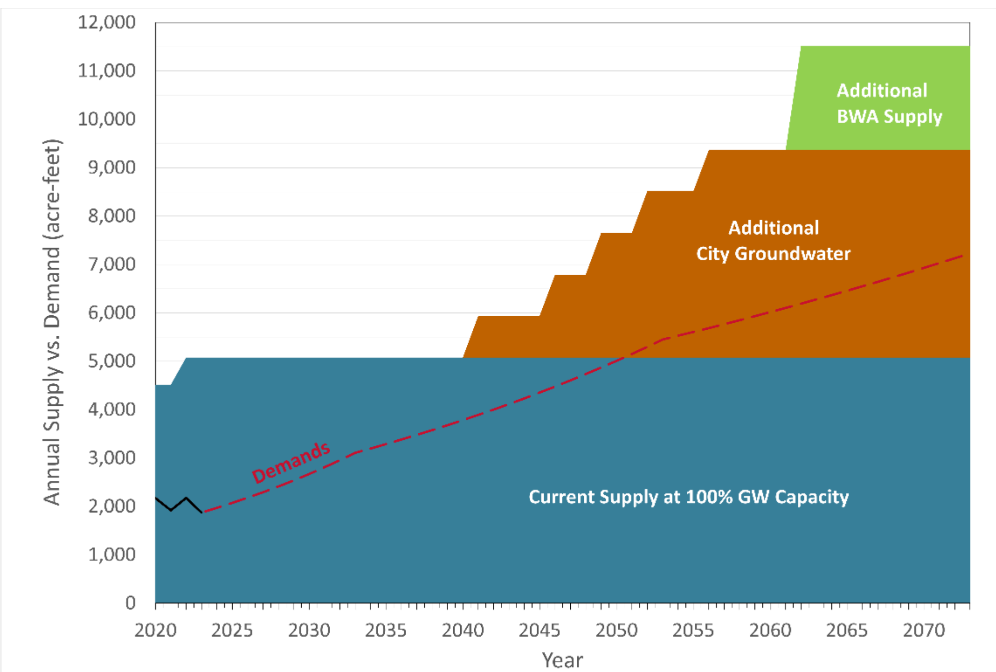
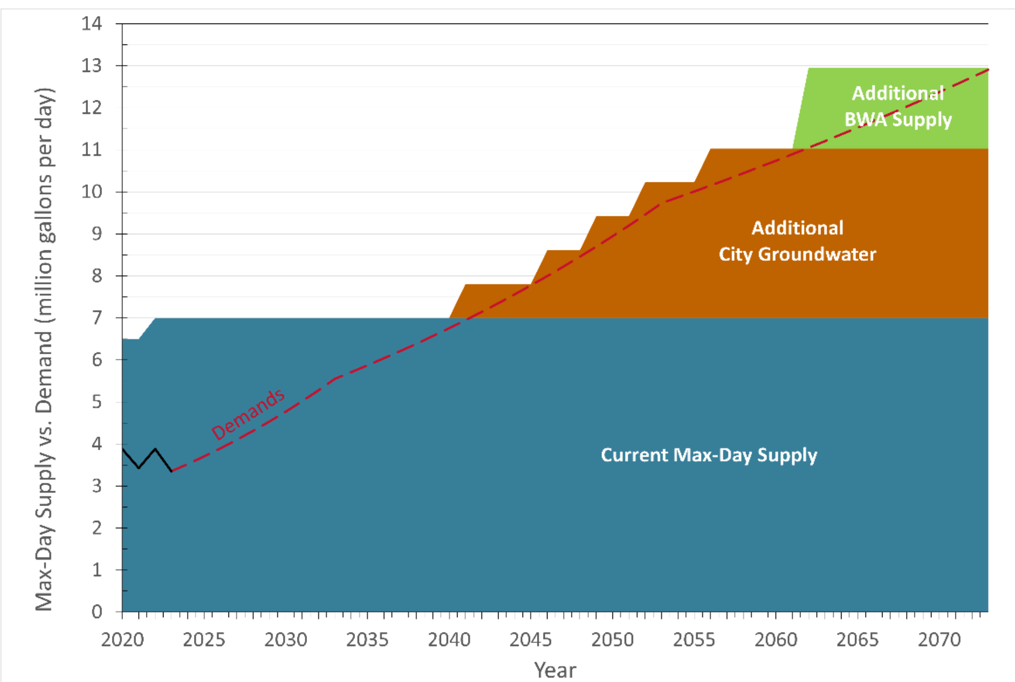


Table ES-8. Strategy Implementation to Supply Maximum-Day Demands (mgd) – Water Supply Option B

Demand / Supply / Strategy	2028	2033	2043	2073
Current System				
Projected Maximum-Day Demand	4.31	5.55	7.35	12.91
Current Supply Capacity	7.00	7.00	7.00	7.00
Surplus/(Need)	2.69	1.45	(0.35)	(5.91)
Recommended Water Management Strategies				
Development of Additional City Groundwater	0	0	862	4,310
Additional BWA Surface Water Supplies	0	0	0	2,151
Total Future System				
Supply from Recommended Strategies	0	0	862	6,461
Total Supplies at 50% Current Groundwater Capacity	3,827	3,827	4,689	10,288
Total Supplies at 100% Current Groundwater Capacity	5,077	5,077	5,939	11,538

Figure ES-5. Strategy Implementation Timeline: Maximum-Day Supplies with Current Groundwater Supply Capacity – Water Supply Option B



Summary of Wastewater Master Plan

The City's wastewater collection system is comprised of about 110 miles of gravity and force main pipes, and a large number of lift stations discharging into a variety of force mains. Some of the lift stations are regional in nature, transmitting wastewater flows collected from more than one upstream gravity line or force main.

The hydraulic model developed for this master plan indicates that the existing system generally conveys dry weather flows well under both existing and future conditions, with relatively few capacity issues and none that indicate an SSO will occur during dry weather.

Operational data provided by the City indicates that large amounts of inflow and infiltration (I&I) enter the wastewater collection system and contribute to excessively high wastewater flows during storm events, resulting in a number of areas of concern for wet weather SSOs. It is recommended that the City conduct an I&I study to better characterize system performance and ultimately rehabilitate areas that exhibit elevated levels of wet weather flow, and better refine the City's wastewater CIP.

The City's primary focus when it comes to CIP projects should be improvements that can decrease I&I. An I&I study should be conducted to understand the wastewater collection system wholistically.

The City's wastewater treatment plant (WWTP) is located along Sebesta Road in the southwest portion of town. The WWTP's current Texas Pollutant Discharge Elimination System (TPDES) Permit (Permit No. WQ0010548004) allows a maximum annual average effluent flow of 3.6 mgd to be discharged into Oyster Creek, and no more than 12,500 gpm (~18 mgd) during any two hour period.

Analysis of lift station run times during observed wet weather events indicates that many lift stations experience substantial wet weather flows with peaking factors well exceeding 12. Overall, the system at the discharge to the wastewater treatment plant exhibits a peaking factor 5.6, i.e., the wet weather flow is 5.6 times greater than the dry weather flow. Inflows to the WWTP following storm events frequently overwhelm the plant, increasing the risk of violating the plant's TPDES permit conditions.

If the City pursues an I&I reduction study, it was assumed that individual peaking factors throughout the system greater than 4.0 could be reduced by 30%, with a minimum peaking factor of 4.0. Using this methodology, the overall system-wide peaking would be reduced from 5.6 to 4.7, or a 3.9 mgd (16%) overall reduction of inflows to the WWTP during wet weather events, as summarized in Table ES-9. This is a considerable reduction, but still greatly exceeds the current capacity of the WWTP. Note that TCEQ requires new WWTPs be designed for a peaking factor of at least 4.0 in the absence of hourly peak flow data (30 TAC §217.32(a)(2)).

Table ES-9. Long-Term Wastewater Flows, with and without I&I Reduction

	Long-Term Flows	Long-Term Flows With I&I Reduction
Peak Dry Weather Flow (mgd)	4.4	4.4
Inflow and Infiltration (mgd)	19.9	16.0
Peak Wet Weather Flow (mgd)	24.3	20.4
System Peaking Factor	5.6	4.7

Proposed CIP projects were identified and sized to accommodate long-term growth through 2053 under wet weather conditions with no consideration of I&I reduction, and with an assumed I&I reduction of 30% for those areas exhibiting greater than a 4.0 peaking factor.

The CIP to provide the necessary infrastructure to meet the near-term and long-term system flows is shown in Table ES-10 (without I&I reduction) and Table ES-11 (with I&I reduction). If no efforts are made to reduce I&I, the capital costs to convey wet weather wastewater flows to the wastewater treatment plant total $51.99 million. However, if an aggressive program is implemented to reduce I&I, this cost reduces to $22.67 million, a reduction of $29.32 million (56.4%). This savings would be realized by eliminating several lift station, force main, and gravity sewer projects and reducing the diameter of several other gravity and force main projects.

HDR strongly encourages the City to pursue an aggressive I&I reduction program to reduce the occurrences of SSOs and better prepare the City to meet the demands of future growth by dramatically reducing the costs of wastewater infrastructure. Simply installing larger pipes to convey the wastewater flows will simply fill those new, larger pipes with I&I flows.

Table ES-10. Wastewater CIP without I&I Reduction

Project ID	Recommended CIP	Number of Pumps Added	Pump Capacity Added (gpm)	OPCC (2025 dollars)	% of Cost Impact Fee Eligible (portion of capacity used within 10 years)
PUMP-1	LS 1 Lift Station	2	800	$1,815,000	25%
PUMP-2	LS 7 Bypass Lift Station	2	2,250	$1,815,000	50%
PUMP-3	LS 7 Lift Station	1	1,200	$1,815,000	50%
PUMP-4	LS 8 Lift Station	3	1,200	$1,815,000	50%
PUMP-5	LS 9 Lift Station	1	250	$1,815,000	0%
PUMP-6	LS 23 Lift Station	1	350	$1,815,000	0%
PUMP-7	LS 24 Lift Station	1	350	$1,815,000	25%
Project ID	**Recommended CIP**	**Pipe Diameter (in)**	**Pipe Length (LF)**	**OPCC (2025 dollars)**	**% of Cost Impact Fee Eligible**
FM-1	Lift Station 1 Force Main	18	1,010	$1,284,000	25%
FM-2	Lift Station 7 Bypass Force Main	24	12,300	$20,762,000	50%
FM-3	Lift Station 8 Force Main	18	277	$176,000	50%
FM-4	Lift Station 24 Force Main	10	405	$144,000	25%
WWL-1	Shannon Street & Karankawa Lane	36	4,110	$5,222,000	50%
WWL-2	Hospital Dr. from Buchta Rd to Valderas St	27	3,210	$3,059,000	50%
WWL-3	E. Mulberry St. West of I-35	16	3,860	$4,344,000	50%
WWL-4	Highway 288B from FM 523 to Henderson Rd.	12	4,265	$3,600,000	25%
WWL-5	FM 523/Henderson Rd Wastewater Line	16	1,230	$693,000	25%
WWL-6	Lift Station 46 Tributary	12	2,425	$1,035,000	100%
Total Cost of CIP Projects Without I&I Reduction				**$51,989,000**	

Table ES-11. Wastewater CIP with I&I Reduction Program

Project ID	Recommended CIP	Number of Pumps Added	Pump Capacity (gpm)	OPCC (2025 dollars)	% of Cost Impact Fee Eligible (portion of capacity used within 10 years)
PUMP-1	LS 1 Pump Station	2	800	$1,815,000	25%
PUMP-2	No longer needed after I&I reduction.				
PUMP-3	LS 7 Pump Station	1	1,200	$1,815,000	50%
PUMP-4	LS 8 Pump Station	3	1,200	$1,815,000	50%
PUMP-5	No longer needed after I&I reduction.				
PUMP-6	No longer needed after I&I reduction.				
PUMP-7	LS 24 Pump Station	1	350	$1,815,000	25%
Project ID	**Recommended CIP**	**Pipe Diameter (in)**	**Pipe Length (LF)**	**OPCC (2025 dollars)**	**% of Cost Impact Fee Eligible**
FM-1	Lift Station 1 Force Main	18	1,010	$1,284,000	25%
FM-2	No longer needed after I&I reduction.				
FM-3	Lift Station 8 Force Main	**16***	277	$156,000	50%
FM-4	Lift Station 24 Force Main	10	405	$144,000	25%
FM-5	No longer needed after I&I reduction.				
WWL-1	Shannon Street & Karankawa Lane	**30***	4,110	$4,327,000	50%
WWL-2	No longer needed after I&I reduction.				
WWL-3	E. Mulberry St. West of I-35	16	3,860	$4,344,000	50%
WWL-4	Highway 288B from FM 523 to Henderson Rd.	12	4,265	$3,600,000	25%
WWL-5	FM 523/Henderson Rd Wastewater Line	16	1,230	$693,000	25%
WWL-6	Lift Station 46 Tributary	**10***	2,425	$859,000	100%
Total Cost of CIP Projects With I&I Reduction				**$22,667,000**	

*Diameter of project is reduced with I&I reduction.

1 Background

Incorporated in 1912, the City of Angleton is located about 40 miles south of Houston on Highway 288 and is the Brazoria County seat. The City of Angleton owns and manages its own water and wastewater systems to service a population of approximately 20,200. The water system includes the purchase of potable water from the Brazosport Water Authority (BWA), production of potable water from City wells, transmission, distribution and storage of water for customer use.

The City's last Comprehensive Master Plan was completed in 2019. This plan covered details pertaining to the City's utilities (water and wastewater), land use, and public facilities. Several of the recommendations from that plan have been implemented. However, expected development areas have changed since 2019. The City has experienced fluctuations in growth, new developments, and system expansions. In addition, wear and tear on the water and wastewater facilities have created a need for greater focus on rehabilitation of the water distribution and wastewater collection systems. This master plan will serve as a road map for the City by identifying system deficiencies through hydraulic analyses, provide a plan for future growth, and the infrastructure improvements required to accommodate anticipated growth.

2 Water Master Plan

The system is responsible for supplying potable water that complies with all federal and state water quality standards and to meet customer water demands at all times. Water is provided through three ground storage and booster pump stations, six wells, and two elevated storage tanks. In addition, the City also purchases approximately2.3 million gallons per day (mgd) (approximately 840 million gallons per year) from the BWA, delivered through a transmission pipeline from the BWA water treatment facility to the City's Henderson and Jamison water plants.

2.1 Objectives and Scope of Work

The scope of work for the water distribution portion of this Utility Master Plan (UMP) includes the following tasks:

- Analyze historical and existing water demands
- Project future water demands
- Update and analyze the hydraulic model of the water distribution system
- Evaluate hydraulic deficiencies for existing and future conditions using the hydraulic model
- Develop recommendations for improvement in a Capital Improvement Program (CIP)

2.2 Data Sources

Various sources of data were provided by the City for use with the water hydraulic model update. These sources included reports, geographic information system (GIS) electronic files, and record drawings from completed construction projects, as well as the following:

- 2019 Utility Master Plan (UMP)
- Monthly total connections from 2017 – 2024
- Texas Water Development Board (TWDB) Data
- Historical Production Data
- Land Use Plan
- City Development Services map of future development areas
- Facility SCADA
- Storage Tank Condition Assessments

2.3 Existing Water Distribution System

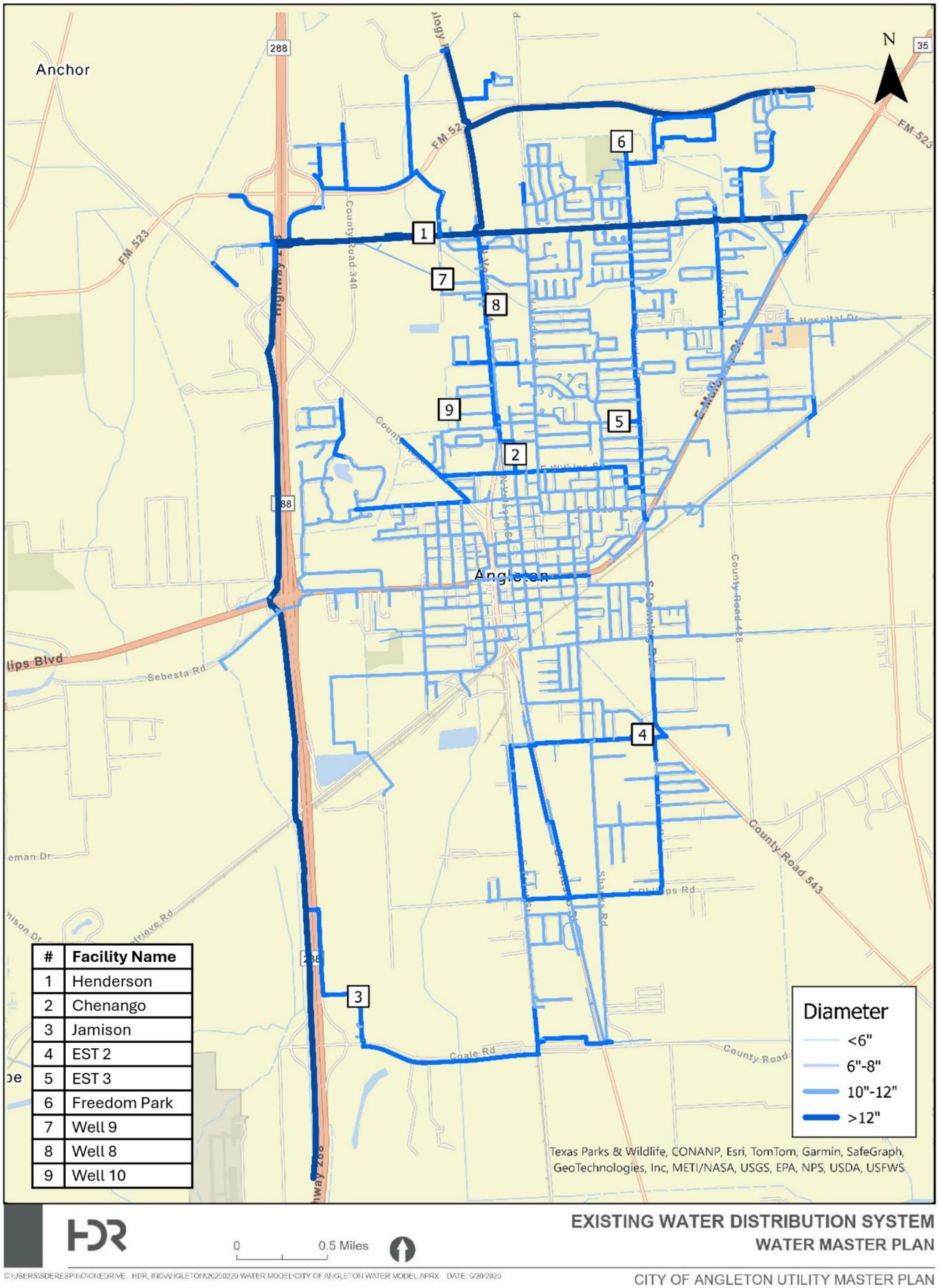
The Department of Public Works operates and maintains the water distribution system, consisting of three ground storage tanks and booster pump stations (Henderson Plant, Chenango Street Plant, and Jamison Plant) and two elevated water storage tanks (Northside and Southside). The City obtains its water from the BWA, a surface water wholesaler. The surface water supply is supplemented with City-owned groundwater wells in times of high demand. The City's water distribution system consists of pipelines, storage reservoirs, pumping stations, control valves, fire hydrants, and water meters located throughout the system. The City has approximately 144 miles of water pipelines varying in size from 1 inch to 18 inches in diameter, and approximately 7,500 metered water service connections. Accounting for apartment complexes served by single master meters, the City serves approximately 9,513 total units.

Figure 2.1 shows the City's water distribution system. The following sub-sections describe the details of the City's water system.

2.3.1 Water System Pipeline Network

The City's distribution system consists of a wide variety of pipe types, sizes, and ages, and reflects ongoing growth of the system. Table 2.1 presents the total length of pipes by diameter, and Table 2.2 shows the breakdown of pipes by material. New pipes installed since the 2019 UMP were assumed to be polyvinyl chloride (PVC) if not otherwise identified.

Figure 2.1. City of Angleton Existing Water Distribution System



#	Facility Name
1	Henderson
2	Chenango
3	Jamison
4	EST 2
5	EST 3
6	Freedom Park
7	Well 9
8	Well 8
9	Well 10

Table 2.1. Water System Pipeline Diameter Summary

Diameter (inches)	Length (feet)	Percent of Total
1	8,206	1.1%
2	92,526	12.2%
3	5,977	0.8%
4	17,328	2.3%
6	164,180	21.6%
8	273,915	36.0%
10	23,607	3.1%
12	109,805	14.4%
16	35,599	4.7%
18	29,063	3.8%
Total	760,207	

Source: City's GIS database

Table 2.2. Water System Pipeline Material Summary

Material	Length (feet)	Percent of Total
Asbestos Cement	305,323	40.2%
Cast Iron	35,472	4.7%
Ductile Iron	1,566	0.2%
Galvanized	7,834	1.0%
Polyethylene	9,018	1.2%
Polypropylene	11	0.0%
PVC	343,933	45.2%
Unknown	57,050	7.5%
Total	760,207	

Source: City's GIS database

The age and material of the pipelines within a system is important for a variety of reasons. As pipelines age and deteriorate, the likelihood of failure increases. As pipelines age, the hydraulic carrying capacity can decrease if the lining of the pipe deteriorates. Depending on the material, the decrease in capacity and the frequency of repairs can be significant. Monitoring the age of the pipelines in a system is essential so that system operators and managers can make informed decisions about the pipe network and its needs.

2.3.2 Storage Facilities

The City's existing storage facilities are shown in Table 2.3.

Table 2.3. Storage Facilities

Storage Facilities	Capacity (gallons)
EST 1	500,000
EST 2	750,000
Total Existing Elevated Storage	**1,250,000**
Water Plant #3 (Henderson) GST 1	1,000,000
Water Plant #2 (Chenango) GST	1,000,000
Water Plant #4 (Jamison) GST	400,000
Total Existing Ground Storage	**2,467,890**

2.3.3 Booster Pumping Stations

The City has three booster pump stations which provide water supply to the various City customers and boost system pressures in the service area. Table 2.4 shows a summary of the pump stations. The Henderson plant also has two 750 gallons per minute (gpm) pumps that transfer water from the storage tank at Plant 3 to the storage tank at the Chenango Plant via a dedicated 12" water line.

Table 2.4. Existing Booster and Transfer Pumps

Description	Type	Capacity (gpm, each)	No. of Pumps	Total dynamic head (feet)
Chenango Plant	Booster	850	3	137
Jamison Plant	Booster	850	3	220*
Henderson Plant	Booster	850	3	137
	Transfer	750	2	39

*A pressure reducing valve in the system is designed to reduce pressure to 60 psi downstream of the Jamison Plant, but is currently not utilized. It likely will be needed in the future after system improvements are made to the south part of the system.

2.3.4 Wells

The City owns seven groundwater production wells. Wells 6 and 7 are out of service; however, a rehabilitation project in the early planning stages may enable these wells to supply water in the future. Supply from these wells is not considered in this plan. Table 3-5 shows the capacity of each of the production wells in the distribution system.

Table 2.5. City Water Well Capacities

Well Number	Capacity (gpm)*
Well #6 (Out of Service)**	400
Well #7 (Out of Service)**	450
Well #8	550
Well #9	635
Well #10	725
Well #11	697
Freedom Park Well	750

*Capacities from Texas Drinking Water Watch Tested Capacity
**Wells #6 and #7 may be put back into service pending the results of a rehabilitation project that is in the early planning stages. Supply from these wells is not considered in this plan.

2.4 Water Demands

2.4.1 Existing Demands

WATER DEMAND CLASSIFICATION BY CUSTOMER TYPE

The City provides water to a variety of customer classes, as shown in Table 2.6. The single largest customer category is single family residential (SFR) customers, followed by commercial and multi-family residential (MFR) customers. Total water use was reported by the TWDB[2]. Volumes were allocated to customer categories based on an average percent of total demand from historical data (2009-2013). In the future, this allocation of demand is expected to continue as single family residential and multi-family residential make up a large majority of the non-rural parcels in the City's service area.

[2] Texas Water Development Board Regional Water Planning Water User Group (WUG) Utility – Summary Estimates. https://www3.twdb.texas.gov/apps/reports/WU_REP/SumFinal_UtilityWUGSum

Table 2.6. Annual Retail Water Used by Customer Type

Water Use Category	Annual Retail Water Use (million gallons)					
	2018	2019	2020	2021	2022	2023
SFR	508.3	492.3	493.1	435.8	494.0	508.3
MFR	88.8	86.0	86.1	76.1	86.3	88.8
Industrial	-	-	-	-	-	-
Commercial	132.2	128.0	128.3	113.3	128.5	132.2
Institutional	-	-	-	-	-	-
Agricultural	-	-	-	-	-	-
Total*	**729.2**	**706.3**	**707.5**	**625.2**	**708.8**	**729.2**

*Total water use from TWDB

WATER DEMAND CLASSIFICATION BY NUMBER OF CONNECTIONS

The City's roughly 7,500 metered service connections serve a variety of different customer types, including single family residential, multi-family residential, and commercial/industrial. The number of existing SFR meters was estimated based on yearly additional connection data provided by the City for 2017-2023. Historical data indicates approximately 35 SFR connections were added to the system between 2014-2016.

To estimate MFR and Commercial/Industrial total meters, ratios of MFR or Commercial total meters to SFR total meters were maintained from the 2019 UMP.

89 percent of the City's total metered service connections are SFR, and 1 percent are MFR. The majority of water consumption occurs within the residential sector. Typically, MFR service connections serve multiple residences and therefore use more water per meter. Commercial and Industrial accounts make up the remaining 10 percent of the total connections. Table 2.7 lists the total number of meters and estimated equivalent SFR connections by customer type.

Table 2.7. Average Number of Meters by Customer Type

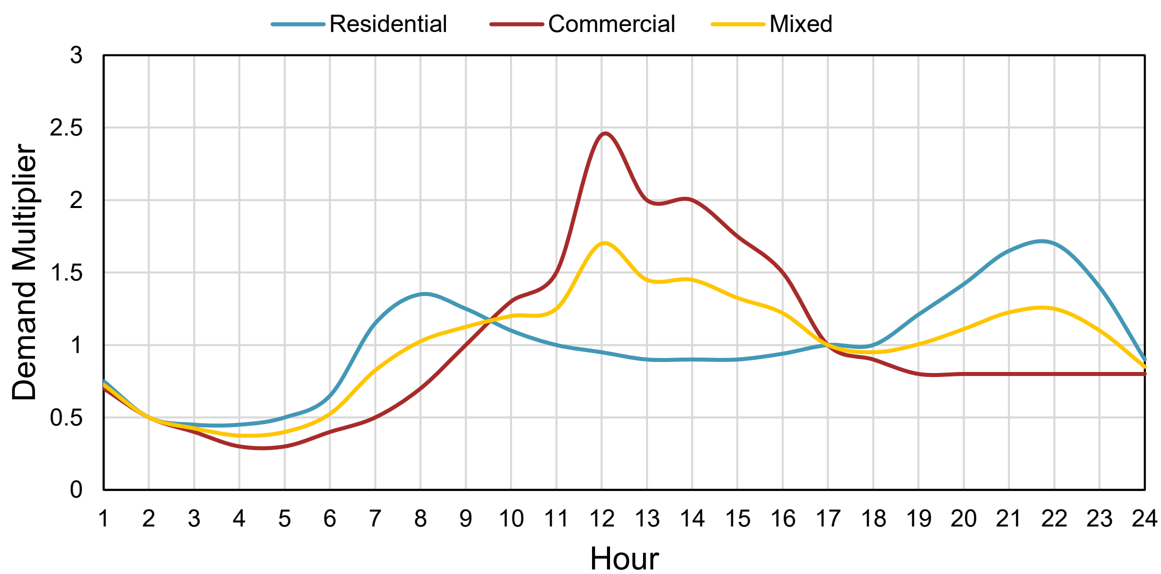
Water Use Category	Total Meters	Equivalent SFR Connections	Average Use per Meter (1,000 gal)
SFR	6,717	6,717	75.7
MFR	67	1,134	1,325.4
Commercial/Ind.	754	1,742	175.3
Total	7,538	9,593	

Note: Meter and connection counts shown are as of August 2024.

DIURNAL PATTERNS BY CUSTOMER TYPE

Water demand varies temporally throughout a day, and this variation is referred to as a diurnal pattern. Typical diurnal pattens for residential, commercial, and mixed customers are shown in Figure 2.2. Mixed customers are 50% residential and 50% commercial based on assumptions for new growth in mixed-use developments. The residential diurnal patten shows water demand peaking twice per day, once in the morning around 8:00 AM and once in the evening around 10:00 PM. The commercial users follow an opposite pattern, with demand low in the mornings and evenings but peaking in the middle of the day around noon. The mixed customers follow a combination of residential and commercial patterns.

Figure 2.2. Diurnal Patterns by Customer Type



EXISTING WATER SUPPLIES AND RECENT HISTORICAL DEMANDS

The existing water supplies and recent historical demands are summarized in Table 2.8. The average-day demands (ADD) for 2020-2022 were calculated using annual volumes published in the TWDB Water Use Reports[3]. The total annual supply was calculated as the sum of BWA surface water supply and the City's groundwater well supply. Well production was included at both 50% and 100% capacity, to capture potential variations in the total supply. The ADD and total annual supplies were used to calculate the annual surplus or need.

[3] Texas Water Development Board Regional Water Planning Water User Group (WUG) Utility – Summary Estimates. https://www3.twdb.texas.gov/apps/reports/WU_REP/SumFinal_UtilityWUGSum

Table 2.8. Existing Water Supplies and Current Annual Demands

Year	Average-day Demands (ADD) - (ac-ft/yr)	BWA Surface Water Supply (ac-ft/yr)	Annual Well Supply Capacity (ac-ft/yr)		Total Annual Supplies (ac-ft/yr)	
			100% GW Capacity	50% GW Capacity	100% GW Capacity	50% GW Capacity
2020	2,171	2,016	2,501	1,251	4,517	3,267
2021	1,919	2,016	2,501	1,251	4,517	3,267
2022	2,175	2,576**	2,501	1,251	5,077	3,827
2023	2,132*	2,576	2,501	1,251	5,077	3,827

* HDR-calculated ADD
** Contract increase was effective October 1, 2022

The existing water supplies and current demand based on maximum-day full well capacity are shown in Table 2.9. The maximum daily demand (MDD) was calculated using a peaking factor of 2.0. The total annual supply was calculated as the sum of BWA surface water supply and the City's groundwater well supply. Well production at 50% and 100% capacity was used to capture potential variations in the total supply. The MDD and maximum-day supplies were used to calculate the annual surplus or need.

Table 2.9. Existing Water Supplies and Current Maximum-Day Demands

Year	Maximum-day Demands (mgd)	BWA Surface Water Supply (mgd)	Well Supply Capacity (mgd)	Total Maximum-Day Supplies (mgd)
2020	3.88	1.80	4.70	6.50
2021	3.43	1.80	4.70	6.50
2022	3.88	2.30*	4.70	7.00
2023	3.88	2.30	4.70	7.00

* Contract increase was effective October 1, 2022

2.4.2 Land Use Projections

Angleton city limits cover approximately 7,666 acres. Table 2.10 and Figure 2.3 show the breakdown of zoning districts within city limits based on the 2018 Official Zoning Map. Land use designations used for this report are primarily based upon the City's 2003 Comprehensive Plan and the City's Zoning Ordinance completed in 2009. As part of the Comprehensive Plan, an inventory of existing land use was conducted in August 2003. This inventory provided an understanding of the location, pattern and extent of development in and around the City of Angleton. Land use information in rural and relatively undeveloped portions of the City was more generalized to reflect the limited extent of development. Categories used to collect data were typical of general land use analysis, including various categories of residential, commercial, industrial, and public or semi-public activity. The following “Base” and “Overlay” zoning districts have been established by the City’s Planning and Zoning Commission.

Base Districts

- AG: Agricultural
- SFE-20: Single-Family Estate Residential-20 (minimum 20,000 square-foot lots)
- SF-7.2: Single-Family Residential-7.2 (minimum 7,200 square-foot lots)
- SF-6.3: Single-Family Residential-6.3 (minimum 6,300 square-foot lots)
- SF-5: Single-Family Residential-5 (minimum 5,000 square-foot lots)
- 2F: Two-Family Residential (duplex homes)
- SFA: Single-Family Attached Residential (townhomes)
- MFR-14: Multi-Family Residential-14 (apartments – maximum 14 units/acre)
- MFR-29: Multi-Family Residential-29 (apartments – maximum 29 units/acre)
- MFR-36: Multi-Family Residential-36 (apartments – maximum 36 units/acre)
- MH: Modular Homes
- C-N: Commercial – Neighborhood
- C-G: Commercial – General
- C-OR: Commercial – Office/Retail
- CBD: Central Business District
- LI: Light Industrial

Overlay Districts

- PD: Planned Development

2.4.3 Development Areas

The City anticipates substantial residential, commercial, and industrial growth in the next 30 years. Most developments will be located to the south, northeast, or northwest parts of the City. The anticipated development areas and how much growth City planning staff anticipate will occur in each area over the next 10 years are shown in Figure 2.4. The anticipated land use types for each development area are shown in Table 2.11. The projected land use designations are shown in based on the anticipated development areas and current zoning designations.

Table 2.10. Existing Zoning Designations

Type	Land Use Designation	Approximate Acreage	Percent of Total
Residential	Single Family	2,952	39%
	Multi Family	272	4%
Commercial	Commercial General	1,150	15%
	Central Business District	39	1%
	Commercial/Office Retail	168	2%
	Light Industrial	823	11%
Agricultural		305	4%
Planned Development		543	7%
Other*		1,415	18%
Total		**7,666**	**100%**

*Includes parcels with no zoning designation

Figure 2.3. Existing Zoning Designations

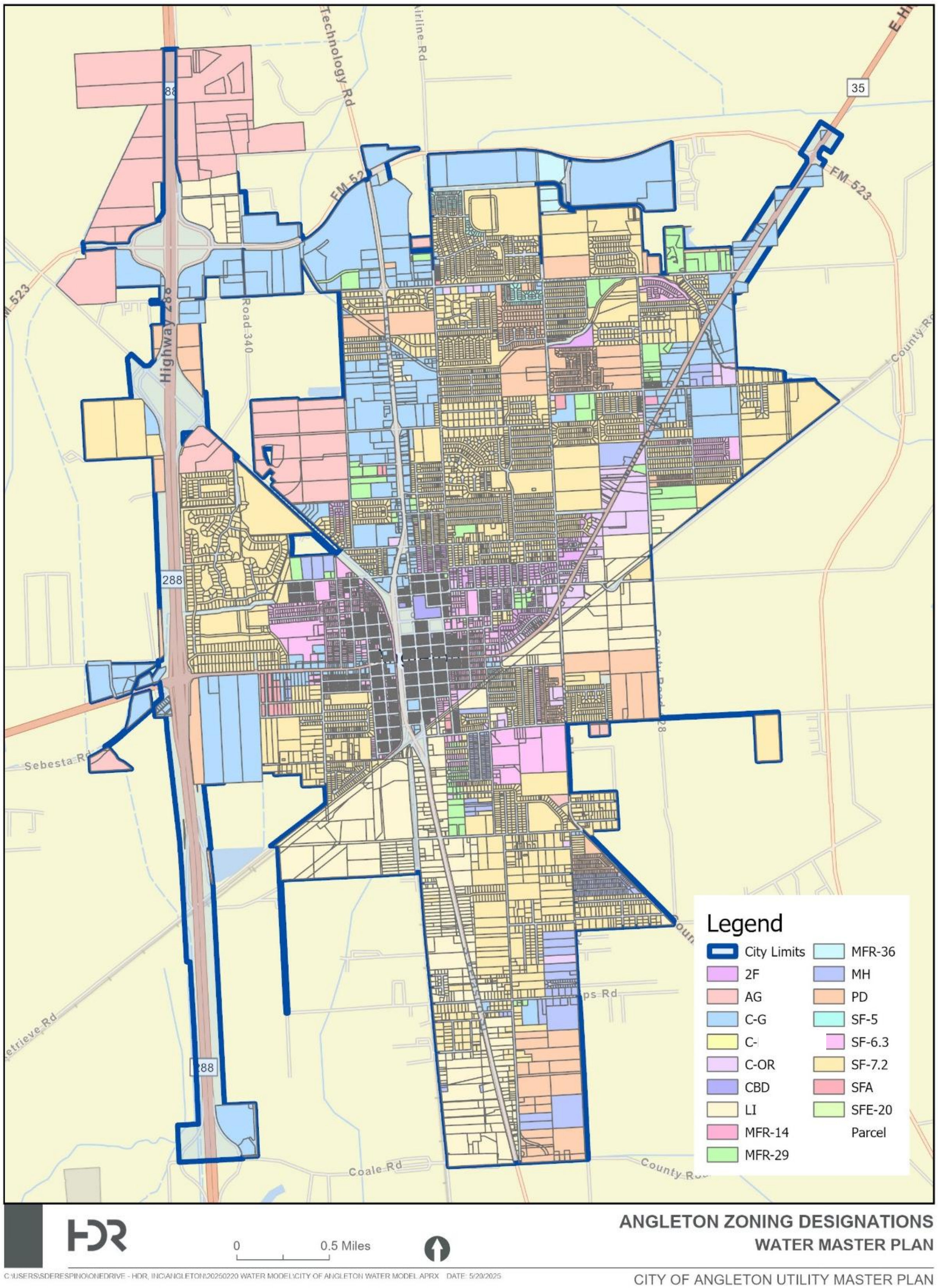


Figure 2.4. Development Areas for Assumed Growth

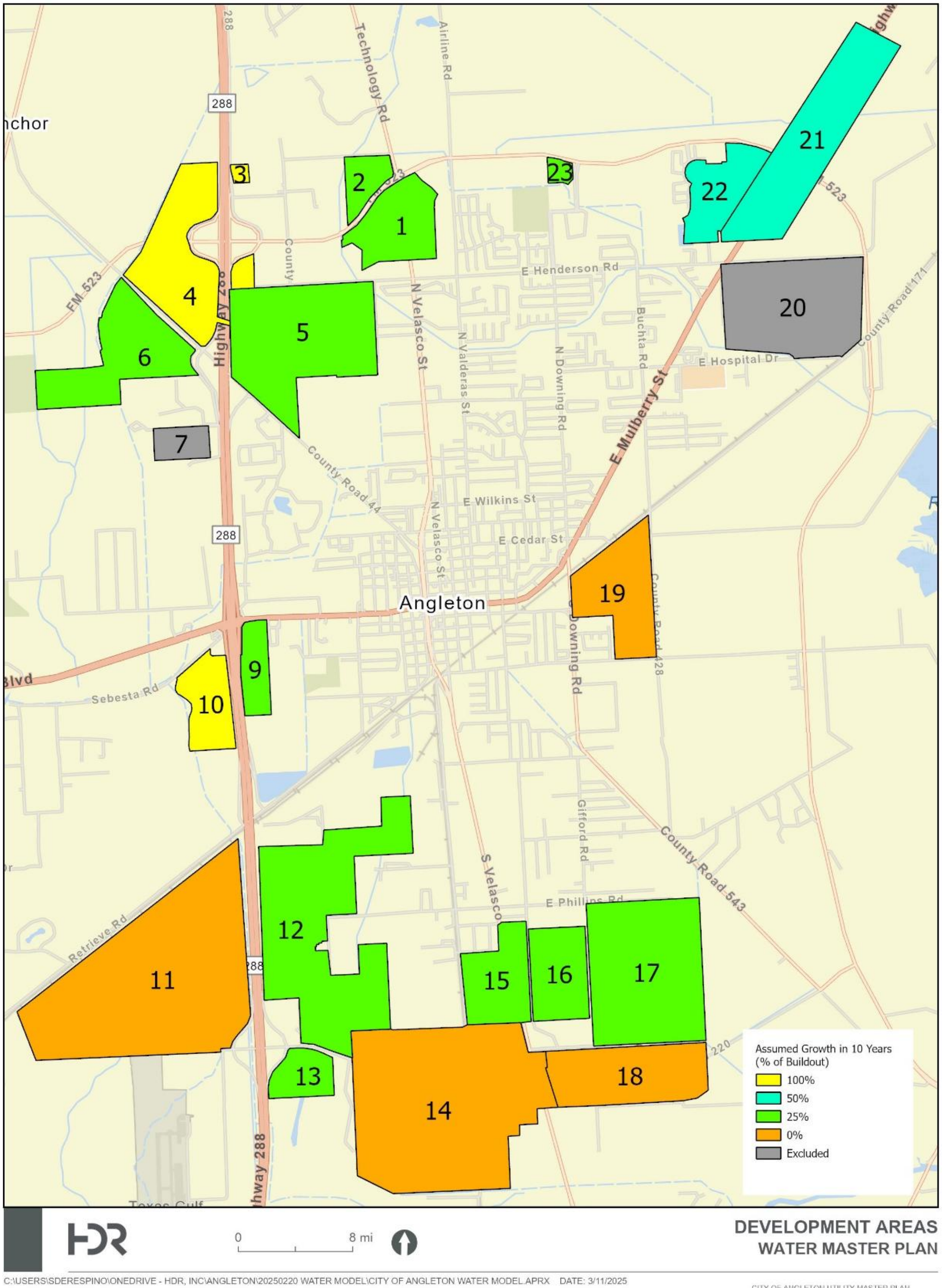


Table 2.11. Anticipated Characteristics of each Development Area

Number ID	Development Type	Area (acres)
1	Mixed Use: Multi-Family/Commercial	137
2	Mixed Use: Multi-Family with Commercial Frontage	50
3	Car lot and wash 17 ESU	8
4	General Commercial and Light Industrial	284
5	Hotel and Commercial	365
6	Residential (30-Years to Build-out)	224
7	Fire Field	43
8	Not Considered	61
9	Medium-High Density Mixed Residential	101
10	Medical Center	712
11	Industrial (30-yr Build out Possible)	521
12	SW Angleton Res Growth	65
13	Low Density Residential	683
14	Mixed Use: Single-Family Residential/Light Industrial	133
15	Mixed Use: Commercial/Industrial	126
16	Low Density Residential	387
17	Light Residential	213
18	Light Industrial	180
19	Residential	308
20	High Density Industrial	311
21	Mixed Use: Commercial/Light Industrial	119
22	Single Family and Multi-Family Residential	14
23	Senior Living Facility	137
Total		5,045

Table 2.12. Projected Total Areas of Land Use with Future Development Areas

Type	Land Use Designation	Approximate Acreage	Percent of Total
Residential Use	Single Family	4,874	46%
	Multi Family	433	4%
Commercial	Commercial General	1,703	16%
	Central Business District	40	0.4%
	Commercial/Office Retail	190	2%
	Light Industrial	2,242	21%
Other	Agricultural	617	6%
	Planned Development	438	4%
	Total	10,537	100%

2.4.4 Future Demands

Additional future average-day demands for near-term and long-term based on anticipated developments are shown in Table 2.13, based on the projected number of future connections and water use per connection. For purposes of this plan, near-term demands are expected within the next 10 years (2033) and long-term demands are expected at 30 years (2053), based on the time this planning effort was initiated (2023).

Table 2.13. Additional Near-Term and Long-Term Average-Day Demands

Demands	Total Demands Added Near-Term (2033)	Total Demands Added Long-Term (2053)
Total Projected Additional Residential Demand (gpm)	306	1,334
Total Projected Additional Non-residential Demand (gpm)	369	869

Water use by residential, commercial and other customers can be influenced by various factors like climate, economy, water conservation, regulatory changes, etc. The extent of these effects may vary based on local conditions and can be significant. Increased demands may result in the need for additional system capacities, enhanced water conservation efforts in order to comply with state mandates, or additional water supply sources.

The number of additional connections was estimated using historical data of demand and total equivalent connections for SFR, MFR, and commercial customers. The residential demand per connection was estimated as 0.139 gpm and commercial demand per connection was estimated as 0.320 gpm. The estimated number of connections based on projected demands is shown in Table 2.14.

Table 2.14. Near-Term and Long-Term Number of Connections

Connections	Near-Term (2033)	Long-Term (2053)
Number of Existing Connections	8,738	
Number of Additional Residential Connections	2,206	9,628
Number of Additional Non-residential Connections	1,152	2,714
Total Number of Existing and Future Connections	**12,095**	**21,080**

2.4.5 Minimum System Capacity Requirements

The Texas Administrative Code (TAC) details minimum system capacity requirements that must be met by public water systems based on number of connections in the system (30 TAC §290.45). The minimum pumping capacity requirement is 0.6 gpm per connection; however, the City is approved for an alternative capacity requirement (ACR) of 0.37 gpm per connection. These regulations also stipulate that systems the size of the City's are to maintain at least 200 gallons of storage per connection, of which at least 100 gallons of storage per connection must be elevated storage. The projected requirements for the system, including existing connections and future connections, are shown in Table 2.15 for near-term (2033) projections. The existing system meets TAC requirements for the near-term projection.

Table 2.15. Minimum System Capacity per TAC Requirements (Near-Term)

System	Existing System	TAC requirement	Near-Term Requirements (2033)	Surplus/ (Deficit)
Total Storage (gal)	3,650,000	200 gal/connection	2,419,200	1,230,800
Elevated Storage (gal)	1,250,000	100 gal/connection	1,209,600	40,400
Firm Pumping Capacity (gpm)	7,050	0.37 gpm/connection	4,475	2,575
		0.6 gpm/connection	7,257	(207)

Table 2.16 shows the number of additional connections allowed in the system for near-term projections before the minimum system capacity conditions require additional infrastructure. The elevated storage requirement is the limiting factor. After 404 connections are added to the system beyond the near-term projection, additional elevated storage capacity will need to be constructed.

Table 2.16. Additional Connections Allowed per TAC Requirements (Near-Term)

System	Additional Connections Allowed
Total Storage (gal)	6,154
Elevated Storage (gal)	404
Firm Pumping Capacity (gpm)	6,959

Projected long-term (30-year) requirements are shown in Table 2.17. The existing system will not meet TAC requirements for elevated storage, total storage, or firm pumping capacity under the future (long-term) anticipated number of connections. This indicates additional elevated storage and pumping capacity should be included in long-term planning.

Table 2.17. Minimum System Capacity per TAC Requirements (Long-Term)

System	Existing System	TAC requirement	Long-Term Requirements (2053)	Surplus/ (Deficit)
Total Storage (gal)	3,650,000	200 gal/connection	4,216,000	(566,000)
Elevated Storage (gal)	1,250,000	100 gal/connection	2,108,000	(858,000)
Firm Pumping Capacity (gpm)	7,050	0.37 gpm/connection	7,800	(750)
		0.6 gpm/connection	12,648	(5,598)

2.5 System Analysis

2.5.1 Existing System Update and Analysis

The distribution system model developed for the previous UMP was compared to the latest water lines GIS shapefile and facility inventory table to identify assets currently in service but not represented in the hydraulic model. All missing water lines were added to the hydraulic model network and assigned geometry based on attribute data assigned to each pipeline asset. New water lines were assigned a roughness factor of 130, consistent with modeling standards for water pipes in good condition. Parcels adjacent to the added water lines were assigned water demand loading based on their land use type and acreage. The additional demands from these recently developed parcels were allocated based on geographic proximity to the new modeled water lines. The Freedom Park groundwater well and booster pump station was added to the model and assigned storage volumes, pump capacities, and operational parameters based on the facility inventory table provided by City staff.

Once the distribution system hydraulic model was updated, a present-day simulation was developed to evaluate existing system conditions. The present-day water system simulation was evaluated for pump run times, storage tank cycling, distribution system pressures, and total water supply utilization. Differences between the previous and updated hydraulic models include:

- Freedom Park groundwater well and pump station added;
- Jamison Booster Pump Station pressure reducing valve (PRV) is no longer active and is currently being bypassed;
- Demands in the south half of the distribution system are sufficient to facilitate cycling of EST 2 without the Jamison PRV;
- Fire flow capacity in the south half of the distribution system has been improved by recent distribution system improvements which loop previously dead-end mains and by the replacement of small diameter mains with larger diameter mains;
- Expansion of the distribution system to serve Rancho MUD and customers to the northeast between FM 523 and E Henderson Rd; and
- Infill development and associated water system improvements in neighborhoods south of E Henderson Rd.

Hydraulic model simulations of the present-day distribution system indicate no significant operational or supply limitations in its current configuration. These results suggest that improvements made to the distribution system since the previous UMP have improved capacity in growing areas of town sufficient to accommodate the increasing demands. Additionally, the development of the Freedom Park well and utilization of existing wells supplying the Chenango Booster Pump Station effectively diversify water supplies under maximum-day demand conditions without exceeding the wholesale water supply contract with BWA.

Existing distribution system pressures were found to exceed TCEQ minimum requirements, with model pressure only dropping below 35 psi inside pumping facilities on the suction side of pumps or at the end of two small diameter, dead-end mains. Minimum pressure was evaluated assuming maximum day demands, existing controls schemes, firm capacity at each pumping facility, and tanks in normal operation. Minimum pressures are slightly higher in the central and southeast areas of the distribution system due to lower ground elevation. Except for small diameter, dead-end mains, the existing system can deliver 2,000 gpm of fire protection flow at all locations at a residual pressure of 20 psi.

2.5.2 Future System Analysis

Future planning areas to be accommodated in future system model simulations were defined during two meetings with City of Angleton staff. The planning areas were each assigned an expected land use type and approximate build-out schedule (Figure 2.4). Demands from the future planning areas were loaded into the existing model based on a near-term planning horizon and a long-term planning horizon.

The near-term planning horizon and capacity utilization of existing and future proposed assets is the basis for potential impact fee reimbursement calculations based on the proportional capacity required to meet the near-term growth. If the City were to adopt an impact fee ordinance, this portion of the costs would be considered eligible. The long-term development horizon defined the full capacity required to meet the needs of anticipated demands and avoid capital project duplication in the short to medium term.

Two five-day extended period simulations, based on near-term (10-year) growth and long-term (30-year) growth, were developed to evaluate the impact of the future demands on system assets. Various operational parameters were evaluated to assess system performance, including:

- Minimum pressure requirements established by TCEQ;
- Distribution pipeline velocities;
- Pump run time and firm pumping capacity at each facility; and
- Elevated storage tank cycling and the system's ability to replenish storage tank volumes.

The near-term and long-term growth simulations were further refined to evaluate average-day and maximum-day demand conditions. The average-day demand scenario defined the baseline distribution system pressures at all junctions and maximum detention time of water stored in ground and elevated tanks. The maximum-day demand simulation was used to assess system minimum pressure values throughout the diurnal demand cycle, pump runtimes, tank cycling, and maximum, non-emergency pipeline velocities. Examples of the operational performance of EST 1 under existing and near-term horizon demand conditions, for average and maximum-day demands are illustrated in Figure 2.5 through Figure 2.8.

2.5.1 Operations Modifications

All high service pump operations are currently controlled by the level in EST 1. Transfer pumps from the Henderson BPS and the four active groundwater wells supplying the transfer line between the Henderson BPS and Chenango BPS are controlled by the level in the Chenango GST. Future demand simulations identified reduced distribution system performance with regard to minimum system pressure and EST cycling, caused by the control scheme at the Jamison and Chenango BPS's being linked to levels in EST 1. To address this issue, an alternative future operational scenario was developed that would modify the operation of the Jamison and Chenango BPSs. Converting the Chenango BPS to be controlled by the level in EST 2, and the Jamison BPS to be controlled by a proposed future EST near the intersection of CR 220 and S Velasco St addressed the noted deficiencies. The minimum modeled pressures for the current and the alternative operating scenarios are illustrated in Figure 2.9 and Figure 2.10. Modeled EST cycling and minimum/maximum levels for the current and alternative operating scenarios are illustrated in Figure 2.11 through Figure 2.14. As shown in the figures, modifying the system's controls as described in the alternative scenario greatly increases system pressures.

While the City's demands can be met during average demand periods solely with supply from BWA, the groundwater supplies should be operated routinely to maintain operational reliability and minimize the potential for water quality degradation during times of low groundwater use.

Figure 2.5. Existing System Average-day EST 1 Cycling

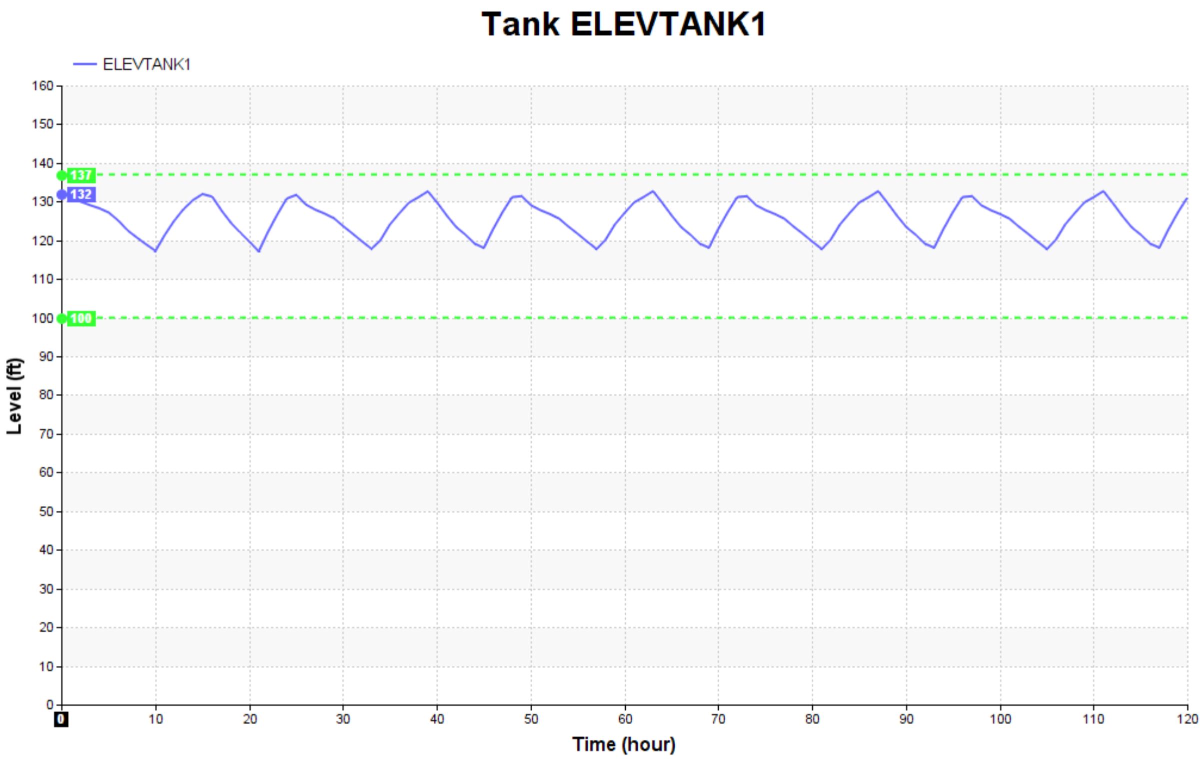


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Figure 2.6. Near-term Average-day with Capital Improvements - EST 1 Cycling

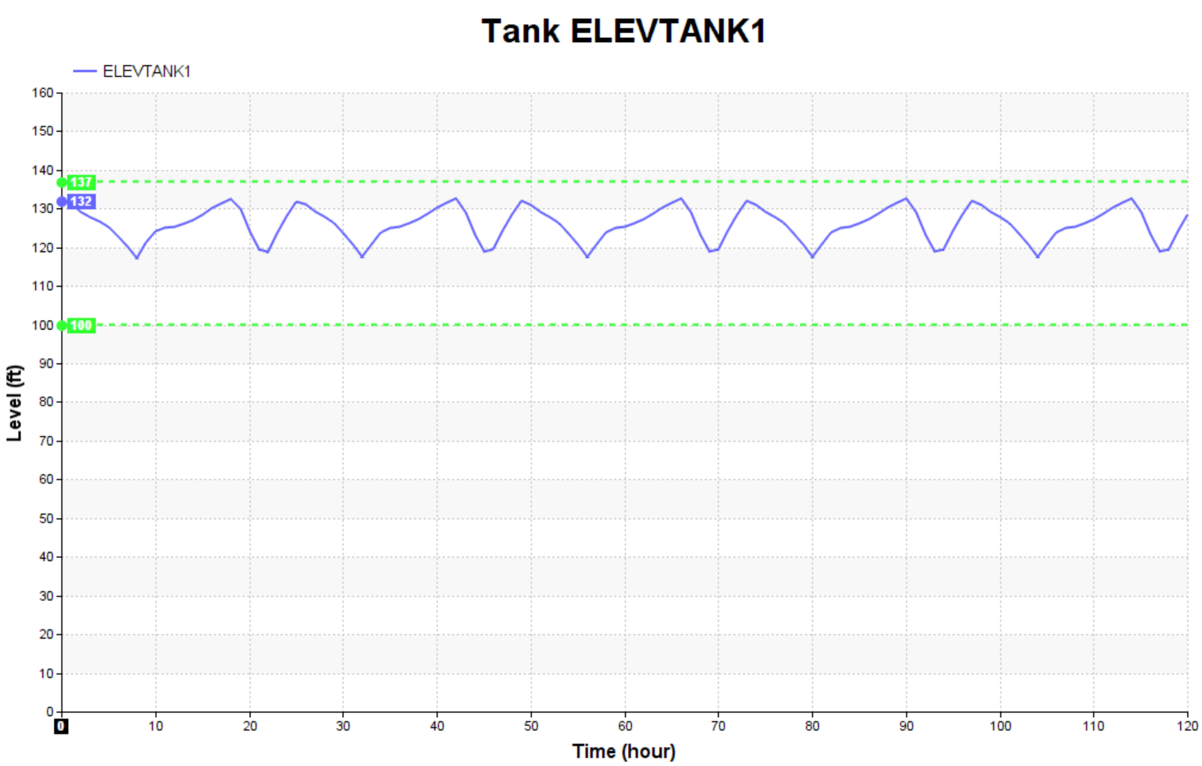


Figure 2.7. Existing System Maximum-day EST 1 Cycling

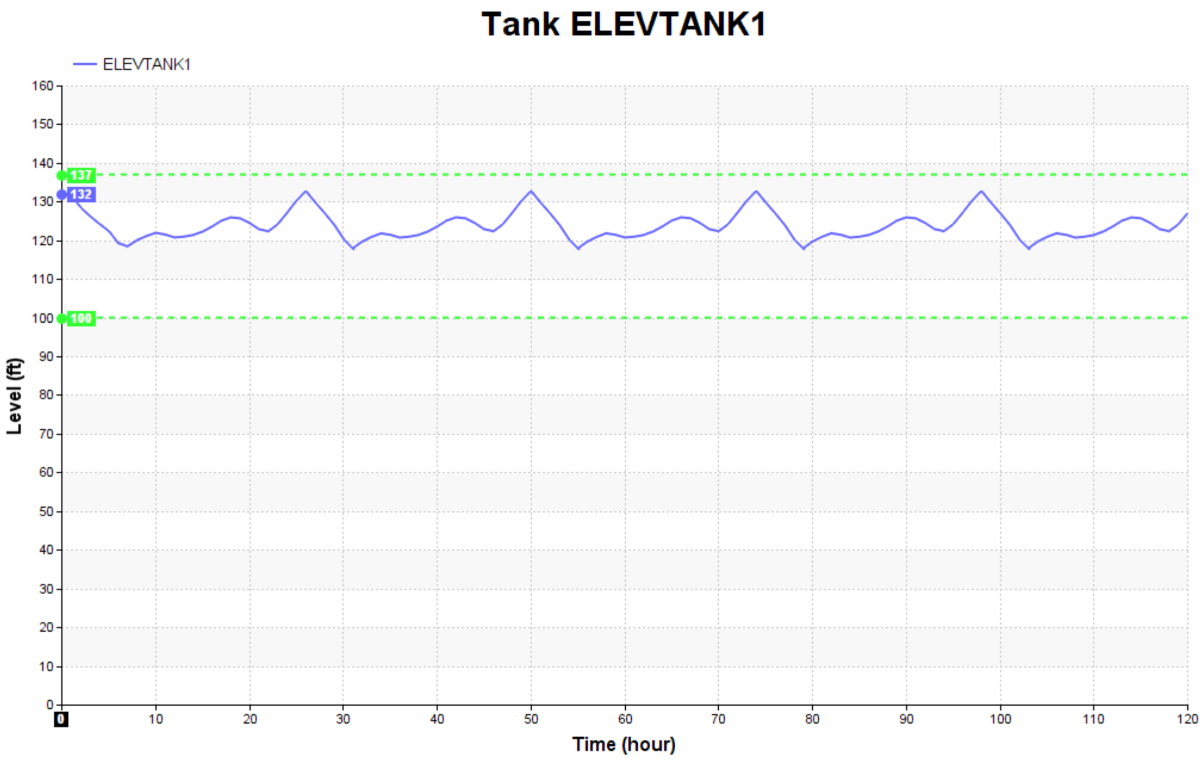


Figure 2.8. Near-term Maximum-day with Capital Improvements - EST 1 Cycling

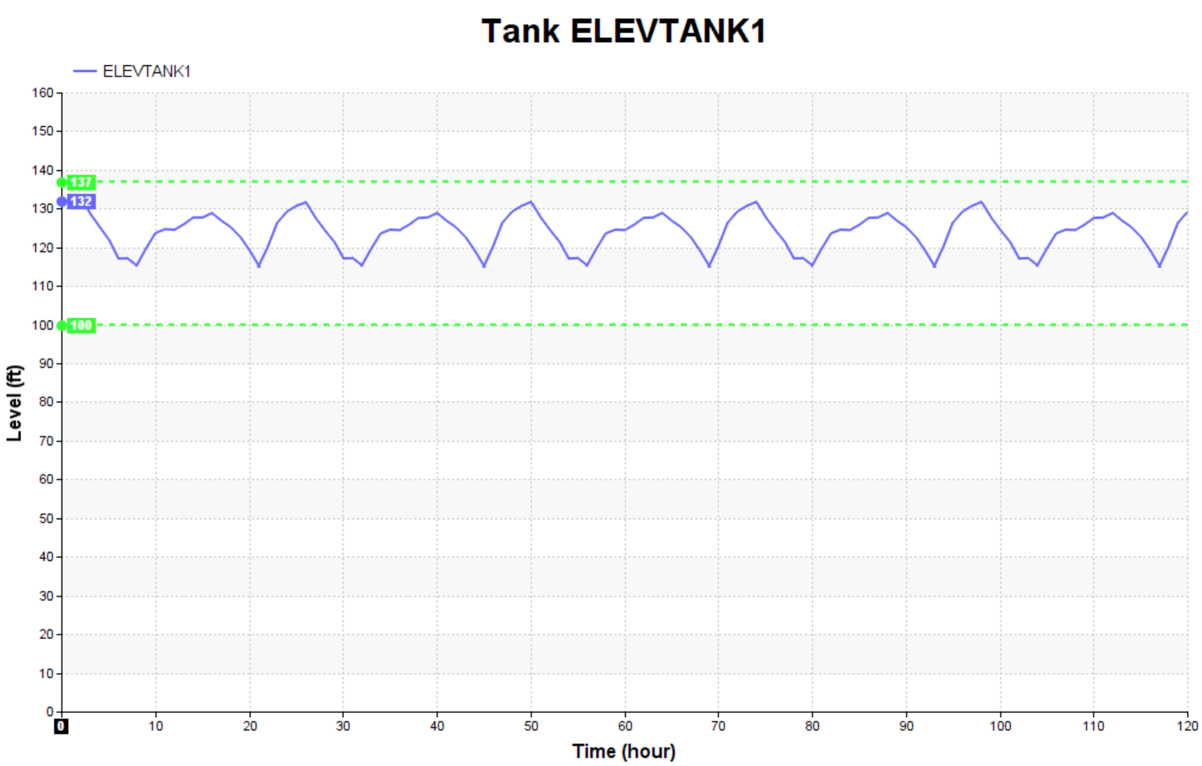


Figure 2.9. System Minimum Pressures: Long-Term Max Day - Existing Controls

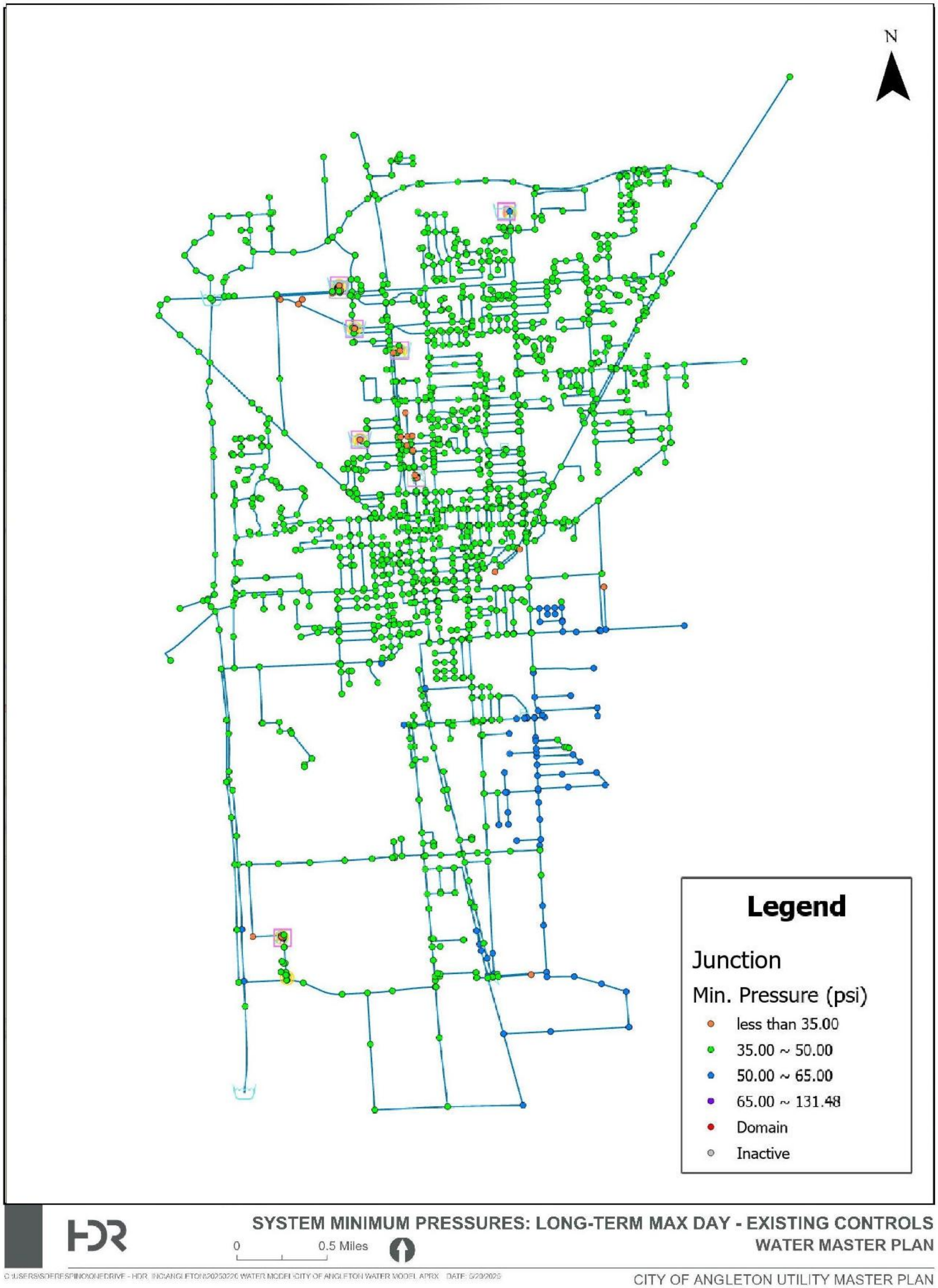


Figure 2.10. **System Minimum Pressures: Long-Term Max Day - Modified Controls**

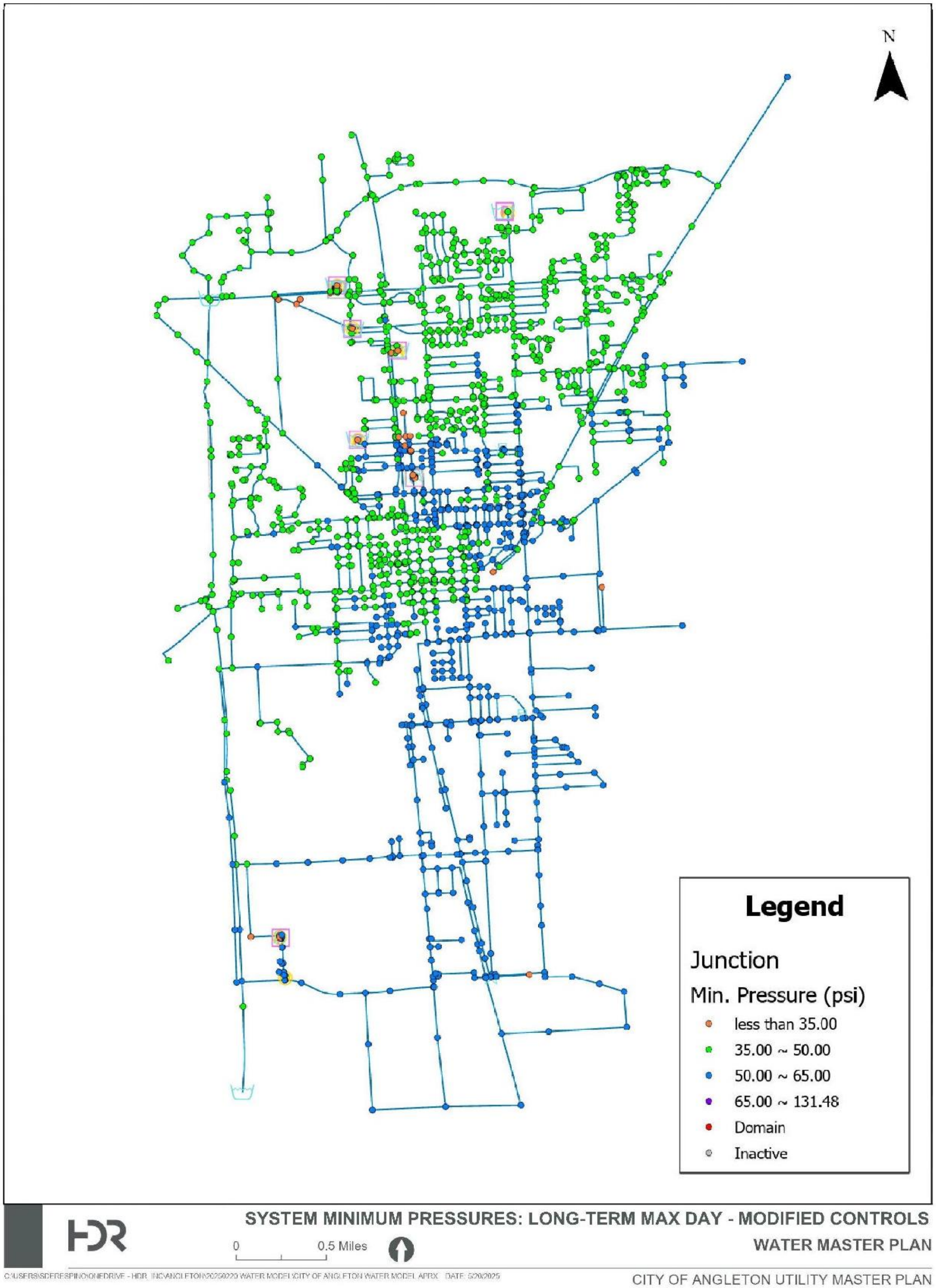


Figure 2.11. Long-Term Max Day EST 1 - Existing Controls

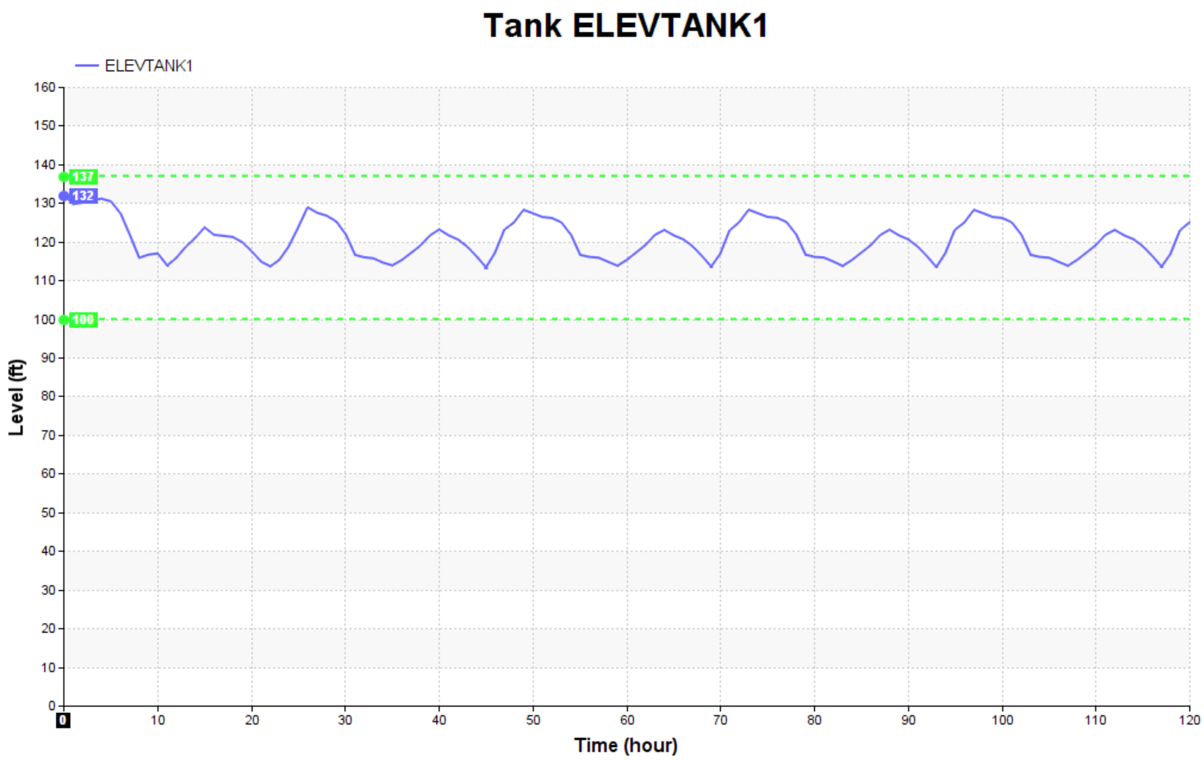


Figure 2.12. Long-Term Max Day EST 1 - Modified Controls

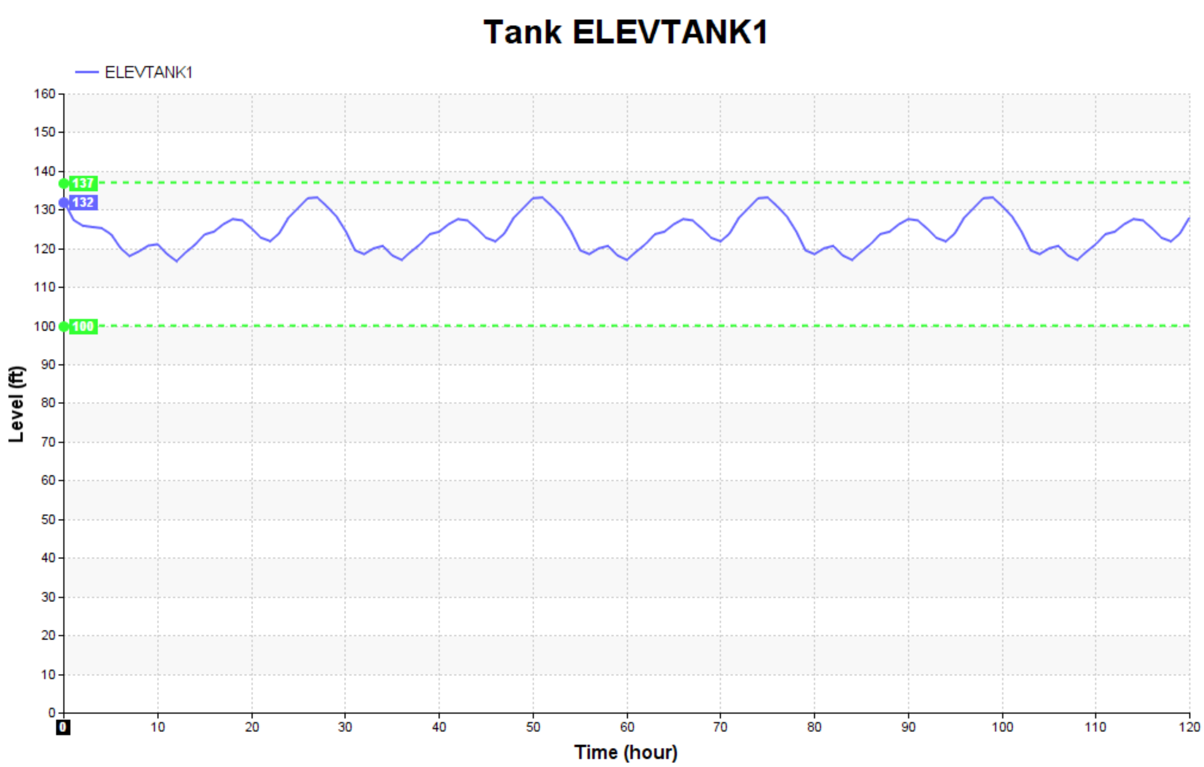


Figure 2.13. Long-Term Max Day EST 2 - Existing Controls

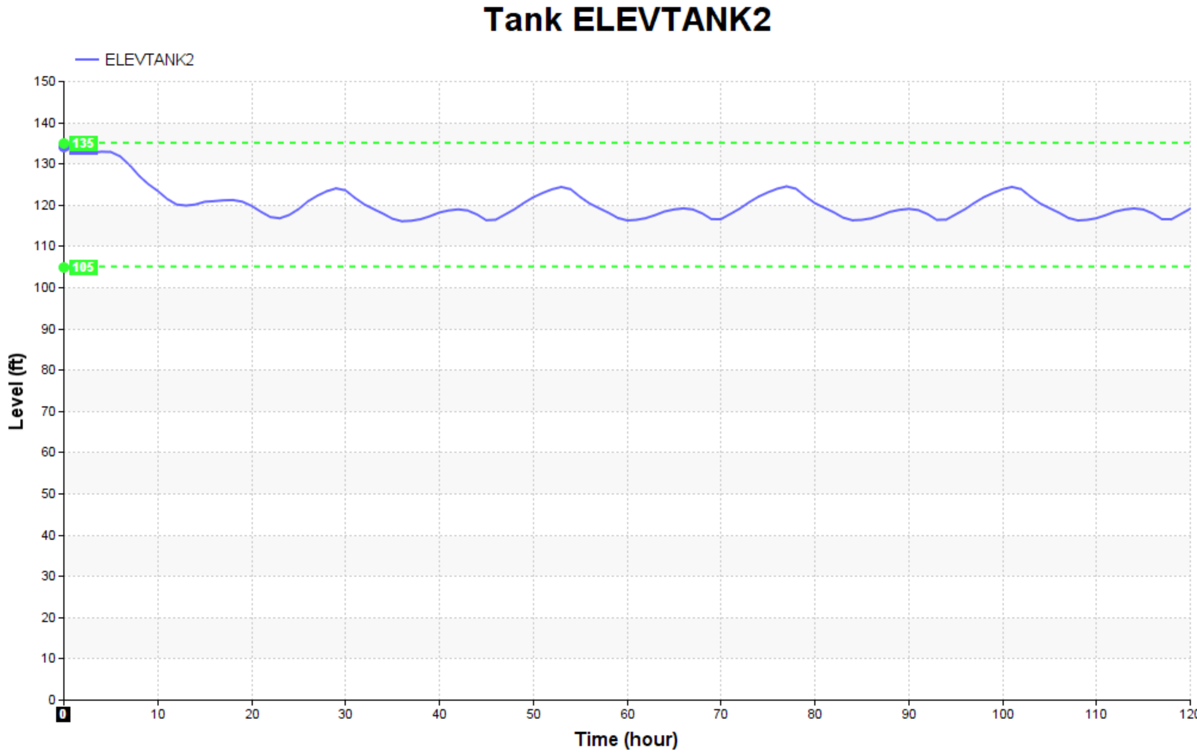
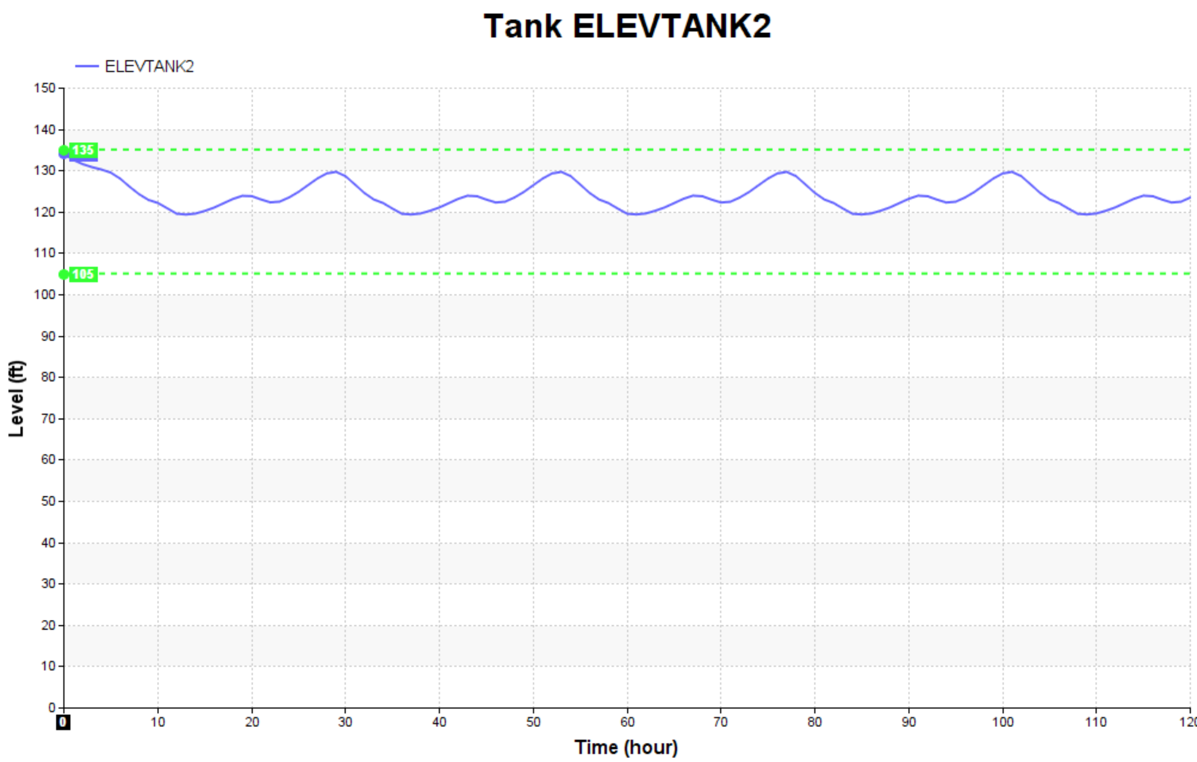


Figure 2.14. Long-Term Max Day EST 2 - Modified Controls



2.5.2 Future Improvements

Facility and pipeline improvements were added to the model where existing system capacities were exceeded, or where distribution system infrastructure was needed to serve new growth areas. Improvements were phased to evaluate the percentage utilization of each proposed project for the near-term planning horizon in relation to the required long-term capacity.

DISTRIBUTION SYSTEM IMPROVEMENTS

Henderson pump improvements
Maximum-day demands utilize all three existing pumps. A fourth pump was added as a future improvement for operational redundancy and to meet TCEQ standards for required firm pumping capacity.

Chenango distribution line pipe size increase
Future model simulations identified that the future predicted increased volume of water pumped from the Chenango BPS would result in excessive velocities in the distribution main from the Chenango BPS to the 12-inch diameter looped distribution system, beginning at the intersection of E Wilkins St and N Chenango St. The existing 10-inch and 12-inch diameter water lines are proposed to be replaced with a new 16-inch diameter water line.

Chenango pump improvements
Future model simulations under maximum-day demands utilize all three existing Chenango BPS pumps. A fourth pump was added as a future improvement for operational redundancy and to meet TCEQ standards for required firm pumping capacity.

Northeast Expansion
Pipeline improvements are proposed near the intersection of Hwy 35 and FM 523 to support anticipated mixed-use developments along Hwy 35 and to close a distribution system loop serving the northeastern portion of the Rancho MUD and Growth Areas 21 and 22.

Northwest area pipeline improvements
Pipeline improvements are proposed along CR 44, E Henderson Rd, FM 523, and Hwy 288 to support anticipated near-term and long-term mixed-use growth. Projects include:

- FM 532 Interconnect closes a loop along the north side of FM 523 and directly serves Growth Area 2.
- Hwy 288 & FM 523 closes a loop from Carbtex Rd, east across Hwy 288, south to FM 523. This project directly serves Growth Areas 3 and 4.
- Henderson to CR 44 improves capacity to Growth Area 5 and reduces maximum-day head loss in the local distribution system.
- CR 44 Extension improves capacity along CR 44 and directly serves Growth Areas 4 and 6.

Southwest area pipeline improvements

Pipeline improvements are proposed along Hwy 288, CR 219, and Coale Rd to support anticipated long-term mixed-use and industrial growth. Southwest area improvements will also support additional utilization of the Jamison BPS. Projects include:

- Coale Rd & Hwy 288 Loop improves conveyance from the Jamison BPS along Hwy 288 and serves Growth Areas 10, 11, 12, and 13.
- CR 219 Waterline creates a loop from CR 219 to Hwy 288 and serves Growth Area 12.
- Hwy 288 Northbound Waterline Extension creates a loop from the proposed Coale Rd and Hwy 288 Loop and existing mains near the intersection of Hwy 288 and W Mulberry St. This project serves Growth Area 9.

South area pipeline improvements

Pipeline improvements are proposed in the area bounded by CR 220 in the west, CR 44 in the south, and E Phillips Rd in the north. This area is anticipated to experience significant long-term residential, mixed-use, and industrial growth but is currently served by limited infrastructure and distribution system capacity. Projects include:

- Coale Rd & Hwy 288B Loop creates a loop around Growth Area 14, improves capacity between the Jamison BPS and the Hwy 288B area, and supports the operation of a proposed EST near the intersection of S Velasco St and CR 220.
- CR 288 Waterline Extension connects existing distribution system assets to the proposed Coale Rd and Hwy 288B Loop. This project serves Growth Area 14.
- E Phillips Rd & CR 220 Interconnect connects existing distribution system assets along E Phillips Rd to the location of a proposed EST near the intersection of S Velasco St and Cr 220. This project serves Growth Areas 16 and 17.
- CR 220 Loop connects the proposed Coale Rd and Hwy 288B Loop project to the proposed E Phillips Rd & CR 220 Interconnect project, extending water service to the far southeast. This project serves Growth Areas 17 and 18.
- S Velasco St Loop closes a gap along S Velasco St and serves Growth Area 15.

East area pipeline improvements

Pipeline improvements are proposed in the area bounded by CR 171 in the north, E Kiber St in the south, S Downing Rd to the west, and CR 428 in the east. These proposed improvements support long-term growth and create additional looping between existing distribution system waterlines. Projects include:

- CR 428 Waterline creates a loop from CR 171 to E Kiber St, along CR 428 and serves Growth Area 19.
- CR 428 & S Downing Rd Interconnect connects existing distribution system waterlines along S Downing Rd to the proposed CR 428 Waterline project. This project serves Growth Area 19.

New southside elevated storage tank (EST 3)

A new tank is proposed in the southside of the distribution system to meet TCEQ storage requirements, based on anticipated future connections, and to serve Growth Areas 11, 12, 13, 14, 15, 16, 17, and 18. Operational control of the Jamison BPS is proposed to be converted from the level in EST 1 to the level in the proposed EST 3 once future development in the areas along CR 220 occurs.

TRANSFER SYSTEM IMPROVEMENTS

Henderson transmission line

The existing transmission line that supplies treated water from the Henderson Water Plant to the Chenango Water Plant is also utilized as a well supply line when Water Wells 8, 9, and 10 are used to meet water demands. City staff are able to operate valves on the existing transmission line and direct well water from Water Wells 8, 9, and 10 to the Henderson Water Plant or the Chenango Water Plant. However, during this time, the Chenango Water Plant cannot receive any treated water from the Henderson Plant (combined surface water and well water – chloraminated water) and can only utilize well water that has been disinfected with chlorine. The chloramine-treated water from the Henderson Plant and Jamison Plant mixing with the chlorine-treated water from the Chenango Plant will cause odor and taste issues as well as potentially cause a disinfection byproduct. To remedy this, City staff would like to have two separate lines, one for wells (existing transfer line) and one for supply (new line). This will allow water quality to remain consistent in the City and will make operations more efficient when Water Wells 8, 9, and 10 are required to meet water demands. While this situation could be remedied by the addition of an ammonia feed to the Chenango Water Plant to chloraminate the groundwater supply, the second supply line will alleviate hydraulic capacity limitations that inhibit full utilization of the well supplies and supplies transferred from the Henderson Water Plant to the Chenango Water Plant.

2.6 Capital Improvements

The process for identifying capital improvement projects involves the following steps:

1. Assess the growth areas and forecast their future demand.
2. Evaluate the location and capacity of nearby mains that could support the growth areas.
3. Recommend upsizing existing mains where increased pipeline capacity is needed.
4. Propose the addition and proper sizing of new mains to serve growth areas where the current distribution system does not reach.
5. Incorporate looping of pipes to address water age concerns, minimize headloss, and reduce the number of dead end connections.

Capital improvements for the installation of new water mains is shown in Figure 2.15. The projects are categorized by CIPs recommended to be completed in the next 10 years (Near-Term) and CIPs to serve developments in the next 30 years (Long-Term).

The existing water mains located near the Chenango pump are recommended to be upsized to 16” mains. The location of the water mains is shown in Figure 2.16.

Figure 2.15. New Water Mains

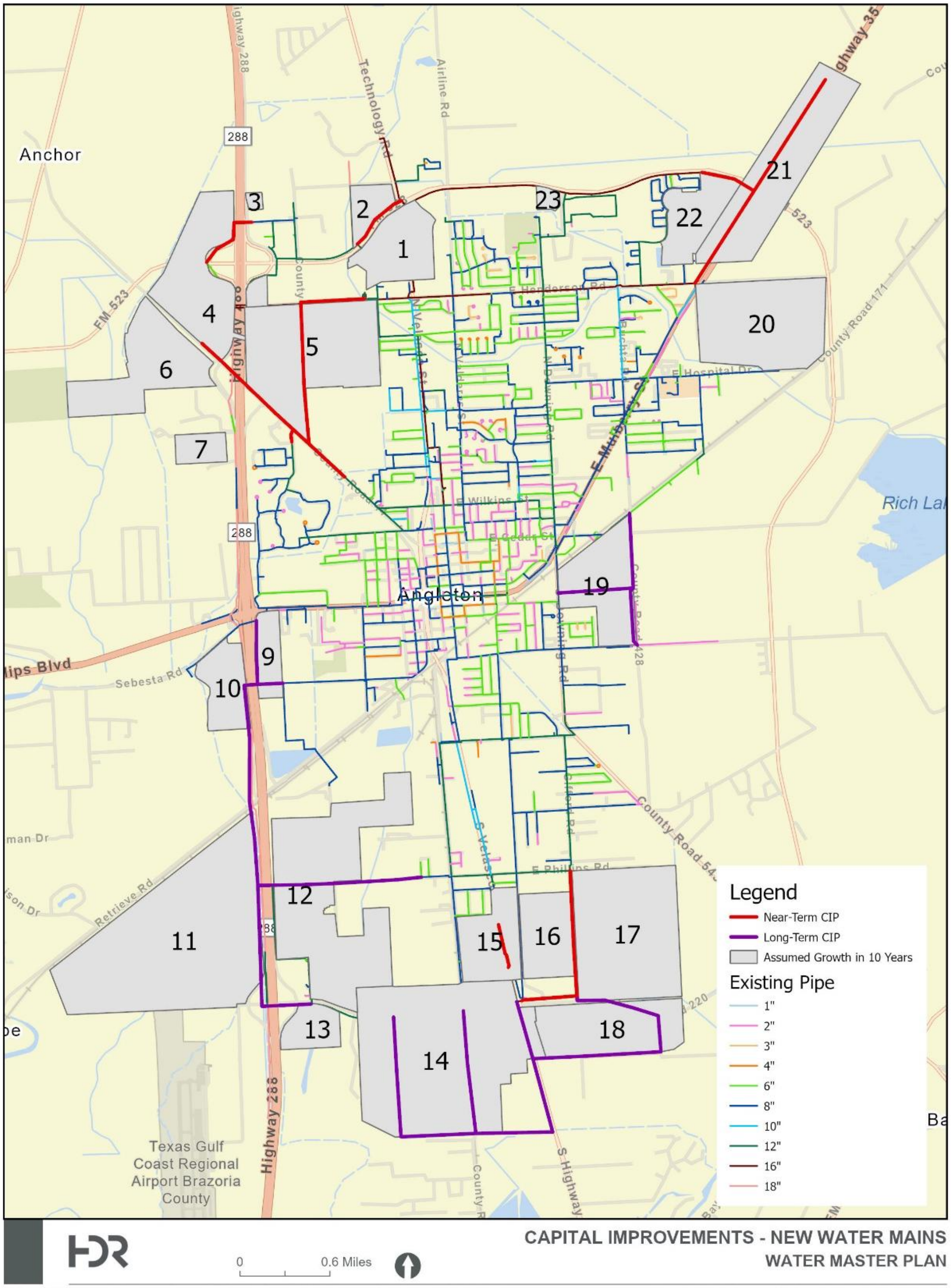
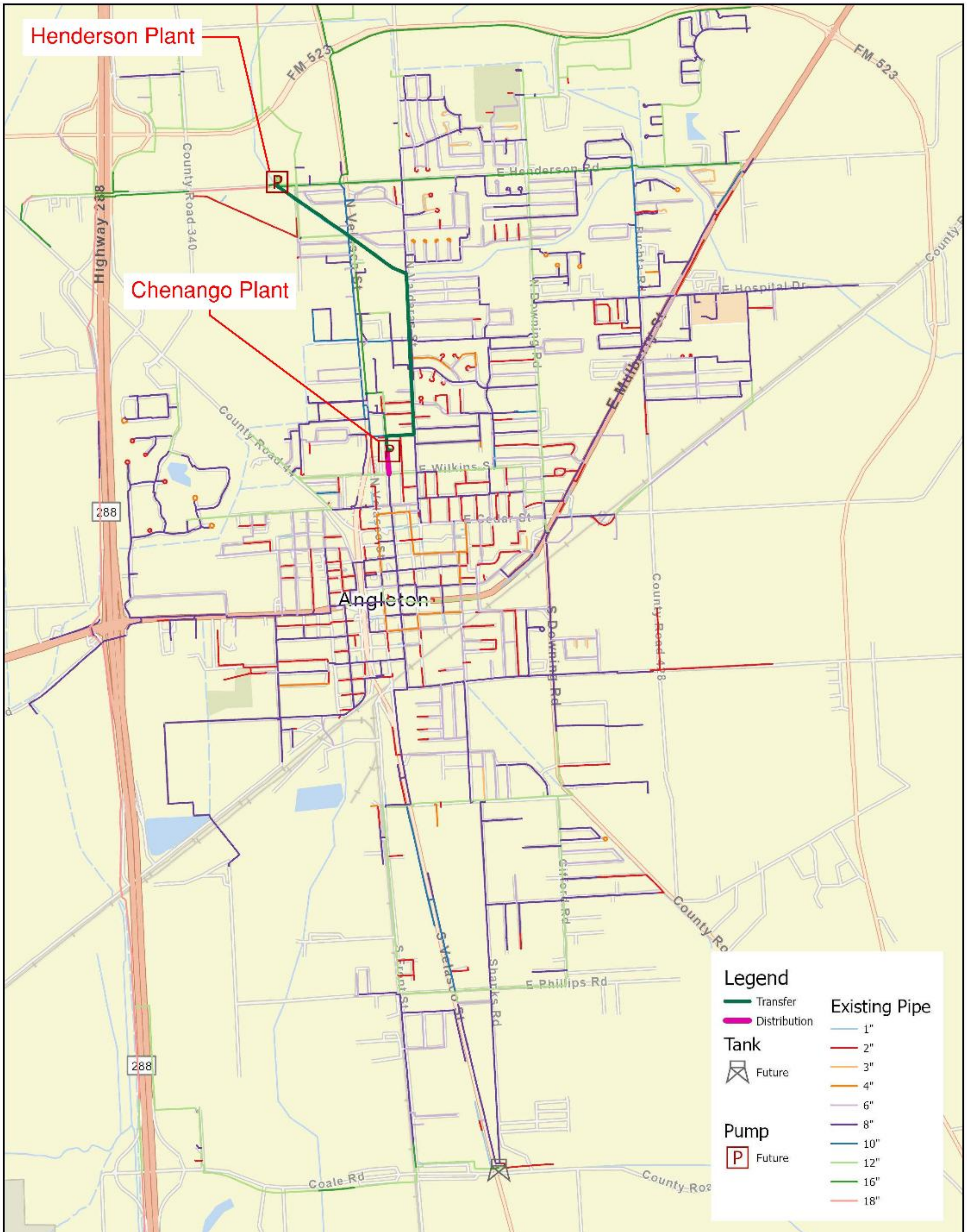


Figure 2.16. Pump, Storage, and Existing Mains Improvements



HDR **CAPITAL IMPROVEMENTS - PUMP, STORAGE, AND INCREASED CAPACITY OF EXISTING MAINS**
WATER MASTER PLAN

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CITY OF ANGLETON UTILITY MASTER PLAN

Based on demand projections and minimum TCEQ capacity requirements (Table 2.17), an elevated storage capacity deficit exists in 2055. An elevated storage tank of 1 million gallons (mg), located south of the City to serve future developments, is recommended. The proposed location of the tank is shown in Figure 2.16.

Based on demand projections and minimum TCEQ capacity requirements (Table 2.17), a firm pumping capacity deficit exists in 2055. It is recommended to include an additional pump at the Chenango pump site, as shown in Figure 2.16. Additionally, the long-term model indicates all 3 service pumps at the Henderson pump station are active during maximum-day demands. A 4th pump is recommended, as shown in Figure 2.16.

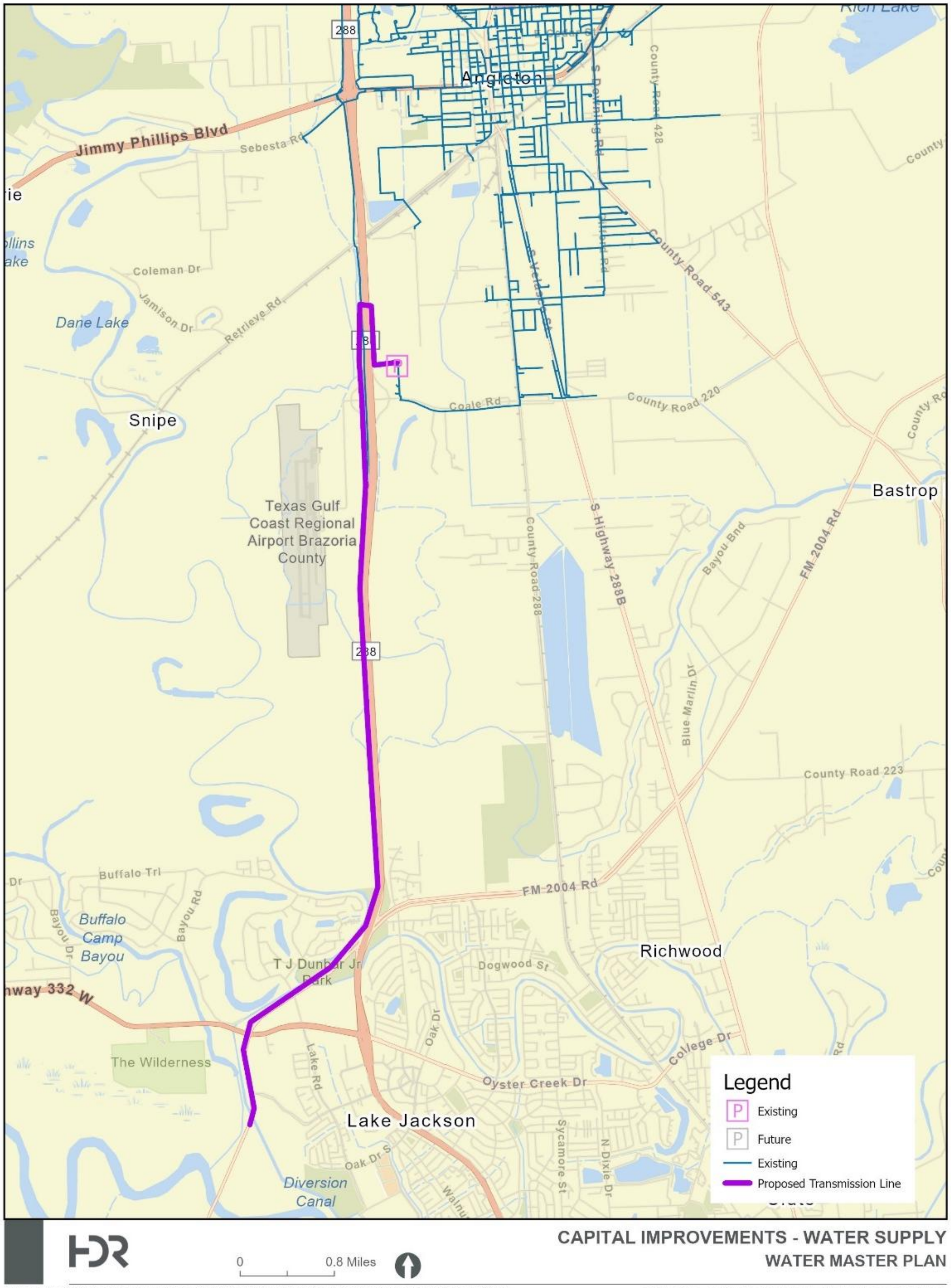
Based on the analysis of water demands and supplies, additional supplies will be needed to meet future demands (see Section 3). Two alternative water supply options are presented in Section 3.

Water Supply Option A assumes the City will provide the funds to construct a stand-alone 12-inch transmission line from the BWA treatment facility to the south side of the City, entering at the Jamison Water Plant, consistent with a September 8, 2021, letter from BWA regarding additional supply through a parallel pipeline. The original plan for this parallel water line was to deliver water to the Henderson Water Plant. However, the analysis of future water demand patterns in this study indicate a greater need for additional supply to enter the system on the south side, through the Jamison Water Plant. In actuality, BWA would likely construct this line, sized to provide supply to other BWA customers in additional to Angleton. The assumption of the City constructing this transmission line to the Jamison water plant will provide an estimate of what the City's portion of the shared capital cost would be for a larger capacity project. The proposed transmission line for additional water from BWA is shown in Figure 2.17. Five additional groundwater wells would constructed. The first would be constructed about 2041, with subsequent wells constructed every three to six years until all five are complete.

Note that the transmission line and new wells are included in the long-term (30-year) CIP, but are not included in the near-term (10-year) CIP.

Water Supply Option B is the Council's preferred path forward and assumes the City will construct additional groundwater wells beginning about 2041, with a new well constructed every three to five years thereafter until five new wells are completed. Following completion of the fifth well, additional BWA supply would be obtained in about 2062, through the new transmission line as described above. The new groundwater wells and the new transmission line are included in the long-term (30-year) CIP, but are not included in the near-term (10-year) CIP.

Figure 2.17. Proposed Transmission Line for Additional Water Supply from BWA



2.7 Water Distribution CIP Opinion of Probable Construction Cost (OPCC)

The recommended CIPs are shown in Table 2.18 and Table 2.19. Table 2.18 details “near-term” CIPs, or projects that are recommended to serve future demand in 10 years. Table 2.19 shows “long-term” CIPs, or projects that are recommended to serve future demand in 30 years. The total project cost was calculated based on bid tabs in the greater Houston area that involved installation of 8”, 12”, and 16” PVC water lines. A 10% increase was included in the construction subtotal for miscellaneous items. The total project cost also includes a 25% fee for professional services, 30% contingency, and 10% increase to account for market volatility. A cost breakdown is included with the CIP summaries in Appendix B.

Table 2.18. Near-Term (10-year) Water Line CIPs

Recommended CIP	Pipe Diameter (in)	Pipe Length (LF)	OPCC (2025 dollars)	% of Cost Impact Fee Eligible (portion of capacity used within 10 years)
North East Expansion	8	8,600	$3,920,000	50%
	16	2,000		
CR 44 Extension	12	9,000	$3,334,000	25%
HWY 288 & FM 523	12	2,500	$1,089,000	100%
Henderson to CR 44	12	9,000	$3,920,000	25%
FM 523 Interconnect	12	2,300	$1,002,000	25%
E Phillips Rd & CR 220 Interconnect	12	6,400	$2,788,000	25%
S Velasco St Loop	8	1,600	$421,000	25%
Henderson Transmission Line[1]	12	9,400	$4,095,000	50%
N Chenango St and Wilkins	16	550	$294,000	50%

[1] A transfer line does not directly connect into the City’s distribution system, but rather fills a ground storage tank that then is connected to the distribution system through a pump station.

Table 2.19. Long-Term (30-year) Water Line CIPs

Recommended CIP	Pipe Diameter (in)	Pipe Length (LF)	OPCC (2025 dollars)
CR 428 & S Downing Rd Interconnect	8	2,700	$711,000
CR 428 WL	8	4,800	$1,263,000
CR 220 Loop	8	8,900	$2,342,000
HWY 288 NB WL Extension	8	2,300	$605,000
Coale Rd and HWY 288 Loop	12	13,100	$5,706,000
CR 219 WL	16	7,100	$3,802,000
Coale Rd and HWY 288B Loop	8	14,400	$3,790,000
CR 288 WL Extension	8	4,400	$1,158,000

The recommended pumping, storage, and water supply improvements are shown in Table 2.20, Table 2.21, and Table 2.22. Long-Term (30-year) Water Supply Improvements. Costs were estimated based on bid tabs in the greater Houston area. A 10% increase was included in the construction subtotal for miscellaneous items. The total project cost also includes a 25% fee for professional services, 30% contingency, and 10% increase to account for market volatility.

Table 2.20. Long-Term (30-year) Pumping Improvements

Recommended CIP	Additional capacity	OPCC[1] (2025 dollars)
Chenango Pump Station Improvements	750 gpm	$980,000
Henderson Distribution Pump	850 gpm	$1,116,000

[1]Pump station improvement costs assume no additional appurtenances are necessary to accommodate additional pumping capacity.

Table 2.21. Long-Term (30-year) Storage Improvements

Recommended CIP	Volume (mg)	OPCC (2025 dollars)
EST 3	1.0	$10,890,000

Table 2.22. Long-Term (30-year) Water Supply Improvements

Recommended CIP	Facilities to Be Constructed	OPCC (2025 dollars)
BWA Transmission Line	39,600 LF of 12 in diameter pipe	$17,250,000
New Groundwater Wells	5 new wells plus appurtenances	$31,165,000

3 Water Supply Evaluation

The City's current and projected water demands were evaluated against current supplies to determine future needs on an annual (average-day, expressed in ac-ft/yr) and maximum-day (expressed in mgd) basis through the 2073 planning horizon. A water supply plan consisting of two water supply strategies, additional surface water from BWA and the development of additional City groundwater, is proposed to meet the projected needs. Note that the planning horizon for the water supply plan extends to 2073, which is 20 years beyond the long-term time period of the utility master plan.

3.1 Water Demand

Water demand projections were developed based on current (2023) demands, the near-term (2033) growth, long-term (2053) growth, and 50-year growth (2073) excluding Growth Areas 7,8, and 20 (Figure 2.4). For 2054 through the end of the planning period (2073), an annual growth rate of 1.42% was applied to determine the demand projections. This growth rate was determined using one-half of the growth rate projected for 2033-2053 (2.85%). The maximum-day demand projections assume a peaking factor of 2.0 over average-day demands.

Annual (average day) water demands are projected to increase from 2,413 ac-ft/yr in 2028 to 7,229 ac-ft/yr by 2073, and Maximum-Day Demands are projected to increase from 4.31 mgd in 2028 to 12.91 mgd in 2073, as shown in Table 3.1.

Table 3.1. Water Demands

Year	Average-Day Demand) (ac-ft/yr)	Maximum-Day Demand (mgd)
2023	1,873	3.35
2028	2,413	4.31
2033	3,108	5.55
2043	4,115	7.35
2053	5,449	9.73
2073	7,229	12.91

3.2 Existing Water Supply

The City of Angleton's water supply is comprised of surface water supply from the BWA and groundwater from City-owned wells.

The current surface water contract with BWA provides for a total of 2.3 mgd on an average-day basis, which is equivalent to an annual volume of 2,576 ac-ft. Based on the language in the contract, it was assumed that there is no additional peaking capacity from the BWA surface water supply to help the City meet maximum-day demands.

For groundwater supply, the City has five in-service groundwater production wells with a total maximum-day capacity of 4.7 mgd (3,257 gpm), as shown in Table 3.2. Note that wells 6 and 7 are out of service and are not included in the groundwater supply evaluation. However, a rehabilitation project in the early planning stages may result in those wells being able to supply water in the future. Well capacities were determined by taking the minimum capacity from the following sources:

- Tested and rated capacities from the Texas Commission on Environmental Quality (TCEQ) Drinking Water Watch (DWW) website accessed September 2024,
- Well capacities listed in the 2019 City of Angleton Utilities Master Plan, and
- Treatment or pump capacity obtained from communication with City staff (Freedom Park Well[4])

Table 3.2. City Water Well Capacities

Well Number	Capacity (gpm)
Well #8	450
Well #9	635
Well #10	725
Well #11	697
Freedom Park Well	750
In Service Wells Total	**3,257**
Well #6 (Out of Service)	400
Well #7 (Out of Service)	450

To account for summer peaking needs and maintenance activities, 50% of the total of in-service groundwater well capacity, as well as a five percent downtime, was applied to estimate an average-day groundwater supply of 2.23 mgd (2,501 ac-ft/yr).

Assuming the in-service groundwater wells are pumped at full capacity, the City of Angleton has a total combined annual supply of 5,077 ac-ft/yr and a maximum-day capacity of 7.00 mgd across the entire planning period, as shown in Table 3.3.

It is a possibility that the City's groundwater withdrawals will be limited in the future by subsidence-related regulations, due to the large growth expected in the Brazoria County area. Therefore, for the purpose of this water supply plan, a scenario where the City uses only half of the annual groundwater supply capacity is also considered. Assuming the groundwater wells are used primarily to meet maximum-day demands, resulting in utilization of about half of their annual supply, the City of Angleton has a total combined annual supply of 3,827 ac-ft/yr, as

[4] The Freedom Park Plant is limited by the 750 gallons per minute (gpm) booster pump capacity (the well and treatment plant can supply up to 1,000 gpm).

shown in Table 3.4.

Table 3.3. Water Supply Using 100% Annual Groundwater Capacity

Annual Supply (ac-ft/yr)			Maximum-Day Capacity (mgd)		
Contractual BWA Surface Water Supply	*Annual Well Supply*	*Total Annual Supply*	*Contractual BWA Surface Water Supply*	*Well Capacity*	*Total Maximum-Day Capacity*
2,576	2,501	5,077	2.30	4.70	7.00

Table 3.4. Water Supply Using 50% Annual Groundwater Capacity

Annual Supply (ac-ft/yr)			Maximum-Day Capacity (mgd)		
Contractual BWA Surface Water Supply	*Annual Well Supply*	*Total Annual Supply*	*Contractual BWA Surface Water Supply*	*Well Capacity*	*Total Maximum-Day Supply*
2,576	1,251	3,827	2.30	4.70	7.00

3.3 Water Supply Needs

3.3.1 Future Water Needs Utilizing All Current Groundwater Supply

Under average-day demands while using 100% of the City's groundwater supply alongside the contracted BWA surface water supply, the City has sufficient annual supplies for the next 10 years, but will need additional water supplies before 2051, as shown in Figure 3.1. The City will need an additional 2,152 ac-ft/yr (1.92 mgd average-day) by the end of the water supply planning period (2073), as shown in Table 3.5.

To meet the projected maximum-day demands while using 100% of the City's groundwater supply, the City will need additional water supply capacity before 2042, and will need an additional 5.91 mgd by the end of the water supply planning period (2073), as shown in Figure 3.2 and Table 3.6. Appendix A includes a yearly accounting table of current supplies compared to demand. This need was calculated assuming that the City will run its wells at full capacity during maximum-day demands.

3.3.2 Future Water Needs Assuming the City Conserves Groundwater Supply

Under average-day demands, while using 50% of the City's groundwater supply alongside the current contracted BWA surface water supply, the City will need additional water supplies before 2041, with a maximum need of 3,403 ac-ft/yr (3.04 mgd average-day) by 2073, as shown in Figure 3.1 and Table 3.5.

3.3.3 Summary of Future Water Supply Needs

The following tables summarize project annual demands, supplies and needs. Annual demands are projected based on utilizing both the full groundwater capacity, or 50% of the full groundwater capacity.

These amounts are what is anticipated to meet the City's projected demands; however, TCEQ requirements for public water systems may require the City to develop additional maximum-day capacity. For example, an estimated 28,000 total connections are anticipated by 2073, which would require a total supply (firm pumping) capacity of 14.9 mgd assuming the City's current ACR of 0.37 gpm/connection for pumping supply capacity. This is roughly 2 mgd greater than the max-day demand shown in Figure 3.2, and would represent additional capacity the TCEQ may require. Any additional capacity greater than needed to meet maximum-day demands should be evaluated and managed in the future.

Table 3.5. Annual Demand, Supply, and Need (acre-feet per year)

Year	Ave-Day Demand	BWA Surface Water Supply	Annual Well Supply		Total Annual Supply		Annual Surplus/(Need)	
			100% GW Capacity	*50% GW Capacity*	*100% GW Capacity*	*50% GW Capacity*	*100% GW Capacity*	*50% GW Capacity*
2023	1,873	2,576	2,501	1,251	5,077	3,827	3,204	1,954
2028	2,413	2,576	2,501	1,251	5,077	3,827	2,664	1,414
2033	3,108	2,576	2,501	1,251	5,077	3,827	1,969	719
2043	4,115	2,576	2,501	1,251	5,077	3,827	962	(289)
2053	5,449	2,576	2,501	1,251	5,077	3,827	(372)	(1,622)
2073	7,229	2,576	2,501	1,251	5,077	3,827	(2,152)	(3,403)

Figure 3.1. Comparison of Annual Supplies and Demands (2020-2073)

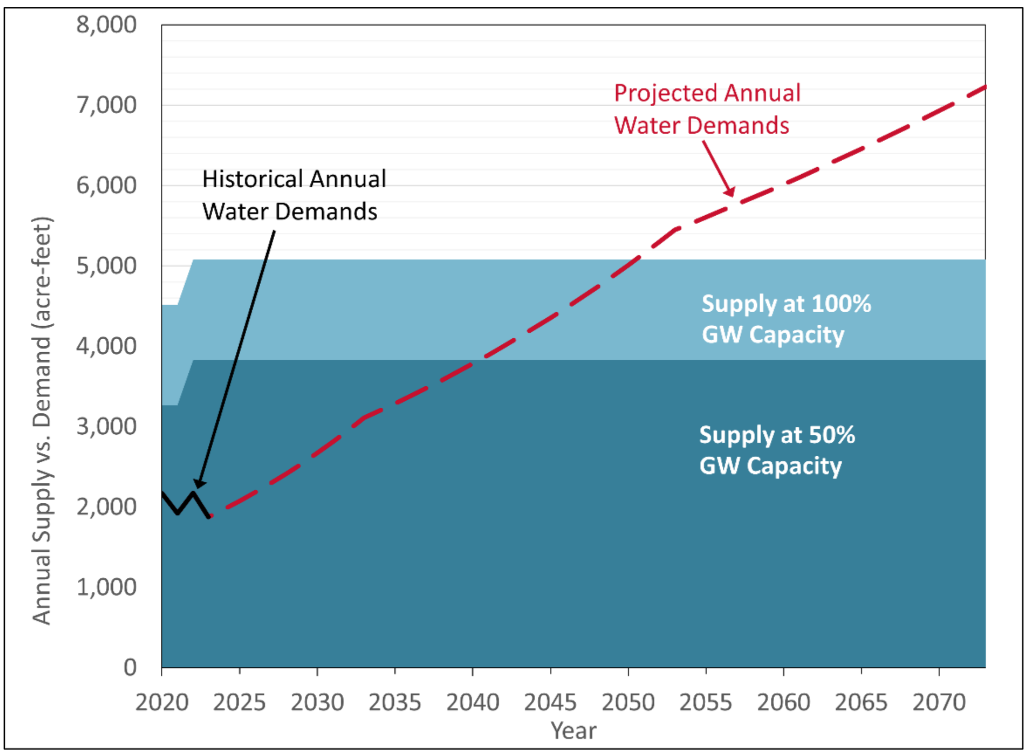
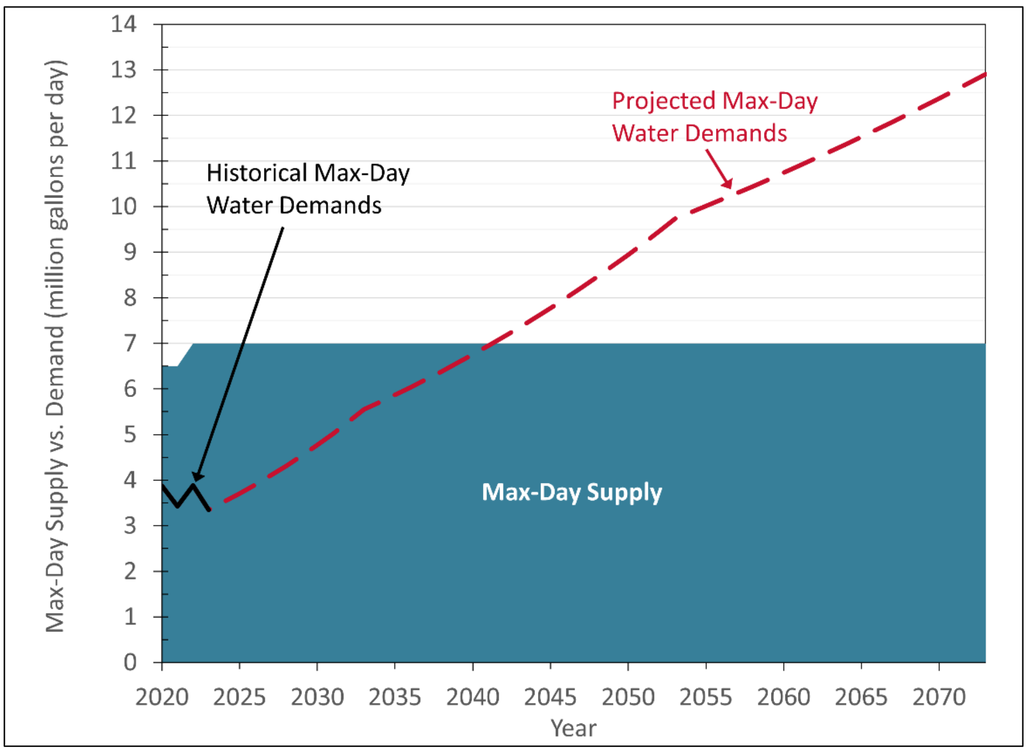


Table 3.6. Maximum-Day Demand, Capacity, and Need (million gallons per day)

Year	Max-Day Demands	BWA Surface Water Supply Capacity	Well Capacity	Total Capacity	Maximum-Day Surplus/(Need)
2023	3.35	2.30	4.70	7.00	3.65
2028	4.31	2.30	4.70	7.00	2.69
2033	5.55	2.30	4.70	7.00	1.45
2043	7.35	2.30	4.70	7.00	(0.35)
2053	9.73	2.30	4.70	7.00	(2.73)
2073	12.91	2.30	4.70	7.00	(5.91)

Figure 3.2. Comparison of Maximum-Day Capacity and Demands (2020-2073)



3.4 Water Supply Strategies

The combination of two water supply strategies, additional purchases from BWA and development of City-owned groundwater supply, are proposed to meet the City's annual and maximum-day needs through the end of the water supply planning period (2073).

3.4.1 Additional Purchases from BWA

Reserving an additional 1.92 mgd of surface water supply from BWA is recommended to meet the City's annual and maximum-day demand.

STRATEGY INFRASTRUCTURE

The main infrastructure components of this strategy include a new waterline parallel to the existing BWA water line. Water will be delivered to the Jamison Water Plant on the southwest side of the City, consistent with a September 8, 2021 letter from BWA regarding additional supply through a parallel pipeline.

STRATEGY COSTS

Costs for this project were developed using the Uniform Costing Model developed by the TWDB for regional water planning. Costs associated with this strategy are presented in Table 3.7. Assumptions and conditions associated with these costs include:

- The projects described in the water distribution CIP are sufficient to integrate this project into the system, and are assumed to be already implemented.
- A market volatility buffer was included at 10% of the project cost.
- Engineering, legal, and contingency costs is 30 percent of the pipeline cost.
- Power is available at $0.09 per kWh.
- The project will be financed for 20-years at a 3.5 percent interest rate.
- Interest during the period of construction is not included in the costs.
- 1.92 mgd of supply will be purchased from BWA at an estimated rate of $2.72 per 1,000 gallons. This cost to purchase water was determined by subtracting the annual costs per 1,000 gallons for capital, O&M, and power from the current $4.60/1,000 gallons charged by BWA to estimate an equivalent purchase cost.

Table 3.7. Additional Purchases from BWA Costs (January 2025 Prices)

Item	Estimated Costs for Facilities:
CAPITAL COST	
Transmission Pipeline (12 in. dia., 7.5 miles)	$9,504,000
Miscellaneous	$950,000
TOTAL COST OF FACILITIES	**$10,454,000**
Engineering:	
- Planning (5%)	$523,000
- Design (9%)	$941,000
- Construction Engineering (3%)	$314,000
Legal Assistance (4%)	$418,000
Fiscal Services (4%)	$418,000
Pipeline Contingency (30%)	$2,851,000
All Other Facilities Contingency (30%)	$285,000
Market Volatility (10%)	$1,045,000
TOTAL COST OF PROJECT	**$17,249,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,140,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$105,000
Pumping Energy Costs (0.09 $/kW-hr)	$71,000
Purchase of Water (2,151 ac-ft/yr @ 434.64 $/ac-ft [$2.72 per 1,000 gallons])	$1,906,000
TOTAL ANNUAL COST	**$3,222,000**
Available Project Yield (ac-ft/yr)	2,151
Annual Cost of Water ($ per ac-ft)	$1,498
Annual Cost of Water After Debt Service ($ per ac-ft)	$968
Annual Cost of Water ($ per 1,000 gallons)	$4.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$2.97

For acquiring additional surface water from BWA, the total cost is estimated to be $17,249,000. Annual debt service over 20 years would be $1,140,000, assuming a 3.5% interest rate. The annual operational cost, including power, is $176,000, plus an annual purchase cost of water of $1,906,000. Combined, this results in a total annual cost of $3,222,000. During the debt service period, the unit cost for 2,151 ac-ft/yr of supply is estimated to be $1,498 per ac-ft, or $4.60 per 1,000 gallons. After debt service, the unit cost of water is estimated to be $968 ac-ft, or $2.97 per 1,000 gallons.

3.4.2 Development of City Owned Groundwater Supply

Five new 560 gpm wells are proposed to add a total 4.03 mgd to the City's groundwater supply to increase the City's groundwater maximum-day capacity. Individual wells will be drilled and brought online as needed to meet projected maximum-day demands.

STRATEGY INFRASTRUCTURE

The locations of the wells will be decided based on actual growth patterns within the City and availability of land. Each well is assumed to be its own groundwater plant, so the main infrastructure components of this strategy include five separate packages consisting of:

- One groundwater well at a depth of 878 feet with a 560 gpm capacity,
- One ground storage tank (1.5 mg),
- One booster pump station with a 1,069 gpm capacity,
- 150 feet of 8-inch wellfield piping, and
- 200 feet of 8-inch pipe to connect the booster pump to the distribution system.

It may be possible to integrate multiple wells into a single water plant or utilize existing infrastructure at Chenango or Jamison and avoid some of the booster pumping and ground storage tank costs.

STRATEGY COSTS

Costs associated with this strategy are presented in Table 3.8. Assumptions and conditions associated with these costs include:

- 5% downtime is allocated for well and pipeline maintenance.
- Wells are designed with a 1.0 peaking factor.
- Integration costs are not included, as well locations will be determined in the future based on the location of future demands and availability of property.
- A market volatility buffer was included at 10% of the project cost.
- Engineering, legal, and contingency costs are 30 percent of pipelines and other facilities.
- Power is available at $0.09 per kWh.
- The project will be financed for 20-years at a 3.5 percent interest rate.

The total cost is estimated to be $6,233,000 per groundwater plant. Annual debt service over 20 years would be $412,000 per groundwater plant, assuming a 3.5% interest rate. The annual operational cost, including power, is $170,000 per groundwater plant. This results in a total annual cost of $582,000. During the debt service period, the unit cost for 862 ac-ft/yr of supply is estimated to be $675 per ac-ft, or $2.07 per 1,000 gallons. After debt service, the unit cost of water is estimated to be $197 per ac-ft, or $0.61 per 1,000 gallons.

Table 3.8. Additional City Owned Groundwater Costs (January 20205 Prices)

Item	Estimated Costs for Facilities: Individual Well	Estimated Costs for Facilities: All 5 Wells
Well and Piping	$1,148,000	$5,740,000
Booster Pump, Ground Storage Tank, Water Treatment	$2,521,000	$12,605,000
TOTAL COST OF FACILITIES	**$3,669,000**	**$18,345,000**
Engineering:		
- Planning (5%)	$183,000	$915,000
- Design (9%)	$330,000	$1,650,000
- Construction Engineering (3%)	$110,000	$550,000
Legal Assistance (4%)	$147,000	$735,000
Fiscal Services (4%)	$147,000	$735,000
Pipeline Contingency (30%)	$9,000	$45,000
All Other Facilities Contingency (30%)	$1,092,000	$5,460,000
Environmental & Archaeology Studies and Mitigation	$85,000	$425,000
Land Acquisition and Surveying (7 acres)	$94,000	$470,000
Market Volatility (10%)	$367,000	$1,835,000
TOTAL COST OF PROJECT	**$6,233,000**	**$31,165,000**
ANNUAL COST		
Debt Service (3.5 percent, 20 years)	$412,000	$2,060,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$24,000	$120,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$29,000	$145,000
Water Treatment	$84,000	$420,000
Pumping Energy Costs (0.09 $/kW-hr)	$33,000	$165,000
TOTAL ANNUAL COST	**$582,000**	**$2,910,000**
Available Project Yield (ac-ft/yr)	862	4,310
Annual Cost of Water ($ per ac-ft)	$675	$675
Annual Cost of Water After Debt Service ($ per ac-ft)	$197	$197
Annual Cost of Water ($ per 1,000 gallons)	$2.07	$2.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.61	$0.61

3.5 Water Supply Plan

3.5.1 Total Supplies and Implementation Timeline

Both the additional surface water from BWA and the development of additional City-owned groundwater will be needed to meet the City's water supply needs through the planning period. Two alternative options were considered, differing only in the timing of when specific components are implemented.

- Water Supply Option A. Obtain the additional BWA supplies first, and
- Water Supply Option B. Develop the additional groundwater first.

With either option, when the two water management strategies are fully implemented, the City will have an additional 6,461 ac-ft/yr of annual supplies and an additional 5.95 mgd of maximum-day capacity, as shown in Table 3.9 and 3.10.

Option A was the water supply plan recommended originally and Option B was not presented originally in this report. However, during the City Council meeting of October 14, 2025, the Council requested that Option B be added as the Council's preferred path forward to delay expenditure on the additional BWA supply as long as possible.

WATER SUPPLY OPTION A. OBTAIN ADDITIONAL BWA SUPPLY FIRST

Under Option A, the additional BWA surface water supply is recommended to be brought online by 2030 to meet annual demands, as shown in Figure 3.3 and Figure 3.4. This will provide the City flexibility in the timing of developing additional groundwater supplies. The initial development of the additional City groundwater is recommended to be brought online by 2050 to meet maximum-day demands, as shown in Figure 3.5.

The additional BWA water will provide for the City's future growth in annual (average-day) demands through 2059, and in maximum-day demands through 2039 with conservative use of groundwater supply. Without conservative use of current groundwater supplies, the additional BWA supply will allow the City to meet annual demands through 2072 and maximum-day demands through 2049.

In summary, the additional supply from BWA provides several benefits:

1. The City will be able to meet projected maximum-day demands through 2039 while only utilizing half of the City's groundwater supply.
2. The City can use its groundwater supply conservatively.
3. The City will be provided flexibility in meeting future growth demands by keeping some groundwater supply in reserve through approximately 2072.

To meet the projected maximum-day demands later in the planning period, the City will need to rely on 100% of the City's current groundwater maximum-day capacity alongside both water management strategies. To meet these maximum-day demands, it is anticipated that the City will need to add a new groundwater plant every two to six years starting in 2050, with new wells operational by 2050, 2052, 2058, 2063, and 2068.

Figure 3.3. Strategy Implementation Timeline: Annual Supplies with Current Groundwater Supply Operated at 50% Annual Capacity – Water Supply Option A

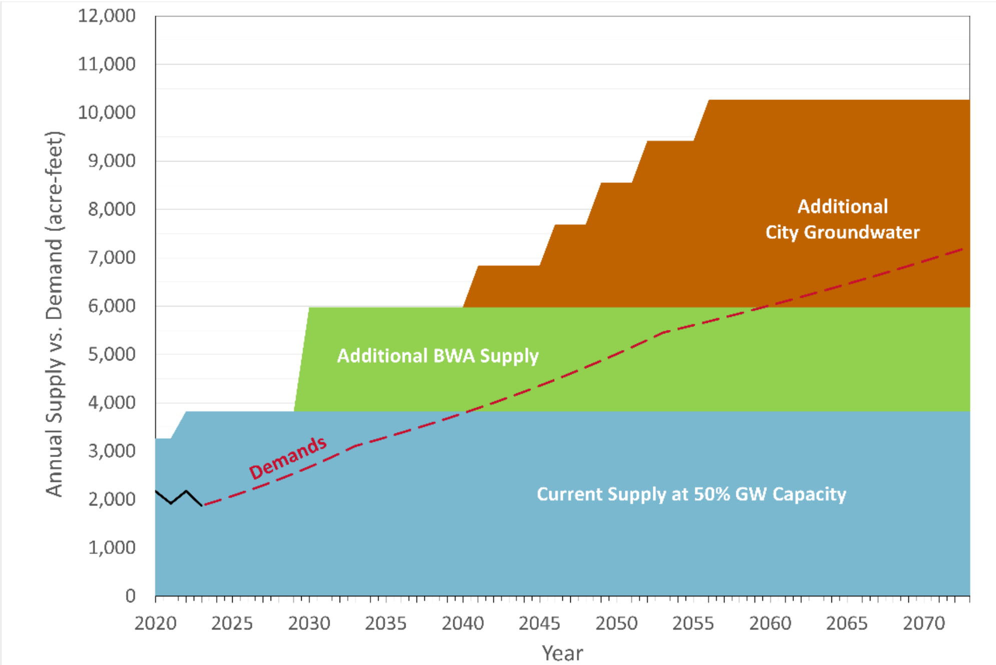


Figure 3.4. Strategy Implementation Timeline: Annual Supplies with Current Groundwater Supply Operated at 100% Capacity– Water Supply Option A

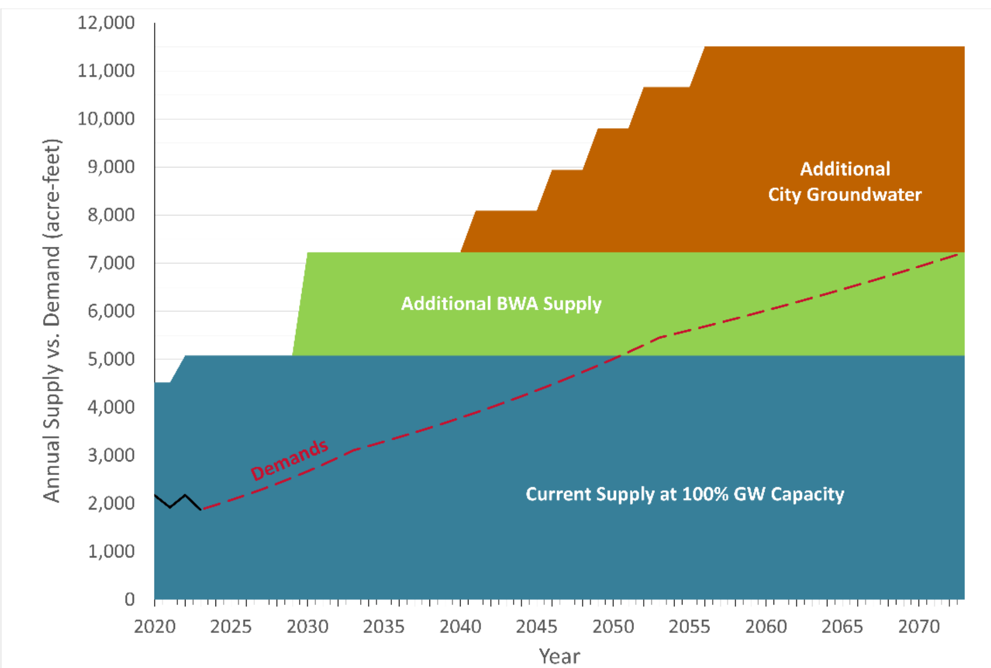
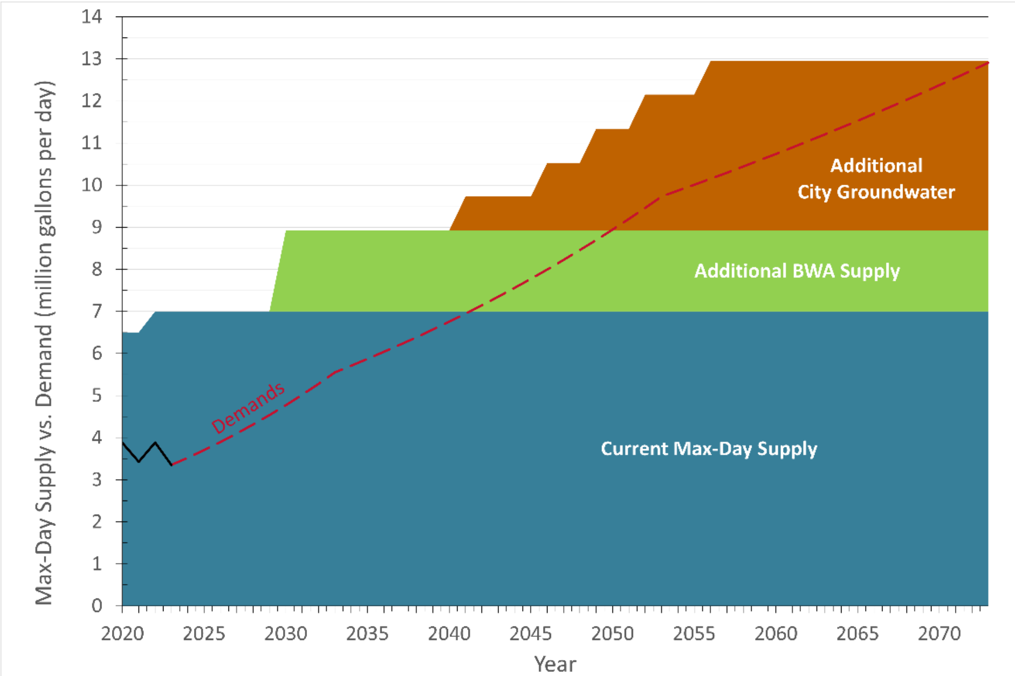


Figure 3.5. Strategy Implementation Timeline: Maximum-Day Supplies with Current Groundwater Supply Capacity– Water Supply Option A



WATER SUPPLY OPTION B. DEVELOP ADDITIONAL GROUNDWATER FIRST

Under the Council's preferred Option B, additional groundwater supply capacity will be added beginning in 2040, with an additional well added every three to five years depending on how rapidly water demands increase. After five additional wells are added, 1.92 mgd of additional supply from BWA will be obtained. Based on current demand projections, this will occur about 2062. The timeline for the Option B alternative to meet annual demands is shown in Figures 3.6 and 3.7, and for maximum-day demands in Figure 3.8.

The timelines and data for Option A and Option B are shown in Table 3.9 for annual demands and Table 3.10 for maximum-day demands.

Figure 3.6. Strategy Implementation Timeline: Annual Supplies with Current Groundwater Supply Operated at 50% Annual Capacity – Water Supply Option B

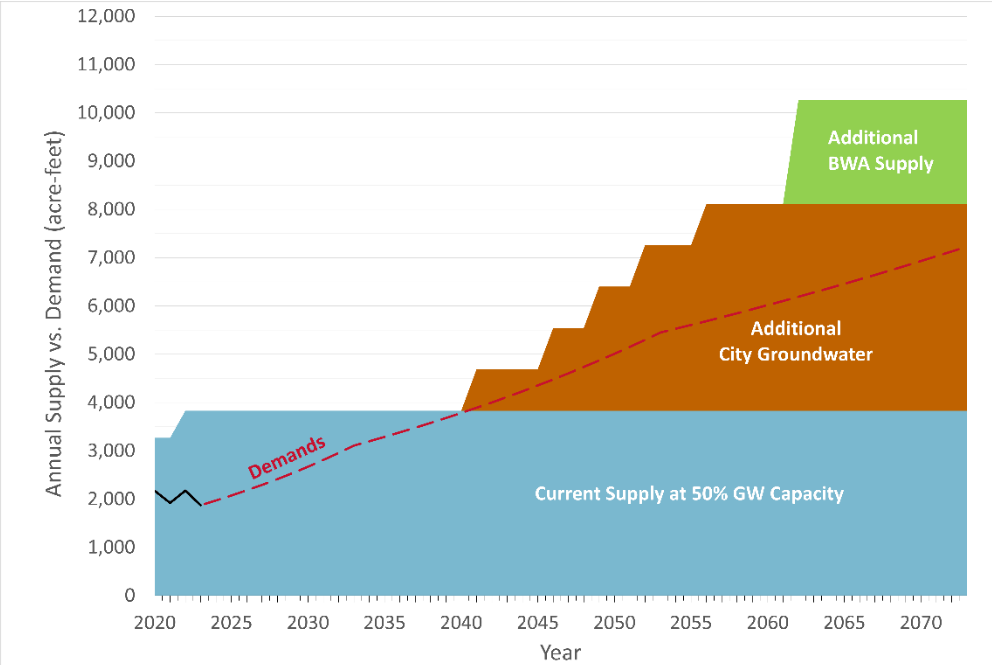


Figure 3.7. Strategy Implementation Timeline: Annual Supplies with Current Groundwater Supply Operated at 100% Capacity– Water Supply Option B

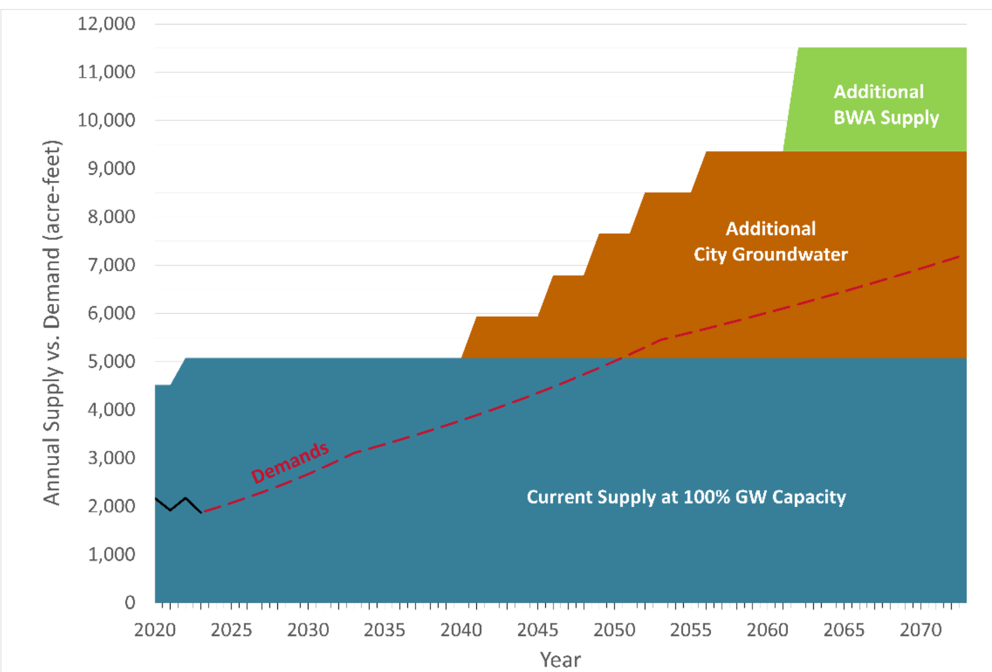


Figure 3.8. Strategy Implementation Timeline: Maximum-Day Supplies with Current Groundwater Supply Capacity– Water Supply Option B

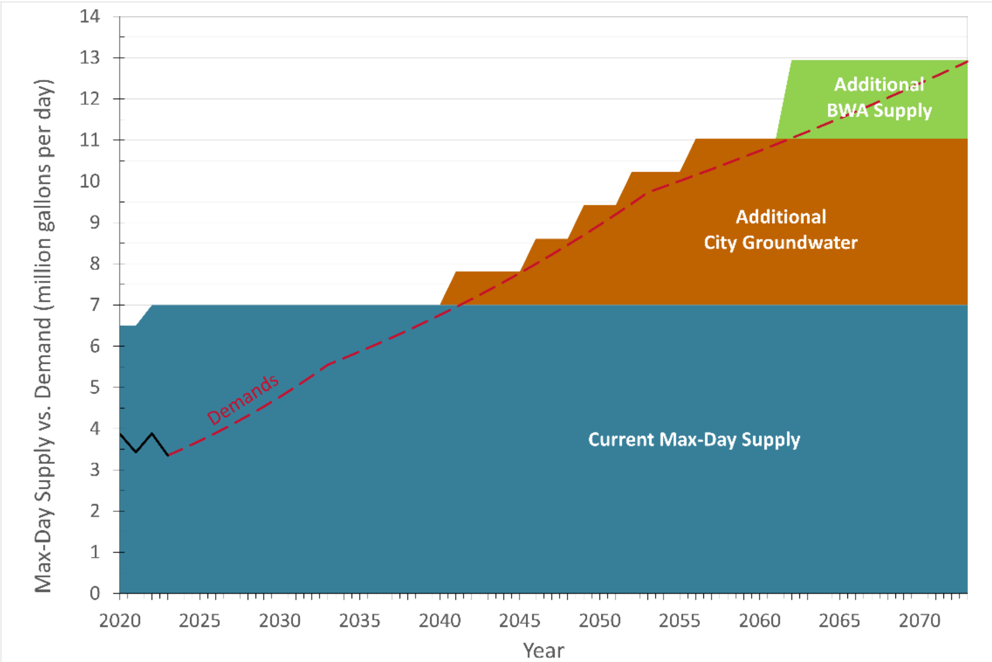


Table 3.9. Strategy Implementation to Supply Annual Demands (ac-ft/yr)

Demand / Supply / Strategy	2028	2033	2043	2073
Current System				
Projected Average-Day Demand	2,413	3,108	4,115	7,229
Current Supply at 50% Groundwater Capacity	3,827	3,827	3,827	3,827
Current Supply at 100% Groundwater Capacity	5,077	5,077	5,077	5,077
Surplus/(Need) at 50% Groundwater Capacity	1,414	719	(288)	(3,402)
Surplus/(Need) at 100% Groundwater Capacity	2,664	1,969	962	(2,152)
Water Supply Option A. Obtain Additional BWA Supplies First				
Recommended Water Management Strategies				
Additional BWA Surface Water Supplies	0	2,151	2,151	2,151
Development of Additional City Groundwater	0	0	0	4,310
Total Future System				
Supply from Recommended Strategies	0	2,151	2,151	6,461
Total Supplies at 50% Current Groundwater Capacity	3,827	5,978	5,978	10,288
Total Supplies at 100% Current Groundwater Capacity	5,077	7,228	7,228	11,538
Surplus/(Need) at 50% Current Groundwater Capacity	1,414	2,870	1,862	3,059
Surplus/(Need) at 100% Current Groundwater Capacity	2,664	4,120	3,113	4,309
Water Supply Option B. Develop Additional Groundwater First				
Recommended Water Management Strategies				
Development of Additional City Groundwater	0	0	862	4,310
Additional BWA Surface Water Supplies	0	0	0	2,151
Total Future System				
Supply from Recommended Strategies	0	0	862	6,461
Total Supplies at 50% Current Groundwater Capacity	3,827	3,827	4,689	10,288
Total Supplies at 100% Current Groundwater Capacity	5,077	5,077	5,939	11,538
Surplus/(Need) at 50% Current Groundwater Capacity	1,414	719	574	3,059
Surplus/(Need) at 100% Current Groundwater Capacity	2,664	1,969	1,824	4,309

Table 3.10. Strategy Implementation to Supply Maximum-Day Demands (mgd)

Demand / Supply / Strategy	2028	2033	2043	2073
Current System				
Projected Maximum-Day Demand	4.31	5.55	7.35	12.91
Current Supply Capacity	7.00	7.00	7.00	7.00
Surplus/(Need)	2.69	1.45	(0.35)	(5.91)
Water Supply Option A. Obtain Additional BWA Supplies First				
Recommended Water Management Strategies				
Additional BWA Surface Water Supplies	0.00	1.92	1.92	1.92
Development of Additional City Groundwater	0.00	0.00	0.00	4.03
Total Future System				
Supply from Recommended Strategies	0.00	1.92	1.92	5.95
Total Supplies	7.00	8.92	8.92	12.95
Surplus/(Need)	2.69	3.37	1.57	0.04
Water Supply Option B. Develop Additional Groundwater First				
Recommended Water Management Strategies				
Development of Additional City Groundwater	0.00	0.00	0.81	4.03
Additional BWA Surface Water Supplies	0.00	0.00	0.00	1.92
Total Future System				
Supply from Recommended Strategies	0.00	0.00	0.81	5.95
Total Supplies	7.00	7.00	7.81	12.95
Surplus/(Need)	2.69	1.45	0.46	0.04

4 Wastewater Master Plan

4.1 Objectives and Scope of Work

The scope of work for the wastewater collection and treatment portion of the UMP includes the following tasks:

- Analyze historical and existing wastewater flows
- Project future wastewater flows using available data
- Update and analyze the hydraulic model of the City's wastewater collection system
- Evaluation of hydraulic deficiencies for existing and future conditions using the hydraulic model
- Development recommendations for improvement in a CIP.

4.2 Wastewater Data Sources

Various sources of data were provided by the City for use with the wastewater hydraulic model update. These sources included reports, GIS electronic files, and record drawings from completed construction projects.

- 2019 Utility Master Plan
- Reports and Maps
- Existing InfoSewer Model
- Wastewater Treatment Plant (WWTP) Discharge Monitoring Reports (DMR)
- Geographic Information System (GIS) Data from City GIS staff
- Lift Station Runtime Data via Lift Station Logs
- Lift Station Pump Capacity
- Rainfall Data (NOAA ATLAS 14)

4.3 Background

The City's wastewater system consists of a combination of gravity sewers, lift stations, force mains, and a wastewater treatment plant. The wastewater treatment plant is located on the southwest side of the City. The plant treats an average of 1.8 mgd during dry weather conditions, with a permitted annual average flow of 3.6 mgd. Angleton is located in the flat coastal plain of the Texas Gulf Coast, and this geographical setting limits the opportunity for gravity wastewater collection, requiring numerous lift stations.

4.3.1 Existing Wastewater Collection System

WASTEWATER TREATMENT PLANT

The City's WWTP is located in the southwest portion of town, along Sebesta Road. The WWTP's current TPDES Permit (Permit No. WQ0010548004) allows a maximum effluent flow of

3.6 mgd to be discharged into Oyster Creek, and no more than 12,500 gpm (~18 mgd) during any two-hour period.

GRAVITY SEWER NETWORK

The City's wastewater collection system consists of a wide variety of pipe types, sizes and ages, and reflect ongoing growth of the system. Table 4.1 presents the total length of gravity and force main pipes by diameter, shows the breakdown of gravity and force main pipes by material. New pipes installed since the 2019 UMP were assumed to be PVC.

Table 4.1. Wastewater System Pipeline Diameter Summary

Diameter (inches)	Length (feet)	Percent of Total
Unknown	3,695	0.64%
4	549	0.09%
6	120,589	20.76%
8	263,506	45.37%
10	75,376	12.98%
12	53,190	9.16%
14	2,631	0.45%
15	8,558	1.47%
18	9,610	1.65%
20	4,186	0.72%
24	14,875	2.56%
27	6,809	1.17%
30	16,573	2.85%
33	167	0.03%
36	15	0.00%
48	467	0.08%

Source: City of Angleton GIS database

Table 4.2. Wastewater System Pipeline Material Summary

Material	Length (feet)	Percent of Total
Concrete	91,709	15.79%
Corrugated Metal Pipe	467	0.08%
Ductile Iron	499	0.09%
Fiberglass	4,286	0.74%
HDPE	2,300	0.40%
PVC	294,014	50.62%
PVC-U	6,844	1.18%
Truss	1,340	0.23%
Vitrified Clay Pipe	158,586	27.30%
Unknown	20,750	3.57%

Source: City of Angleton GIS database

LIFT STATIONS

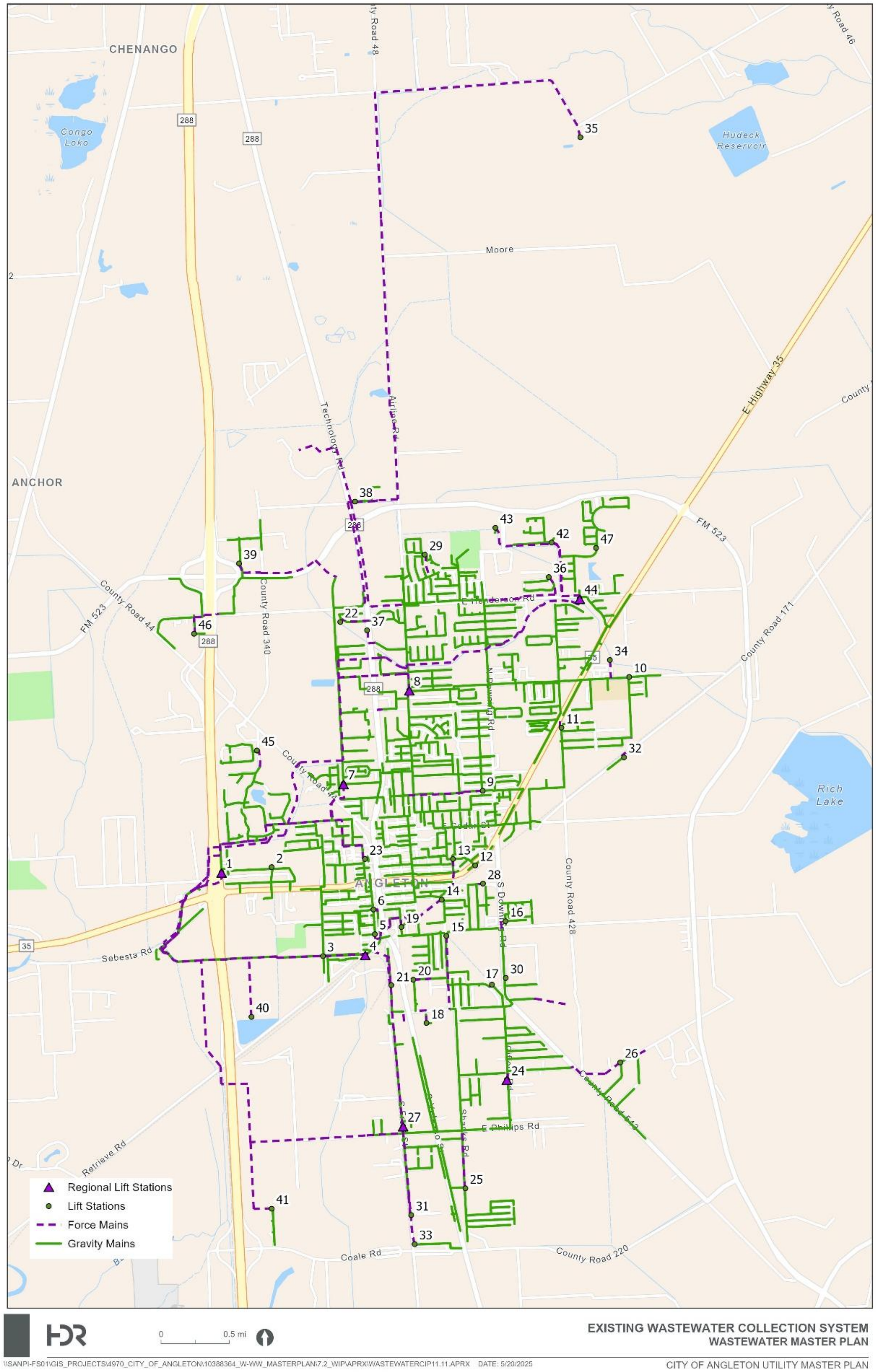
The City owns and operates a large number of lift stations due to the relatively flat terrain, which precludes gravity sewer mains throughout much of the City. As a result, lift stations are located in all areas of town, as shown in Figure 4.1. A handful of these lift stations are classified as regional lift stations, due to their location and function of conveying large amounts of wastewater flows from various other lift stations upstream. Regional lift stations can be identified by the purple triangle in the system map.

Lift station pump run-time information was used to understanding how the wastewater collection system functions, as described in later in this report.

FORCE MAINS

Lift stations discharge into force mains, which are also shown on the existing system map (Figure 4.1) and can be identified by the dashed purple lines. Regional lift stations 7, 8, and 24 have a secondary bypass force main that provide additional conveyance capacity to those areas. These secondary force mains typically travel much further downstream than the original force main.

Figure 4.1. Existing Wastewater Collection System



4.4 Wastewater Loading

Dry weather flows provide the basis for the hydraulic model loading and are impacted primarily by population and land use density. Dry weather flows are the wastewater flows originating primarily from sewage outflow from residences and commercial buildings, although they can also include groundwater infiltrating into pipes through loose joints, broken pipes, or damaged manholes. HDR primarily utilized water consumption data to spatially distribute wastewater flows throughout the system.

Wet weather flows occur following storm events and represent a large, relatively sudden, increase in system flows due to stormwater entering the collection system through manholes, broken pipes, and illegal connections. The system's wet weather response is used in the identification and sizing of capital projects as discussed later in this report.

4.4.1 Dry Weather Flow Development

Various data provided by the City were used for development of the sanitary sewer loading flow rates, with GIS, water consumption, and lift station runtime data being the primary data sources. The process to develop the flow rates required verifying the conveyance system geometry and determining the extents to be included in the model for the service area. With these model hydraulic limits defined, the service area was determined, checked against the data provided, and adjusted as necessary.

A widely recognized relationship between water consumption and wastewater loading was used to estimate the dry weather flows (DWF) throughout the system. As described in Section 2.4, maximum-day water demands were assumed to be twice as much as average-day water demands. In an average system most of the potable water consumed by a customer is directed to the wastewater collection system. Based on previous efforts to determine the amount of water consumption that becomes wastewater in the 2019 UMP, average daily wastewater flows were assumed to be 85% of the water consumption, demonstrated in the equation below.

$$ADF(wastewater, gpm) = 0.85 * ADF\ (water, gpm)$$

No flow monitoring data were available to confirm residential, commercial, or industrial land use flows or patterns. Additionally, the data provided in the InfoSewer model only consisted of steady state loading, with no diurnal profiles incorporated into the system. Therefore, the hydraulic model utilized steady state loading for the peak flow capacity analysis of the collection system.

4.4.2 Dry Weather Flow Validation

In addition to the water consumption data, the City also provided the daily influent flows to the City's WWTP via DMRs. The WWTP daily influent flows were compared to the estimated existing dry weather flows in the wastewater model. This comparison allowed validation of the assumptions made and the predicted flows in the absence of flow monitoring throughout the wastewater system.

4.4.3 Wet Weather Flow Development

LIFT STATION FLOW ANALYSIS

The primary method used to estimate the wet weather flows was analysis of lift station operational data. The City provided lift station operational data from 2024 for certain lift stations. The data provided included the number of hours per day each pump was running and the corresponding amount of rain in inches that was recorded that day. Data were not provided for the following lift stations:

- Lift Station 5
- Lift Station 6
- Lift Station 19
- Lift Station 22
- Lift Station 28
- Lift Station 30
- Lift Station 33
- Lift Station 40
- Lift Station 43
- Lift Station 48
- Lift Station 49
- Lift Station 50

Depending on the lift station, the data provided included a combination of pump run times in hours and pump design capacity. Flow monitoring data were not available to aid in wet weather calibration of the wastewater model. The lift station runtime data provided insight into the system performance during dry weather and rain events. Lift station runtime data for rain events in March and May were compared to the baseline dry weather lift station runtime data. These data are summarized in Appendix D. The lift station runtime data indicate wet weather peaking factors are large in multiple locations, indicating the system operates outside accepted standards for wastewater collection systems. An approximate peaking factor for a design rain event was determined by extrapolating the lift station runtime data. The design rain event selected was a 5 year – 6 hour design storm with a 90% confidence interval, utilizing NOAA Atlas 14 rain data, as summarized in Table 4.3.

Table 4.3. Atlas 14 Angleton Design Storm Estimates

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.520 (0.394-0.687)	0.605 (0.457-0.783)	0.735 (0.558-0.964)	0.850 (0.638-1.13)	1.02 (0.744-1.40)	1.16 (0.821-1.64)	1.30 (0.896-1.88)	1.44 (0.968-2.14)	1.63 (1.06-2.51)	1.77 (1.12-2.80)
10-min	0.820 (0.621-1.08)	0.956 (0.722-1.24)	1.16 (0.883-1.52)	1.35 (1.01-1.80)	1.61 (1.18-2.23)	1.84 (1.31-2.61)	2.07 (1.42-3.00)	2.28 (1.53-3.39)	2.56 (1.66-3.94)	2.77 (1.75-4.37)
15-min	1.05 (0.798-1.39)	1.22 (0.925-1.58)	1.48 (1.12-1.94)	1.71 (1.28-2.28)	2.04 (1.49-2.81)	2.31 (1.64-3.27)	2.59 (1.79-3.76)	2.87 (1.93-4.27)	3.24 (2.10-4.99)	3.52 (2.23-5.56)
30-min	1.53 (1.16-2.02)	1.77 (1.34-2.29)	2.13 (1.62-2.80)	2.45 (1.84-3.26)	2.91 (2.12-4.00)	3.28 (2.33-4.64)	3.68 (2.54-5.33)	4.09 (2.74-6.08)	4.64 (3.02-7.15)	5.08 (3.22-8.03)
60-min	2.03 (1.54-2.68)	2.36 (1.79-3.06)	2.87 (2.18-3.76)	3.32 (2.49-4.42)	3.97 (2.89-5.46)	4.50 (3.19-6.36)	5.07 (3.50-7.35)	5.69 (3.82-8.46)	6.56 (4.26-10.1)	7.26 (4.59-11.5)
2-hr	2.48 (1.89-3.24)	2.97 (2.24-3.76)	3.69 (2.82-4.78)	4.36 (3.30-5.76)	5.38 (3.97-7.36)	6.27 (4.49-8.81)	7.25 (5.03-10.4)	8.31 (5.60-12.2)	9.82 (6.39-14.9)	11.0 (7.01-17.2)
3-hr	2.72 (2.09-3.54)	3.34 (2.51-4.15)	4.20 (3.22-5.40)	5.04 (3.83-6.62)	6.35 (4.71-8.65)	7.52 (5.42-10.5)	8.84 (6.15-12.6)	10.3 (6.93-15.0)	12.3 (8.02-18.6)	13.9 (8.87-21.6)
6-hr	3.15 (2.44-4.06)	3.98 (2.99-4.86)	5.11 (3.95-6.50)	6.25 (4.79-8.13)	8.04 (6.02-10.9)	9.66 (7.01-13.4)	11.5 (8.07-16.3)	13.6 (9.21-19.5)	16.5 (10.8-24.7)	18.9 (12.1-29.0)
12-hr	3.61 (2.82-4.61)	4.66 (3.54-5.63)	6.10 (4.76-7.69)	7.53 (5.82-9.70)	9.73 (7.31-13.0)	11.7 (8.51-16.0)	13.9 (9.82-19.4)	16.5 (11.3-23.6)	20.4 (13.4-30.2)	23.7 (15.2-35.9)
24-hr	4.07 (3.20-5.15)	5.33 (4.10-6.41)	7.12 (5.60-8.88)	8.84 (6.88-11.3)	11.5 (8.64-15.1)	13.7 (10.0-18.6)	16.4 (11.6-22.6)	19.5 (13.4-27.5)	24.2 (16.0-35.4)	28.2 (18.2-42.2)
2-day	4.45 (3.53-5.57)	5.93 (4.60-7.04)	8.03 (6.38-9.92)	10.0 (7.89-12.7)	13.1 (9.98-17.1)	15.8 (11.6-21.1)	18.8 (13.4-25.7)	22.4 (15.4-31.2)	27.6 (18.3-39.8)	32.0 (20.7-47.2)
3-day	4.75 (3.79-5.92)	6.36 (4.97-7.52)	8.66 (6.92-10.6)	10.8 (8.56-13.6)	14.2 (10.8-18.4)	17.0 (12.6-22.7)	20.3 (14.5-27.5)	24.0 (16.6-33.2)	29.4 (19.6-42.0)	33.9 (21.9-49.6)
4-day	5.11 (4.10-6.35)	6.80 (5.35-8.04)	9.24 (7.41-11.3)	11.5 (9.13-14.4)	15.0 (11.5-19.4)	18.0 (13.3-23.8)	21.3 (15.3-28.7)	25.0 (17.4-34.5)	30.5 (20.3-43.4)	35.0 (22.7-50.9)
7-day	6.18 (4.98-7.60)	7.99 (6.37-9.46)	10.7 (8.62-13.0)	13.1 (10.5-16.3)	16.8 (12.9-21.5)	19.9 (14.8-26.0)	23.3 (16.8-31.1)	27.1 (18.9-36.9)	32.4 (21.7-45.7)	36.8 (23.9-53.0)
10-day	7.01 (5.68-8.59)	8.90 (7.17-10.6)	11.7 (9.55-14.2)	14.3 (11.5-17.7)	18.1 (14.0-23.0)	21.3 (15.9-27.7)	24.7 (17.8-32.8)	28.4 (19.9-38.5)	33.7 (22.6-47.2)	38.0 (24.7-54.3)
20-day	9.05 (7.40-11.0)	11.1 (9.13-13.2)	14.4 (11.8-17.3)	17.1 (13.9-20.9)	21.1 (16.4-26.5)	24.3 (18.2-31.1)	27.6 (20.0-36.2)	31.2 (21.9-41.8)	36.2 (24.4-50.0)	40.2 (26.3-56.7)
30-day	10.8 (8.84-13.0)	12.9 (10.8-15.5)	16.5 (13.7-19.8)	19.5 (15.8-23.6)	23.6 (18.3-29.3)	26.7 (20.1-34.0)	29.9 (21.8-39.0)	33.4 (23.6-44.4)	38.2 (25.8-52.4)	42.0 (27.5-58.8)
45-day	13.5 (11.2-16.2)	15.9 (13.4-19.0)	20.0 (16.7-23.8)	23.2 (18.9-28.0)	27.6 (21.5-34.0)	30.8 (23.2-38.8)	34.0 (24.9-43.9)	37.3 (26.5-49.4)	41.9 (28.4-57.0)	45.4 (29.8-63.0)
60-day	16.1 (13.4-19.2)	18.7 (15.8-22.3)	23.2 (19.4-27.6)	26.7 (21.9-32.1)	31.3 (24.5-38.4)	34.6 (26.2-43.5)	37.8 (27.8-48.7)	41.1 (29.2-54.1)	45.4 (30.9-61.5)	48.7 (32.0-67.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

NOAA Atlas 14, Volume 11, Version 2 ANGLETON 2 W
Station ID: 41-0257
Location name: Angleton, Texas, USA*
Latitude: 29.1572°, Longitude: -95.4592°
Elevation:
Elevation (station metadata): 26 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

WET WEATHER FLOW VALIDATION

Comprehensive flow monitoring data were not available to estimate true wet weather flow (WWF) peaking factors throughout the system. Field data based on lift station run times and historical WWTP daily influent flows were used to estimate a peaking factor. At this stage, with the given wastewater flow data and current system performance, HDR does not recommend sizing capital improvement projects using existing flows. Because the collection system performs outside accepted standards for wet weather, peak flow conveyance appears to be driven by wet weather inflow. Based on the best available data and regional wastewater flow estimation standards, a maximum WWF peaking factor of 12 was applied in the model (Recommended Standards for Wastewater Facilities, Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2014).

WWF was validated by comparing the DMRs during rain events to the estimated WWF seen in the Infoworks ICM model.

INFLOW AND INFILTRATION

Inflow and infiltration (I&I) describes groundwater and stormwater that enters a sanitary sewer collection system through cracks, joint failures, illegal connections, and faulty connections in the system. I&I causes significant issues in wastewater treatment operation and sanitary sewer flow. At the Angleton Wastewater Treatment Plant, influent flows are significantly greater during rain events due to I&I. Additionally, lift station pumps experience a large increase in operation runtimes during rain events. Larger flows can overload lift station and plant capacity, dilute wastewater, and increase operational costs. When wastewater flows increase over pipe capacity in the collection system, overflow can occur at manholes, known as a sanitary sewer overflows (SSOs). When left unaddressed, I&I results in larger flows throughout the entire sanitary sewer collection system and increases the amount of collection system upgrades needed.

The City’s existing InfoSewer model, GIS data, and lift station reports were used to create a flow chart that maps how lift stations influence each other, and how their performance varies. A high lift station runtime factor can be correlated to poor upstream performance due to excessive I&I during wet weather events. High I&I upstream leads to poor system performance downstream, since the drastic increase in flows will either be released due to SSOs or carried further downstream towards the treatment plant. Appendix D contains a flow chart that shows the lift station runtime factor, the Infosewer modeled average daily flow, and the InfoSewer model peaking factor for each modeled lift station. Lift stations that were not modeled in InfoSewer or lack operational data are grayed out. This representation of the collection system aids in identifying major areas of I&I concern and shows what areas were modeled with a higher margin of uncertainty due to a lack of information.

4.4.4 Wastewater Flows from Development Areas

The City considered the city limits, Extraterritorial Jurisdiction (ETJ) boundary, annexation plans and agreements currently in progress with developers to estimate spatial growth in the City for future planning horizons. These areas of anticipated future development are described in

Section 2.4. Using the methods described previously in Section 2.4, water demands were allocated to development tracts based on a combination of land use, area, and population density information. Water consumption data was transformed to wastewater loading using the equation from Section 4.4.1. and spatially distributed to manholes in the system.

4.5 Wastewater System Analysis

The hydraulic model was used to analyze the collection system performance, and to assess available capacity for existing wet weather conditions. As described previously, in the absence of system-wide flow monitoring data, a simplified peaking factor wet weather simulation was conducted. The hydraulic model was also used to analyze future and build-out conditions.

4.5.1 Wastewater System General Performance Metrics

The criteria for the system capacity analysis included:

- Sanitary sewer overflows
- Surcharging of the collection system pipes

Any SSO is considered a collection system failure. Surcharging was defined as any section flowing full, or with the water surface grade line above the crown of a pipe. System surcharge was evaluated to determine whether the section surcharged due to insufficient capacity or because of backwater or other downstream controlling factors.

A pipe was considered under capacity when it was both flowing full (surcharged), and the flow in the pipe was greater than the rated full pipe capacity, based on diameter and slope. Otherwise, the pipe was classified as surcharged due to a flow backup caused by a downstream capacity bottleneck. If the downstream bottleneck were resolved, this pipe would flow without surcharging.

For existing pipes, a degree of surcharging is acceptable, and varies depending on the level of risk a City or utility is willing to accept. Acceptable surcharge was defined as surcharge that remains a minimum of 3 feet below the ground surface level. Although surcharging pipes may not be recommended for replacement if the potential to produce SSOs is low, any new pipe will be designed according to the following conditions:

- For sewer mains 15 inches in diameter and smaller, the peak WWF will not exceed 90 percent of the pipe’s capacity flowing full.
- For sewer mains 18 inches in diameter and larger, the peak WWF will not exceed 80 percent of the pipe’s capacity flowing full.

These design criteria will be considered when recommending pipe sizes for the current and all future evaluation scenarios and CIP development.

4.5.2 Wastewater Model Update and Software Selection

The City provided their wastewater model in InfoSewer, which is an extension of ESRI's Arc Map. ESRI began retiring Arc Map in 2024, thus InfoSewer will no longer have an application to function in and is no longer being sold by Innovyze. Due to the retirement of the model software, HDR migrated the Angleton wastewater model to Infoworks ICM by importing the information previously housed in InfoSewer. An added benefit to changing software is that Infoworks ICM is more capable of evaluating I&I and pump station performance. This is advantageous as the City's wastewater system has many lift stations and experiences substantial wet weather flows.

GIS shapefiles of the modeled network of pipes and manholes were exported from InfoSewer and compared to the GIS data provided by the City. The exported model shapefiles were edited to reflect the location and pipe diameters found in the City's GIS information. Portions of the collection system such as regional lift stations or force mains that were not included in the original model were added based on the City's GIS data. For these new portions of the collection system, the size listed in GIS was assumed correct.

GIS data are typically maintained by wastewater agencies and cities as a mapping and data management tool for sewer assets. As such, it provides good data for developing the pipe network in the hydraulic model, including pipe alignments and diameters and manhole locations. However, additional data is needed to accurately represent how water moves through the system (pipe invert elevations and pipe to manhole connectivity), which is often incomplete or inaccurate in a typical GIS. In these areas, the GIS data were supplemented with additional information.

Manhole rim elevations were extracted from GIS ground elevation data. The loading data for manholes was estimated as described in 4.4 and entered into GIS.

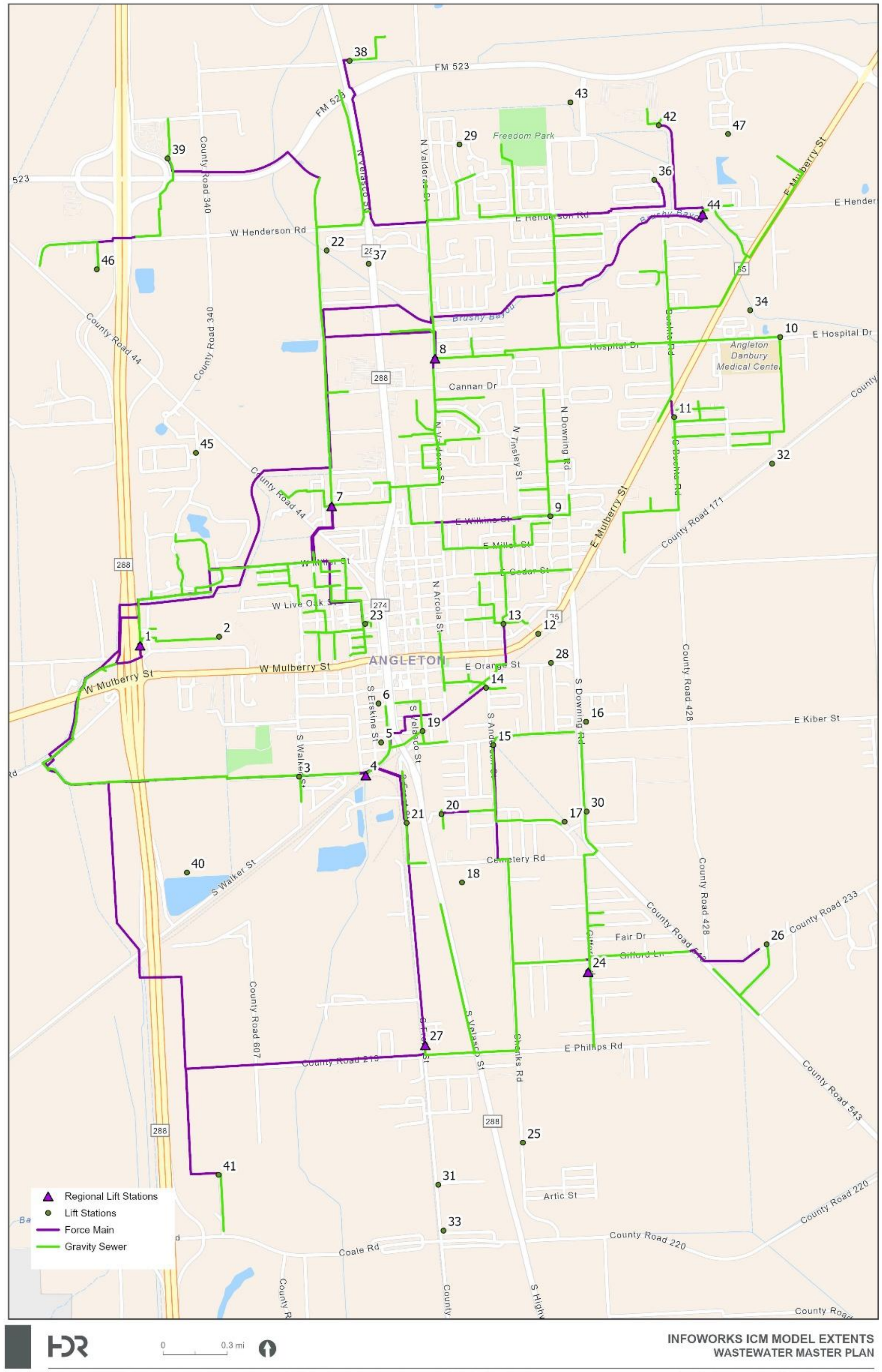
4.5.3 Wastewater Model Extents

The wastewater model includes all lift stations and wastewater collection mains that constitute the central collection system. The following lift stations and associated gravity mains, and force mains were excluded from the wastewater model due to a lack of lift station runtime and negligible flows from their service areas:

- Lift Station 200
- Lift Station 205
- Lift Station 206
- Lift Station 208
- Lift Station 25 Tributary Gravity Mains & Force Main
- Lift Station 31 Tributary Gravity Mains & Force Main
- Lift Station 33 Tributary Gravity Mains & Force Main
- Lift Station 35 Tributary Gravity Mains & Force Main

Flows from these areas are included as part of the flows to the system that these service areas feed.

Figure 4.2. Hydraulic Model Extents



4.6 Wastewater Model Evaluation

A wastewater model is a computer simulation of a wastewater collection system using fundamental hydraulic principles. The model is a tool to assist in understanding capacity limitations throughout the system and allows for large scale planning and development of capital improvement projects. The following parameters were evaluated to assess the wastewater system's performance.

4.6.1 Wastewater Line Size/Capacity

The capacity of a wastewater line is determined both by its diameter (via cross sectional area), and its slope. Infoworks ICM uses this information to calculate the pipe's full capacity (pfc), or the amount of wastewater a pipe conveys without surcharging. The pipe's surcharge state is calculated in Infoworks ICM as the ratio of hydraulic depth to the pipe height. Below shows the meaning of possible surcharge states within the wastewater model.

Table 4.4. Explanation of Wastewater Model Pipe Surcharge States

Value	Description
< 1	Pipe is not surcharged.
1.00	Wastewater flow is less than or equal to the pipe's full capacity. The pipe is surcharged due to system constraints that exist downstream of this pipe.
2.00	Wastewater flow is greater than the pipe's full capacity. The pipe is surcharged due to local constraints.

This parameter within the wastewater model was used to estimate the existing wastewater line capacity in the collection system.

TCEQ has also provided maximum and minimum pipe slopes for wastewater lines, as shown in Figure 4.3: TAC §217.53(l)(2)(A) Table C.2. These guidelines were followed when establishing proposed wastewater lines within the Infoworks ICM model.

Figure 4.3. TAC §217.53(l)(2)(A) Table C.2

Table C.2. - Minimum and Maximum Pipe Slopes

Size of Pipe *(inches)*	**Minimum Slope** *(%)*	**Maximum Slope** *(%)*
6	0.50	12.35
8	0.335	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.115	2.83
21	0.095	2.30
24	0.08	1.93
27	0.07	1.65
30	0.06	1.43
33	0.055	1.26
36	0.045	1.12
39	0.04	1.01
>39	*	*

* For pipes larger than 39 inches in diameter, the slope is determined by Manning's formula to maintain a velocity greater than 2.0 feet per second and less than 10.0 feet per second when flowing full.

4.6.2 Lift Station Pump Capacity

Lift station pump capacity was determined using vendor data when available. Many of the pump assets within the City's wastewater system have unknown equipment models or manufacturers. In these cases, the lift station pump capacity was estimated using the pump size, motor type, and voltage. The pump data in Appendix C: Table was used in the wastewater model to estimate the lift station pumping capacities.

4.6.3 Force Main Capacity

Force main capacity was determined as the volumetric flow in the pipe that maintained a maximum velocity of 5 feet per second (fps). This is the maximum velocity adopted for pressure piping as it prevents significant head losses in the system. Based on this velocity criteria, Table 4.5 shows the maximum flow assumed in force mains throughout the wastewater system.

Table 4.5. Force Main Maximum Capacity for Various Pipe Sizes

Diameter (in)	4	6	8	10	12
Max Flow (gpm)	196	441	783	1,224	1,762
Diameter (in)	**14**	**16**	**18**	**20**	**24**
Max Flow (gpm)	2,399	3,150	4,000	4,895	7,000

4.6.4 Existing System Performance

EXISTING DRY WEATHER PERFORMANCE

Generally, the hydraulic model indicates that the existing system conveys current peak DWFs well, with relatively few capacity issues. Figure 4.4 displays the modeled results for surcharge state, which represents the ratio of modeled flow depth to the pipe's height. Pipes in green indicate a modeled DWF of 80 percent or less (0 – 0.8) of the pipe's capacity. Pipes in yellow indicate a modeled DWF between 80 and 99 percent (0.8 – 0.99) of the pipe's capacity. Pipes in orange indicate a modeled DWF of 100 percent (1) of the pipe's capacity due to downstream constraints. Wastewater lines near regional lift stations 7 and 8 exhibit some surcharge, but not at a level that poses risk of SSOs. At each of these locations, the peak DWF is contained within the pipe, although the pipes do surcharge.

EXISTING WET WEATHER PERFORMANCE

Although the system is adequately sized for DWF, the wastewater model indicates that large amounts of inflow and infiltration cause surcharge during wet weather events, as show in Figure 4.5. Pipes in red indicate a modeled WWF exceeding the pipe's capacity. The model indicates that the WWF is contained in most pipes throughout the system, but there are multiple areas of concern as shown in Figure 4.5.

The areas of concern primarily exist upstream of regional lift stations 1, 7, and 8, as well as lift stations 9 and 23. Lift stations 1, 7, and 8 are locations where large amounts of system flows converge before traveling to the WWTP. Discussions with City staff and review of lift station runtime reports suggest that these lift stations run for long periods of time during and after rainfall events. While the system is adequate for current WWF, improvements in these areas should be prioritized as the City grows further to the north and increases contributing flows to these areas.

Figure 4.4. Existing System Dry Weather Flow Wastewater Model Results

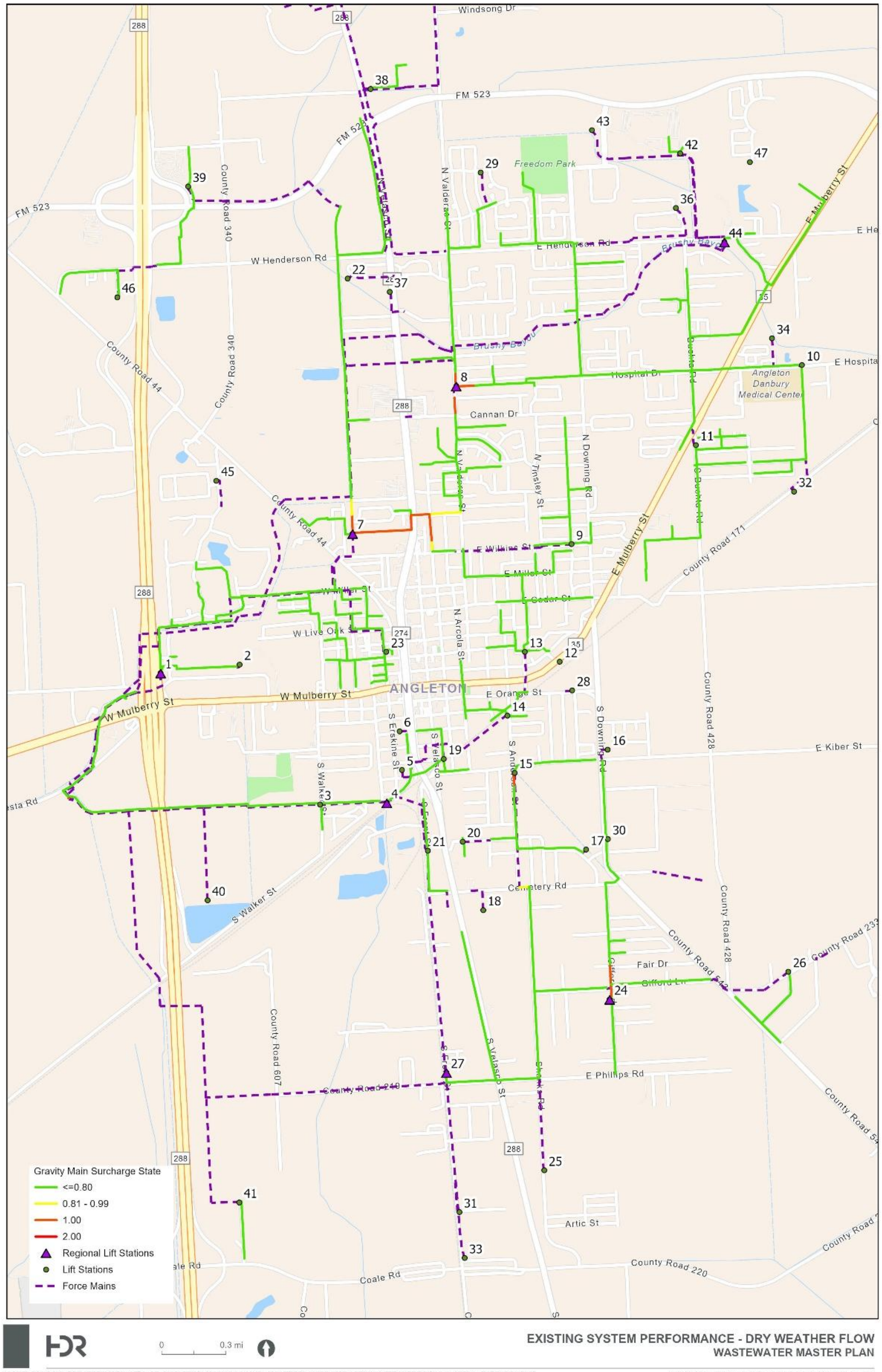
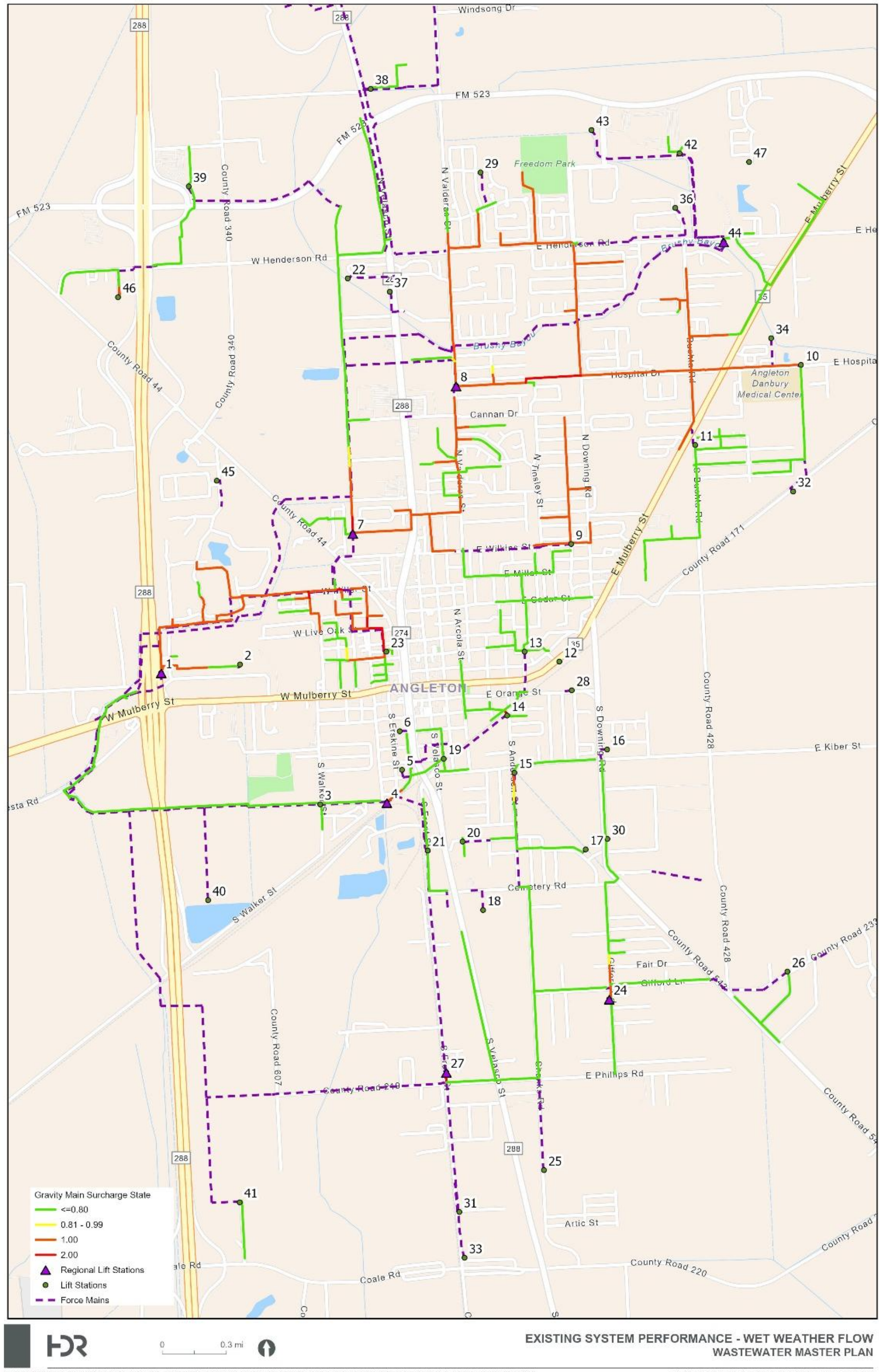


Figure 4.5. Existing System Wet Weather Wastewater Model Results



4.6.5 Future System Performance

LONG-TERM DRY WEATHER PERFORMANCE

The hydraulic model indicates that the existing system will be able to convey estimated peak DWFs well, with few capacity issues. Figure 4.6 below shows that wastewater lines in the northeast portion of town, upstream of lift station 46 exhibit surcharge under the future DWF conditions, but this is likely due to planned growth in that area. Otherwise, the system constraints expected at from long-term dry weather loading are similar to those seen in the existing dry weather model.

LONG-TERM WET WEATHER PERFORMANCE

Model results, shown in Figure 4.7, indicate that the existing system will not be able to convey estimated future peak WWFs. It is likely that a design rainstorm event will result in SSO's throughout the system, primarily concentrated in the northern portion of town. Wastewater lines in the northeast, upstream of lift station 46, exhibit surcharge likely due to planned growth in that area. The major regional lift stations servicing the north, lift stations 1, 7, and 8, have significant surcharge upstream of their intakes, demonstrating that the current lift station capacities are not adequate to convey inflow and infiltration in addition to the future dry weather loading. There is also an increase in surcharge near southern lift stations 24 and 30. The system constraints expected at long-term wet weather conditions are primarily dictated by inflow and infiltration occurring in the system and should be addressed in a variety of maintenance and capital improvement activities.

Figure 4.6. Long-Term System Dry Weather Wastewater Model Results

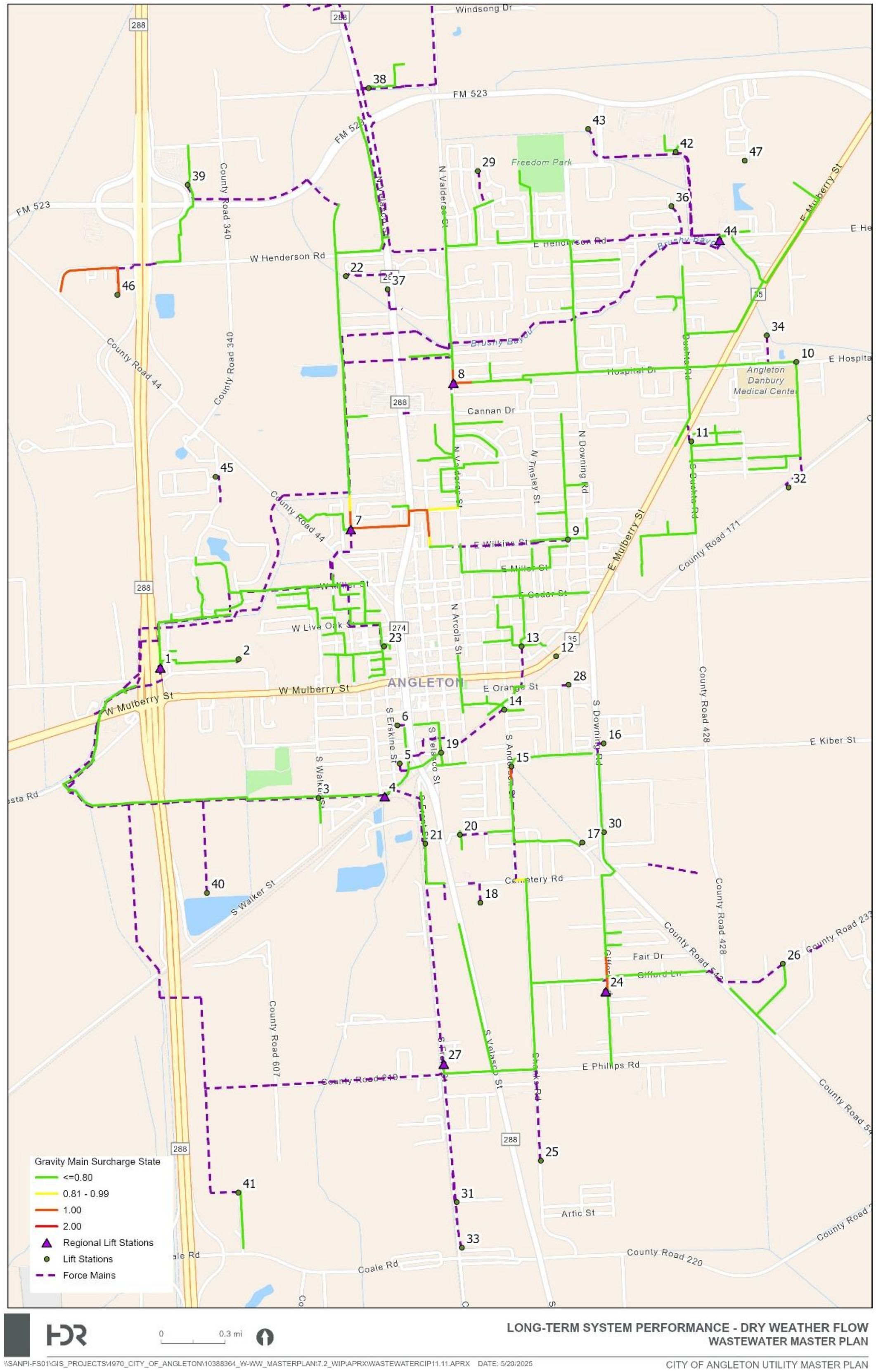
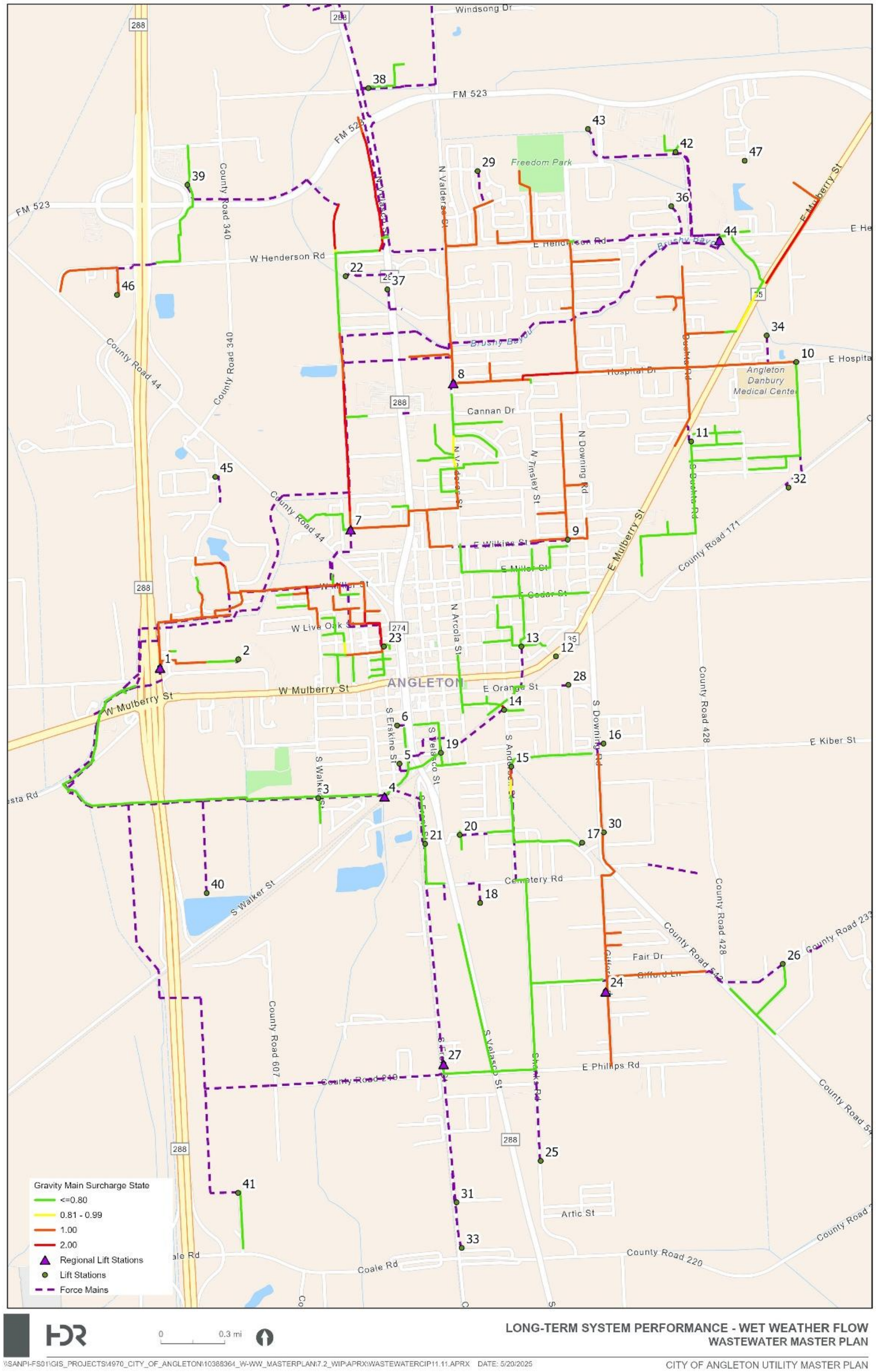


Figure 4.7. Long-Term System Wet Weather Wastewater Model Results



4.7 Capital Improvements

The future land use data provided by the City were used to estimate future wastewater flows and create model scenarios for each planning horizon. Wastewater mains were identified for replacement when the projected peak wet weather flows (PWWF) exceeded the full pipe capacity and resulted in SSOs.

Once the system deficiencies were identified in the hydraulic model, recommended improvements for the pipelines or lift stations with capacity limitations were considered. Recommended improvements were sized based on the standards described in Section 4.5.1.

4.7.1 Inflow and Infiltration Study Recommendations

As illustrated previously in this report, the existing wastewater system conveys both existing and build out peak dry weather flows with relatively few capacity issues. It is during wet weather conditions that the system experiences widespread surcharging and SSOs. This system performance indicates that the wastewater system is experiencing excessive levels of I&I.

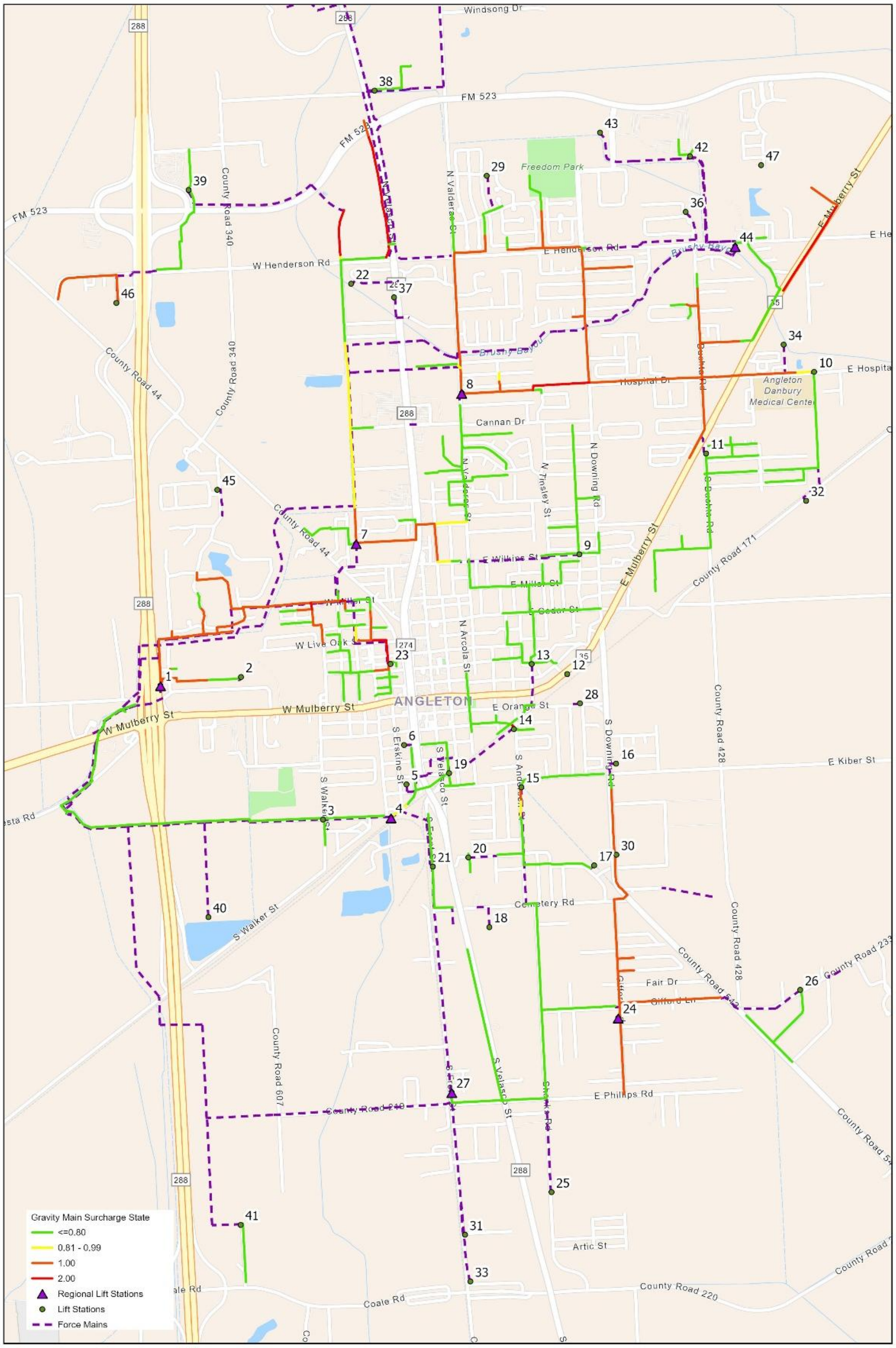
An I&I study will provide recommendations to strategically reduce I&I within the wastewater collection system. For the purpose of this master plan, it was assumed that I&I in the new portions of the system would be drastically reduced due to the new materials, manholes, and improved pipe installation.

Using historical references for I&I reduction and predicted system performance for a system of this size, wet weather I&I was assumed to decrease by approximately 30% by following a systematic treatment of the causative factors for I&I. This was simulated in the model by reducing any estimated peaking factors greater than 4, by 30% with a minimum peaking factor of 4. Using this method, an overall I&I reduction of 16% would be achieved throughout the collection system. As a result, the modeled long-term wet weather flows and associated surcharge would decrease, illustrated by Table 4.6 and Figure 4.8. This I&I reduction will greatly benefit collection system operations as well as operations at the WWTP. When evaluating the CIP below, the necessary improvements for the system with and without any I&I reduction are shown. I&I reduction decreases both the number and scope of CIP projects needed for build out, resulting in a significant decrease in CIP costs.

Table 4.6. Long-Term Wastewater Flows, with and without I&I Reduction

	Long-Term Flows	Long-Term Flows With I&I Reduction
Peak Dry Weather Flow (mgd)	4.4	4.4
Inflow and Infiltration (mgd)	19.9	16.0
Peak Wet Weather Flow (mgd)	24.3	20.4
System Peaking Factor	5.6	4.7

Figure 4.8. Long-Term System Wet Weather Model Results with I&I Reduction



LONG-TERM SYSTEM PERFORMANCE - I&I REDUCTION
WASTEWATER MASTER PLAN
CITY OF ANGLETON UTILITY MASTER PLAN

4.7.2 Wastewater Conveyance CIP

The long-term wastewater conveyance CIP projects are outlined in Table 4.7. Suggested improvements are categorized based on improvements needed if no I&I reduction is done, and improvements needed if the previously mentioned I&I reduction is accomplished by the City. A fraction of the CIP projects would be eligible for impact fees, as they provide additional capacity needed to serve areas of new growth in the City.

Table 4.7. Wastewater Conveyance Projects

CIP Without I&I Reduction			
Project ID	**Recommended CIP**	**Pipe Diameter (in)**	**Pipe Length (LF)**
WWL-1	Shannon Street & Karankawa Lane	36	4,110
WWL-2	Hospital Dr. from Buchta Rd to Valderas St	27	3,210
WWL-3	E. Mulberry St. West of I-35	16	3,860
WWL-4	Highway 288B from FM 523 to Henderson Rd.	12	4,265
WWL-5	FM 523/Henderson Rd Wastewater Line	16	1,230
WWL-6	Lift Station 46 Tributary	12	2,425
CIP With I&I Reduction			
WWL-1*	Shannon Street & Karankawa Lane	**30**	4,110
WWL-2	No longer needed after I&I reduction		
WWL-3	E. Mulberry St. West of I-35	16	3,860
WWL-4	Highway 288B from FM 523 to Henderson Rd.	12	4,265
WWL-5	FM 523/Henderson Rd Wastewater Line	16	1,230
WWL-6*	Lift Station 46 Tributary	**10**	2,425

*Note change in CIP project pipe diameters with I&I Reduction

4.7.3 Lift Station Pumping CIP

Several lift stations throughout the wastewater conveyance system will need to increase their capacity to satisfy the projected long term wastewater loading. Most of these improvements are located at regional lift stations that are responsible for a large fraction of the system's wastewater flows. Table 4.8 provides a summary of the additional pumping capacity needed.

Table 4.8. Lift Station Improvements

CIP Without I&I Reduction			
Project ID	**Recommended CIP**	**Number of Pumps Added**	**Pump Capacity, each (gpm)**
PUMP-1	LS 1 Pump Station	2	800
PUMP-2	LS 7 Bypass Pump Station	2	2,250
PUMP-3	LS 7 Pump Station	1	1,200
PUMP-4	LS 8 Pump Station	3	1,200
PUMP-5	LS 9 Pump Station	1	250
PUMP-6	LS 23 Pump Station	1	350
PUMP-7	LS 24 Pump Station	1	350
CIP With I&I Reduction			
PUMP-1	LS 1 Pump Station	2	800
PUMP-2	No longer needed after I&I reduction		
PUMP-3	LS 7 Pump Station	1	1,200
PUMP-4	LS 8 Pump Station	3	1,200
PUMP-5	No longer needed after I&I reduction		
PUMP-6	No longer needed after I&I reduction		
PUMP-7	LS 24 Pump Station	1	350

4.7.4 Force Main CIP

As lift station capacity increases, force main capacity will also need to increase to convey long term wastewater loading while maintaining reasonable velocities. Most of the force main improvements correspond to the improvements at regional lift stations and areas that are known to convey large volumes of wastewater.

Table 4.9. Long-Term Force Main Projects

CIP Without I&I Reduction			
Project ID	Recommended CIP	Pipe Diameter (in)	Pipe Length (LF)
FM-1	Lift Station 1 Force Main	18	1,010
FM-2	Lift Station 7 Bypass Force Main	24	12,300
FM-3	Lift Station 8 Force Main	18	277
FM-4	Lift Station 24 Force Main	10	405
FM-5	Lift Station 39 Force Main	8	4,450
CIP With I&I Reduction			
FM-1	Lift Station 1 Force Main	18	1,010
FM-2	No longer needed after I&I reduction		
FM-3*	Lift Station 8 Force Main	**16**	277
FM-4	Lift Station 24 Force Main	10	405
FM-5	No longer needed after I&I reduction		

*Diameter of project is reduced with I&I reduction.

4.7.5 WWTP Expansion

Per the Texas Commission on Environmental Quality (TCEQ) Chapter 305.126, when a facility reaches 75% of the permitted flow, financial planning and design for the necessary additional treatment facilities shall be initiated, and when a facility reaches 90% of the permitted flow, construction of the additional treatment facilities shall commence.

Projected wastewater flows at build out were shown previously in Table 4.6. The peak wet weather flow with and without I&I reduction exceeds the City's current Texas Pollutant Discharge Elimination System (TPDES) Permit. The existing permit allows a maximum effluent flow of 3.6 mgd to be discharged into Oyster Creek, and no more than 12,500 gpm (~18 mgd) during any two-hour period. The current wastewater loading projections predict that the City will need to amend its TPDES permit and expand the WWTP in the next 30 years to serve its growing population.

Note that further evaluation of WWTP improvements is beyond the scope of work of the master plan, which was limited to evaluation of the wastewater collection system.

4.8 Wastewater OPCC

4.8.1 Wastewater CIP Cost Summary

Based on the hydraulic modeling results and prioritization efforts, HDR developed a CIP program as summarized in Section 4.7. The costs are considered planning level only based on recent unit costs and are in 2025 dollars. The cost for each project includes a 30% contingency for unknowns and 10% for market volatility, in addition to 25% for engineering and contractor costs. A cost breakdown is included with the CIP summaries in Appendix E. The alignments and extents of projects are based on the hydraulic modeling. Prior to design or construction, it is recommended that flow monitoring be initiated and used to validate the hydraulic model results to “right size” the projects. The flow monitoring would help confirm both the necessity of the project and the required pipe size.

The planned developments shown previously in Figure 2.4 will greatly contribute to predicted flows at build out. As with the water CIP outlined in Section 2, the wastewater CIP table includes an impact fee percentage. This percentage represents the amount of the overall project cost that is eligible for impact fees, based on the portion of the new service loadings each project will contribute with a near-term planning window. These impact fees allow the City to impose a portion of the cost on new developments to provide utility services.

Table 4.10. CIP Cost Summary - Without I&I Reduction

Project ID	Recommended CIP	Number of Pumps Added	Pump Capacity (gpm)	OPCC (2025 dollars)	% of Cost Impact Fee Eligible (portion of capacity used within 10 years)
PUMP-1	LS 1 Pump Station	2	800	$1,815,000	25%
PUMP-2	LS 7 Bypass Pump Station	2	2,250	$1,815,000	50%
PUMP-3	LS 7 Pump Station	1	1,200	$1,815,000	50%
PUMP-4	LS 8 Pump Station	3	1,200	$1,815,000	50%
PUMP-5	LS 9 Pump Station	1	250	$1,815,000	0%
PUMP-6	LS 23 Pump Station	1	350	$1,815,000	0%
PUMP-7	LS 24 Pump Station	1	350	$1,815,000	25%
Project ID	**Recommended CIP**	**Pipe Diameter (in)**	**Pipe Length (LF)**	**OPCC (2025 dollars)**	**% of Cost Impact Fee Eligible**
FM-1	Lift Station 1 Force Main	18	1,010	$1,284,000	25%
FM-2	Lift Station 7 Bypass Force Main	24	12,300	$20,762,000	50%
FM-3	Lift Station 8 Force Main	18	277	$176,000	50%
FM-4	Lift Station 24 Force Main	10	405	$144,000	25%
WWL-1	Shannon Street & Karankawa Lane	36	4,110	$5,222,000	50%
WWL-2	Hospital Dr. from Buchta Rd to Valderas St	27	3,210	$3,059,000	50%
WWL-3	E. Mulberry St. West of I-35	16	3,860	$4,344,000	50%
WWL-4	Highway 288B from FM 523 to Henderson Rd.	12	4,265	$3,600,000	25%
WWL-5	FM 523/Henderson Rd Wastewater Line	16	1,230	$693,000	25%
WWL-6	Lift Station 46 Tributary	12	2,425	$1,035,000	100%
Total Cost of CIP Projects Without I&I Reduction				**$51,989,000**	

Table 4.11. CIP Cost Summary - With I&I Reduction

Project ID	Recommended CIP	Number of Pumps Added	Pump Capacity (gpm)	OPCC (2025 dollars)	% of Cost Impact Fee Eligible (portion of capacity used within 10 years)
PUMP-1	LS 1 Pump Station	2	800	$1,815,000	25%
PUMP-3	LS 7 Pump Station	1	1200	$1,815,000	50%
PUMP-4	LS 8 Pump Station	3	1200	$1,815,000	50%
PUMP-7	LS 24 Pump Station	1	350	$1,815,000	25%
Project ID	**Recommended CIP**	**Pipe Diameter (in)**	**Pipe Length (LF)**	**OPCC (2025 dollars)**	**% of Cost Impact Fee Eligible**
FM-1	Lift Station 1 Force Main	18	1,010	$1,284,000	25%
FM-3*	Lift Station 8 Force Main	**16**	277	$156,000	50%
FM-4	Lift Station 24 Force Main	10	405	$144,000	25%
WWL-1*	Shannon Street & Karankawa Lane	**30**	4,110	$4,327,000	50%
WWL-3	E. Mulberry St. West of I-35	16	3,860	$4,344,000	50%
WWL-4	Highway 288B from FM 523 to Henderson Rd.	12	4,265	$3,600,000	25%
WWL-5	FM 523/Henderson Rd Wastewater Line	16	1,230	$693,000	25%
WWL-6*	Lift Station 46 Tributary	**10**	2,425	$859,000	100%
Total Cost of CIP Projects With I&I Reduction				**$22,667,000**	

*Note change in CIP Projects pipe diameter with I&I reduction.

4.8.2 Wastewater CIP Prioritization

The City's primary focus when it comes to CIP projects should be improvements that can decrease I&I. An I&I study should be conducted to understand the wastewater collection system wholistically.

4.9 Additional Wastewater Recommendations

4.9.1 Asset Management Program

An asset management program can record and monitor the City's wastewater assets, evaluate their remaining life, and estimate the investment required to maintain reliable services. An asset management program can focus the City's operation and maintenance budget and resources. This program can document renewal strategies, creating defensible documentation for annual budget planning.

4.9.2 Manhole Condition Assessment

Because the City has had historical indications of high I&I, part of an asset management program could include a manhole condition assessment program. In conjunction with a sampling plan to determine the viability of reducing hydrogen sulfide (H_2S) generation in the collection system, a manhole condition assessment program would determine the degree of deterioration of manholes. This would also provide information on the remaining life of the manholes, as well as their reliability.

4.9.3 Flow Monitoring Program

Investing in a targeted flow monitoring program can provide valuable data to use in refining and calibrating the hydraulic model, which will improve its accuracy and its usefulness for planning system improvements. Flow monitoring will streamline future efforts to develop wastewater master plans and give further insight to the operation of the existing collection system. The model results developed after incorporating flow monitoring data can validate the necessity and sizing of proposed CIP projects.

4.9.4 Model Updates and GIS Integration

The hydraulic model is a representation of the system created with the available data at the time. However, systems are constantly changing and evolving. A model can continue to characterize the changing system, but requires regular maintenance and updating to do this effectively. Hydraulic models should typically be updated at least annually, or after the construction of a major wastewater CIP project or the addition of a significant development.

The current hydraulic model operates within the GIS environment. A unique asset identification system in GIS could be integrated with the model identification system, simplifying future model updates. This identification system would allow the model software to quickly recognize manholes or pipe segments with a new identification number and import those assets into the model.

Appendix A – Comparison of Supplies and Demands

Table A.1. Annual Supplies and Demands

Year	BWA Surface Water Supply (ac-ft/yr)	Annual Well Supply (ac-ft/yr)		Total Annual Supplies (ac-ft/yr)		Average-day Demands (ADD) - HDR Calculated (ac-ft/yr)	Annual Surplus/(Need) Based on HDR ADD (ac-ft/yr)	
		100% GW Capacity	50% GW Capacity	100% GW Capacity	50% GW Capacity		100% GW Capacity	50% GW Capacity
2023	2,576	2,501	1,251	5,077	3,827	1,873	3,204	1,954
2024	2,576	2,501	1,251	5,077	3,827	1,970	3,107	1,856
2025	2,576	2,501	1,251	5,077	3,827	2,073	3,004	1,754
2026	2,576	2,501	1,251	5,077	3,827	2,180	2,897	1,646
2027	2,576	2,501	1,251	5,077	3,827	2,294	2,783	1,533
2028	2,576	2,501	1,251	5,077	3,827	2,413	2,664	1,414
2029	2,576	2,501	1,251	5,077	3,827	2,538	2,539	1,288
2030	2,576	2,501	1,251	5,077	3,827	2,670	2,407	1,157
2031	2,576	2,501	1,251	5,077	3,827	2,809	2,268	1,018
2032	2,576	2,501	1,251	5,077	3,827	2,955	2,122	872
2033	2,576	2,501	1,251	5,077	3,827	3,108	1,969	719
2034	2,576	2,501	1,251	5,077	3,827	3,196	1,881	630
2035	2,576	2,501	1,251	5,077	3,827	3,287	1,790	539
2036	2,576	2,501	1,251	5,077	3,827	3,381	1,696	445
2037	2,576	2,501	1,251	5,077	3,827	3,477	1,600	349
2038	2,576	2,501	1,251	5,077	3,827	3,576	1,501	250
2039	2,576	2,501	1,251	5,077	3,827	3,678	1,399	148
2040	2,576	2,501	1,251	5,077	3,827	3,783	1,294	44
2041	2,576	2,501	1,251	5,077	3,827	3,891	1,186	(64)
2042	2,576	2,501	1,251	5,077	3,827	4,001	1,076	(175)
2043	2,576	2,501	1,251	5,077	3,827	4,115	962	(289)
2044	2,576	2,501	1,251	5,077	3,827	4,232	845	(406)
2045	2,576	2,501	1,251	5,077	3,827	4,353	724	(526)
2046	2,576	2,501	1,251	5,077	3,827	4,477	600	(650)
2047	2,576	2,501	1,251	5,077	3,827	4,604	473	(778)
2048	2,576	2,501	1,251	5,077	3,827	4,735	342	(909)
2049	2,576	2,501	1,251	5,077	3,827	4,870	207	(1,044)
2050	2,576	2,501	1,251	5,077	3,827	5,009	68	(1,182)
2051	2,576	2,501	1,251	5,077	3,827	5,151	(74)	(1,325)
2052	2,576	2,501	1,251	5,077	3,827	5,298	(221)	(1,472)

Year	BWA Surface Water Supply (ac-ft/yr)	Annual Well Supply (ac-ft/yr)		Total Annual Supplies (ac-ft/yr)		Average-day Demands (ADD) - HDR Calculated (ac-ft/yr)	Annual Surplus/(Need) Based on HDR ADD (ac-ft/yr)	
		100% GW Capacity	50% GW Capacity	100% GW Capacity	50% GW Capacity		100% GW Capacity	50% GW Capacity
2053	2,576	2,501	1,251	5,077	3,827	5,449	(372)	(1,622)
2054	2,576	2,501	1,251	5,077	3,827	5,527	(450)	(1,700)
2055	2,576	2,501	1,251	5,077	3,827	5,605	(528)	(1,779)
2056	2,576	2,501	1,251	5,077	3,827	5,685	(608)	(1,859)
2057	2,576	2,501	1,251	5,077	3,827	5,766	(689)	(1,939)
2058	2,576	2,501	1,251	5,077	3,827	5,848	(771)	(2,022)
2059	2,576	2,501	1,251	5,077	3,827	5,931	(854)	(2,105)
2060	2,576	2,501	1,251	5,077	3,827	6,016	(939)	(2,189)
2061	2,576	2,501	1,251	5,077	3,827	6,101	(1,024)	(2,275)
2062	2,576	2,501	1,251	5,077	3,827	6,188	(1,111)	(2,362)
2063	2,576	2,501	1,251	5,077	3,827	6,276	(1,199)	(2,450)
2064	2,576	2,501	1,251	5,077	3,827	6,366	(1,289)	(2,539)
2065	2,576	2,501	1,251	5,077	3,827	6,456	(1,379)	(2,630)
2066	2,576	2,501	1,251	5,077	3,827	6,548	(1,471)	(2,722)
2067	2,576	2,501	1,251	5,077	3,827	6,641	(1,564)	(2,815)
2068	2,576	2,501	1,251	5,077	3,827	6,736	(1,659)	(2,909)
2069	2,576	2,501	1,251	5,077	3,827	6,832	(1,755)	(3,005)
2070	2,576	2,501	1,251	5,077	3,827	6,929	(1,852)	(3,103)
2071	2,576	2,501	1,251	5,077	3,827	7,028	(1,951)	(3,201)
2072	2,576	2,501	1,251	5,077	3,827	7,128	(2,051)	(3,301)
2073	2,576	2,501	1,251	5,077	3,827	7,229	(2,152)	(3,403)

Table A.2. Max-Day Capacity and Demands

Year	BWA Surface Water Supply Capacity (mgd)	Well Capacity (mgd)	Total Capacity (mgd)	Maximum-day Demands (mgd)	Max Day Surplus/(Need) (mgd)
2023	2.30	4.70	7.00	3.35	3.65
2024	2.30	4.70	7.00	3.52	3.48
2025	2.30	4.70	7.00	3.71	3.29
2026	2.30	4.70	7.00	3.90	3.10
2027	2.30	4.70	7.00	4.10	2.90
2028	2.30	4.70	7.00	4.31	2.69
2029	2.30	4.70	7.00	4.54	2.46
2030	2.30	4.70	7.00	4.77	2.23
2031	2.30	4.70	7.00	5.02	1.98
2032	2.30	4.70	7.00	5.28	1.72
2033	2.30	4.70	7.00	5.55	1.45
2034	2.30	4.70	7.00	5.71	1.29
2035	2.30	4.70	7.00	5.87	1.13
2036	2.30	4.70	7.00	6.04	0.96
2037	2.30	4.70	7.00	6.21	0.79
2038	2.30	4.70	7.00	6.39	0.61
2039	2.30	4.70	7.00	6.57	0.43
2040	2.30	4.70	7.00	6.76	0.24
2041	2.30	4.70	7.00	6.95	0.05
2042	2.30	4.70	7.00	7.15	(0.15)
2043	2.30	4.70	7.00	7.35	(0.35)
2044	2.30	4.70	7.00	7.56	(0.56)
2045	2.30	4.70	7.00	7.77	(0.77)
2046	2.30	4.70	7.00	7.99	(0.99)
2047	2.30	4.70	7.00	8.22	(1.22)
2048	2.30	4.70	7.00	8.46	(1.46)
2049	2.30	4.70	7.00	8.70	(1.70)
2050	2.30	4.70	7.00	8.94	(1.94)
2051	2.30	4.70	7.00	9.20	(2.20)
2052	2.30	4.70	7.00	9.46	(2.46)
2053	2.30	4.70	7.00	9.73	(2.73)
2054	2.30	4.70	7.00	9.87	(2.87)
2055	2.30	4.70	7.00	10.01	(3.01)
2056	2.30	4.70	7.00	10.15	(3.15)

Year	BWA Surface Water Supply Capacity (mgd)	Well Capacity (mgd)	Total Capacity (mgd)	Maximum-day Demands (mgd)	Max Day Surplus/(Need) (mgd)
2057	2.30	4.70	7.00	10.30	(3.30)
2058	2.30	4.70	7.00	10.44	(3.44)
2059	2.30	4.70	7.00	10.59	(3.59)
2060	2.30	4.70	7.00	10.74	(3.74)
2061	2.30	4.70	7.00	10.89	(3.89)
2062	2.30	4.70	7.00	11.05	(4.05)
2063	2.30	4.70	7.00	11.21	(4.21)
2064	2.30	4.70	7.00	11.37	(4.37)
2065	2.30	4.70	7.00	11.53	(4.53)
2066	2.30	4.70	7.00	11.69	(4.69)
2067	2.30	4.70	7.00	11.86	(4.86)
2068	2.30	4.70	7.00	12.03	(5.03)
2069	2.30	4.70	7.00	12.20	(5.20)
2070	2.30	4.70	7.00	12.37	(5.37)
2071	2.30	4.70	7.00	12.55	(5.55)
2072	2.30	4.70	7.00	12.73	(5.73)
2073	2.30	4.70	7.00	12.91	(5.91)

Appendix B – Water CIP Summary Sheets

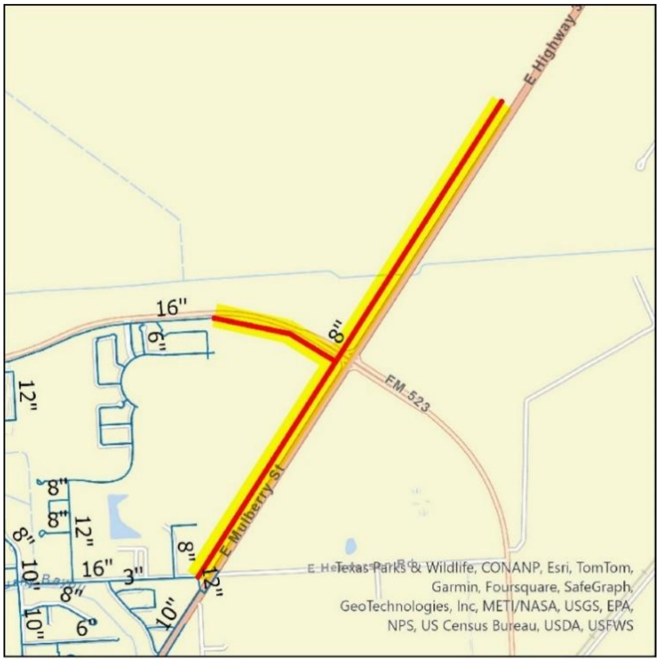
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: North East Expansion
CIP Year: 2035

Vicinity Map:



Project Description and Location:

Extending existing water lines to the northeast area of the City, including a 16" segment and 8" segment running along E Mulberry St to support anticipated mixed-use developments along Hwy 35 and to close a distribution system loop serving the northeastern portion of the Rancho MUD and Growth Areas 21 and 22.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	8,600	LF	$145	$1,247,000
16" PVC Water Line	2,000	LF	$295	$590,000
	Subtotal			$1,837,000
	Misc Items		10%	$183,700
	Construction Subtotal			$2,020,700
	Professional services		25%	$505,175
	Contingency		30%	$606,210
	Market volatility		10%	$202,070
	Project Total			$3,334,000

City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: CR 44 Extension
CIP Year: 2035

Vicinity Map:

Project Description and Location:

Connecting existing water lines on Country Road 44 through a 12" water line to improve capacity along CR 44 and directly serve Growth Areas 4 and 6.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	9,000	LF	$240	$2,160,000
	Subtotal			$2,160,000
	Misc Items		10%	$216,000
	Construction Subtotal			$2,376,000
	Professional services		25%	$594,000
	Contingency		30%	$712,800
	Market volatility		10%	$237,600
	Project Total			$3,920,000

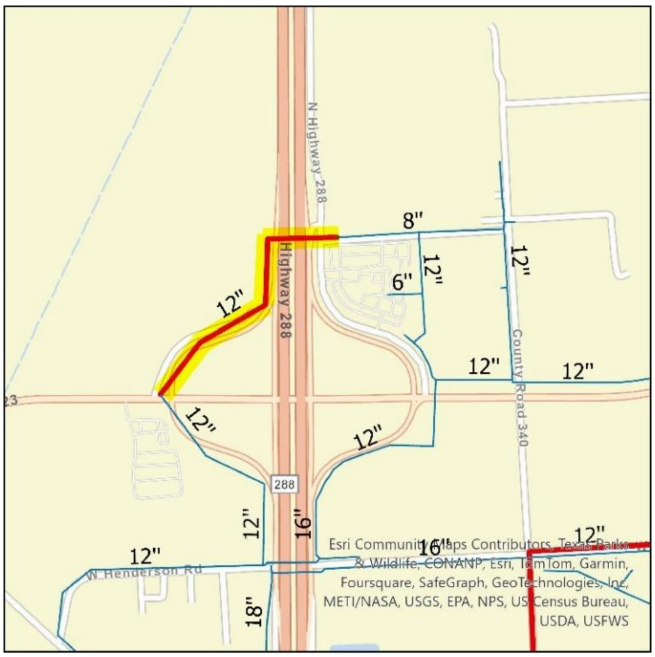
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: HWY 288 & FM 523
CIP Year: 2035

<u>Vicinity Map</u>:



<u>Project Description and Location:</u>

Connecting existing water lines at the intersection of Highway 288 and FM 523 through a 12" line of 2,500 LF to close a loop from Carbtex Rd, east across Hwy 288, south to FM 523. This project directly serves Growth Areas 3 and 4.

<u>Planning Level Opinion of Probable Construction Cost</u>

Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	2,500	LF	$240	$600,000
	Subtotal			$600,000
	Misc Items		10%	$60,000
	Construction Subtotal			$660,000
	Professional services		25%	$165,000
	Contingency		30%	$198,000
	Market volatility		10%	$66,000
	Project Total			$1,089,000

City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: Henderson to CR 44
CIP Year: 2035

Vicinity Map:

Project Description and Location:

Installing approximately 9,000 LF of 12” water lines to connect Henderson Rd to County Road 44. This project improves capacity to Growth Area 5 and reduces maximum-day head loss in the local distribution system.

Planning Level Opinion of Probable Construction Cost

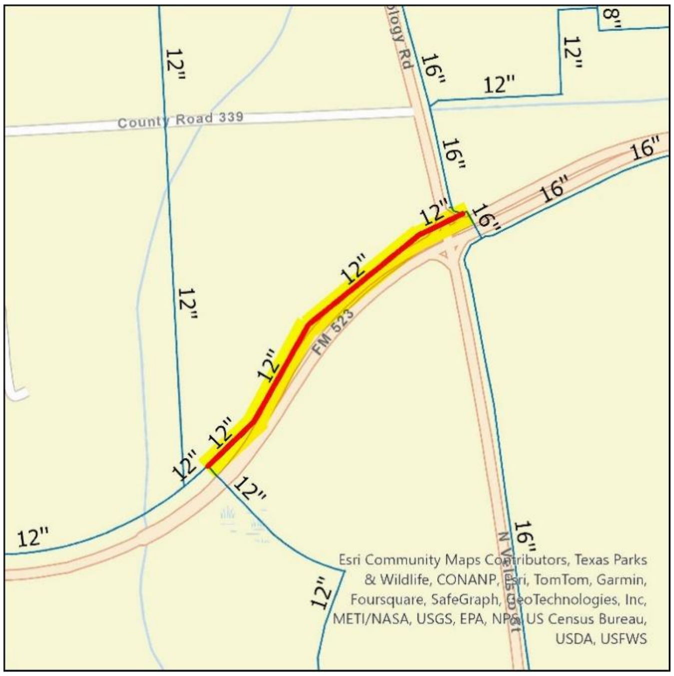
Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	9,000	LF	$240	$2,160,000
	Subtotal			$2,160,000
	Misc Items		10%	$216,000
	Construction Subtotal			$2,376,000
	Professional services		25%	$594,000
	Contingency		30%	$712,800
	Market volatility		10%	$237,600
	Project Total			$3,920,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: FM 523 Interconnect
CIP Year: 2035

Vicinity Map:



Project Description and Location:

Connecting existing water lines with approximately 2,300 LF of 12" line near the intersection of FM 523 and N Velasco St

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	2,300	LF	$240	$552,000

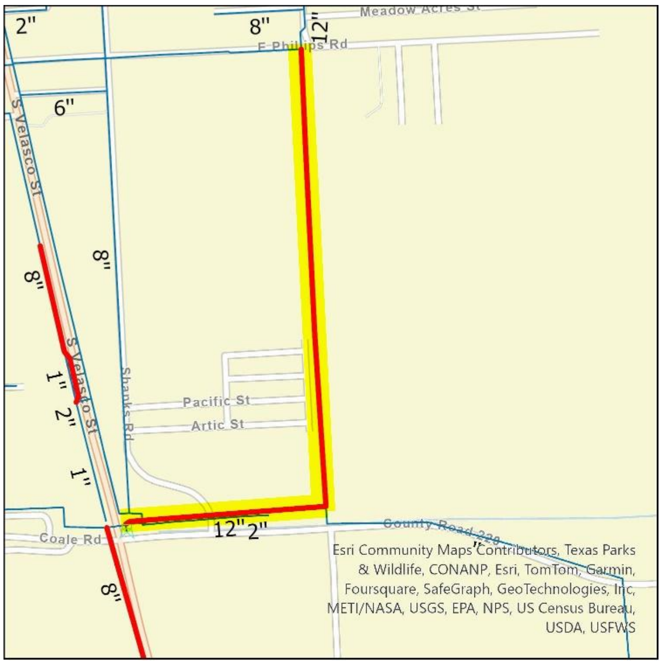
Subtotal		$552,000
Misc Items	10%	$55,200
Construction Subtotal		$607,200
Professional services	25%	$151,800
Contingency	30%	$182,160
Market volatility	10%	$60,720
Project Total		$1,002,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: E Phillips Rd & CR 220 Interconnect
CIP Year: 2035

Vicinity Map:



Project Description and Location:

- Extending 12” water lines for approximately 6,400 LF between County Road 220 and E Phillips Rd to connect existing distribution system assets along E Phillips Rd to the location of a proposed EST near the intersection of S Velasco St and Cr 220. This project serves Growth Areas 16 and 17.

Planning Level Opinion of Probable Construction Cost

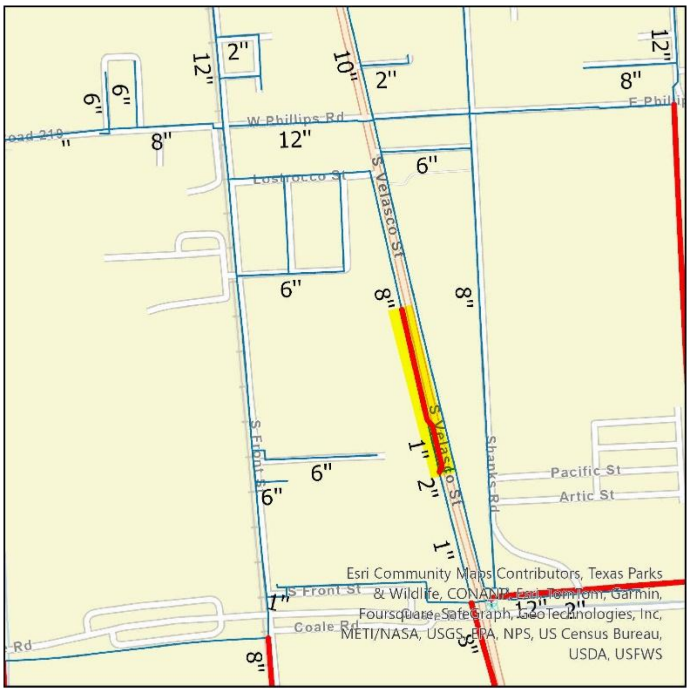
Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	6,400	LF	$240	$1,536,000
	Subtotal			$1,536,000
	Misc Items		10%	$153,600
	Construction Subtotal			$1,689,600
	Professional services		25%	$422,400
	Contingency		30%	$506,880
	Market volatility		10%	$168,960
	Project Total			$2,788,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: S Velasco St Loop
CIP Year: 2035

Vicinity Map:



Project Description and Location:

Installing 1,600 LF of 8” water line to close a gap along S Velasco St and serve Growth Area 15.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	1,600	LF	$145	$232,000
	Subtotal			$232,000
	Misc Items		10%	$23,200
	Construction Subtotal			$255,200
	Professional services		25%	$63,800
	Contingency		30%	$76,560
	Market volatility		10%	$25,520
	Project Total			$421,000

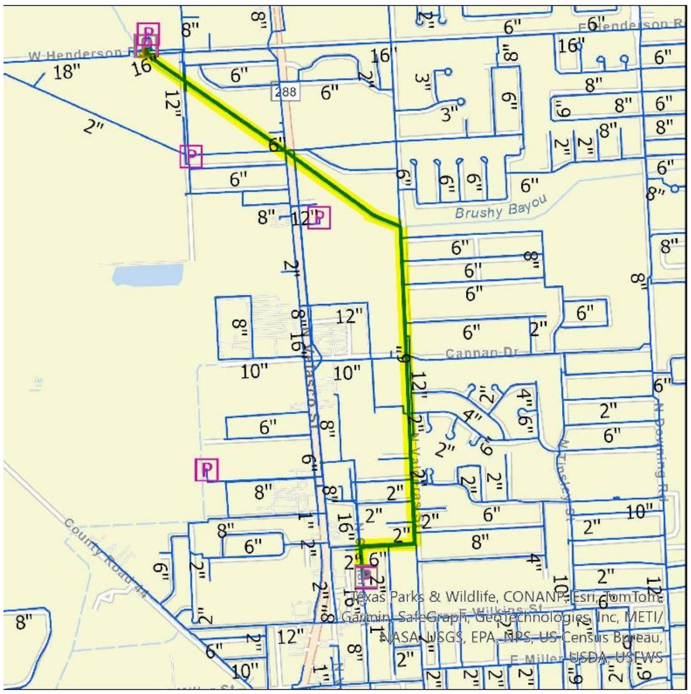
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: Henderson Transmission Line
CIP Year: 2035

Vicinity Map:



Project Description and Location:

Install 9,400 LF of 12" PVC water line to prevent chlorine- and chloramine-treated water from mixing. City staff would like to have two separate lines, one for wells (existing transfer line) and one for supply (new line). This will allow water quality to remain consistent in the City and make operations more efficient when Water Wells #8, 9, & 10 are required to meet water demands. While this situation could be remedied by the addition of an ammonia feed to the Chenango Water Plant to chloraminate the groundwater supply, the second supply line will alleviate hydraulic capacity limitations that inhibit full utilization of the well supplies and supplies transferred from the Henderson Plant to the Chenango Plant.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	9,400	LF	$240	$2,256,000
	Subtotal			$2,256,000
	Misc Items		10%	$225,600
	Construction Subtotal			$2,481,600
	Professional services		25%	$620,400
	Contingency		30%	$744,480
	Market volatility		10%	$248,160
	Project Total			$4,095,000

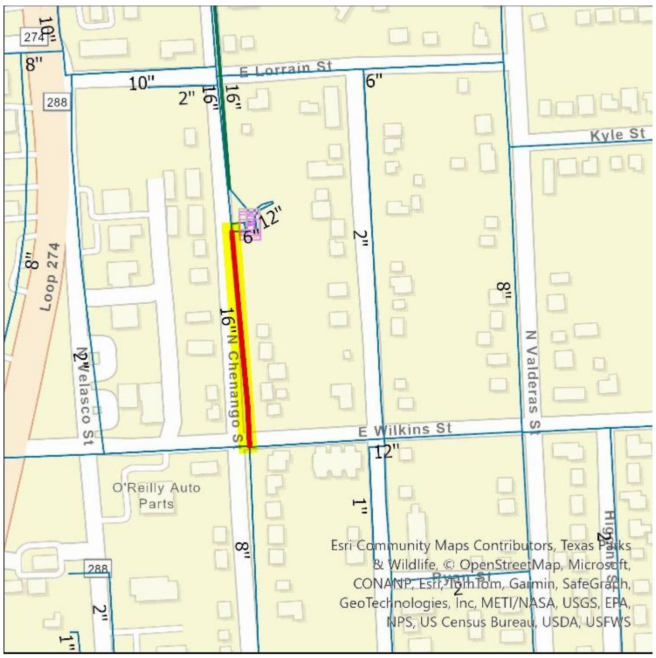
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: North Chenango St and Wilkins St
CIP Year: 2035

Vicinity Map:



Project Description and Location:

Future model simulations identified that the future predicted increased volume of water pumped from the Chenango BPS would result in excessive velocities in the distribution main from the Chenango BPS to the 12-inch diameter looped distribution system, beginning at the intersection of E Wilkins St and N Chenango St. The existing 10-inch and 12-inch diameter water lines are proposed to be replaced with a new 16-inch diameter water line.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
16" PVC Water Line	550	LF	$295	$162,250
	Subtotal			$162,250
	Misc Items		10%	$16,225
	Construction Subtotal			$178,475
	Professional services		25%	$44,619
	Contingency		30%	$53,543
	Market volatility		10%	$17,848
	Project Total			$294,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: CR 428 & S Downing Rd Interconnect
CIP Year: 2055

Vicinity Map:

Project Description and Location:

The 2,700 LF of 8” water line connects existing distribution system waterlines along S Downing Rd to the proposed CR 428 Waterline project. This project serves Growth Area 19.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	2,700	LF	$145	$391,500
	Subtotal			$391,500
	Misc Items		10%	$39,150
	Construction Subtotal			$430,650
	Professional services		25%	$107,663
	Contingency		30%	$129,195
	Market volatility		10%	$43,065
	Project Total			$711,000

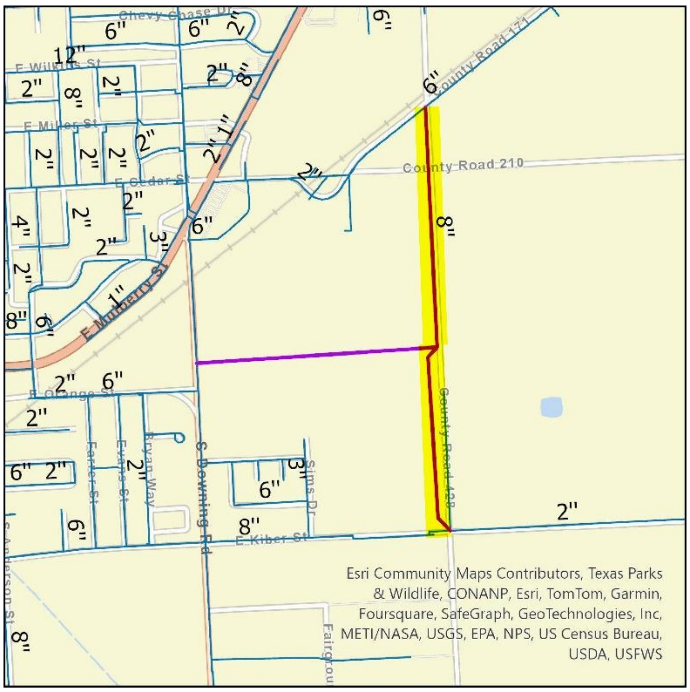
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: CR 428 WL
CIP Year: 2055

Vicinity Map:



Project Description and Location:

Installation of 4,800 LF of 8" PVC water line will create a loop from CR 171 to E Kiber St, along CR 428 and serve Growth Area 19.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	4,800	LF	$145	$696,000
	Subtotal			$696,000
	Misc Items		10%	$69,600
	Construction Subtotal			$765,600
	Professional services		25%	$191,400
	Contingency		30%	$229,680
	Market volatility		10%	$76,560
	Project Total			$1,263,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: CR 220 Loop
CIP Year: 2055

Vicinity Map:

Project Description and Location:

8,900 LF of 8" water line to connect the proposed Coale Rd and Hwy 288B Loop project to the proposed E Phillips Rd & CR 220 Interconnect project, extending water service to the far southeast. This project serves Growth Areas 17 and 18.

Planning Level Opinion of Probable Construction Cost

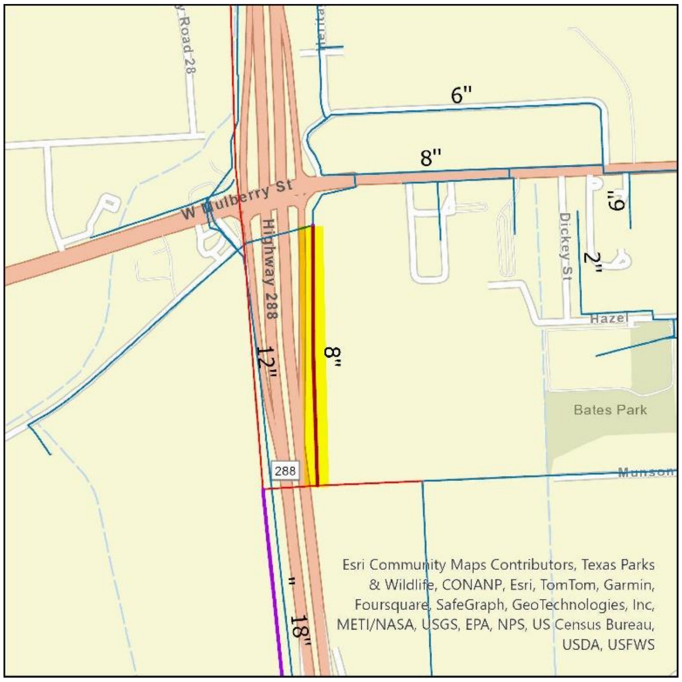
Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	8,900	LF	$145	$1,290,500
	Subtotal			$1,290,500
	Misc Items		10%	$129,050
	Construction Subtotal			$1,419,550
	Professional services		25%	$354,888
	Contingency		30%	$425,865
	Market volatility		10%	$141,955
	Project Total			$2,342,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: HWY 288 NB WL Extension
CIP Year: 2055

Vicinity Map:



Project Description and Location:

2,300 LF of 8” water line creates a loop from the proposed Coale Rd and Hwy 288 Loop and existing mains near the intersection of Hwy 288 and W Mulberry St. This project serves Growth Area 9.

Planning Level Opinion of Probable Construction Cost

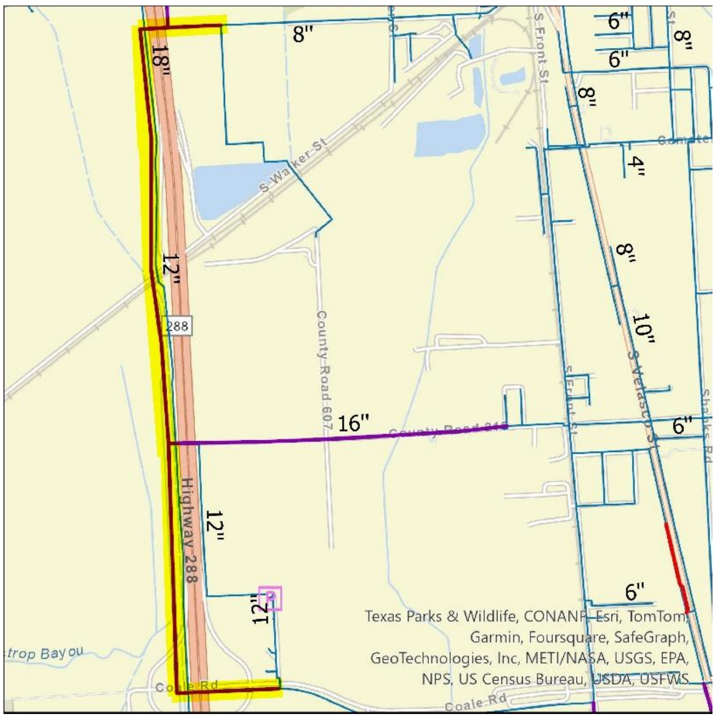
Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	2,300	LF	$145	$333,500
	Subtotal			$333,500
	Misc Items		10%	$33,350
	Construction Subtotal			$366,850
	Professional services		25%	$91,713
	Contingency		30%	$110,055
	Market volatility		10%	$36,685
	Project Total			$605,000

City of Angleton Water System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: Coale Rd and HWY 288 Loop
CIP Year: 2055

Vicinity Map:



Project Description and Location:

Installing 14,480 LF of 12" water line to improve conveyance from the Jamison BPS along Hwy 288 and serves Growth Areas 10, 11, 12, and 13.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
12" PVC Water Line	14,480	LF	$240	$3,475,200
	Subtotal			$3,475,200
	Misc Items		10%	$347,520
	Construction Subtotal			$3,822,720
	Professional services		25%	$955,680
	Contingency		30%	$1,146,816
	Market volatility		10%	$382,272
	Project Total			$6,307,000

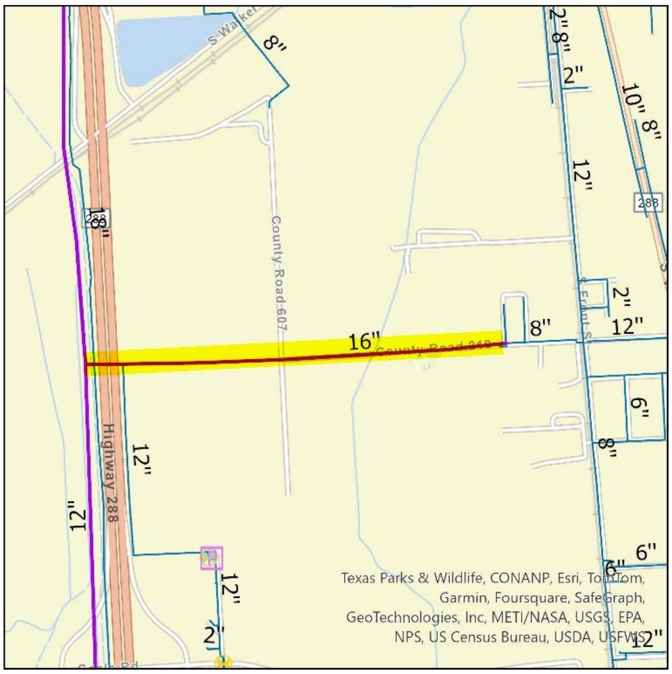
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: CR 219 WL
CIP Year: 2055

Vicinity Map:



Project Description and Location:

Installing 7,100 LF of 16" water line creates a loop from CR 219 to Hwy 288 and serves Growth Area 12.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
16" PVC Water Line	7,100	LF	$295	$2,094,500
	Subtotal			$2,094,500
	Misc Items		10%	$209,450
	Construction Subtotal			$2,303,950
	Professional services		25%	$575,988
	Contingency		30%	$691,185
	Market volatility		10%	$230,395
	Project Total			$3,802,000

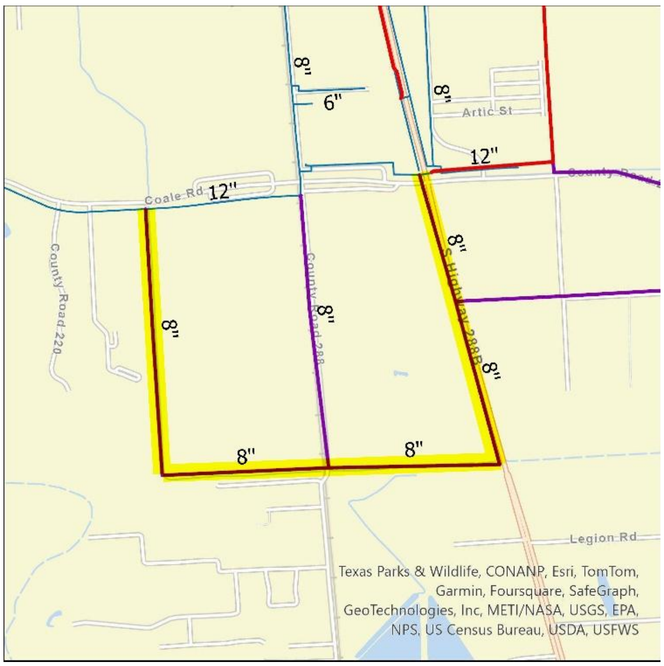
City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: Coale Rd and HWY 288B Loop
CIP Year: 2035

Vicinity Map:



Project Description and Location:

Installing 14,400 LF of 8” water line creates a loop around Growth Area 14, improves capacity between the Jamison BPS and the Hwy 288B area, and supports the operation of a proposed EST near the intersection of S Velasco St and CR 220.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	14,400	LF	$145	$2,088,000
	Subtotal			$2,088,000
	Misc Items		10%	$208,800
	Construction Subtotal			$2,296,800
	Professional services		25%	$574,200
	Contingency		30%	$689,040
	Market volatility		10%	$229,680
	Project Total			$3,790,000

City of Angleton Water System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: CR 288 WL Extension
CIP Year: 2035

Vicinity Map:

Project Description and Location:

Installing 4,400 LF of 8" water line will connect the existing distribution system assets to the proposed Coale Rd and Hwy 288B Loop. This project serves Growth Area 14.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
8" PVC Water Line	4,400	LF	$145	$638,000
	Subtotal			$638,000
	Misc Items		10%	$63,800
	Construction Subtotal			$701,800
	Professional services		25%	$175,450
	Contingency		30%	$210,540
	Market volatility		10%	$70,180
	Project Total			$1,158,000

Appendix C – Lift Station Pump Data

Table C-1. Lift Station Pump Data

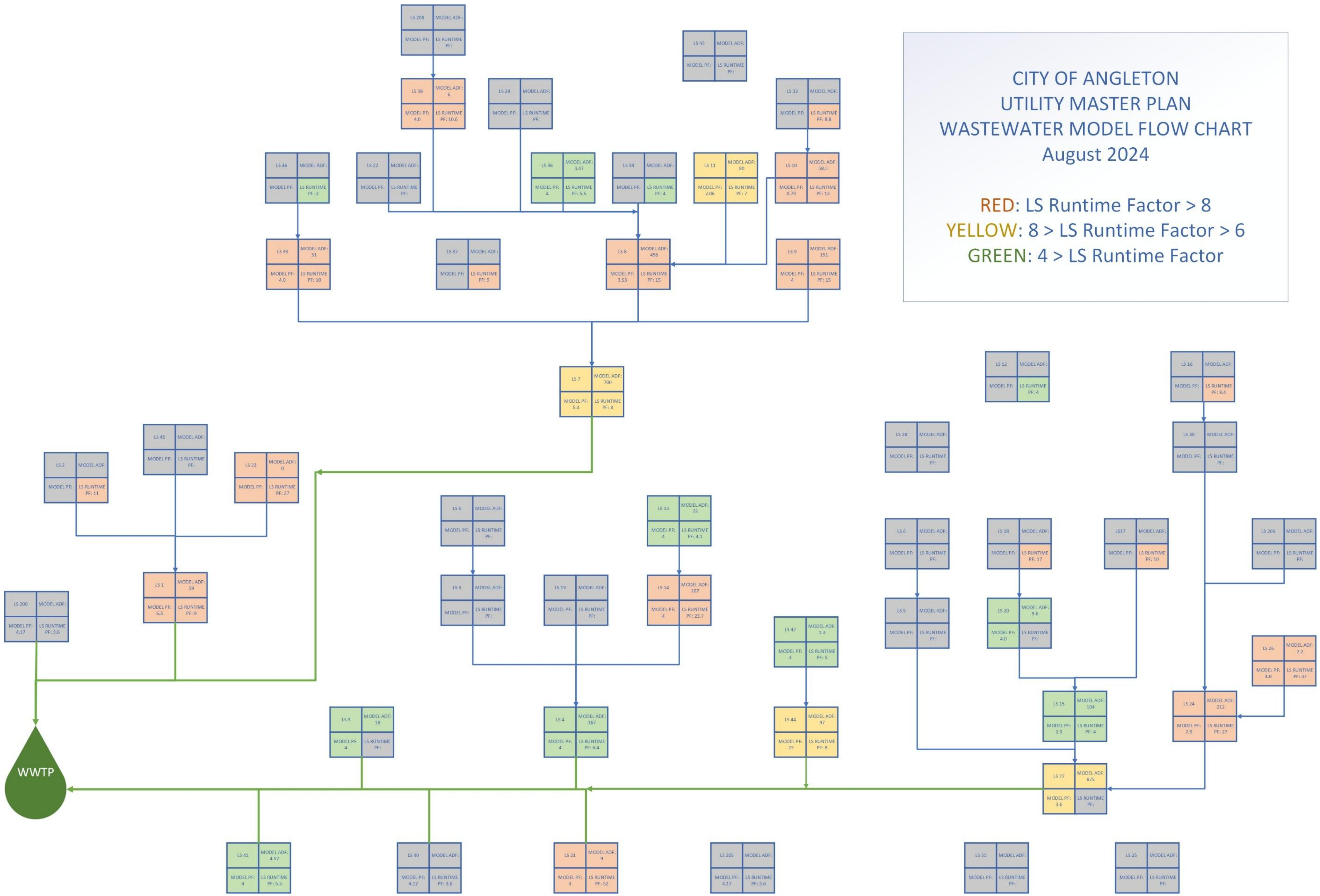
Lift Station #	# of Pumps	Brand	Voltage	Pump Size	Motor Type	Estimated Flow (gpm)	Estimated Head (FT)
1	3	Unknown	230	6 inch	20 hp	800	56
2	2	Unknown	230	4 inch	3 hp	220	25
3	2	Unknown	230	4 inch	3 hp	220	25
4	5	Unknown	480	6 inch	20 hp	800	56
5*	2	Gorman Rupp	230	4 inch	5 hp	250	28
6		Unknown	240	4 inch	7.5 hp	350	33
7*	4	Gorman Rupp	480	6 inch/10 inch	30 hp/ 50 hp	1200/2250	60/60
8*	4	Gorman Rupp	480	6 inch	20 hp	800	56
9	2	Flygt	240	4 inch	5 hp	250	28
10*	2	Gorman Rupp	230	4 inch	5 hp	225	28
11*	2	Gorman Rupp	480	4 inch	5 hp	250	31
12	2	Unknown	240	3 inch	2 hp	150	Unknown
13*	2	Gorman Rupp	240	4 inch	7.5 hp	350	33
14*	2	Gorman Rupp	230	8 inch	20 hp	800	56
15*	2	Gorman Rupp	240	4 inch	10 hp	400	40
16	2	Unknown	240	3 inch	2 hp	150	Unknown
17	1	Unknown	240	3 inch	3 hp	200	Unknown
18	2	Unknown	208	4 inch	5 hp	250	28
19	2	Unknown	240	3 inch	3 hp	200	Unknown
20	2	Unknown	240	4 inch	10 hp	400	40
21	2	Unknown	240	3 inch	3 hp	200	Unknown
22	1	Unknown	240	3 inch	3 hp	200	Unknown
23	2	Unknown	240	6 inch	7.5 hp	350	Unknown
24	2	Barmesa	240	4 inch	7.5 hp	350	33
25*	2	Gorman Rupp	230	4 inch	5 hp	250	31
26*	2	Gorman Rupp	230	4 inch	5 hp	250	31
27*	4	Gorman Rupp	480	8 inch	30 hp	1200	56
28	1	Unknown	240	2 inch	Unknown	Unknown	Unknown
29	2	Unknown	240	4 inch	5 hp	250	28
30	1	Unknown	480	inch	20 hp	800	56
31	2	Unknown	230	3 inch	3 hp	200	Unknown
32	2	Unknown	240	4 inch	10 hp	400	40
33	2	Unknown	480	8 inch	20 hp	800	56
34	1	Unknown	230	3 inch	5 hp	220	25
35	2	Unknown	480	6 inch	Unknown	Unknown	Unknown
36	2	Unknown	230	4 inch	4 hp	225	28
37	2	Unknown	240	2 inch	2 hp	150	Unknown
38	2	Unknown	230	4 inch	15 hp	400	40
39	2	Unknown	230	4 inch	5 hp	250	28

Lift Station #	# of Pumps	Brand	Voltage	Pump Size	Motor Type	Estimated Flow (gpm)	Estimated Head (FT)
40	1	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
41	2	Unknown	480	6 inch	5 hp	500	Unknown
42	2	Unknown	480	6 inch	4 hp	350	Unknown
43	2	Unknown	480	8 inch	20 hp	800	56
44	2	Unknown	480	10 inch	47 hp	2250	60
45	2	Unknown	480	4 inch	3 hp	220	25
46	2	Unknown	240	4 inch	3 hp	220	25
47	2	Unknown	480	6 inch	20 hp	800	56

Note: Lift stations with an asterisk have pump flow and head data provided by the manufacturer. All other lift stations have estimated flow and head data.

Appendix D – Lift Station Runtime Flow Chart

Figure D.1. Lift Station Runtime Flow Chart



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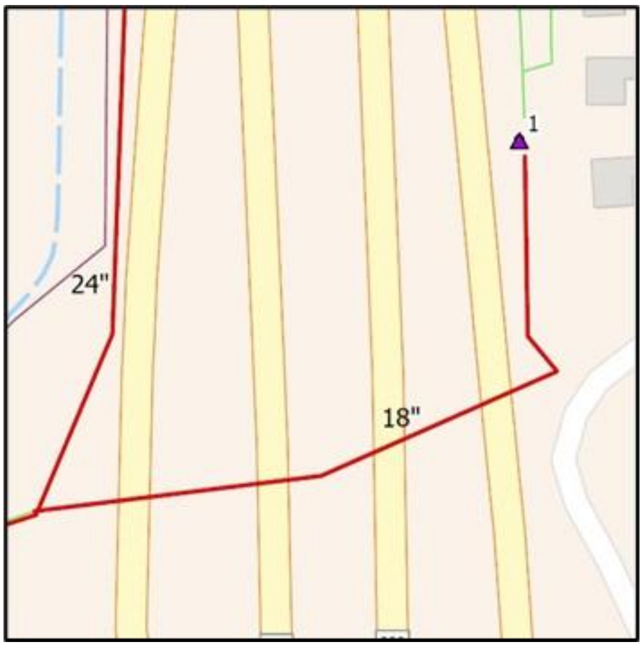
Appendix E – Wastewater CIP Summary Sheets

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: FM-1: Lift Station 1 Force Main
CIP Year: 2045

Vicinity Map:



Project Description and Location:

Upsizing existing small diameter force mains serving central regional lift station 1 to support projected infill and growth. Project includes approximately 1,010 feet of 18-inch PVC force main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
18" PVC Force Main	1,010	LF	$700	$707,000
-	Subtotal			$707,000
	Misc items		10%	$70,700
	Construction Subtotal			$777,700
	Professional services		25%	$194,425
	Contingency		30%	$233,310
	Market volatility		10%	$77,770
	Project Total			$1,284,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: FM-2: Lift Station 7 Bypass Force Main
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing Lift Station 7 bypass force main to direct regional flows directly to the WWTP to accommodate increased loading in the area. Project consists of approximately 12,300 feet of 24-inch force main.

Planning Level Opinion of Probable Construction Cost

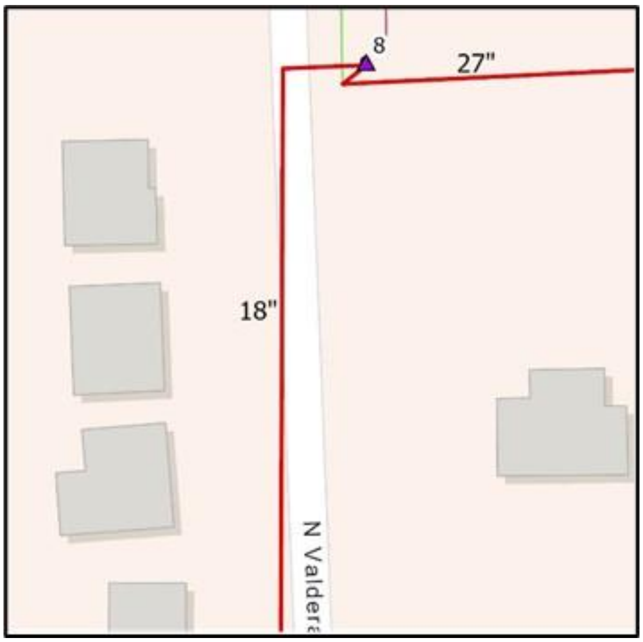
Description	Quantity	Unit	Unit Price	Total
24" PVC Force Main	12,300	LF	$930	$11,439,000
-	Subtotal			$11,439,000
	Misc items		10%	$1,143,900
	Construction Subtotal			$12,582,900
	Professional services		25%	$3,145,725
	Contingency		30%	$3,774,870
	Market volatility		10%	$1,258,290
	Project Total			$20,762,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: FM-3: Lift Station 8 Force Main
CIP Year: 2045

Vicinity Map:



Project Description and Location:

Upsizing Lift Station 8 force main to accommodate regional flows and accommodate increased loading in the area. Project consists of approximately 277 feet of 18-inch force main.

Planning Level Opinion of Probable Construction Cost

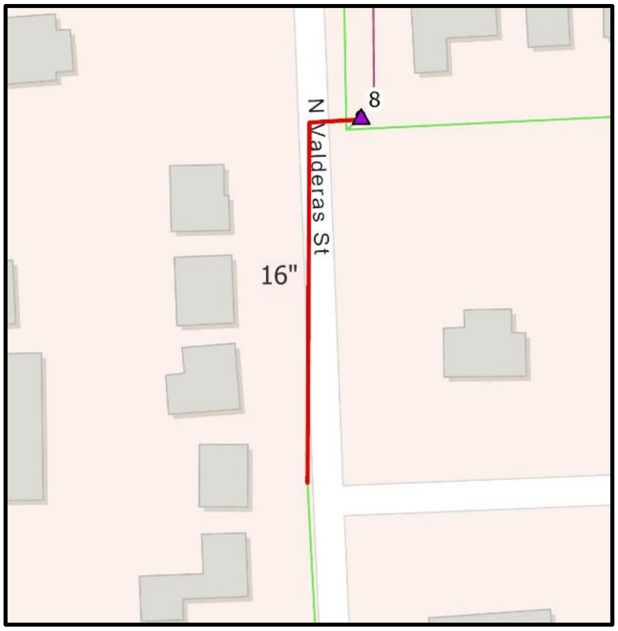
Description	Quantity	Unit	Unit Price	Total
18" PVC Force Main	277	LF	$350	$96,950
-	Subtotal			$96,950
	Misc items		10%	$9,695
	Construction Subtotal			$106,645
	Professional services		25%	$26,661
	Contingency		30%	$31,994
	Market volatility		10%	$10,665
	Project Total			$176,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: FM-3 with I&I Reduction: Lift Station 8 Force Main
CIP Year: 2045

Vicinity Map:



Project Description and Location:

Upsizing Lift Station 8 force main to accommodate regional flows and accommodate increased loading in the area. Project consists of approximately 277 feet of 16-inch force main.

Planning Level Opinion of Probable Construction Cost

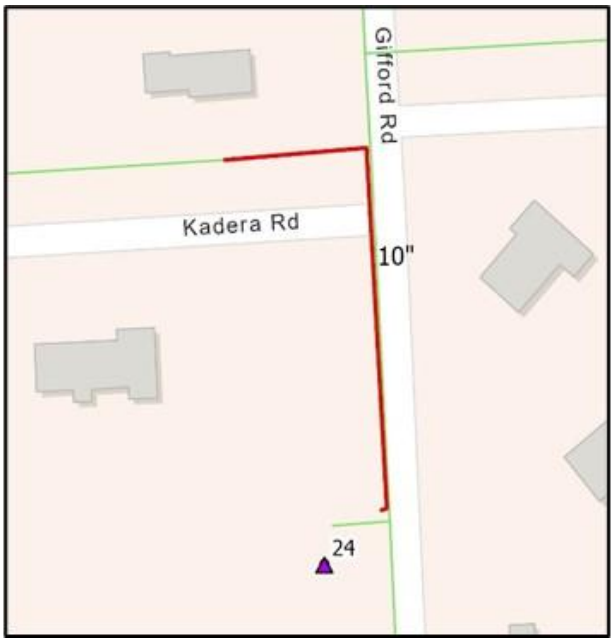
Description	Quantity	Unit	Unit Price	Total
16" PVC Force Main	277	LF	$310	$85,870
-	Subtotal			$85,870
	Misc items		10%	$8,587
	Construction Subtotal			$94,457
	Professional services		25%	$23,614
	Contingency		30%	$28,337
	Market volatility		10%	$9,446
	Project Total			$156,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: FM-4: Lift Station 24 Force Main
CIP Year: 2045

Vicinity Map:



Project Description and Location:

Upsizing Lift Station 24 force main to direct regional flows to accommodate increased loading in the area. Project consists of approximately 405 feet of 10-inch force main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
10" PVC Force Main	405	LF	$195	$78,975
-	Subtotal			$78,975
	Misc items		10%	$7,898
	Construction Subtotal			$86,873
	Professional services		25%	$21,718
	Contingency		30%	$26,062
	Market volatility		10%	$8,687
	Project Total			$144,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: WWL-1: Shannon Street & Karankawa Lane
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing large diameter interceptor upstream of Lift Station 1 to support projected infill and growth. Project includes approximately 4,110 feet of 36-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
36" PVC Wastewater Line	4,110	LF	$700	$2,877,000
-	Subtotal			$2,877,000
	Misc items		10%	$287,700
	Construction Subtotal			$3,164,700
	Professional services		25%	$791,175
	Contingency		30%	$949,410
	Market volatility		10%	$316,470
	Project Total			$5,222,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: WWL-1 with I&I Reduction: Shannon Street & Karankawa Lane
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing large diameter interceptor upstream of Lift Station 1 to support projected infill and growth. Project includes approximately 4,110 feet of 30-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
30" PVC Wastewater Line	4,110	LF	$580	$2,383,800
-	Subtotal			$2,383,800
	Misc items		10%	$238,380
	Construction Subtotal			$2,622,180
	Professional services		25%	$655,545
	Contingency		30%	$786,654
	Market volatility		10%	$262,218
	Project Total			$4,327,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: WWL-2: Hospital Dr. from Buchta Rd to Valderas St
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing large diameter interceptor upstream of Lift Station 8 to support projected infill and growth. Project includes approximately 3,210 feet of 27-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
27" PVC Wastewater Line	3,210	LF	$525	$1,685,250
-	Subtotal			$1,685,250
	Misc items		10%	$168,525
	Construction Subtotal			$1,853,775
	Professional services		25%	$463,444
	Contingency		30%	$556,133
	Market volatility		10%	$185,378
	Project Total			$3,059,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: WWL-3: E. Mulberry St. West of I-35
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing small diameter main to support anticipated growth along I-35 corridor. Project includes approximately 3,860 feet of 16-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
16" PVC Wastewater Line	3,860	LF	$620	$2,393,200
-	Subtotal			$2,393,200
	Misc items		10%	$239,320
	Construction Subtotal			$2,632,520
	Professional services		25%	$658,130
	Contingency		30%	$789,756
	Market volatility		10%	$263,252
	Project Total			$4,344,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: WWL-4: Highway 288B from FM 523 to Henderson Rd.
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing small diameter main to support anticipated growth in Highway 288 corridor. Project includes approximately 4,265 feet of 12-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
12" PVC Wastewater Line	4,265	LF	$350	$1,983,225
-	Subtotal			$1,983,225
	Misc items		10%	$198,323
	Construction Subtotal			$2,181,548
	Professional services		25%	$545,387
	Contingency		30%	$654,464
	Market volatility		10%	$218,155
	Project Total			$3,600,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: WWL-5: FM 523/Henderson Rd Wastewater Line
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing small diameter main downstream of Lift Station 39 to support anticipated growth in are. Project includes approximately 1,230 feet of 16-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
16" PVC Wastewater Line	1,230	LF	$310	$381,300
-	Subtotal			$381,300
	Misc items		10%	$38,130
	Construction Subtotal			$419,430
	Professional services		25%	$104,858
	Contingency		30%	$125,829
	Market volatility		10%	$41,943
	Project Total			$693,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

THE HEART OF BRAZORIA COUNTY ANGLETON

Capital Improvements Plan Project ID: WWL-6: Lift Station 46 Tributary
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing small diameter main to support anticipated growth in NW portion of town, west of HWY 288. Project includes approximately 2,425 feet of 12-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
12" PVC Wastewater Line	2,425	LF	$235	$569,875
-	Subtotal			$569,875
	Misc items		10%	$56,988
	Construction Subtotal			$626,863
	Professional services		25%	$156,716
	Contingency		30%	$188,059
	Market volatility		10%	$62,686
	Project Total			$1,035,000

City of Angleton Wastewater System Master Plan

Capital Improvements Plan

Capital Improvements Plan Project ID: WWL-6: Lift Station 46 Tributary
CIP Year: 2045

Vicinity Map:

Project Description and Location:

Upsizing existing small diameter main to support anticipated growth in NW portion of town, west of HWY 288. Project includes approximately 2,425 feet of 10-inch main.

Planning Level Opinion of Probable Construction Cost

Description	Quantity	Unit	Unit Price	Total
10" PVC Wastewater Line	2,425	LF	$195	$472,875
-	Subtotal			$472,875
	Misc items		10%	$47,288
	Construction Subtotal			$520,163
	Professional services		25%	$130,041
	Contingency		30%	$156,049
	Market volatility		10%	$52,016
	Project Total			$859,000