BELL COUNTY WCID NO. 1

MASTER PLAN

January 2022

Aerial imagery of Belton Lake courtesy of EagleView.

Prepared by:

CDM Smith

TBPE Firm Registration No. F-3043

MASTER PLAN
FINAL

BELL COUNTY WCID NO. 1

JANUARY 2022

STATE OF TEXAS
ALLEN D. WOELKE, P.E.
54386
REGISTERED
PROFESSIONAL ENGINEER
1/21/2022

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Table of Contents

Section 1 Introduction 1-1
1.1 Water Distribution System Overview 1-1
1.2 Scope of Work 1-3
1.3 Study Limitations 1-3
1.4 Report Organization 1-3

Section 2 Water Service Area and Demands Development 2-1
2.1 Conclusions and Recommendations 2-3
2.1.1 439 WSC 2-3
2.1.2 Bell County WCID No. 3 2-3
2.1.3 City of Belton 2-3
2.1.4 City of Copperas Cove 2-4
2.1.5 City of Harker Heights 2-4
2.1.6 City of Killeen 2-4

Section 3 Hydraulic Model Update, Calibration, and Analysis 3-1
3.1 Model Development Background 3-1
3.2 Model Update and Calibration 3-2
3.2.1 Link/Node Network 3-2
3.2.2 Node Elevation Data 3-2
3.2.3 Node Demand Data 3-2
3.2.4 Special Features 3-3
Delivery Point Setup 3-4
3.2.5 Operational Settings 3-5
North Transmission Main 3-5
South Transmission Main 3-6
Belton Transmission Main 3-7
Stillhouse Transmission Main 3-7
3.3 Analysis of Existing and Future System 3-7

Section 4 Belton Water Treatment Plant Evaluation 4-1
4.1 Existing Water Treatment Plant Facilities 4-1
4.2 Treatment Process Facilities 4-2
4.2.1 Plant No. 1 4-2
4.2.2 Plant No. 2 4-3
4.2.3 Plant No. 3 4-3
4.2.4 Plant No. 4 4-4
4.2.5 Raw Water Pump Station 4-4
4.2.6 Summary of Recommended Treatment Process Upgrades 4-4
4.3 Chemical Storage and Feed Facilities 4-5
4.4 Residuals Handling 4-6
4.5 Finished Water Storage 4-7
4.6 Emergency Backup Power 4-7
4.7 Belton WTP Improvements Summary 4-8

4.8 Plant Expansion 4-9

Section 5 System Alternatives Evaluation 5-1

5.1 Alternatives Development 5-1

5.1.1 Option 1: Lake Stillhouse WTP Serves Killeen Only 5-1

5.1.2 Option 2: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights 5-2

5.1.3 Option 3: Lake Stillhouse WTP Serves Killeen and Ties into Ground Storage Tank Near Harker Heights 5-3

5.1.4 Option 4: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights Inline Pumping Installed Along South Transmission Main 5-4

5.2 Alternatives Analysis 5-5

5.2.1 Option 1: Lake Stillhouse WTP Serves Killeen Only - Analysis 5-6

5.2.2 Option 2: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights - Analysis 5-7

5.2.3 Option 3: Lake Stillhouse WTP Serves Killeen and Ties into Ground Storage Tank Near Harker Heights - Analysis 5-8

5.2.4 Option 4: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights Inline Pumping Installed Along South Transmission Main - Analysis 5-9

5.3 Summary and Conclusions 5-10

5.3.1 Lake Stillhouse Transmission Main 5-10

5.3.2 2040 MDD Scenario with North Transmission Main Out of Service 5-10

Belton WTP Pumping 5-11

Transmission Main Velocity and Pressure 5-11

5.3.3 Preferred Alternative 5-11

Section 6 Capital Improvement Projects 6-1

6.1 Cost Estimating 6-1

6.2 Proposed Water Treatment and Hydraulic Improvements 6-1

6.2.1 Raw Water Delivery and Treatment 6-1

6.2.2 Storage 6-2

6.2.3 Pumping 6-2

6.2.4 Transmission 6-2

6.3 CIP Summary 6-4

List of Figures

Figure 1.1 Water Distribution System Overview 1-2
Figure 2.1 Summary of additional water supply needed 2-4
Figure 2.2 Summary of additional treated water capacity 2-5
Figure 3.1 Typical delivery point layout 3-5
Figure 3.2 Station 6 Tank Levels – 2020 MDD with the north transmission main closed. 3-9
Figure 4.1 Belton WTP Existing Overall Site Plan 4-11
Figure 4.2 Recommended Belton WTP Upgrades – Alternative 1 4-12
Figure 4.3 Recommended Plant 3 Clarifier Upgrades - Alternative 2 4-13
Figure 4.4 Belton WTP Future Plant Expansion 4-14
Figure 5.1 Option 1 Layout 5-2
Figure 5.2 Option 2 Layout 5-3
Figure 5.3 Option 3 Layout. Note: encircled red Xs indicate closed pipes 5-4
Figure 5.4 Option 4 Layout 5-5
Figure 5.5 Option 1: Station 6 GST levels during 2040 MDD simulation with the north loop closed. 5-7
Figure 5.6 Option 1: Station 6 GST levels during 2040 MDD simulation with the south loop closed. 5-7
Figure 5.7 Option 2: Station 6 GST levels during 2040 MDD simulation with the north loop closed. 5-8
Figure 5.8 Option 3: “Dummy Pump” flow rate and pump head during 2040 MDD simulation with the north loop closed. 5-9
Figure 5.9 Option 3 and Option 4: “Dummy Pump” flow rate and pump head during 2040 MDD simulation with the north loop closed. 5-10

List of Tables

Table 2.1 Region G Initially Prepared Plan Population Projections 2-1
Table 2.2 Region G Initially Prepared Plan Water Demand Projections........ 2-1
Table 2.3 Maximum Day to Average Day Peaking Factors 2-2
Table 2.4 Final Adjusted Population Projections 2-2
Table 2.5 Final Adjusted Average Day Water Demands (ac-ft/yr) 2-2
Table 2.6 Final Adjusted Maximum Day Water Demands (MGD) 2-3
Table 2.7 Summary of additional treated water capacity and the year it will be needed per customer 2-5
Table 3.1 Model Demand Allocations (gpm) 3-3
Table 3.2 North Loop Pump Operations........ 3-6
Table 3.3 Throttle Control Valve Operation 3-6
Table 3.4 South Loop Pump Operations........ 3-6
Table 3.5 South Loop Delivery Points 3-7
Table 4.1 Belton WTP – Existing Plant Capacities........ 4-1
Table 4.2 Belton WTP – Summary of Recommended Treatment Process Upgrades 4-4
Table 4.3 Belton WTP – Summary of Recommended Chemical Systems Upgrades........ 4-6
Table 4.4 Belton WTP – Summary of Recommended Residuals Handling Upgrades 4-7
Table 4.5 Belton WTP – Summary of Recommended Finished Water Storage Upgrades........ 4-7
Table 4.6 Belton WTP – Summary of Recommended Finished Water Storage Upgrades........ 4-8
Table 4.7 Belton WTP – Summary of Recommended Improvements and Upgrades........ 4-8
Table 5.1 Lake Stillhouse WTP High Service Pump Operations........ 5-2
Table 5.2 South Transmission Main Pipe Velocity and Required Pump Head for Various Pipe Sizes...... 5-11
Table 5.3 2040 Pump Station Requirements for Levy Crossing Rd Site and Warrior Path Rd. Site when Pumping to Station 6 5-12
Table 6.1 Recommended Capital Improvements Projects........ 6-4

Appendices

Appendix A Demand Projection Curves: Max Day and Average Day
Appendix B CIP Cost Estimates

Section 1

Introduction

Bell County Water Control and Improvement District Number 1 (the District) provides wholesale water to its member cities, serving a population in excess of 250,000, and can treat and deliver over 107 million gallons of water per day (MGD) with the recently completed Stillhouse Water Treatment Plant (WTP). The District last completed a water master plan in 2009 and contracted with CDM Smith in 2020 to develop this water master plan update.

1.1 Water Distribution System Overview

Water is currently supplied to the distribution system from one source: Bell County WCID #1 WTP, also known as the Lake Belton WTP. The Lake Belton WTP is located on the northeast end of the system and pumps water directly into two major pipelines, the North Loop Transmission Main and the South Loop Transmission Main (**Figure 1.1**). Both major transmission mains terminate at Station 6 at the southwest end of the system, where three five-million-gallon (MG) ground storage tanks (GST) float at an overflow elevation of 882.5'. The system provides potable water to seven wholesale customers:

- City of Killeen
- City of Harker Heights
- City of Nolanville
- 439 WSC
- Fort Hood
- City of Belton
- WCID #3

A new source, the Stillhouse WTP, will be producing treated water in Spring 2021. While the capacity in the new water treatment plant is shared by five wholesale customers (Killeen, Copperas Cove, Harker Heights, 439 WSC, and WCID #3), water will be temporarily delivered to a single delivery point at the south end of the City of Killeen water system on Chaparral Road. In the future, it is possible a new pipeline will connect the Lake Stillhouse line directly to the south loop of the existing distribution system, likely between the delivery points at Nolanville and Harker Heights.

Figure 1.1 Water Distribution System Overview

1.2 Scope of Work

This water master plan project involves the following major tasks:

- Develop water demand forecasts based on existing customer demand factors. Determine the average day and maximum day water demand under existing conditions (2020) and project demands for the 2030 and 2040 planning horizons for each customer city.
- Update the District's water distribution model, based in WaterGEMS, to incorporate new construction since the last master plan, remove abandoned facilities, and update demands based on discussions with member jurisdictions.
- Use the updated model to analyze the capacity of the existing system to meet existing and future needs. If the existing system is not able to satisfactorily meet future needs, then expansions and/or improvements to the system will be modeled. The existing system will also be modeled for reliability by removing certain transmission lines and determining if average day demands can still be met.
- Complete a modified condition assessment of the Lake Belton Water Treatment Plant consisting of visual observation of the condition of key process units and equipment and the overall performance of the treatment process with specific emphasis on the performance of the existing filters. Summarize the existing capacity and discuss high level options for expansion.
- Develop alternative scenarios for balancing flow between the north and south transmission systems including the addition of a new transmission line to bring flow from the Stillhouse WTP.

1.3 Study Limitations

The findings and recommendations contained in this study are valid as of the date of this report and based on the information referenced herein. Changes in the ranges or patterns of growth within the study area, changes in water use patterns, implementation of more detailed investigations, or changes in regulations may affect the conclusions and recommendations presented in this report. Master plans such as this should be thoroughly reviewed every three to five years to determine whether the underlying assumptions and recommendations are still valid.

1.4 Report Organization

This report is organized as follows:

- Section 2 describes the development and analysis of the modeled water demands. This includes a discussion held with wholesale customers and describes how future average day and maximum day demands were determined.
- Section 3 discusses the hydraulic model updates, calibration, and analysis.
- Section 4 discusses the Lake Belton WTP evaluation.

- Section 5 presents the analysis of alternatives proposed to address system deficiencies identified in Section 3.
- Section 6 presents the capital improvement plan (CIP) projects with planning level cost estimates. The CIP includes both hydraulic performance considerations and regulatory considerations.
- Appendix A provides background information on the long-range demand development.
- Appendix B provides detailed cost estimates for CIP projects.

Section 2

Water Service Area and Demands Development

The foundation of the water master planning effort is to determine the future water supply and treated water capacity needs of the existing customers. This will allow the District to compare the projected annual average water demands and treated water demands of its customers to existing water supply contracts and total water treatment capacity. The District has six retail water suppliers and Fort Hood as water customers. Our scope of work calls for starting the water demand projections and treated water capacity needs based on recently updated Region G projections and modifying the Region G projections based on demand data available from the District and input from the District's customers.

Table 2.1 lists the District's customers and their population projections from the Region G Initially Prepared Plan (IPP).

Table 2.1 Region G Initially Prepared Plan Population Projections

Customer Name	2020	2030	2040	2050	2060	2070
439 WSC	10,220	12,327	14,490	16,700	18,961	21,285
Bell Co WCID No. 3	7,403	10,072	13,930	16,468	18,362	20,216
Belton	21,753	25,571	29,514	33,433	37,278	41,063
Copperas Cove	36,253	41,385	47,053	52.016	57,332	62,549
Fort Hood	16,936	17,196	17,282	17,282	17,282	17,282
Harker Heights	31,372	36,879	42,566	48,218	53,763	59,222
Killeen	144,243	173,431	198,764	221,697	247,195	272,291

Table 2.2 lists the District's customers and their average annual water demands from the Region G IPP. The demands are expressed in acre-feet/year.

Table 2.2 Region G Initially Prepared Plan Water Demand Projections

Customer Name	2020	2030	2040	2050	2060	2070
439 WSC	1,407	1,656	1,917	2,191	2,483	2,785
Bell Co WCID No. 3	1,207	1,601	2,176	2,552	2,840	3,125
Belton	3,791	4,353	4,951	5,568	6,198	6,824
Copperas Cove	4,304	4,722	5,225	5,707	6,267	6,833
Fort Hood	3,874	3,850	3,815	3,809	3,804	3,804
Harker Heights	6,099	7,043	8,042	9,060	10,087	11,106
Killeen	18,308	20,193	23,716	26,629	29,619	32,599

Table 2.3 lists the maximum day demand to average day demand factors determined by evaluating the District's water supply data derived from meter data for each of its customers.

Table 2.3 Maximum Day to Average Day Peaking Factors

Customer Name	Max Day Peaking Factor
439 WSC	2.13
Bell Co WCID No. 3	1.97
Belton	1.90
Copperas Cove	1.59
Fort Hood	1.99
Harker Heights	1.64
Killeen	1.65

Following compilation of Region G data and the District's water meter data, meetings were conducted with representatives from each retail water provider. At the meetings, the Region G population and water supply data were presented, and each retail water provider was requested to provide input on development of a final population projection, average day demand, and maximum day demand for every decade from 2020 to 2070.

Final adjusted population projections, average days water demands, and maximum day water demands for each customer are presented in **Tables 2.4**, **2.5** and **2.6**, respectively. Average annual water demand is shown in acre-feet/year and the maximum day water demands are shown in million gallons per day (MGD).

Table 2.4 Final Adjusted Population Projections

Customer Name	2020	2030	2040	2050	2060	2070
439 WSC	10,220	12,327	14,490	16,700	18,961	21,285
Bell Co WCID No. 3	6,100	9,460	11,636	14,996	18,356	19,140
Belton	22,850	28,600	36,000	45,100	56,600	71,000
Copperas Cove	35,307	49,804	70,253	99,099	139,790	197,187
Fort Hood	16,936	17,196	17,282	17,282	17,282	17,282
Harker Heights	31,372	36,879	42,566	48,218	50,000	50,000
Killeen	144,243	173,431	198,764	221,697	247,195	272,291

Table 2.5 Final Adjusted Average Day Water Demands (ac-ft/yr)

Customer Name	2020	2030	2040	2050	2060	2070
439 WSC	1,407	1,656	1,917	2,191	2,483	2,785
Bell Co WCID No. 3	872	1,352	1,663	2,144	2,624	2,736
Belton	3,584	4,485	5,646	7,073	8,877	11,135
Copperas Cove	4,192	5,691	7,870	10,879	15,346	21,648
Fort Hood	3,874	3,850	3,815	3,809	3,804	3,804
Harker Heights	6,099	7,043	8,042	9,060	9,381	9,377
Killeen	19,713	23,702	27,164	30,299	33,783	37,213

Table 2.6 Final Adjusted Maximum Day Water Demands (MGD)

Customer Name	2020	2030	2040	2050	2060	2070
439 WSC	2.68	3.15	3.65	4.17	4.73	5.30
Bell Co WCID No. 3	1.54	2.38	2.93	3.78	4.62	4.82
Belton	6.07	7.60	9.57	11.99	15.04	18.87
Copperas Cove	5.96	8.09	11.19	15.47	21.83	30.79
Fort Hood	6.88	6.84	6.77	6.76	6.75	6.75
Harker Heights	8.94	10.32	11.78	13.28	13.75	13.74
Killeen	29.04	34.92	40.02	44.64	49.77	54.82

These average annual water demands and maximum day water demands are plotted for each retail water provided in Appendix A. Also shown on the average day demand graph for each retail water provider is their total contracted raw water supply. The total contracted water supply may be solely with the District but in a few cases the retail water providers have individual contracts for water supply with the Brazos River Authority (BRA). Shown on the maximum day water demand graph for each retail water provider is their capacity interest in the District's two water treatment plants and a line that represents 85% of the customer's treated water capacity interest. The District's total treated water capacity is 107 MGD.

When the projected average annual demand exceeds the contracted supply, the customer will be out of water to meet their water demands. Likewise, when the maximum day demand exceeds the customer's water treatment plant capacity interest, the customer will not have sufficient capacity to meet their treated water demands. The line representing 85% of the treated water capacity interest is shown because TCEQ requires entities that hold a CCN to start planning on how to meet their future water needs when demands exceed 85% of the existing capacity.

2.1 Conclusions and Recommendations

2.1.1 439 WSC

The average annual water demand exceeds the available water supply in 2050. Maximum day water demands exceed 85% of treated water capacity interest in 2044 and completely exceeds treated water capacity interest in 2055.

2.1.2 Bell County WCID No. 3

The average annual water demand exceeds the available water supply in 2022. Maximum day water demands exceed 85% of treated water capacity interest in 2025 and completely exceeds treated water capacity interest in 2030.

2.1.3 City of Belton

The average annual water demand exceeds the available water supply in 2060. Maximum day water demands exceed 85% of treated water capacity interest in 2035 and completely exceeds treated water capacity interest in 2042.

2.1.4 City of Copperas Cove

The average annual water demand exceeds the available water supply in 2042. Maximum day water demands exceed 85% of treated water capacity interest in 2045 and completely exceeds treated water capacity interest in 2050.

2.1.5 City of Harker Heights

The average annual water demand exceeds the available water supply in 2043. Maximum day water demands do not exceed 85% of treated water capacity and do not exceed the treated water capacity interest.

2.1.6 City of Killeen

The average annual water demand does not exceed the available water supply through the 2070 planning period. Maximum day water demands exceed 85% of treated water capacity interest in 2030 and completely exceeds treated water capacity interest in 2045.

A summary of the additional needed water supply is shown in **Figure 2.1** and a summary of the additional treated water capacity is shown in **Figure 2.2**. **Table 2.7** summarizes the needed treatment plant water capacity by customer. A small amount of additional water supply (1,746 Ac-Ft/Yr) is needed in 2022 to meet the needs of Bell County WCID No. 3. Over 12,000 Ac-Ft/Yr is needed in 2042 for the City of Copperas Cove. Beyond 2042, small amounts of additional supply are needed for the City of Harker Heights (877 Ac-Ft/Yr in 2044), 439 WSC (626 Ac-Ft/Yr in 2050), and the City of Belton (2,668 Ac-Ft/Yr in 2060).

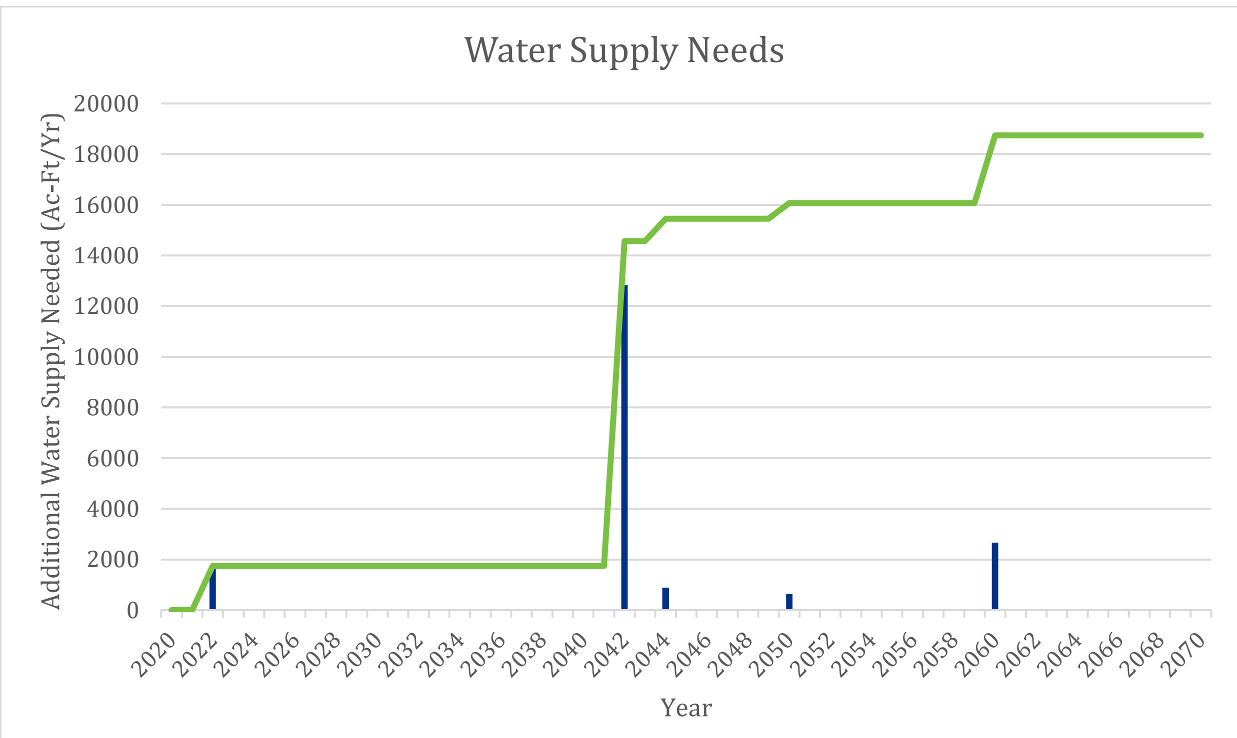

Figure 2.1 Summary of additional water supply needed

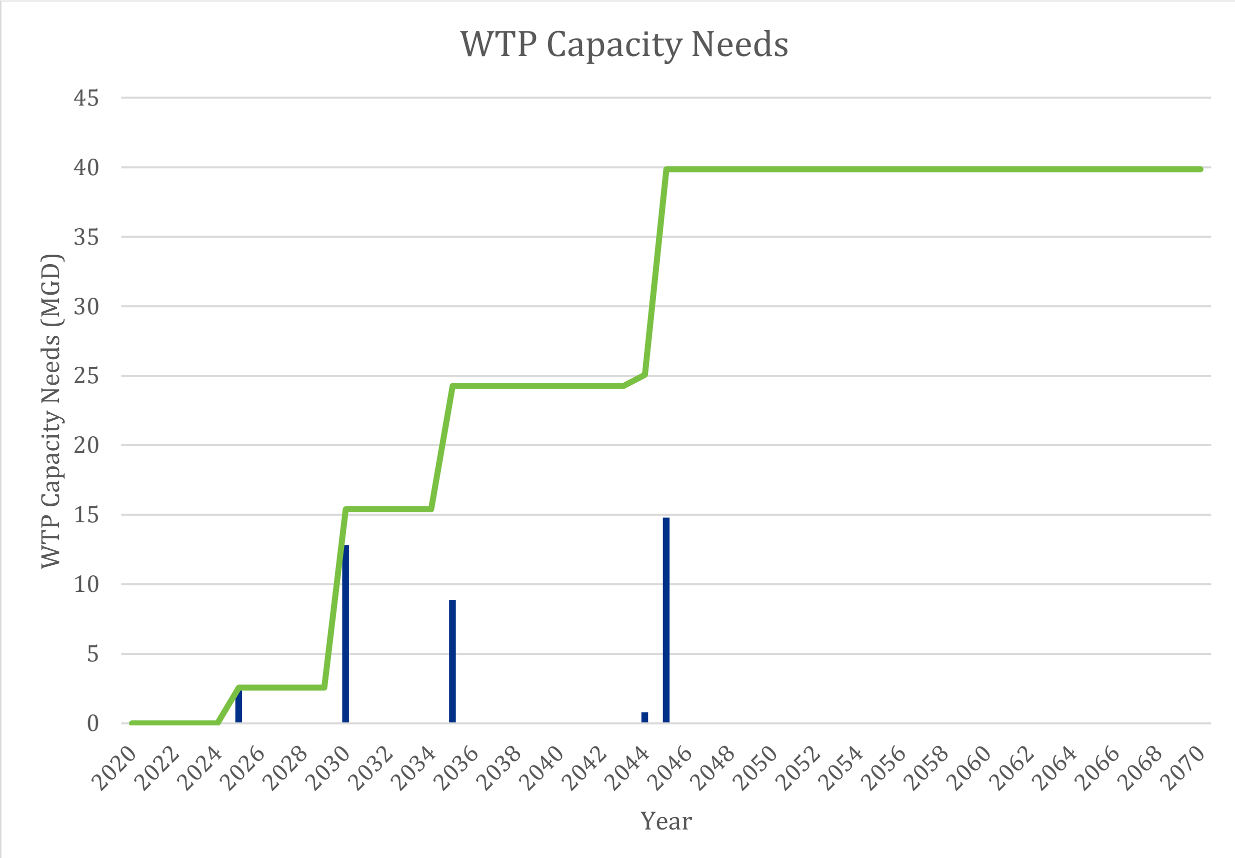

Figure 2.2 Summary of additional treated water capacity

Additional treatment is needed for the retail water providers as summarized below.

Table 2.7 Summary of additional treated water capacity and the year it will be needed per customer

Retail Water Provider	Additional Treated Water Capacity	Year Needed
Bell County WCID3	2.57 MGD	2025
City of Killeen	12.82 MGD	2030
City of Belton	8.87 MGD	2035
439 WSC	0.8 MGD	2044
City of Copperas Cove	14.79 MGD	2045

It is not practical to expand the treatment plants in five separate small steps. It is recommended that the District consider expanding the plants in two incremental steps that work with the existing treatment plant infrastructure. The first expansion would be at the Lake Belton WTP and would be a 25 MGD expansion bringing the total capacity of the Lake Belton plant to 115 MGD. This expansion would be accomplished by removing the existing Plant 3 clarifiers and constructing a new flocculation/ sedimentation basin. The capacity of the Plant 3/ 4 complex is sufficient for this capacity increase. In addition to the flocculation/ sedimentation basin, additional raw water and high service pumping would be required. It would also be worthwhile adding the second 4 MG clearwell with this expansion. This capacity increase would provide the needed capacity interest for Bell County WCID No. 3, the City of Killeen and the City of Belton. A second expansion of 17 MGD at the Stillhouse WTP would be completed by 2044 and would provide the capacity interest for 439 WSC and the City of Copperas Cove. The Stillhouse WTP is currently a 17 MGD facility and has been planned for a 17 MGD expansion.

Section 3

Hydraulic Model Update, Calibration, and Analysis

3.1 Model Development Background

The primary purpose for developing a water distribution system hydraulic model is to allow system planners, managers, and operators to better understand system performance and analyze "what if" conditions that may range from the outage of a key facility to growth in the system. Operational use of hydraulic models is an emerging trend in the industry, as opposed to the past where hydraulic modeling was used primarily in a planning function using steady state simulations. There are five general areas of model construction and update that were addressed:

1. **Link/node network.** This portion of the model forms the backbone and comprises a very high percentage of the model features. It includes all pipes, and junctions at points necessary to connect pipes – where three or more pipes are joined together, where a diameter or other pipe change occurs, at the end of a pipe, or where another point of interest occurs.

1. **Node elevation data.** The hydraulic model operates on the elevation of the HGL – i.e. all calculations are performed using the HGL elevation. To make the model useful for most utility applications, ground elevation data is needed so that HGL values can be converted to pressure values. To do this, the model has ground elevations assigned at each junction.

2. **Node demand data.** Water demand data specify both the amounts and the locations where customers consume water. There are two essential elements required to model customer demands in the water distribution model. The first is the base demand, which is an average daily rate that is assigned to each customer account. This average daily rate is used for both steady state and extended period simulations (EPS). The second is the demand pattern, which dictates how water is used by a customer over time, using a daily or weekly variation. Demand patterns are only used in EPS runs.

3. **Special features.** While most of the model features are pipes or junctions, the most critical features in terms of impact on the hydraulic model are pumps, tanks and control valves. Pumps impart energy to water so that adequate pressure can be maintained as water moves from lower elevations to higher elevations, or across long distances. Tanks store water so that it is available when needed for high demand periods or firefighting. Control valves can be used to reduce pressure downstream, make sure that pressure is maintained upstream, to control flow rates, to allow flow in only one direction, or for other purposes.

4. **Operational settings.** This data type does not represent physical features, rather it represents system controls that define operational relationships between features that will govern how the model will operate over an extended period. Settings can be used

to control feature status (open, closed or a set point) based on the time of day, the level in a tank, the pressure at a junction, etc.

The procedures and data used to create the water model under each of these five categories are discussed below.

3.2 Model Update and Calibration

The District's existing WaterGEMS/WaterCAD model was updated for this project. The model is currently in Bentley CONNECT Edition 3 (Version 10.03.00.69 dated March 5, 2020). WaterCAD/WaterGEMS provides an advanced graphical user interface (GUI) for data development and results presentation while leveraging the speed of the industry standard EPANET hydraulic engine. WaterGEMS runs in either a standalone mode or as an extension in the ArcGIS desktop Geographic Information System (GIS) environment, so the District can view the model features and results together with their other GIS data. WaterGEMS also provides a variety of add-ons that can be used for complex analyses beyond hydraulic modeling for planning and operations purposes.

3.2.1 Link/Node Network

CDM Smith evaluated the GIS data provided by the District and added the piping from the GIS to the model manually, filling in gaps where new construction has occurred, primarily the pipeline from Stillhouse WTP and the new 24" pipeline to the Belton delivery point. The resulting model has over 270 pipes, 153 junctions and 16 pressure sustaining valves.

3.2.2 Node Elevation Data

Node (junction) elevation data was calculated from an overlay of the node network on LiDAR data available from the State of Texas. The GIS software can calculate the ground elevation for each node.

3.2.3 Node Demand Data

Demands for each wholesale customer were developed in coordination with the District and its customers. The process for determining customer demand projections through the year 2040 is outlined in Section 2.

CDM Smith allocated wholesale customer demands to various delivery points at the same allocation rates observed in September 2019 billing data with the City of Killeen being the exception. The City of Killeen is expected to add a new south delivery point at Chaparral Road to receive water from the new Stillhouse WTP. Because population projections indicate growth in Killeen will primarily take place south of existing development, all future demand growth for the City of Killeen was assigned to the new Chaparral Road delivery point. For 2020 scenarios, demand at Chaparral Road was assumed to be 5 MGD for average day and 8 MGD for maximum day demand. **Table 3.1** summarizes demand allocations for each delivery point in the model.

Table 3.1 Model Demand Allocations (gpm)

		2020		2030		2040	
Delivery Point	**Percentage**	**ADD**	**MDD**	**ADD**	**MDD**	**ADD**	**MDD**
Chaparral Road	**Note 1*	3,472	5,555	5,943	9,815	8,088	13,357
Killeen 2	6%	524	866	524	866	524	866
Killeen 3	24%	2,098	3,464	2,098	3,464	2,098	3,464
Killeen 5	18%	1,573	2,598	1,573	2,598	1,573	2,598
Killeen 6	52%	4,545	7,506	4,545	7,506	4,545	7,506
Killeen Total	**100%**	**12,213**	**20,168**	**14,684**	**24,249**	**16,829**	**27,791**
HH Verna Lee	60%	2,267	3,725	2,618	4,300	2,989	4,908
HH Maint. Yard	40%	1,511	2,483	1,745	2,867	1,993	3,272
Harker Heights Total	**100%**	**3,779**	**6,208**	**4,363**	**7,167**	**4,982**	**8,181**
Belton	100%	2,220	4,217	2,779	5,279	3,498	6,644
Belton Total	**100%**	**2,220**	**4,217**	**2,779**	**5,279**	**3,498**	**6,644**
Cove 6	55%	1,429	2,277	1,939	3,091	2,682	4,275
Copperas Cove	45%	1,169	1,863	1,587	2,529	2,194	3,498
Copperas Cove Total	**100%**	**2,597**	**4,141**	**3,526**	**5,620**	**4,876**	**7,773**
Nolanville Main	55%	297	587	461	910	567	1,119
Nolanville School	45%	243	480	377	744	464	916
WCID 3 Total	**100%**	**540**	**1,067**	**838**	**1,654**	**1,030**	**2,035**
439 Pit	44%	384	819	451	964	523	1,116
Elliot's Pasture	52%	453	968	533	1,139	618	1,319
Jack Rabbit Flat	4%	35	74	41	88	48	101
439 WSC Total	**100%**	**872**	**1,861**	**1,026**	**2,190**	**1,188**	**2,536**
Fort Hood DP	95%	2,280	4,538	2,266	4,510	2,245	4,469
Fort Hood DP7	5%	120	239	119	237	118	235
Fort Hood Total	**100%**	**2,400**	**4,777**	**2,385**	**4,748**	**2,364**	**4,705**

Note 1: All future demands for the City of Killeen were assigned to Chaparral Road delivery point

Non-revenue water (NRW) is assumed to be 10% of the total system demand. NRW was distributed across the system by adding 10% to all junction demands as a fixed demand.

3.2.4 Special Features

Special features in the model include the following:

- Lake Belton WTP

- Stillhouse WTP
- Surge Tanks 1 and 2
- Killeen Station 6 GSTs 1, 2, and 3
- Pressure sustaining valve (PSV) and ground storage tank (GST) at each existing delivery point: Belton, 439 Pit, Elliot's Pasture, Jack Rabbit Flat, Nolanville Main (Sewer Plant), Nolanville School, Harker Heights Verna Lee, Harker Heights Maintenance Yard (Mary Jo), Killeen Station 1, Killeen Station 2, Killeen Station 3, Killeen Station 4, Killeen Station 5, Copperas Cove, Killeen Station 6/ Copperas Cove, Fort Hood Main, and Fort Hood Station 7
- Chapparal Road Elevated Storage Tank (EST)

The settings in the model are designed to allow extended simulations over a period of time. In some cases, this involved the creation of settings or the addition of model elements that are not physically present in the system, but that assist with model stability. For example, the model cannot be continuously operated with the same set of pumps turned on because if all the elevated tanks fill or empty the model will not be able to solve and will crash. For that reason, pumps in the model must be configured with controls to make sure that pumps will turn off before all tanks fill. The set-up and settings for all facilities are described below. All key facilities have a "Named View" that has been created so that model users can quickly navigate to that location in the model. These are available from the >> View >> Named View menu option in WaterGEMS.

Delivery Point Setup

All delivery points generally have the same model setup: a single line diverts from the transmission main to a pressure sustaining valve (PSV) and then to a ground storage tank (GST). The PSV is set to open when the GST water level is low while maintaining the hydraulic grade in the pipeline to some minimum pressure. The PSV closes when the GST is full again.

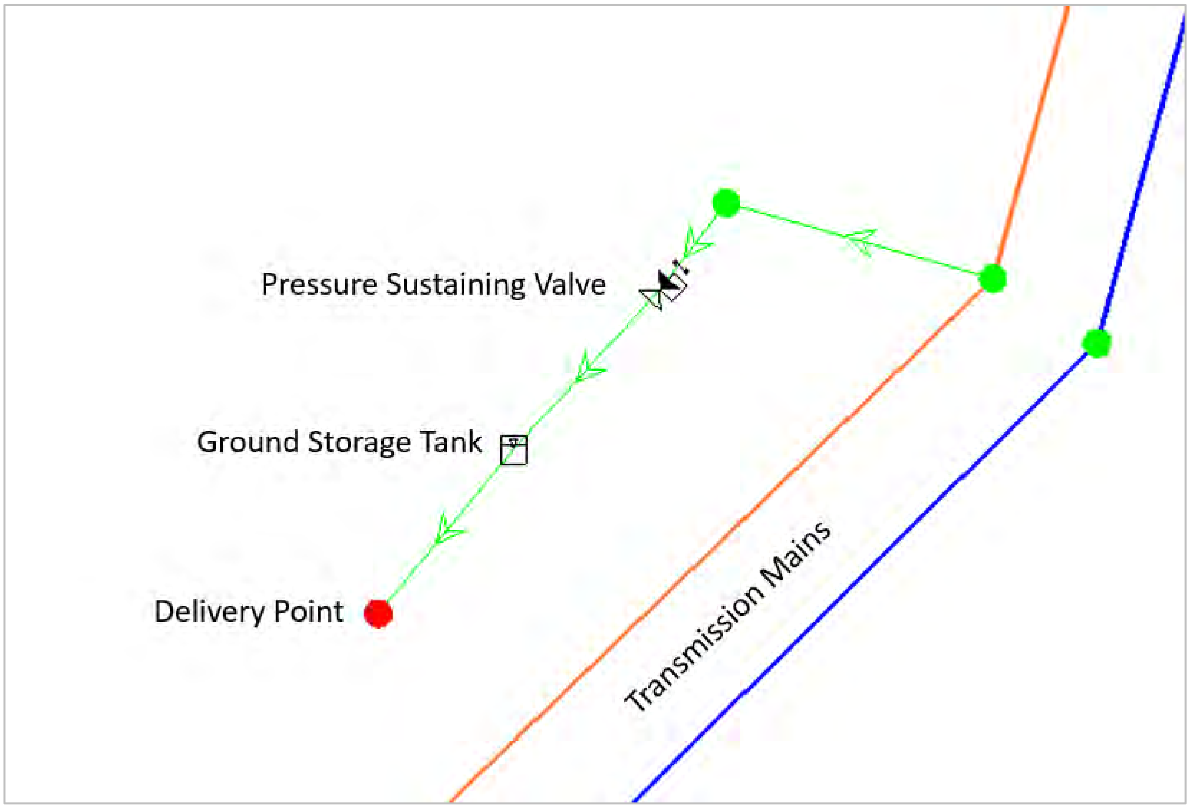

Figure 3.1 Typical delivery point layout

3.2.5 Operational Settings

The narrative below explains how the model is configured. Note that specific settings might change for different model scenarios. For example, the High Service Pumps (HSP) dedicated to the south transmission main are not operated in the "south loop closed" scenarios.

Finished water stored in the Bell County WTP clearwells is supplied to the distribution system by means of sixteen high service pumps, designated HL-1 through HL-16. The Bell County high service pumps serve both the north and south transmission mains. Model controls were set to mimic tank level SCADA data provided by the District. By simply observing SCADA data, one can determine valve open/close set points and run times.

North Transmission Main

The WTP at Lake Belton has eight high-service pumps (**Table 3.2**) that pump finished water to the north transmission main. HL-9 through HL-14 are dedicated to the north transmission main while HL-15 and 16 are variable speed pumps (VSP) that can alternatively pump water to the south transmission main.

Water is pumped through a single 48-inch line to two 0.5 MG surge tanks with an overflow elevation of 992'. From the surge tanks, water flows by gravity to Station 6, delivering water to Killeen Station 5 and Fort Hood Station 7 along the way. The transmission main transitions to a 54" line west of the surge tanks before transitioning back to a 48" line south of Fort Hood Station 7.

Table 3.2 North Loop Pump Operations

Label	Controlled By	Pump ON elev. (ft)	Pump OFF elev. (ft)	Design Flow (gpm)	Design Head (ft)
HL-9	Surge Tank #2	978	991.5	2,160	400
HL-10	Surge Tank #2	985	988	3,500	400
HL-11	Surge Tank #2	982	985	4,900	400
HL-12	Surge Tank #2	978	982	7,300	400
HL-13	STANDBY	NA	NA	10,500	400
HL-14	Surge Tank #2	975	978	10,500	405
HL-15 (VSP)	Surge Tank #2	985	988	10,000	400
HL-16 (VSP)	Surge Tank #2	982	985	10,000	400

Delivery to Station 6 is controlled by a terminal control valve to reduce head before reaching the three 5 MG GSTs. Controls are shown in **Table 3.3**. The north transmission main operates at a hydraulic grade of 992 feet and "floats" on the surge tanks.

Table 3.3 Throttle Control Valve Operation

TCV Status	Controlled By	Lower Limit Level (ft)	Upper Limit Level (ft)
Closed	Sta. 6 Tank 1	31.9	32.0
25% Open	Sta. 6 Tank 1	31.5	31.9
35% Open	Sta. 6 Tank 1	31.0	31.5
50% Open	Sta. 6 Tank 1	30.0	31.0
Open	Sta. 6 Tank 1	0	30.0

South Transmission Main

The WTP at Lake Belton has six dedicated high-service pumps that pump finished water to the south transmission main. These pumps were installed in the 1950s and 1960s and have far exceeded their life expectancies. With a firm capacity of 13,500 gpm (19.4 MGD), the pumps dedicated to the south transmission main deliver significantly less flow than the pumps dedicated to the north transmission main (48,000 gpm, 70 MGD). The existing model simulates all 5 firm capacity pumps ON if Station #6 tanks have a water level less than 31.9' and OFF if the water level is above 31.9' (**Table 3.4**).

Table 3.4 South Loop Pump Operations

Label	Controlled By	Pump ON	Pump OFF	Design Flow (gpm)	Design Head (ft)
HL-1	Station #6 Tank #1	<31.9	>31.9	1,750	250
HL-2	Station #6 Tank #1	<31.9	>31.9	1,750	250
HL-3	Station #6 Tank #1	<31.9	>31.9	3,000	250
HL-4	Station #6 Tank #1	<31.9	>31.9	3,000	250
HL-5	Station #6 Tank #1	<31.9	>31.9	4,000	250
HL-6	STANDBY	NA	NA	5,000	250

A 24-inch and a 30-inch pipeline exit the plant site in parallel and proceed south delivering water to three 439 WSC delivery points before terminating near the town of Nolanville. Here, the 24-

inch and 30-inch pipelines transition to an 18-inch and a 36-inch pipeline at what is known as the Nolanville Wye. The south transmission main serves seven more delivery points before terminating at Station #6. **Table 3.5** describes these delivery points from east to west (from WTP to Station 6). The south transmission main operates at a hydraulic grade of 882.5 feet and floats on the Station 6 ground storage tanks.

Table 3.5 South Loop Delivery Points

Label	Customer	Tank Size (MG)	Tank Overflow Elevation (ft)	2020 Average Day Demand (gpm)
439 WSC By Plant	439 WSC	0.07	770	384
Elliot's Pasture	439 WSC	0.5	675	453
Jackrabbit Flats	439 WSC	0.5	700	35
Nolanville by Sewer Plant	Nolanville	0.5	701	297
Nolanville by School	Nolanville	0.1	800	243
Verna Lee	Harker Heights	3.0	810	2,267
Mary Jo	Harker Heights	0.5	812	1,511
Station 3	Killeen	2 X 5.0	839.5	1,848
Station 2	Killeen	2.0	844.5	462
Station 1	Killeen	0.25	841.5	0
Copperas Cove @ Station 6	Copperas Cove	0.25	850	1,169
Station 6	Killeen	3 X 5.0	882.5	5,432
Fort Hood Main	Fort Hood	3.0	882	2,280

Belton Transmission Main

The transmission main from the Lake Belton WTP to the Belton delivery point is the shortest of the three mains (~3,700') and has recently been upgraded from a 14" line to a 24" line. Two new pumps have also been added to the two existing pumps that were dedicated to Belton. Belton has a 2020 average day demand (ADD) of 2,220 gpm and the GST is 3.0 MG. There is an extra feed line from the south transmission main at the Belton delivery point that can supplement the 24" line in case of emergency.

Stillhouse Transmission Main

Stillhouse WTP in the short term will only pump to a single elevated storage tank (EST) on the south side of Killeen (Chaparral EST). This transmission main is not currently connected to the rest of the system but could be connected to the south transmission main between Harker Heights and Nolanville sometime in the future. Stillhouse WTP has a production capacity of 17 MGD with a footprint to potentially double production capacity.

3.3 Analysis of Existing and Future System

The northern and southern halves of the Bell County distribution system make up two pressure planes. The north transmission main operates at a hydraulic grade of 992' while the south transmission main operates at 882.5'. While the pumping capacity to the north transmission main is much greater than the pumping capacity to the south, the customer demand on the north transmission main is far less. For this reason, most of the flow through the north transmission main is conveyed all the way to Station 6 where it can supplement demands on the south transmission main. Water moving east to west along the south transmission main is met with water moving west to east from Station 6, creating an equilibrium point near Killeen Station 3 (2020 ADD simulation).

While pipeline breaks haven't been a major issue to date (a problematic 24-inch line on the south transmission main was replaced with the 36-inch line in 2007), modeling shows a break on the north transmission main under 2020 max day demands would cut off flow to Killeen Station 5 and nearly empty the Station 6 GSTs entirely (**Figure 4.3**). Note the simulation assumes HL-15 and HL-16 pump to south transmission main.

In addition to redundancy concerns, it is undesirable to have such a large portion of the flow conveyed through the north transmission main for other reasons:

- It is an inefficient use of energy to pump water up to the surge tanks only to break head at the terminal control valve.
- The previous master plan noted the terminal control valve may be experiencing cavitation due to the large difference in head at this point.
- The surge tanks are relatively small. If flow through the terminal control valve continues to grow with future demands, keeping the surge tanks from emptying could prove difficult for operators. Modeling shows flows through the terminal control valve greater than 40,000 gpm, at which rate the two 0.5 MG surge tanks could empty from full in 25 minutes.

Section 5 examines alternatives for more equitably distributing flows between the north and south transmission systems to provide additional resiliency and reliability in service.

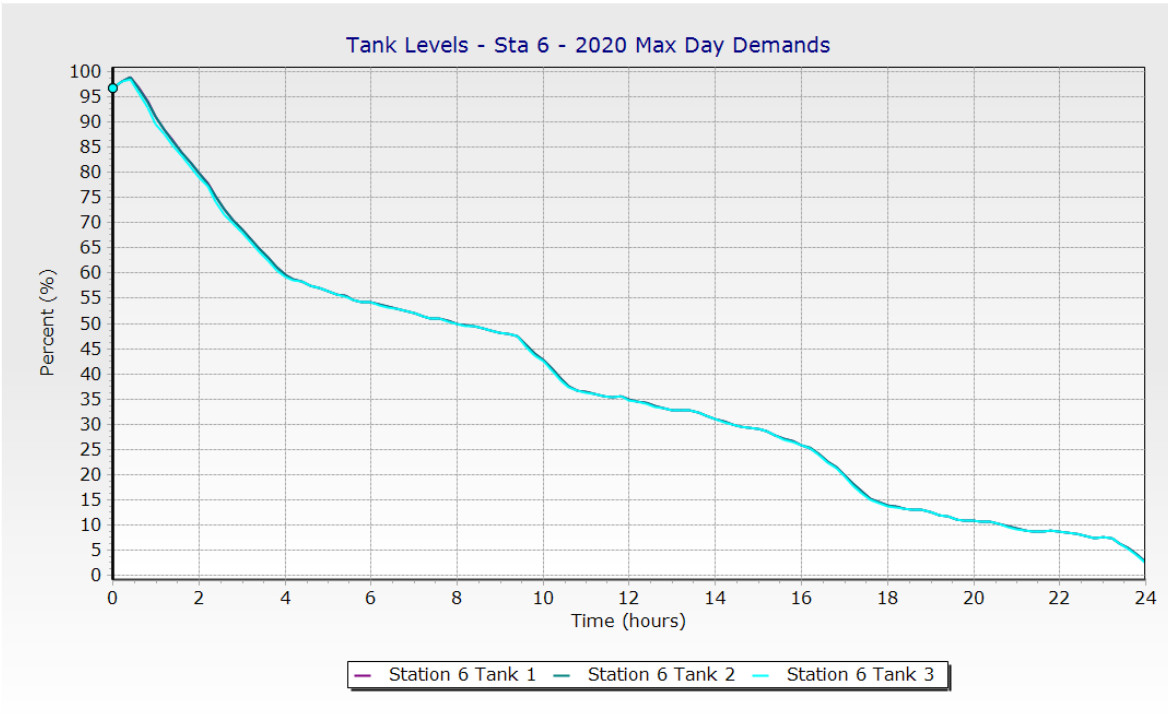

Figure 3.2 Station 6 Tank Levels – 2020 MDD with the north transmission main closed.

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Section 4

Belton Water Treatment Plant Evaluation

The District provides potable water from the existing Belton WTP. The District's newly constructed Stillhouse WTP, will begin delivering potable water in early 2021. The purpose of this section is to present high-level recommendations for the Lake Belton WTP based upon a review of the plant's facilities condition and future capacity needs.

4.1 Existing Water Treatment Plant Facilities

The Lake Belton WTP is located on Lake Belton, which serves as the raw water source. The plant is comprised of four individual WTPs, Plant Nos. 1, 2, 3 and 4. A common raw water intake and pump station pump raw water to each of the four plants. **Figure 4.1** presents a site plan of the Lake Belton WTP. The total capacity of the existing Lake Belton WTP is 90.0 mgd based on TCEQ requirements for unit processes, TCEQ approved disinfection CT study, and raw water delivery capabilities.

Table 4.1 presents a summary of the existing treatment capacities for each of the plants and their associated unit processes. The capacities are based on the allowable TCEQ design criteria, not what the actual current TCEQ ratings for the plant are. These ratings do not consider disinfection capabilities, although sufficient disinfection is available to meet the rated capacities for each plant.

Table 4.1 Belton WTP – Existing Plant Capacities

Plant / Unit Processes	Firm Capacity (MGD)	Total Capacity (MGD)	Comments
Plant No. 1			
▪ Raw Water Delivery	14.0	14.0*	
▪ Flocculation	17.7	17.7	Based on 20 min. detention time (TCEQ)
▪ Clarification	14.0	14.0	Based on 0.6 gpm/sf overflow rate (TCEQ)
▪ Filtration	19.4	19.4	Plants No. 1 and No. 2 filters are connected, so firm capacity with all filters online.
Limiting Capacity	14.0	14.0	Raw water delivery and clarification limit capacity
Plant No. 2			
▪ Raw Water Delivery	16.0	16.0*	
▪ Flocculation	23.8	23.8	Based on 20 min. detention time (TCEQ)
▪ Clarification	19.1	19.1	Based on 0.6 gpm/sf overflow rate (TCEQ)
▪ Filtration	20.0	26.6	Firm capacity with one filter out of service for backwashing
Limiting Capacity	16.0	16.0	Raw water delivery limits capacity
Plant No. 3			
▪ Raw Water Delivery	25.0	25.0*	

Plant / Unit Processes	Firm Capacity (MGD)	Total Capacity (MGD)	Comments
▪ Flocculation	29.9	29.9	Plant 3 has solids contact clarifiers that include flocculation and clarification
▪ Clarification	39.4	39.4	Based on 2-hour detention time (TCEQ)
▪ Filtration	25.4	25.4	Plants No. 3 and No. 4 filters are connected, so firm capacity with all filters online.
Limiting Capacity	25.0	25.0	Raw water delivery limits capacity
Plant No. 4			
▪ Raw Water Delivery	35.0	35.0*	
▪ Flocculation	45.2	45.2	Based on 20 min. detention time (TCEQ)
▪ Clarification	39.1	39.1	Based on 0.6 gpm/sf overflow rate (TCEQ)
▪ Filtration	60.5	72.6	Firm capacity with one filter out of service for backwashing
Limiting Capacity	35.0	35.0	Raw water delivery limits capacity
Total Plant Capacity	**90.0**		

* The Raw Water Pump Station (RWPS) serves all four plants. With the largest pump out of service, the pump station can supply the rate capacity of each plant. The total capacity of the RWPS is 102 MGD. The firm pumping capacity of the RWPS is 90 MGD.

4.2 Treatment Process Facilities

Below is a brief description of each of the treatment process units for the four plants and the raw water pump station. A listing of the various items related to each plant is provided.

4.2.1 Plant No. 1

Plant No. 1 was constructed in 1954. It is a conventional surface water treatment plant with a rated capacity of 14.0 MGD. It consists of a rapid mix basin, two flocculation basins, one sedimentation basin, four filters, and chemical feed systems for chlorine, ammonia, alum, and polymer. The limiting factors for capacity are raw water delivery and the sedimentation basin. It is not anticipated that additional capacity could be obtained from Plant No. 1 in the future. The plant is in generally good condition for its age, but the following items should be considered for future modifications and upgrades:

- **Rapid mixers.** The rapid mix basin has two vertical turbine rapid mixers. Replacement of these units should be considered in the near future due to age and condition.

- **Flocculation basins.** The flocculation basins have redwood baffles that separate the basins into three stages. Replacement of these baffles should be considered in the near future to maintain a separation of the basin for tapered flocculation.

- **Sedimentation basin.** The sedimentation basin has two circular clarifier mechanisms for sludge removal. The units are over 60 years old. Although operating well, the mechanisms may need to be replaced in the near future. The effluent launders and center wells also show signs of corrosion and should be recoated or replaced.

- **Filters**. The existing filters operate well and produce a high-quality filtered water. Although the underdrain blocks are old, they appear to be in good condition from visual inspection. The Plant 1 and Plant 2 filters use the same blowers for providing air to the filters for air scour during backwashing. Since the Plant 1 filters are smaller than the Plant 2 filters, excess air can potentially get to the Plant 1 filters, resulting in loss of filter media. Adding better controls for the air scour flow should be considered to provide optimal air to the filters. This would include a flow meter and flow control valve in the air pipe header. The existing filter piping within the filter pipe gallery should be re-coated on a regular basis to reduce the impact of corrosion. Areas where corrosion is significant should be investigated by a corrosion engineer.

4.2.2 Plant No. 2

Plant No. 2 was constructed in 1964. It is a conventional surface water treatment plant with a rated capacity of 16.0 MGD. It consists of a rapid mix basin, one flocculation basin, one sedimentation basin, four filters, and chemical feed systems for chlorine, ammonia, alum, and polymer. The limiting factor for capacity is the raw water delivery. It is not anticipated that additional capacity would be obtained from Plant No. 2 in the future. The plant is in generally good condition for its age, but the following items should be considered for future modifications and upgrades:

- **Rapid mixers.** The rapid mix basin has two vertical turbine rapid mixers. Replacement of these units should be considered in the near future due to age and condition. These should be replaced at a similar time as the Plant No. 1 rapid mixers.

- **Flocculation basin.** The flocculation basin's original redwood baffles were recently replaced with concrete ported walls. No further improvements are needed at this time.

- **Sedimentation basin.** The sedimentation basin has two circular clarifier mechanisms for sludge removal. The units are over 50 years old. Although operating well, the mechanisms may need to be replaced in the near future.

- **Filters**. The existing filters operate well and produce a high-quality filtered water. Although the underdrain blocks are old, they appear to be in good condition from visual inspection. Addition of better controls for the backwash blower as discussed for the Plant 1 filters is recommended. The existing filter piping within the filter pipe gallery should be re-coated on a regular basis to reduce the impact of corrosion. Areas where corrosion is significant should be investigated by a corrosion engineer.

4.2.3 Plant No. 3

Plant No. 3 was constructed in 1977. It is a solids contact-type surface water treatment plant with a rated capacity of 25.0 MGD. It consists of a rapid mix basin, two solids contact clarifiers (sludge-blanket and solids-recirculation type), four filters, and chemical feed systems for chlorine, ammonia, alum, and polymer. The limiting factor for capacity is the raw water delivery. Obtaining additional capacity at the Belton WTP would most likely need to come from Plant No. 3. However, this would require removal of the existing clarifiers and installing new, more compact flocculation and sedimentation basins. Plant expansion is discussed later in this section. The following items should be considered for future modifications and upgrades:

- **Rapid mixers.** The rapid mix basin has two vertical turbine rapid mixers. Replacement of these units should be considered in the near future due to their condition. These should be replaced with other modifications for Plant No. 3.
- **Solids contact clarifiers.** The existing solids contact clarifier equipment is in poor condition. The outlet launder troughs and flume are corroded. This results in short circuiting of flow through the basin and poor treatment. The flocculation skirt is also corroded. The sludge recirculation and removal equipment are over 40 years old and should be replaced. All of the existing equipment should be replaced to continue to provide effective treatment at the rated capacity.
- **Filters**. The existing filters operate well and produce a high-quality filtered water. There are no recommended improvements to the filters at this time. The existing filter piping within the filter pipe gallery should be re-coated on a regular basis to reduce the impact of corrosion. Areas where corrosion is significant should be investigated by a corrosion engineer.

4.2.4 Plant No. 4

Plant No. 4 was constructed in 1999. It is a conventional surface water treatment plant with a rated capacity of 35.0 MGD. It consists of a rapid mix basin, four flocculation basins, four sedimentation basins, six filters, and chemical feed systems for chlorine, ammonia, alum, and polymer. The limiting factor for capacity is raw water delivery. Plant No. 4 facilities are in relatively good condition and produce high quality water. One issue that should be evaluated further is visible corrosion of piping in the filter pipe gallery. It is recommended that a corrosion engineer review the existing corrosion to determine improvements that should be made to the existing piping. All piping within the filter pipe gallery should be re-coated on a regular basis to reduce the impact of corrosion.

There are no further recommended improvements for Plant No. 4.

4.2.5 Raw Water Pump Station

The Raw Water Pump Station delivers raw water to all four plants. Although the it has a firm pumping capacity of 90 MGD, improvements to the pump discharge header piping and valves could be made to provide flexibility for operation of the pump station. Further study will be required to determine the specific changes that would improve overall performance.

4.2.6 Summary of Recommended Treatment Process Upgrades

Table 4.2 presents the recommended improvements to the Belton WTP treatment process units to maintain current capacity and finished water quality.

Table 4.2 Belton WTP – Summary of Recommended Treatment Process Upgrades

Plant / Unit Processes	Recommended Improvements/Upgrades	Criticality
Plant No. 1		

Plant / Unit Processes	Recommended Improvements/Upgrades	Criticality
▪ Rapid Mix Basins	Replace rapid mixers	Low
▪ Flocculation Basins	Replace redwood baffles	Medium
▪ Sedimentation Basins	Replace clarifier mechanisms and launders	Low
▪ Filters	Provide control valve and automated controls for the air scour blowers Implement filter pipe gallery pipe coating plan.	High Medium
Plant No. 2		
▪ Rapid Mix Basins	Replace rapid mixers	Low
▪ Sedimentation Basins	Replace clarifier mechanisms	Low
▪ Filters	Provide control valve and automated controls for the air scour blowers. (same as for Plant 1 above) Implement filter pipe gallery pipe coating plan.	High Medium
Plant No. 3		
▪ Rapid Mix Basin	Replace rapid mixers	Low
▪ Solids Contact Clarifiers	Replace all equipment or construct new flocculation/sedimentation basins	High
▪ Filters	Implement filter pipe gallery pipe coating plan.	Medium
Plant No. 4		
▪ Filters	Conduct corrosion evaluation of filter pipe gallery piping and make modifications Implement filter pipe gallery pipe coating plan.	High Medium
Raw Water Delivery		
▪ Raw Water Pump Header	Improvements to pump header to improve operation and flexibility	Medium

4.3 Chemical Storage and Feed Facilities

The Belton WTP uses aluminum hydroxide (alum) and cationic polymer for the coagulation process. The plant has the option to use polyaluminum chloride instead of alum depending on raw water quality and cost of treatment and have done this in the past. Chlorine gas and liquid ammonium sulfate (LAS) are used for disinfection purposes. Hydrofluosilicic acid can be added to the water for fluoridation purposes. This is not required by TCEQ.

Alum. Liquid alum is delivered by tanker trucks and stored in FRP bulk storage tanks located outside. Plants No. 1 and No. 2 share a storage tank and Plant No. 3 and No. 4 have individual tanks. Alum is pumped to day tanks and peristaltic metering pumps are used for pumping to the rapid mix basins.

Polymer. Polymer is delivered to FRP bulk storage tanks. Plants No. 1 and No. 2 share a bulk storage tank that is located inside the Chemical Building. Plants No. 3 and No. 4 each have dedicated storage tanks located in the Plant 4 Chemical Building. Peristaltic metering pumps convey the polymer to the rapid mix basins.

Chlorine. Chlorine gas is delivered and stored in one-ton containers. Chlorine gas is fed through chlorinators to injectors that produce chlorine solution. The chlorine solution is fed to application points in the raw water and finished water.

Ammonia. Liquid ammonium sulfate (LAS) is delivered by tanker trucks and stored in FRP bulk storage tanks located outside. Plants No. 1 and No. 2 share a storage tank and Plant No. 3 and No. 4 have individual tanks. LAS is pumped to day tanks and peristaltic metering pumps are used for pumping to the rapid mix basins and finished water line.

Fluoride. Hydrofluosilicic acid is delivered to FRP bulk storage tanks. Plants No. 1 and No. 2 share a bulk storage tank. Plants No. 3 and No. 4 each have dedicated storage tanks. Hydrofluosilicic acid is pumped to day tanks and peristaltic metering pumps are used for pumping to the application point.

The chemical storage and feed equipment are in generally good condition. Some of the bulk storage tanks are beginning to reflect their age and should be evaluated for replacement in the near future. A safety evaluation should be conducted, and improvements made to provide necessary leak detection and alarms.

Table 4.3 presents the recommended improvements to the Belton WTP chemical storage and feed facilities.

Table 4.3 Belton WTP – Summary of Recommended Chemical Systems Upgrades

Facilities/Equipment	Recommended Improvements/Upgrades	Criticality
Chemical Storage Tanks	Evaluate and replace bulk chemical storage tanks in poor condition	Medium
Chlorine Safety	Implement chlorine leak detection, monitoring and alarms where not provided	High

4.4 Residuals Handling

The Lake Belton WTP generates waste filter backwash water and sludge produced during the sedimentation process. Waste backwash water is sent to a series of five lagoons. Decant from the lagoons is discharged into Lake Belton. The plant has a permit to allow this discharge.

Implementation of washwater recovery facilities, including a washwater recovery basin and recycle pump station, would enable the plant to reuse the waste filter backwash water. Recycling this flow upstream of the treatment processes would reduce the amount of raw water required for the plant. Although not an immediate need, it is recommended to add these facilities in the near future. Further study will be needed to size and site these washwater recovery facilities. They could potentially be included with the future expansion of the plant.

Sedimentation basin sludge is pumped to two gravity thickeners (No. 1 and No. 2) from the sedimentation basins. Sludge from Plants No. 1 and No. 2 flows to a collection box and is then pumped to Gravity Thickener No. 1. Sludge from Plant No. 3 solids contact clarifiers that is not recirculated is pumped to Gravity Thickener No. 2. Sludge from Plant No. 4 flows by gravity from the sedimentation basins to both Gravity Thickener No. 1 and No. 2. Sludge can flow by gravity to the lagoon system or be pumped to two belt filter presses for dewatering. Dewatered sludge is hauled off-site for disposal.

The residuals handling facilities are generally in good condition. It is recommended that the existing sludge pumps used to pump to the gravity thickeners be replaced with a submersible type pump which should be better suited for this application.

Table 4.4 presents the recommended improvements to the Belton WTP chemical storage and feed facilities.

Table 4.4 Belton WTP – Summary of Recommended Residuals Handling Upgrades

Facilities/Equipment	Recommended Improvements/Upgrades	Criticality
Washwater Recovery Facilities	Add washwater recovery basin and recycle pump station	Medium
Sludge Transfer Pumps	Replace sludge transfer pumps with submersible sludge pumps	Medium

4.5 Finished Water Storage

The Lake Belton WTP stores finished water in three clearwells located on site. One clearwell is located beneath the Plant No. 1 and No. 2 filters. A second clearwell is located below Plant No. 3 and No. 4 filters. The third clearwell is a 4.0-million gallon (MG) circular concrete clearwell constructed in 2009 that provides most of the overall finished water storage for the plant. The combined storage volume is 6.6 MG.

TCEQ requires that treated water storage exceed 5% of the rated plant flow. Therefore, 4.5 MG of storage are required. Although the plant meets the TCEQ requirement at the current 90 MGD treatment capacity, it is typically recommended to have at least 10% of plant capacity in storage at the plant site for operational reasons. Under this scenario 9 MGD of plant capacity would be required. It is recommended that a second 4.0 MG clearwell be constructed. If not included as part of the initial plant upgrades, it should be included when the plant is expanded.

Table 4.5 presents the recommended improvements to the Lake Belton WTP finished water storage.

Table 4.5 Belton WTP – Summary of Recommended Finished Water Storage Upgrades

Plant / Unit Processes	Recommended Improvements/Upgrades	Criticality
Clearwells	Construct a new 4.0 MG clearwell	Medium

4.6 Emergency Backup Power

Backup power is not required for water treatment plants per TAC 290 rules. However, providing backup power to keep a portion of the plant functioning is recommended for future consideration. This would help to provide some flow from the plant and to maintain system pressure during power outages. Providing the treatment and pumping capacity for approximately one third of the plant capacity, 30 MGD, is recommended. Emergency backup generators are recommended for the following areas:

- **Raw Water Pumps 7 and 8.** These two pumps have the combined pumping capacity of 30 MGD. One 1250 kw generator would be required to operate these two pumps with VFDs.
- **Plant No. 4.** Plant No. 4 is the newest plant and has a treatment capacity of 35 MGD. One 100 kw generator would be required to run the Plant No. 4 facilities.
- **High Service Pumps 15 and 16.** These two pumps have the combined pumping capacity of 30 MGD. Two 1250 kw generators would be required to operate these two pumps.

It is recommended to locate the generators in the vicinity of the facilities they will be running. These backup power generators could be added as part of a future improvements or plant expansion project.

Table 4.6 presents the recommended improvements for adding back up power at the Lake Belton WTP

Table 4.6 Belton WTP – Summary of Recommended Finished Water Storage Upgrades

Plant / Unit Processes	Recommended Improvements/Upgrades	Criticality
Power Supply	Addition of backup power generators for two raw water pumps, Plant 4, and two high services pumps for 30 MGD capacity.	Medium

4.7 Belton WTP Improvements Summary

The above paragraphs recommended several upgrades and improvements for the Lake Belton WTP to maintain its current 90-MGD capacity and to provide facilities conducive to a well-maintained and operated plant that produces high quality water.

Table 4.7 presents a summary of the recommended improvements to the Lake Belton WTP.

Table 4.7 Belton WTP – Summary of Recommended Improvements and Upgrades

Facilities	Recommended Improvements/Upgrades	Criticality
Treatment Process Units		
Rapid Mix Basins	Replace rapid mixers for Plants 1, 2 and 4	Low
Flocculation Basins	Replace redwood baffles for Plant 1	Medium
Sedimentation Basins	Replace clarifier mechanisms for Plants 1 and 2 and launders for Plant 1	Low
Solids Contact Clarifiers	Replace all equipment or construct new flocculation/sedimentation basins.	High
Filters	Provide control valve and automated controls for the Plant 1/Plant 2 air scour blowers. Conduct corrosion evaluation of filter pipe gallery piping for Plant 4 and make modifications Implement filter pipe gallery pipe coating plan for Plants 1, 2, 3 and 4.	High High Medium

Facilities	Recommended Improvements/Upgrades	Criticality
Raw Water Delivery		
Raw Water Pump Header	Improvements to pump header to increase capacity	Medium
Chemical Storage and Feed		
Chemical Storage Tanks	Evaluate and replace bulk chemical storage tanks in poor condition	Medium
Chlorine Safety	Implement chlorine leak detection, monitoring and alarms where not provided	High
Residuals Handling		
Washwater Recovery Facilities	Add washwater recovery basin and recycle pump station	Medium
Sludge Transfer Pumps	Replace sludge transfer pumps with submersible sludge pumps	Medium
Finished Water Storage		
Clearwells	Construct a new 4.0 MG clearwell	Medium

Figure 4.2 presents a site plan showing the proposed high and medium criticality improvements assuming the Plant No. 3 clarifiers are retrofitted with new equipment. **Figure 4.3** presents a site plan showing the proposed improvements to Plant No. 3, if the clarifiers are replaced with new flocculation/sedimentation basins to maintain current plant capacity. Replacing the clarifiers with new basins provides the most cost-effective option for expanding the Lake Belton WTP in the future to meet longer term demands as discussed below. Locations for the washwater recovery facilities and backup power generators are not shown on either of these two figures pending further study.

4.8 Plant Expansion

The Belton WTP will need to be expanded from its current 90-MGD capacity to 115 MGD to meet the projected 2035 Bell County WCID No. 1 water demands as presented in Section 2. Due to current site constraints and condition of the existing plant facilities, the optimum means for expansion is to demolish the current Plant No. 3 solids contact clarifiers and replace with new conventional rectangular flocculation/sedimentation basins similar to Plant No. 2 basins. The plant expansion would increase the Plant No. 3 capacity from 25 MGD to 50 MGD. The expansion could be performed at one time or could be accomplished by first replacing the existing solids contact clarifiers with new 25-MGD flocculation/sedimentation basins. The two-phased approach is recommended. Phase 1 will include demolishing the existing solids contact clarifiers and constructing two new rectangular flocculation/sedimentation basins. This work will maintain the current 90 MGD plant capacity. Phase 2 will include constructing two additional flocculation/sedimentation basins to increase plant capacity to 115 MGD.

Because the existing Plant No. 3 clarifiers need to be demolished prior to constructing the new flocculation/sedimentation basins, the plant capacity will be reduced to approximately 65 MGD during Phase 1 construction. This work should start as soon as possible, allowing for replacement to be completed in 2026. The overall treated water supply capabilities during Phase 1 construction will be 82 MGD, accounting for 17 MGD being available from the Stillhouse WTP.

Upon Phase 1 completion, the plant capacity would be brought back to 90 MGD. The Phase 2 construction will add an addition 25 MGD plant capacity and should be planned for completion prior to 2035.

Figure 4.4 presents a site plan of the proposed additional work required to expand the plant from 90 MGD to 115 MGD, assuming that the existing Plant No. 3 clarifiers have previously been replaced with two additional flocculation/sedimentation basins. Below is a summary of the primary items that will be involved with the two phases of the plant expansion

Phase 1

- Construct new Administration Building and associated driveways and parking.
- Relocate Maintenance Building facilities or construct new building.
- Demolish the two existing Plant No. 3 solids contact clarifiers
- Demolish the existing Maintenance Building
- Demolish the existing Administration Building
- Reroute waste backwash recovery piping system that feeds to Lagoon No. 4 and No. 5.
- Fill in Lagoon No. 4
- Reroute underground electrical ductwork, chemical lines, and other utilities located north of Plant No. 3 clarifiers
- Modify existing chemical storage and feed equipment
- Construct new 25-MGD rapid mix, flocculation and sedimentation basins.
- Install new electrical equipment and duct bank for connecting new facilities
- Perform necessary site grading, paving, and other civil sitework

Phase 2

- Fill in Lagoon No. 5
- Reroute underground electrical ductwork, chemical lines, and other utilities
- Construct new 25-MGD rapid mix, flocculation and sedimentation basins (50-MGD total)
- Upgrade and expand existing chemical storage and feed facilities for increased plant capacity
- Construct new 4.0 MG clearwell
- Construct new yard piping for connecting new facilities to raw water delivery point and filters

- Install new electrical equipment and duct bank for connecting new facilities
- Increase capacity of the Raw Water Pump Station
- Increase capacity of the High Service Pump Station
- Perform necessary site grading, paving, and other civil sitework

Consideration may be given to moving some of the proposed Phase 1 work to Phase 2, such as the Administration Building. Likewise, some of the proposed Phase 2 work could be moved to Phase 1, such as the new 4.0 MG clearwell.

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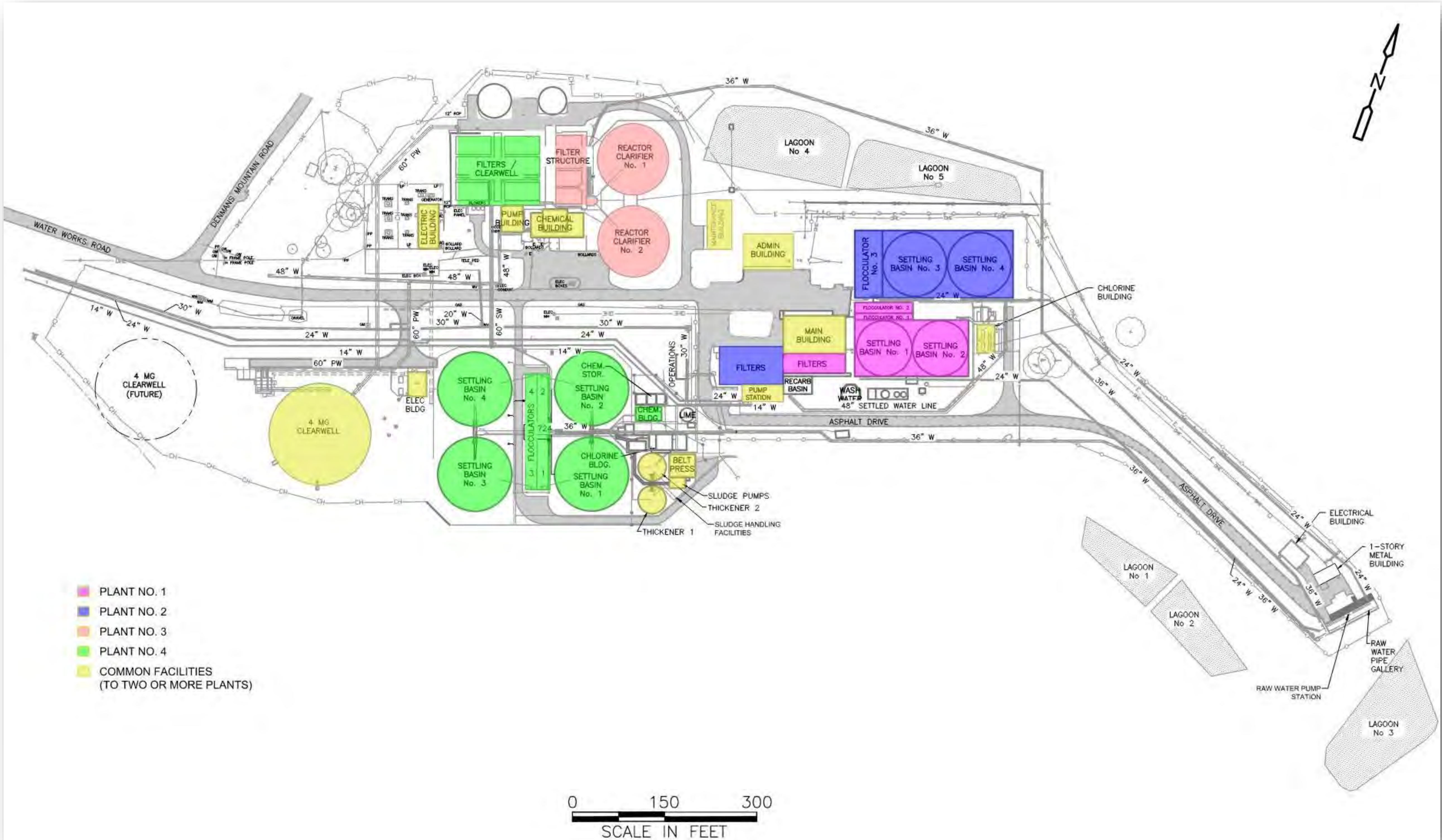

Figure 4.1 Belton WTP Existing Overall Site Plan

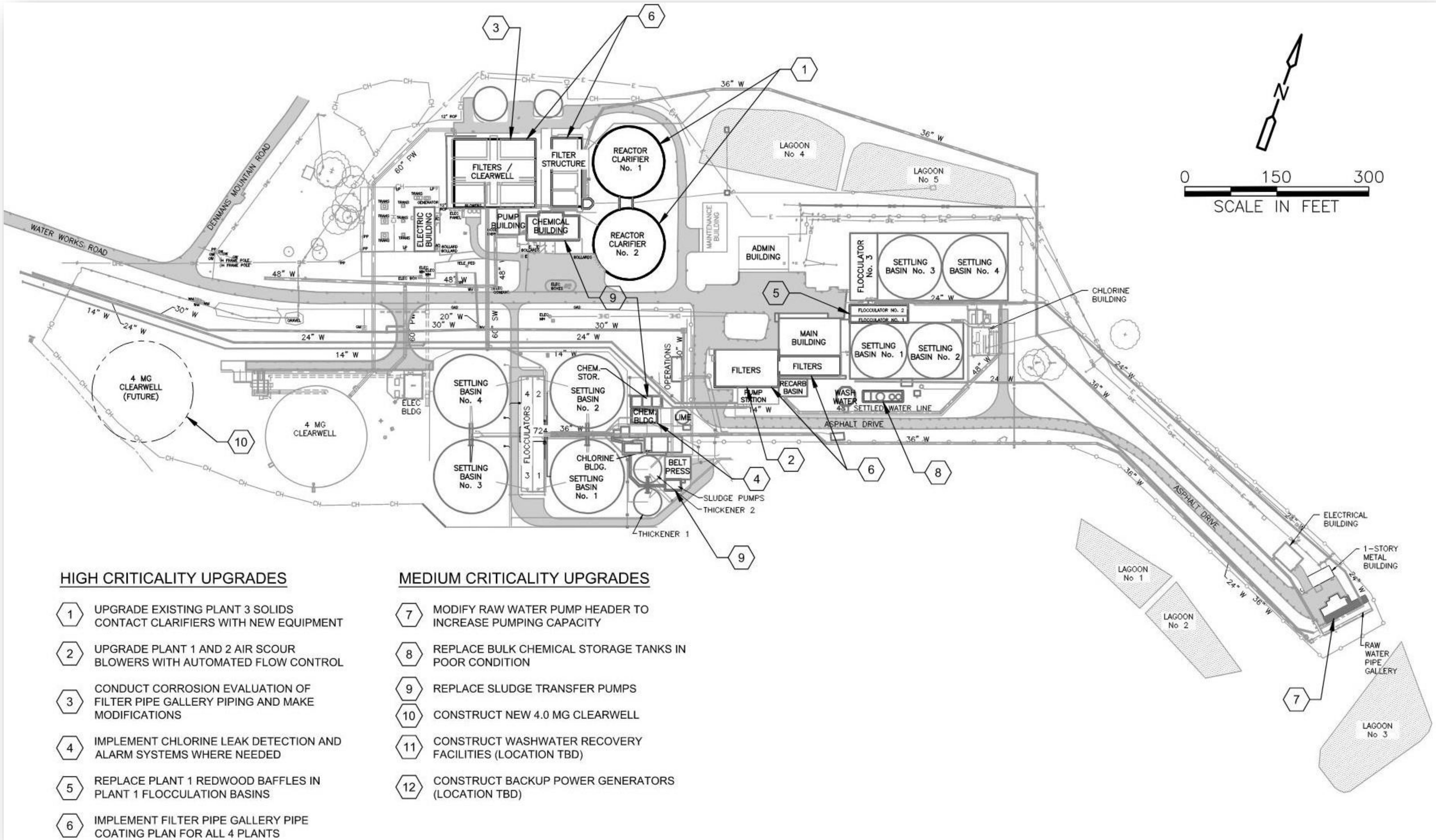

Figure 4.2 Recommended Belton WTP Upgrades – Alternative 1

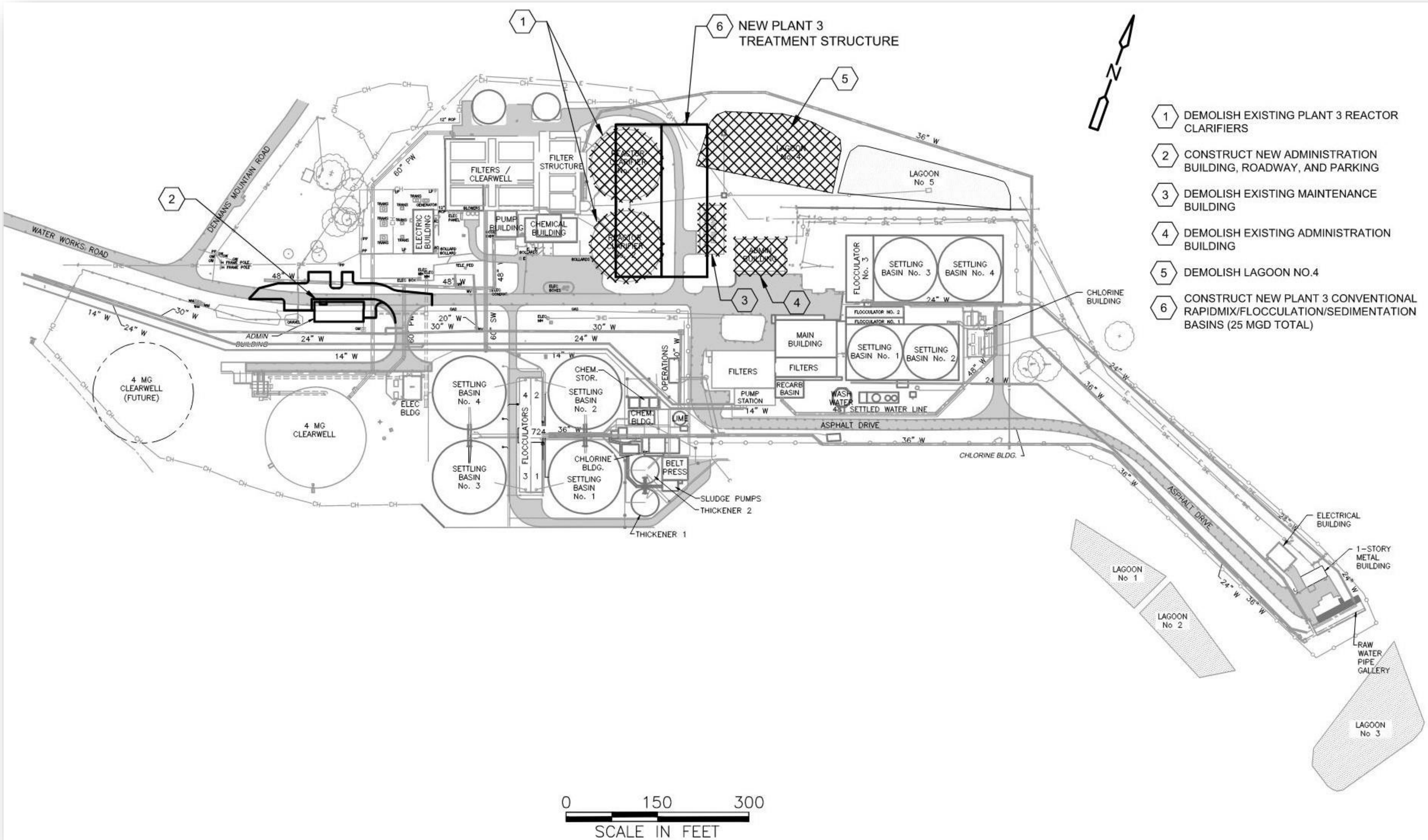

Figure 4.3 Recommended Plant 3 Clarifier Upgrades - Alternative 2

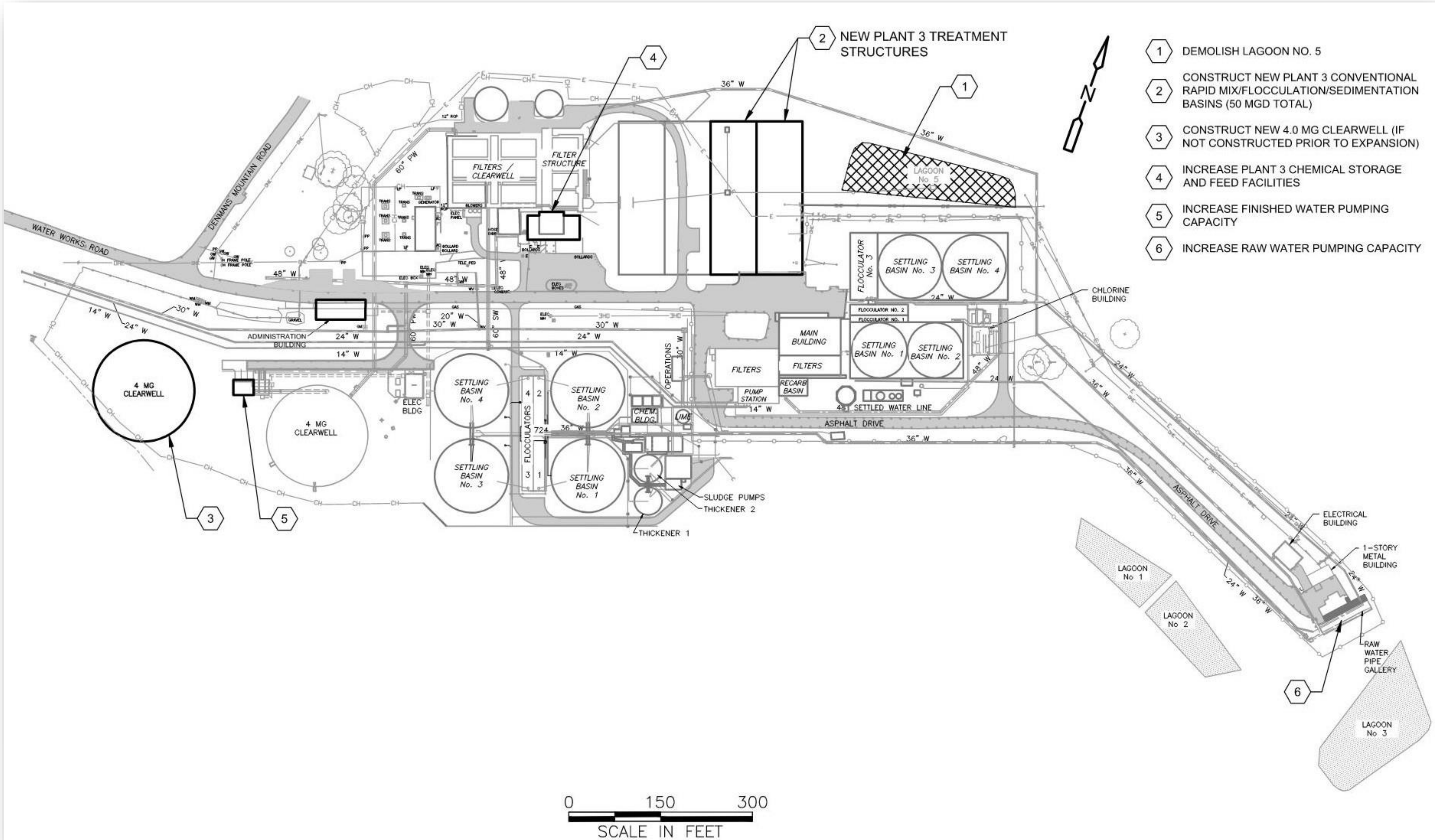

Figure 4.4 Belton WTP Future Plant Expansion

Section 5

System Alternatives Evaluation

5.1 Alternatives Development

To distribute the flows more equitably between the north and south transmission systems and provide additional resiliency and reliability in service, CDM Smith formed four alternatives for evaluation:

1. Lake Stillhouse WTP serves Killeen only through a delivery point at Chaparral Road
2. Same as Option 1 but Lake Stillhouse WTP line also ties directly into the south loop 36" transmission main near Harker Heights
3. Same as Option 2 but Lake Stillhouse WTP line instead ties into a ground storage tank near Harker Heights. Pressure will need to be reduced for water entering the GST and pumped upon leaving the GST.
4. Same as Option 1 but with inline pumping near Harker Heights.

5.1.1 Option 1: Lake Stillhouse WTP Serves Killeen Only

Lake Stillhouse WTP, the transmission main to Killeen, and the Chaparral Road elevated storage tank are each nearing completion. When the system is online it will have a capacity of 17 MGD, which could greatly reduce the amount of water that the north transmission main must supplement to the south transmission main. **Figure 5.1** shows the approximate layout of Lake Stillhouse WTP, Chaparral Road EST, and the transmission main between them relative to the existing distribution system.

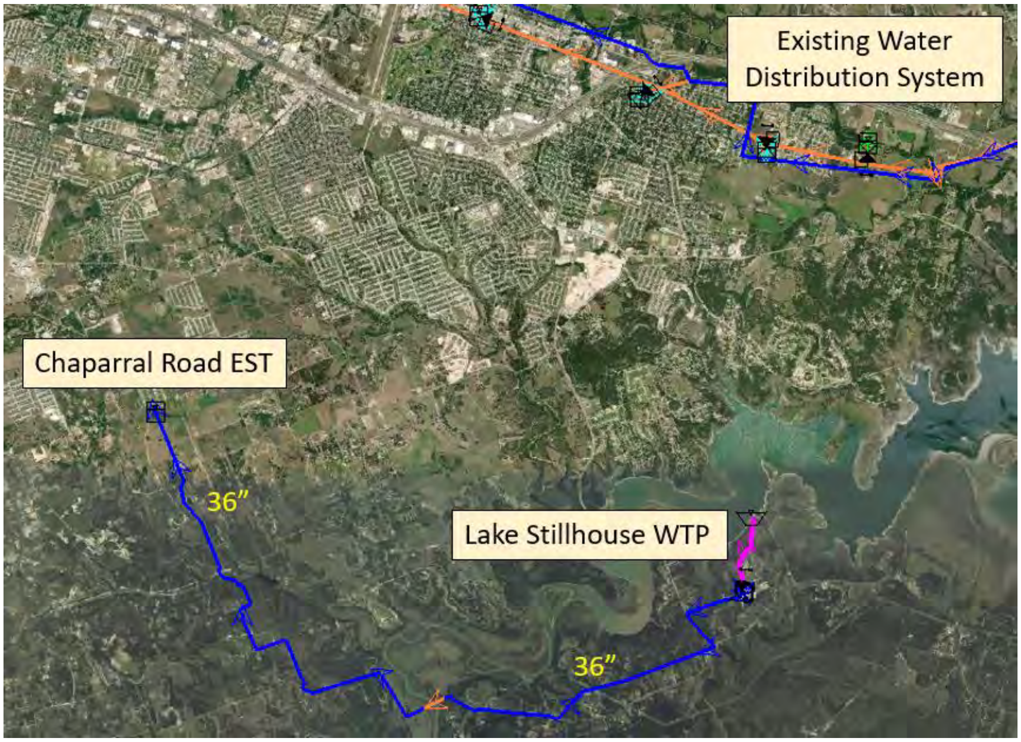

Figure 5.1 Option 1 Layout

The City of Killeen expects max day demands to increase from 29 MGD today to 40 MGD in 2040. If the entirety of this increase (11 MGD) is added to the 2020 MDD estimate (8 MGD) applied to the Chaparral Road delivery point, Lake Stillhouse WTP will be strained to meet demand (19 MGD). In these simulations, the Lake Stillhouse high service pumps operate off the water surface elevation in the Chaparral Road EST. **Table 5.1** shows the details.

Table 5.1 Lake Stillhouse WTP High Service Pump Operations

Label	Controlled By	Pump ON (ft, WSE)	Pump OFF (ft, WSE)	Design Flow (gpm)	Design Head (ft)
LSWTP HSP-1	Chaparral Road EST	980	998	4,000	395
LSWTP HSP-2	Chaparral Road EST	977.5	990	4,000	395
LSWTP HSP-3	Chaparral Road EST	977.5	990	4,000	395
LSWTP HSP-4	STANDBY	NA	NA	4,000	395

5.1.2 Option 2: Lake Stillhouse WTP Serves Killeen and Ties into 36” South Loop Main Near Harker Heights

While the Chaparral Road delivery point may have enough demand in 2040 MDD simulations to receive the entirety of Lake Stillhouse WTP production capacity, there are several scenarios in the interim that would benefit from a new pipeline tapping directly into the south transmission main. Further, the Lake Stillhouse WTP footprint has room for expansion if customers decide to increase their contracted allotments. This pipeline would be approximately 40,000 feet long (7.6 miles) and would tap directly into the 36-inch south transmission main near Warriors Path Road. A pressure sustaining valve was added to the model at the tap-in point to prevent lower pressures in the south transmission main from emptying the Chaparral Road EST.

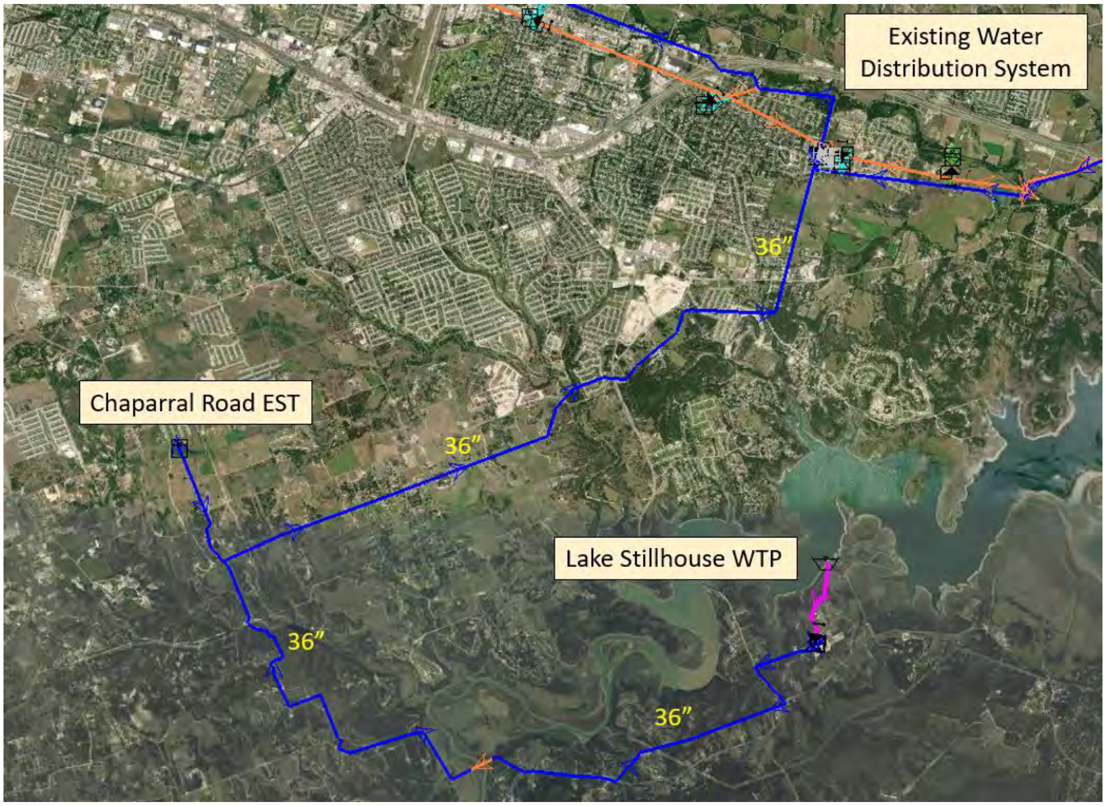

Figure 5.2 Option 2 Layout

5.1.3 Option 3: Lake Stillhouse WTP Serves Killeen and Ties into Ground Storage Tank Near Harker Heights

Option 3 is the same as Option 2 except the pipeline from Lake Stillhouse WTP terminates into a ground storage tank instead of tapping directly into the 36-inch transmission main. Because the ground elevation in this area is between 720' and 750', a pump station would need to be adjacent to the GST to pump water to Station 6 (overflow 882.5').

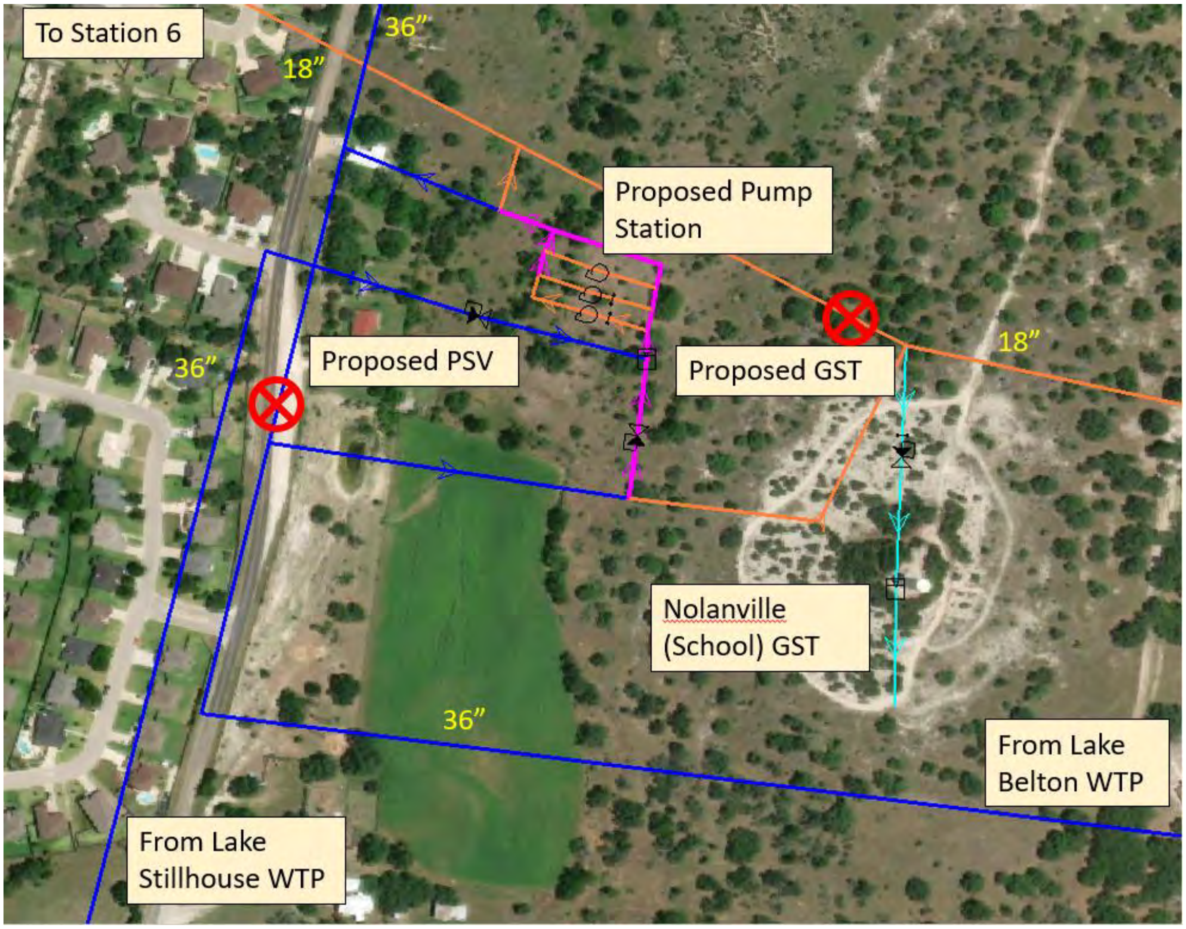

Figure 5.3 Option 3 Layout. Note: encircled red Xs indicate closed pipes

5.1.4 Option 4: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights Inline Pumping Installed Along South Transmission Main

Inline pumping is considered without the pipeline contributing from Lake Stillhouse WTP. The 36-inch and 18-inch transmission mains from Lake Belton WTP converge at a single pump station where water is boosted to Station 6. This simple approach has the advantage of not needing to reduce head only to immediately add it back with a pump. A smaller pump station could be used relative to Option 3.

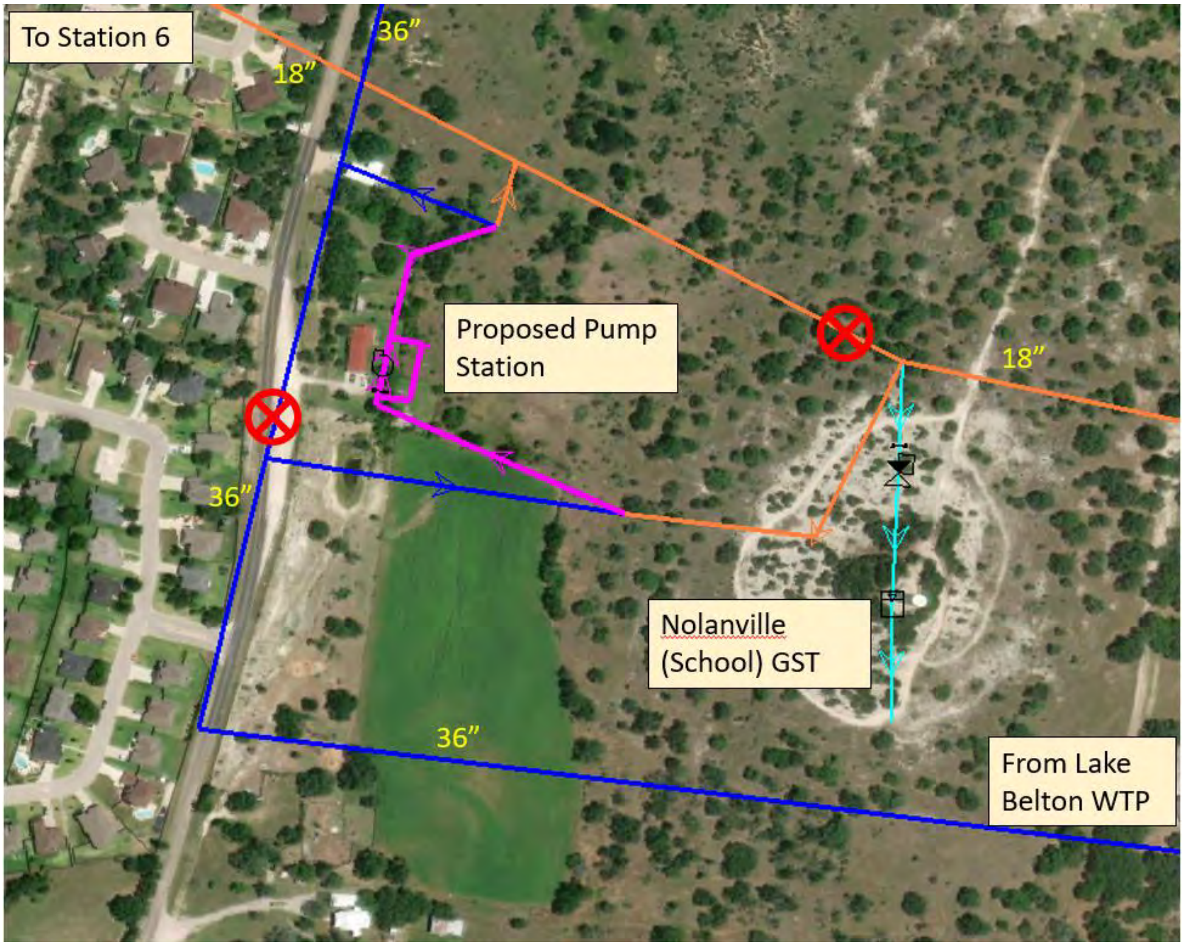

Figure 5.4 Option 4 Layout

5.2 Alternatives Analysis

Each alternative was considered under several scenarios with the goal of maintaining service to all wholesale customers throughout the simulation period.

- Average day demand
- Maximum day demand
- Maximum day demand with a break in the north transmission main
- Maximum day demand with a break in the south transmission main

The two scenarios with pipe breaks assume the incident is near the Lake Belton WTP and water will need to be conveyed from the other transmission main to reach all customers. Maintaining service to all customers does not necessarily mean keeping water in transitional tanks throughout the simulation. For example, in the scenario with the north transmission main closed, Killeen Station 5 can be fed from the Station 6 tanks by gravity meaning the surge tanks may be allowed to empty. The District may have contingency plans in place for a pipe break near the Lake Belton WTP that involve opening valves to allow pumps that are usually dedicated to one transmission main to feed the other. For these simulations, it was assumed that only HL-15 and

HL-16 can feed either transmission main. Other regulations, such as keeping a 20 psi suction head on inline pumps, were also considered.

5.2.1 Option 1: Lake Stillhouse WTP Serves Killeen Only - Analysis

The goal of Option 1 is to reduce the amount of demand on the south transmission main by transferring as much as possible to the Chaparral Road delivery point; however, the current capacity of Lake Stillhouse WTP is 17 MGD and demand projections estimate MDD to increase from 61 MGD in 2020 to 86 MGD 2040, an increase of 25 MGD. Lake Stillhouse WTP will not be able to meet the additional Killeen demand on its own.

The 2020 MDD simulation shows the current system can deliver flow to Killeen Station 5 even if the north transmission main is out of service. This assumes 8 MGD is already applied to the Chaparral Road delivery point and is fed by Lake Stillhouse. Because the City of Killeen is less developed in the south, it is probably not reasonable to allocate more of Killeen's demand to Chaparral Road in 2020, which would relieve demands from the south transmission main. In the 2030 MDD simulation, however, the Killeen Station 5 GST empties when the north transmission main is out of service.

The 2040 MDD simulation allocates 19 MGD of demand at the Chaparral Road location, which stresses the capacity of the Lake Stillhouse WTP. The large demand is reasonable if we assume rapid development continues in the south half of Killeen; however, the system fails to deliver demand to most customers over the course of the simulation because the Station 6 GSTs cannot stay full (**Figure 5.5**). The Lake Stillhouse WTP footprint is such that it can double in capacity on the existing site with an expansion project; however, even if an additional 17 MGD is removed from the south transmission main, Killeen Sta. 5 tank still empties 25 hours into the 2040 MDD simulation.

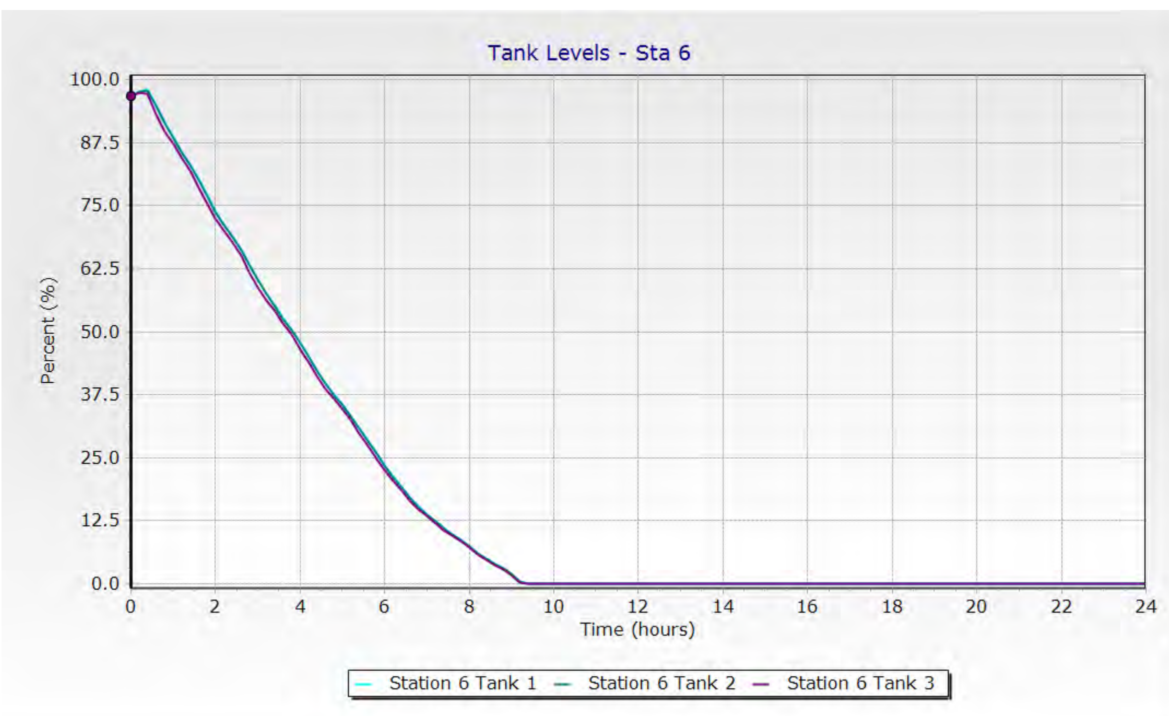

Figure 5.5 Option 1: Station 6 GST levels during 2040 MDD simulation with the north loop closed.

The Option 1 layout can easily accommodate a break in the south transmission main by feeding the entire system through the north transmission main. This is true even for the 2040 MDD scenario. **Figure 5.6** shows Station 6 maintaining a water level over 80% full even when there is a break in the south transmission main.

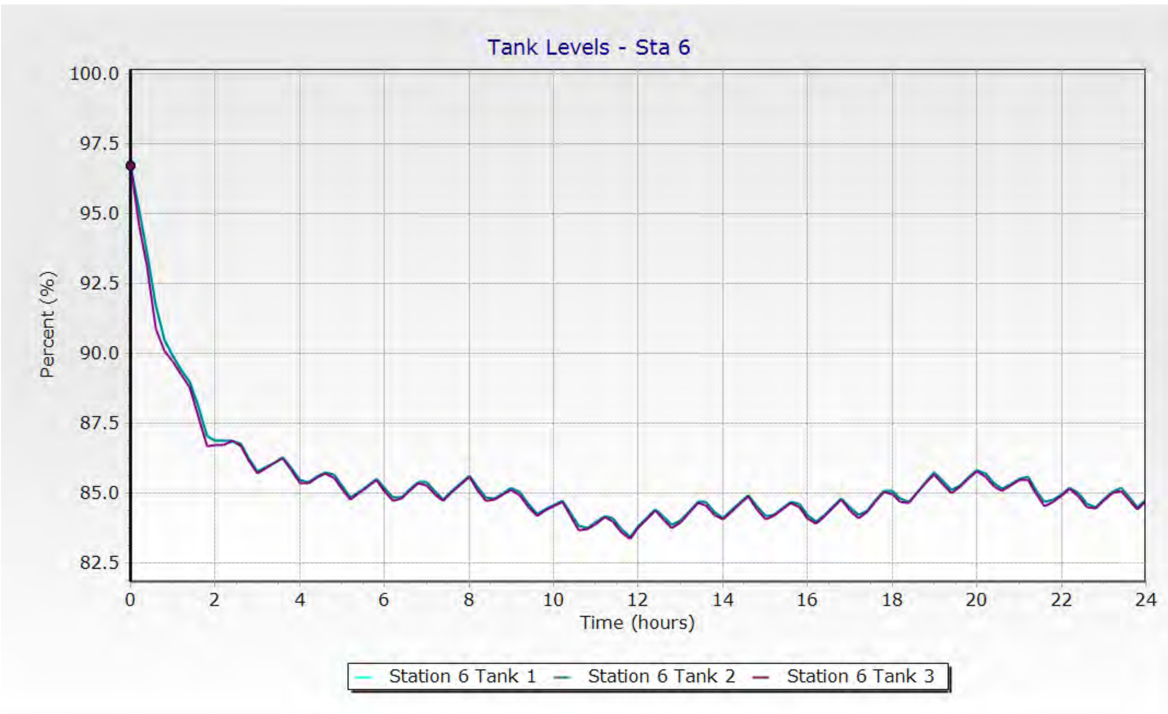

Figure 5.6 Option 1: Station 6 GST levels during 2040 MDD simulation with the south loop closed.

5.2.2 Option 2: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights - Analysis

The south transmission main can be supplemented by Lake Stillhouse WTP. In Option 2 simulations, Lake Stillhouse WTP feeds the Chaparral Road delivery point and the south transmission main by tying directly into the 36-inch main between Nolanville and Harker Heights.

The 2020 MDD simulation with the north transmission main closed shows the new tie-in helps enough to keep water in Station 6 over the 24-hr simulation (and 48-hour simulation); however, with Station 6 falling below 40%, Station 5 struggles to keep water in its tank and is under 25% full at the end of the 24-hour simulation (empties at t = 32 hours). Note that there is no tank level in the Station 6 GSTs that guarantees Killeen Station 5 will have supply. This is because the demand at Station 5 varies from scenario to scenario so the headloss varies as well.

The Option 2 layout can easily accommodate a break in the south transmission main for all demand scenarios by feeding the entire system through the north transmission main.

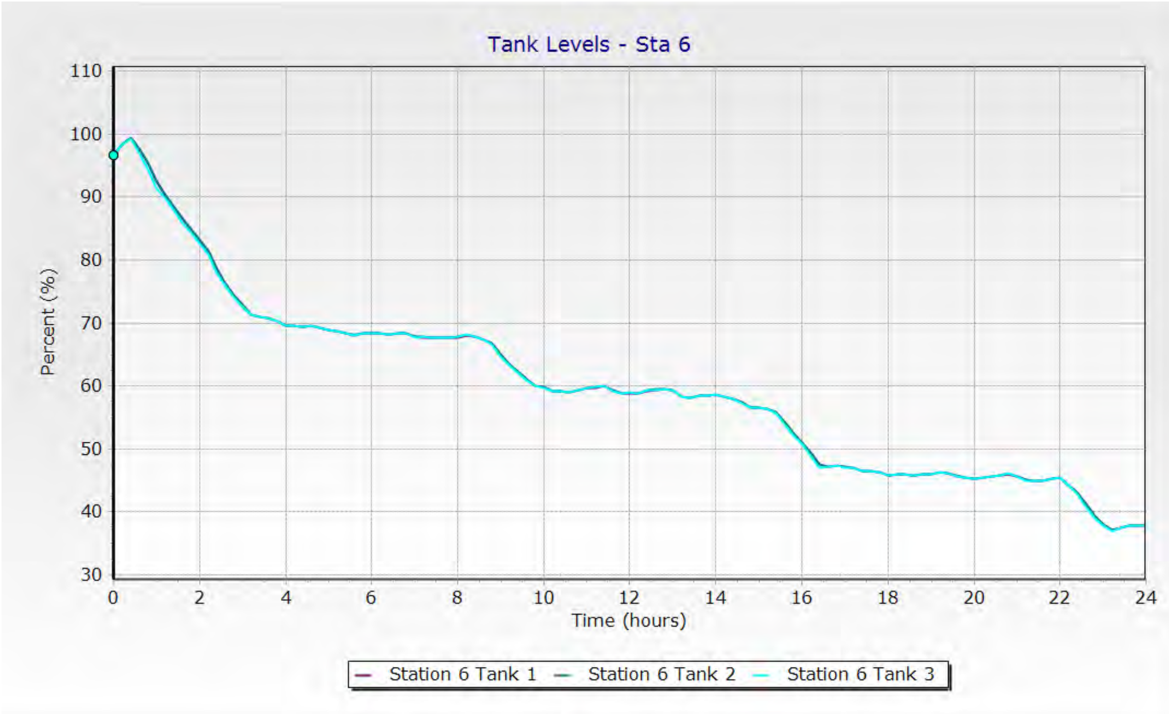

Figure 5.7 Option 2: Station 6 GST levels during 2040 MDD simulation with the north loop closed.

5.2.3 Option 3: Lake Stillhouse WTP Serves Killeen and Ties into Ground Storage Tank Near Harker Heights - Analysis

Option 3 is the same as Option 2 except the pipeline from Lake Stillhouse WTP terminates into a ground storage tank instead of tapping directly into the 36-inch transmission main. The model includes a pressure sustaining valve on the line from Lake Stillhouse WTP to the new GST to ensure the Chaparral Road EST has water in it before the pipeline can supplement the south transmission main.

There is also a pressure sustaining valve upstream of the GST on the feed line from the Lake Belton WTP. During preliminary simulations, it was discovered that the pumps at Lake Belton WTP supplying the south transmission main were insufficient for 2040 max day demands with the north loop closed. For this reason, a "dummy pump" was used to supply as much flow and head as needed from the plant. The dummy pump was modeled as a variable speed pump set to deliver a hydraulic grade of 800' just upstream of the new GST, which is just west of the Nolanville (school) delivery point and adjacent to Warriors Path Road. Pumps on the downstream side of the GST were set off the hydraulic grade in Station 6.

In the 2040 MDD simulation with the north loop closed, nearly all the production from the Lake Stillhouse WTP is consumed at the Chaparral Road delivery point, meaning the Lake Belton WTP is responsible for meeting demands in the existing distribution system. When the north loop is closed, the pumps supplying the south transmission mains (HL-1 through HL-6 and HL-15 and HL-16) are not sufficient to meet 2040 max day demands in the loop, meaning pumping capacity improvements will be necessary. The dummy pump at the plant in the model indicates a required flow of roughly 35,000 gpm (50 MGD) and required pump head of roughly 540'. The required pump head is much higher than the design head of HL-1 through HL-6 (250') because the high flow rates cause high velocities and thus high headloss. The velocities of the 24" and 30" pipelines are between 9.5 and 10.5 feet per second.

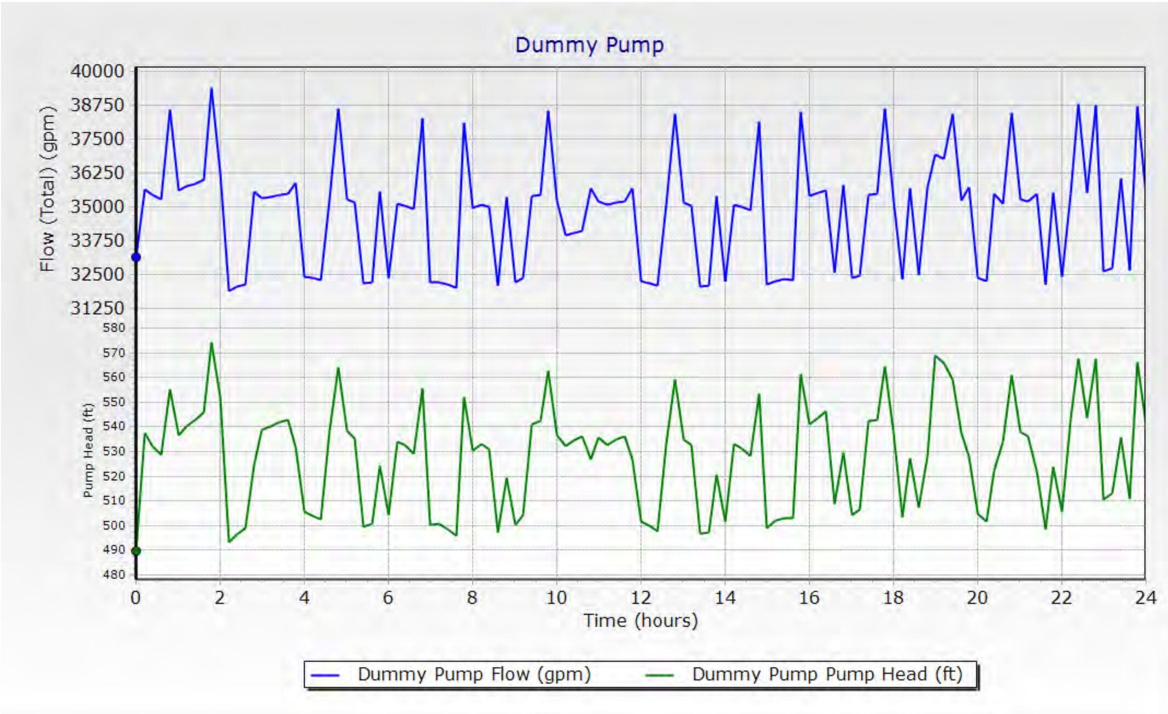

Figure 5.8 Option 3: "Dummy Pump" flow rate and pump head during 2040 MDD simulation with the north loop closed.

The proposed pump station at the new GST can keep up with demand and keep water in the Station 6 GSTs. These pumps put out a total flow around 31,000 gpm (45 MGD) and pump head of 270 feet.

In the case of a break in the south transmission main, the Option 3 layout can easily accommodate all demand scenarios by feeding the entire system through the north transmission main. The GST and pump station would be closed off and bypass back-flow lines would be opened so the east half of system could be fed by gravity from Station 6.

5.2.4 Option 4: Lake Stillhouse WTP Serves Killeen and Ties into 36" South Loop Main Near Harker Heights Inline Pumping Installed Along South Transmission Main - Analysis

Inline pumping is considered without a new ground storage tank and without the pipeline contributing from Lake Stillhouse WTP. Because the south transmission main receives very little to no flow from the Lake Stillhouse main in the Option 3 2040 MDD simulations, the Option 4 pumping rates at the Belton WTP (**Figure 5.9**) are very similar to the corresponding Option 3 pumping rates. The difference is the amplitude of the flow and head rates over time, which is march larger for the Option 4 simulation. The suction side of the inline pump is exposed to large swings in suction pressure when there is no GST. Because the dummy pump at the plant is set to maintain a hydraulic grade of 800' in Nolanville, the speed at which it has to run is erratic.

Alternately, if a single speed pump was modeled at the Belton WTP, the pump flow rate and head would be more constant and the pressures in the south transmission main would be erratic.

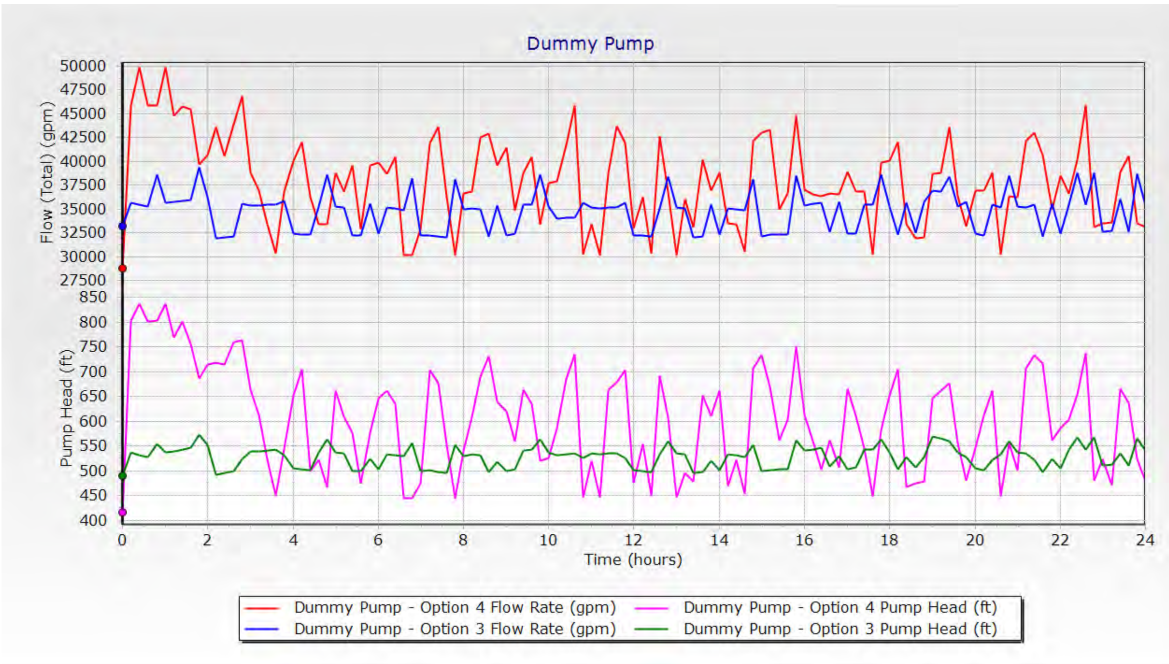

Figure 5.9 Option 3 and Option 4: "Dummy Pump" flow rate and pump head during 2040 MDD simulation with the north loop closed.

5.3 Summary and Conclusions

Below is a discussion about some of the conclusions that can be drawn from the preceding analysis.

5.3.1 Lake Stillhouse Transmission Main

Connecting the Lake Stillhouse transmission main to the south transmission main is not advisable, even if Lake Stillhouse WTP expands capacity. The City of Killeen will likely be able to accommodate all new plant capacity at the south end of their system provided they are timed appropriately. The velocity in the pipeline to Chaparral Road is 3.75 ft/sec when production is at 17 MGD and 7.5 ft/sec when production is at 34 MGD. Both velocities are within industry accepted values for future MDD.

5.3.2 2040 MDD Scenario with North Transmission Main Out of Service

The controlling scenario for planning improvement projects is the 2040 MDD scenario when the north transmission main is out of service. Alternatives presented in Section 5.2 assume all demands would need to be supplied entirely through the south transmission main or supplemented from the Lake Stillhouse WTP. While this ignores the simple solution of constructing a redundant, parallel 48" line along the north transmission main, there are a handful of operational reasons that make this solution undesirable. They are discussed in Section 3.3.

Belton WTP Pumping

Because there is no direct contribution from Lake Stillhouse WTP, the south transmission main will need to be fed entirely by the Lake Belton WTP. Modeling suggests a flow rate of roughly 37,000 gpm (53.3 MGD; Figure 5.8) and a pump head of 540' will be required from the water treatment plant to meet the projected 85.9 MGD for 2040 max day demand (Note: this assumes 17 MGD is provided to Killeen at Chaparral Rd, 10 MGD to Belton and the rest is made up in storage). There is currently not enough pumping capacity capable of pumping to the south transmission main. HL-1 through HL-6 have a firm capacity of 20.8 MGD. HL-15 and HL-16 can provide 28.8 MGD to the south transmission main if they're operated at lower speeds. This leaves a small shortage of approximately 3.7 MGD. Sections 2 and 4 of this report discuss expanding Plant 3 capacity by 25 MGD from 25 to 50 MGD. 9.5 of the 25 MGD will be dedicated to the Belton line (*Treated Water Delivery System Improvements Preliminary Engineering, CDM Smith, 2019*), which has already been included in the model. The additional 15.5 MGD will be sufficient to meet future demand needs.

Note: HL-1 through HL-6 were constructed in the 1950's and 1960's and exceed their expected service life. These pumps should be replaced in-kind to meet future demands.

Transmission Main Velocity and Pressure

The velocity in the south transmission mains would be very high (9.5 to 10.5 ft/sec), meaning the required pump head can be significantly reduced if one or both south transmission mains are upsized. The table below shows how the required pump head can be reduced if the 24-inch main in upsized.

Table 5.2 South Transmission Main Pipe Velocity and Required Pump Head for Various Pipe Sizes

2040 MDD N. Loop Closed	Average Velocity (ft/sec)	Required Pump Head (ft)
Replace 24" with 36"	5.75 – 7.25 ft/sec	340'
Replace 24" with 42"	4.5 – 6 ft/sec	300'
Replace 24" with 48"	3.75 – 5 ft/sec	270'

Pressures in the pipelines

5.3.3 Preferred Alternative

Of the four options considered, Option 3 is the preferred alternative. A transmission main from Lake Stillhouse WTP to the south transmission main is not recommended because development in the south part of Killeen makes it likely that all production at Lake Stillhouse WTP can be received at the Chaparral Road delivery point by the end of the 2040 planning period. A ground storage tank is preferred over inline pumping because it makes operating the high service pumps at the water treatment plant easier.

Two potential locations were considered for a new ground storage tank and pump station: Warriors Path Road (near the Nolanville School delivery point) and Levy Crossing Road (near the Nolanville Wye). The Levy Crossing site is roughly 40' lower and two miles east of the Warriors Path site, and both Nolanville delivery points would be downstream of the new pump station. For these reasons, a larger pump station would be required at the Levy Crossing site compared to the Warriors Path site (**Table 5.3**).

Table 5.3 2040 Pump Station Requirements for Levy Crossing Rd Site and Warrior Path Rd. Site when Pumping to Station 6

Pump Station Location	Elevation (ft)	Pipe Length to Sta. 6 (ft)	Flow (MGD)	TDH (ft)	Power (HP)
Levy Crossing Rd.	680	55,000	53.5	544	6600
Warrior Path Rd.	720	45,000	50.5	413	4700

Another thing to consider while locating the intermediate pump station is the required pumping from Belton WTP. With the increased flow rate required to meet 2040 max day demands, the required TDH from the WTP will be 389 feet if the pump station is located at Warrior Path Road and 289 feet if the pump station is located at Levy Crossing Road assuming no pipeline improvements are made.

Table 5.3 assumes the proposed intermediate pump station/ground storage tank must pump all the way to Station 6. Regardless of the pump station location, the TDH required is very high. A possible solution may be constructing a second intermediate ground storage tank/pump station facility at Killeen Station 3. With the City of Killeen expanding south and the Lake Stillhouse WTP providing more water to the Lake Chaparral delivery point, the City of Killen may have a reduced need for large delivery points on the south transmission main. Killeen Station 3 is roughly 50' lower and 19,000 feet east from Station 6. If the District can utilize the existing ground storage tank at Killeen Station 3, then less head would be required from the intermediate pump station at Warrior Path or Levy Crossing.

Pressures in the existing transmission mains are another consideration. If the high service pump station at Belton WTP is required to pump to Warrior Path Rd. with the existing transmission mains, extremely high pressure (250+ psi) can be expected at the Elliot's Pasture 439 delivery point. Extremely large pressures may be difficult not only for the pipelines themselves which were constructed in the 1950s, but for the valve fixtures at each delivery point. If the intermediate ground storage tank is moved to Levy Crossing Rd., pressures can be reduced. Table 5.2 shows replacing the 24" with a larger pipe is required to keep velocities within a reasonable range. For the 2040 MDD scenario, replacing the 24" with a 36" reduces velocities to roughly 5.75-7.25 fps and pressure at Elliot's Pasture to under 70 psi.

Assuming Killeen Station 3 can be utilized for the District's use, the required pump head at the intermediate pump station at Levy Crossing can be significantly reduced from 544 ft to 382 ft. Because pressure in the transmission main would still be very high (165 psi), increasing the pipeline capacity is recommended. If the existing 18" transmission main is replaced with a 36" main, the required pumping head at Levy Crossing would only be 230 ft and maximum pressures would be kept under 100 psi.

Section 6

Capital Improvement Projects

The overall purpose of this master plan is to determine the adequacy of the existing water treatment and distribution system under both existing and future demand conditions and to provide a strategy for implementing necessary improvements to keep up with demands while maintaining desired levels of service. Existing and future condition models were developed that simulate the location and magnitude of water demands. Based on the results of these models, existing and predicted future system deficiencies were identified and projects to address these deficiencies were developed. Finally, system improvements were sized and divided into individual projects to develop cost estimates and an implementation schedule for the short-term (2030), and long-term (2040) CIP.

6.1 Cost Estimating

Total cost estimates are provided for each project presented in this section. All costs are presented in current (January 2021) dollars and represent planning level (+50%/-30%) costs. For some projects, particularly operations-related projects, a range of costs may be presented to reflect uncertainty of construction conditions. Cost details are provided for most projects in Appendix B. Some projects that do not present details are based on lump sum estimates.

6.2 Proposed Water Treatment and Hydraulic Improvements

Water treatment and hydraulic improvements were assessed based on the evaluations presented in Sections 4 and 5 respectively.

6.2.1 Raw Water Delivery and Treatment

The Lake Belton WTP and associated raw water delivery facilities were evaluated to determine upgrades necessary to maintain the current 90-MGD capacity. These were divided into high-, medium-, and low-criticality upgrades and improvements. In addition, the Lake Belton WTP will need to be expanded to meet future water demands for the District. Some of the upgrades should be incorporated as part of the plant expansion projects, and not as stand-alone projects.

Recommended capital improvements are listed in **Table 6.1** under four categories:

- WTP-1 – High Criticality Plant Upgrades. These projects include: 1) providing improved air flow control for the Plants No. 1 and No. 2 air scour blowers; 2) providing a corrosion evaluation for the Plant No. 4 filter gallery piping, and subsequent improvements; 3) installing chlorine safety alarms and equipment in some areas. Although replacing the Plant No. 3 reactor clarifiers is considered high criticality, it was given its own CIP number WTP-4 and will be part of a two phase plant expansion program.

- WTP-2 – Medium Criticality Plant Upgrades. These projects include: 1) replacing the Plant No. 1 flocculation basin baffles; 2) implementing a filter gallery pipe coating program; 3) replacement of chemical storage tanks; and 4) replacing existing sludge transfer pumps.

Although improvements to the raw water pipe header is a medium-criticality upgrade, it is recommended that this be performed as a part of the Plant Expansion project and is not listed as a recommended CIP project.

- WTP-3 – Low Criticality Plant Upgrades. These projects include: 1) replacement of the Plants No. 1, No. 2, and No. 4 rapid mixers and 2) replacement of the clarifier mechanisms for the Plants No. 1 and No. 2 sedimentation basins and the launders for Plant No. 1.
- WTP-4 – Plant Expansion – Phase 1. This project includes demolishing the existing 25-MGD Plant No. 3 clarifiers and constructing two new flocculation/sedimentation basins rated for a capacity of 25 MGD. The project will also include chemical facilities improvements, new administration and maintenance buildings, site paving improvements, and other associated electrical and instrumentation improvements.
- WTP-5 – Plant Expansion – Phase 2. This project includes increasing the WTP capacity from 90 MGD to 115 MGD by constructing two additional new Plant No. 3 flocculation/sedimentation basins to increase the Plant No. 3 capacity to 50 MGD. The project will also include expansion of the raw water delivery facilities, addition of a 4.0 MG clearwell, expansion of the high service pumping capacity, expanded chemical facilities, site paving improvements, and other associated electrical and instrumentation improvements.

6.2.2 Storage

Two intermediate ground storage tanks, a 5.0 MG GST at Levy Crossing Road and a 3.0 MG GST at Killeen Station 3, should be constructed. Purchasing the existing GST at Killeen Station 3 may be an option for the District if the City of Killeen increases their take from the Chaparral Road delivery point and determines less demand is needed from the Station 3 delivery point. GSTs were sized to provide at least 2 hours of storage during the 2040 MDD scenario.

A 5.0 MG GST should be constructed adjacent to the existing surge tanks. As demand increases over time, water levels in the surge tanks will become increasingly difficult to manage at their relatively small size (2 X 0.5 MG).

6.2.3 Pumping

Respective pump stations should accompany the new 5.0 MG and 3.0 MG GSTs. A larger pump station would be required at the Levy Crossing site (2800 HP) compared to the Killeen Station 3 site (900) because it would serve more customers and would sit lower and more upstream.

6.2.4 Transmission

CDM Smith recommends replacing the 24” south transmission main with a 36” pipe from Belton WTP to the Nolanville Wye by 2040. Peak 2040 velocities will exceed 10 ft/sec in the 24” and 30” mains if pipe sizes aren’t increased. The length of this pipe is roughly 34,300 feet. Also recommended is replacing the 18” transmission main from the Nolanville Wye to Killeen Station 3 with a new 36” pipe. This upgrade reduces the required pump head at the proposed Levy Crossing pump station and reduces pressures in the transmission main. Replacing the 18” transmission main may not be feasible if development has encroached on the District’s easement.

In this case, capping the 18" line and constructing a new 36" transmission main along the existing 36" transmission main is recommended.

6.3 CIP Summary

Table 6.1 provides a listing of all recommended projects. Project sheets with cost details are provided for most projects in **Appendix B**.

Table 6.1 Recommended Capital Improvements Projects

Project Number	Description	Completion Year	Project Cost Estimate	Notes/Assumptions
Raw Water Delivery and Treatment Projects				
WTP-CIP1	**Existing Plant Upgrades – High Criticality**	**2023**	**$0.62M**	
	Provide flow meter and control valve for the Plant 1/Plant 2 air scour blowers	2023	$0.27M	
	Conduct corrosion evaluation of filter gallery for Plant No. 4 and make necessary modifications	2023	$0.20M	Actual cost will be dependent on findings from corrosion evaluation
	Implement chlorine leak detection, monitoring and alarms where not provided.	2023	$0.15M	
WTP-CIP2	**Existing Plant Upgrades – Medium Criticality**	**2025**	**$31.3M**	
	Replace redwood baffles for Plant No. 1	2025	$0.44M	
	Implement filter pipe gallery pipe coating plan for all plants	2025	$0.15M	Actual cost will be dependent on coating requirements
	Improvements to pump header to improve operation and flexibility	2025	$0.30M	Actual cost will be dependent on further study.
	Evaluate and replace bulk chemical storage tanks in poor condition	2025	$0.49M	
	Replace sludge transfer pumps with submersible sludge pumps	2025	$0.07M	
	Construct a new 4.0 MG clearwell	2025	$6.4M	Could be implemented with WTP-CIP4 or WTP-CIP5
	Add washwater recover facilities	2025	$17.9M	Could be implemented with WTP-CIP4
	Add backup power generators	2025	$5.8M	Could be implemented with WTP-CIP4
WTP-CIP3	**Existing Plant Upgrades – Low Criticality**	**2030**	**$2.25M**	
	Replace rapid mixers for Plants No. 1 and No.2	2030	$0.38M	
	Replace clarifier mechanisms for Plants No. 1 and No. 2 and launders for Plant No. 1	2030	$1.87M	
WTP-CIP4	**Plant Expansion – Phase 1 (Replace Plant 3 Clarifiers with new Floc/Sed Basins)**	**2026**	**$28.5M**	

Project Number	Description	Completion Year	Project Cost Estimate	Notes/Assumptions
WTP-CIP5	**Plant Expansion – Phase 2 (Expand Plant 3 by 25 MGD with new Floc/Sed Basins)**	**2035**	**$88.7M**	
Tank/Pump Projects				
DIST-CIP1A	**Construct two ground storage tank/pump station facilities; one near the Nolanville Wye and another near Killeen Sta. 3 (Note: Accompanies TR-1)**	**2030**	**$32 M**	
Nolanville Wye GST	Construct 5.0 MG GST near Nolanville Wye (Levy Crossing Road)	2030	$5.9 M	
Killeen Station 3 GST	Construct 3.0 MG GST near Killeen Station 3	2030	$4.3M	May be able to utilize existing Killeen GSTs if the city elects to take more water from other delivery points
PS - Nolanville Wye	Install 53.5 MGD pump station adjacent to new 5.0 MGD GST at Levy Crossing Road site	2030	$15.3	
PS - Killeen Sta. 3	Install 32.5 MGD pump station adjacent to new 3.0 MGD GST at Killeen Sta. 3	2030	$6.5M	May be able to utilize abandoned pump station at Killeen Sta. 3
DIST-CIP2A	**Construct new ground storage tank at existing surge tank location**	**2030**	**$5.9 M**	
	Construct 5.0 MG GST at surge tank location	2030	$5.9 M	
Transmission Projects				
DIST-CIP1B	**Replace South Transmission Main**	**2040**	**$38.1 M**	
	Replace existing 24” south transmission main with 36” line from Belton WTP to the Nolanville Wye	2040	$18.6 M	
	Replace existing 18” south transmission main with 36” line from Nolanville Wye to Killleen Sta. 3	2040	$19.5 M	
DIST-CIP2B (ALTERNATE)	**Parallel North Transmission Main**	**2040**	**$54.7 M**	
	Parallel North Transmission Main from Belton WTP to surge tanks (48”)	2040	$32.2 M	
	Parallel North Transmission Main from surge tanks to Killeen Sta. 6 (48” and 54”)	2040	$22.5 M	

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Appendix A

Demand Projection Curves: Max Day and Average Day

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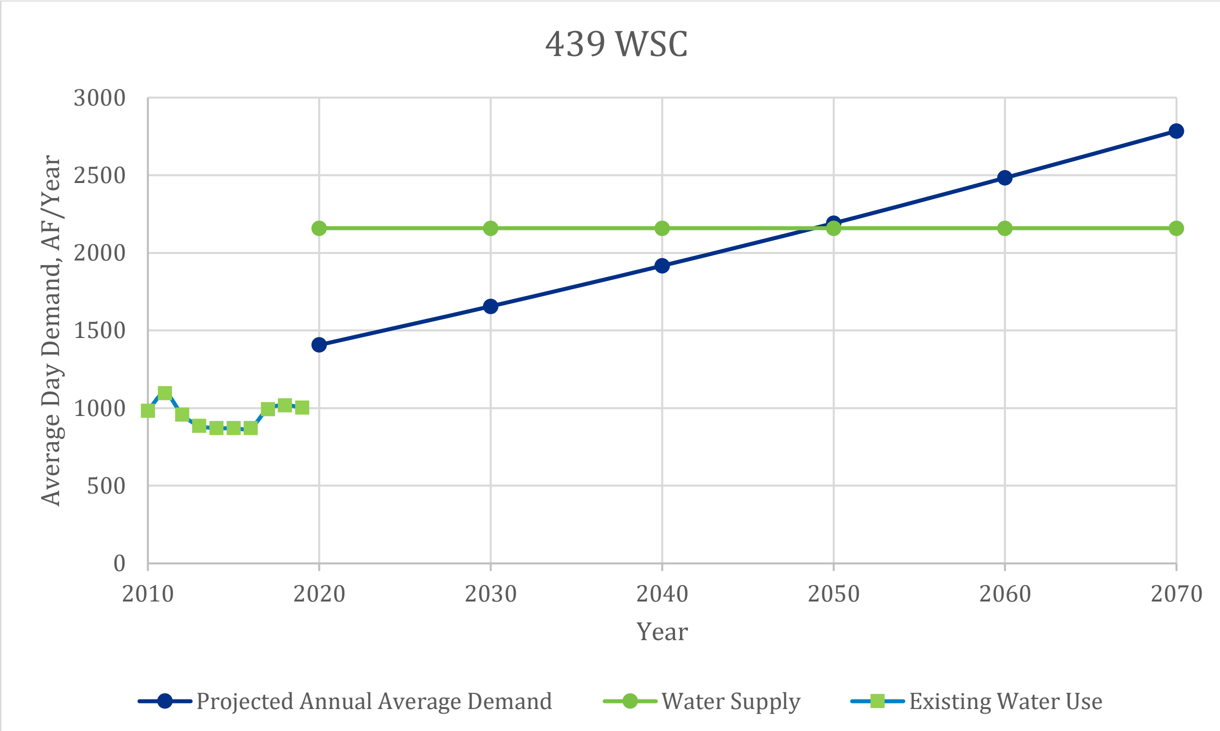
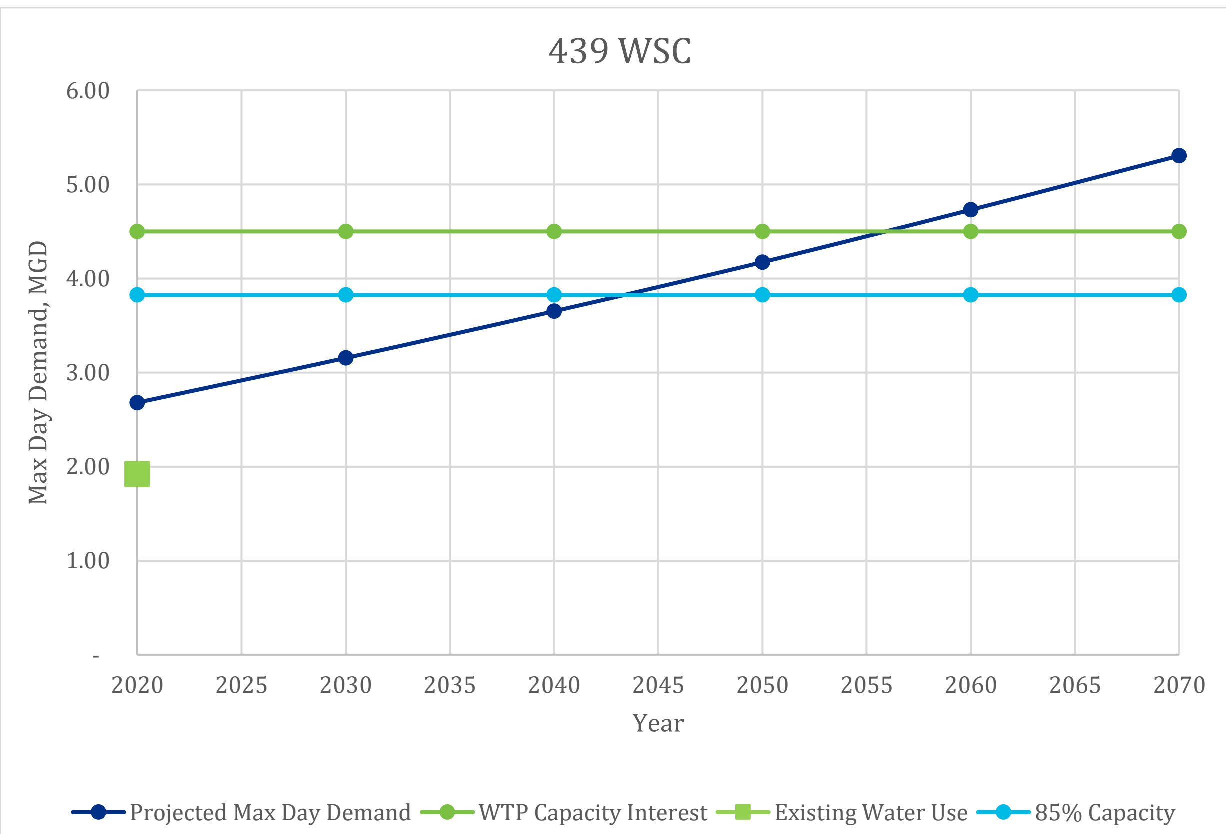
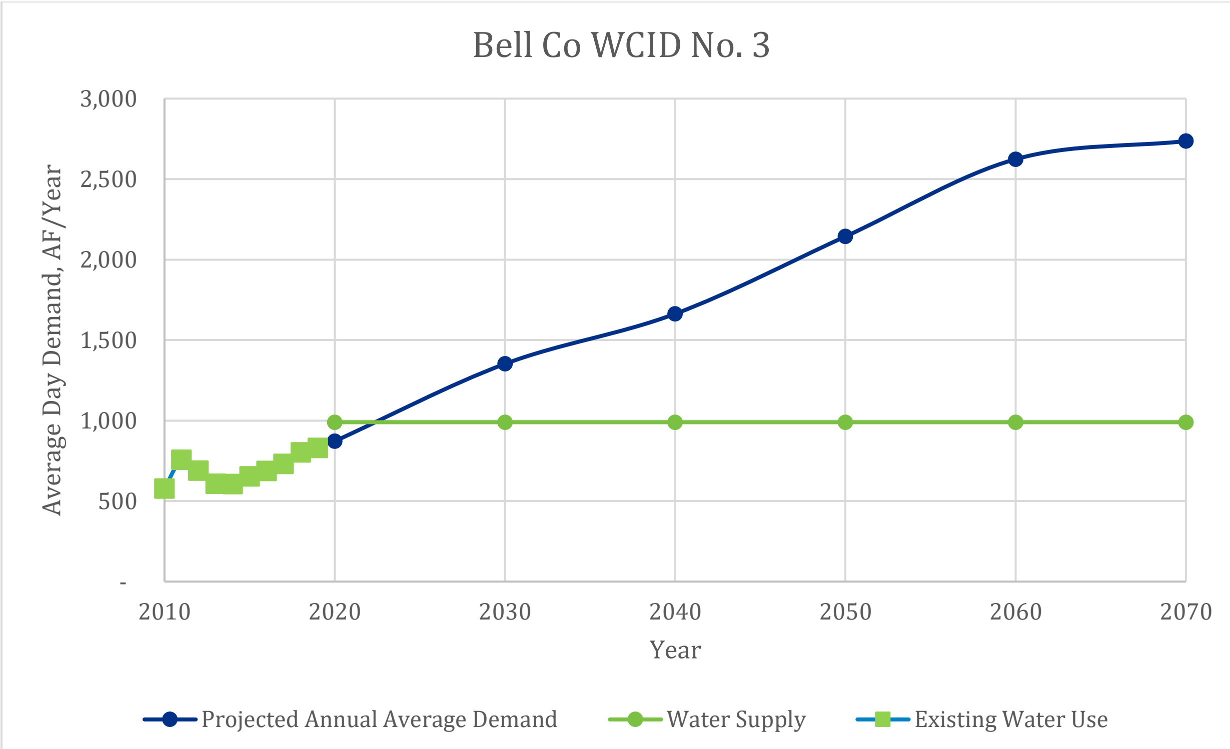
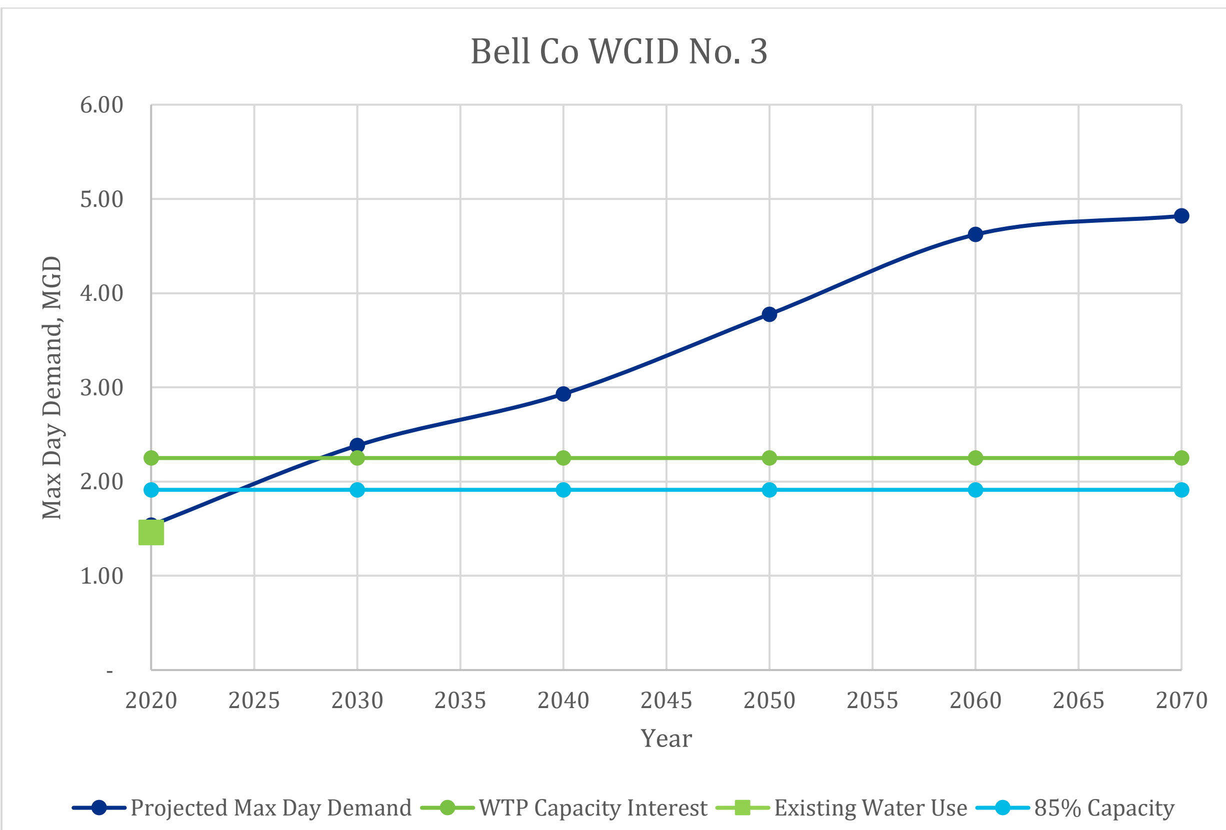
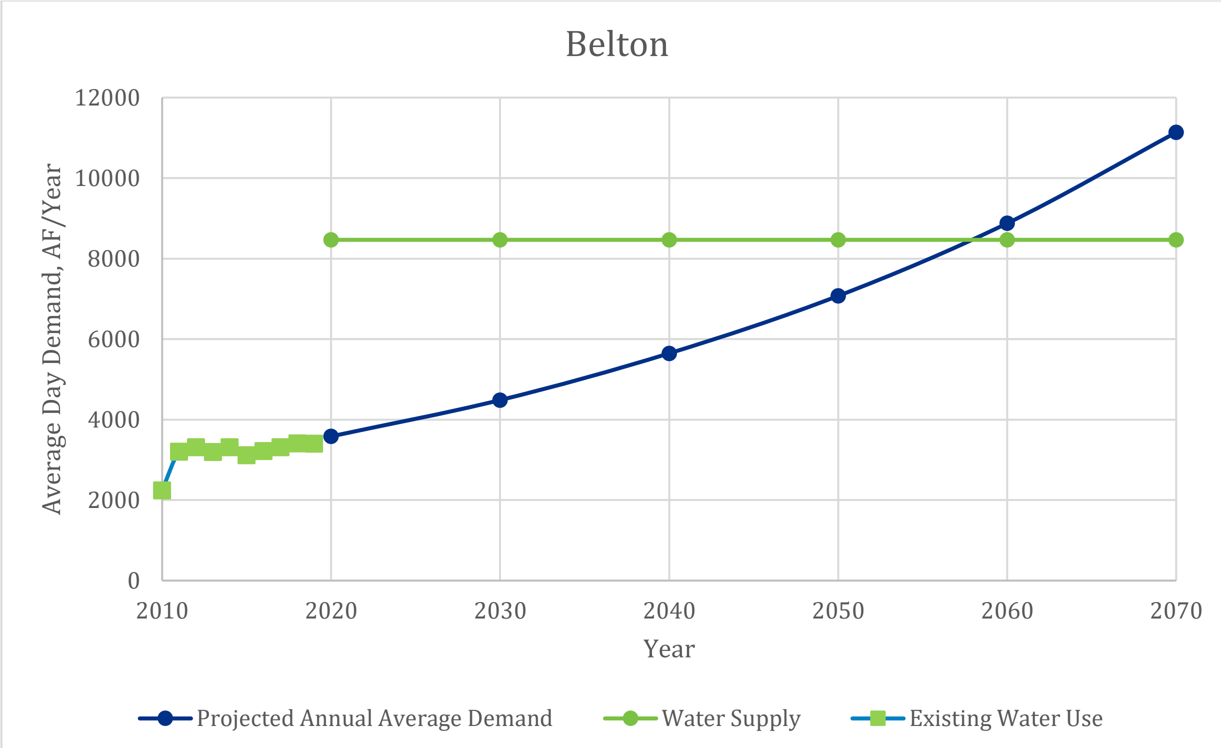
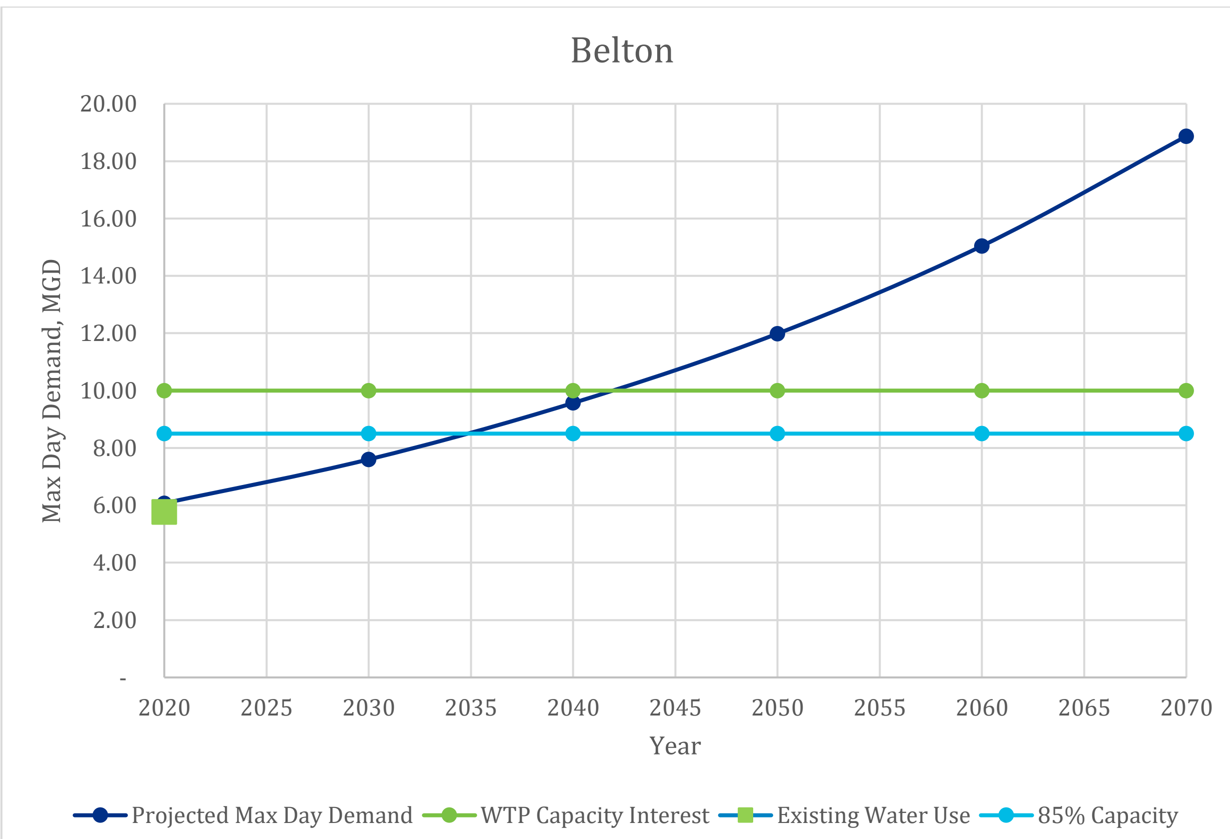

439 WSC
Average Day Demand, AF/Year
3000
2500
2000
1500
1000
500
0
2010
2020
2030
2040
2050
2060
2070
Year
Projected Annual Average Demand
Water Supply
Existing Water Use

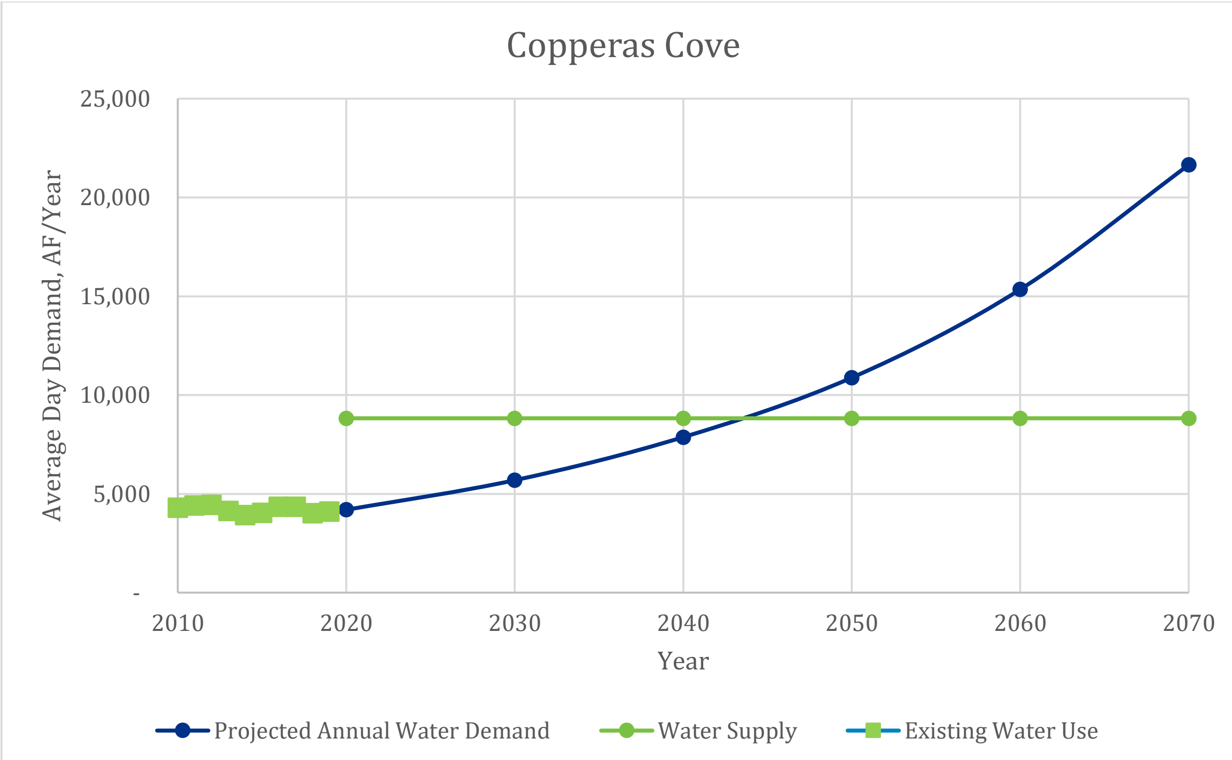

439 WSC
Max Day Demand, MGD
6.00
5.00
4.00
3.00
2.00
1.00
-
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Projected Max Day Demand
WTP Capacity Interest
Existing Water Use
85% Capacity

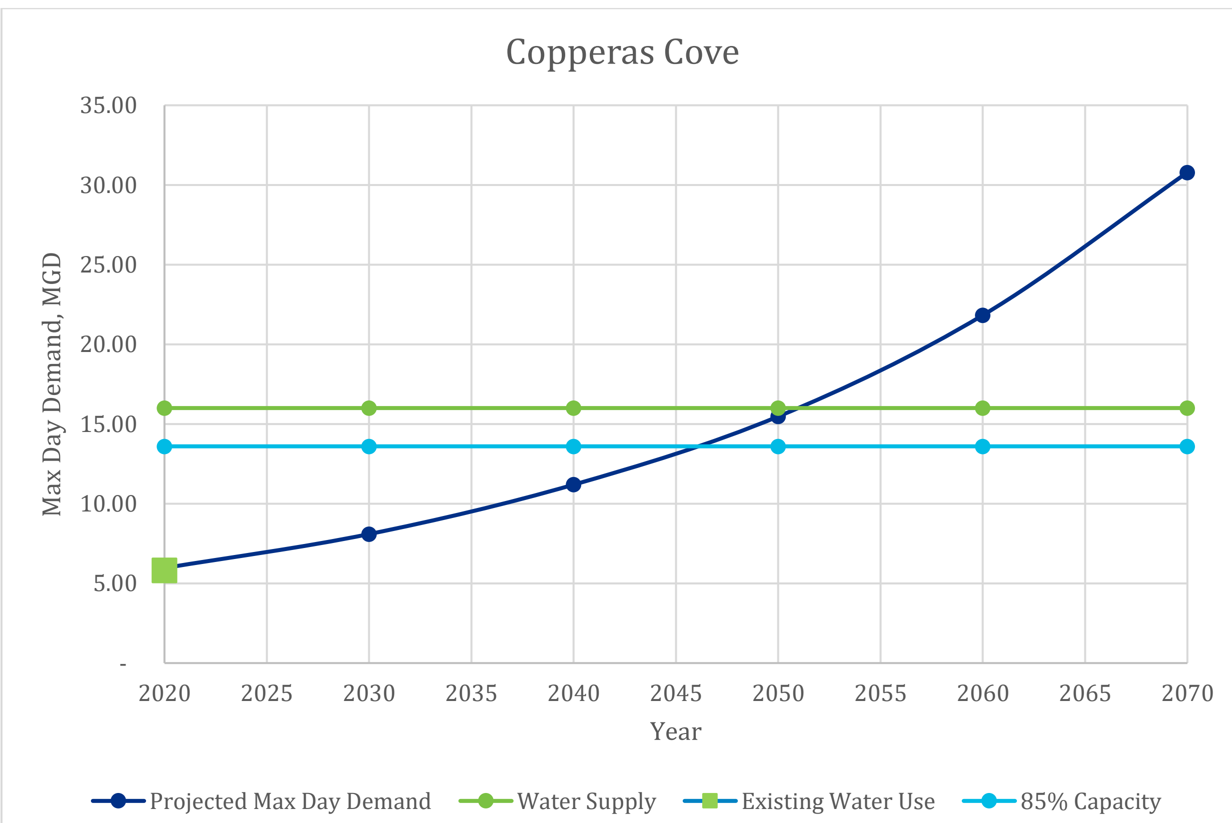

Bell Co WCID No. 3
3,000
2,500
2,000
1,500
1,000
500
-
Average Day Demand, AF/Year
2010
2020
2030
2040
2050
2060
2070
Year
Projected Annual Average Demand
Water Supply
Existing Water Use

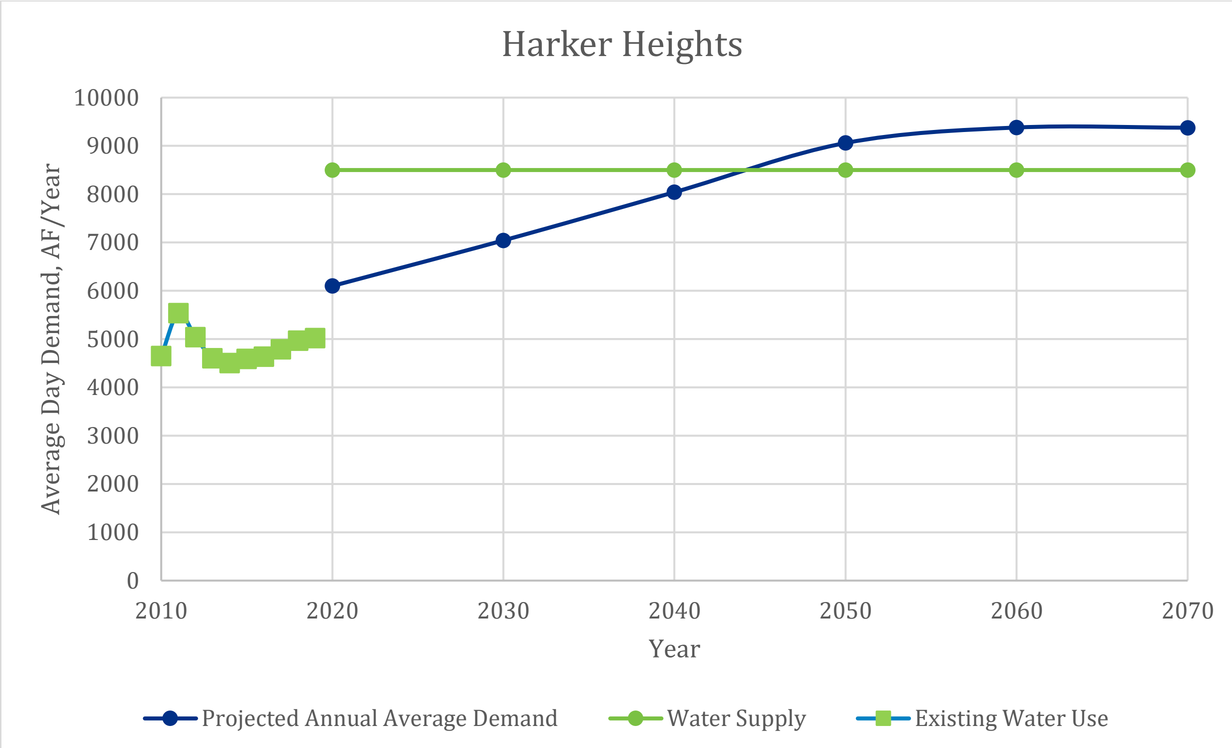

Bell Co WCID No. 3
6.00
5.00
4.00
3.00
2.00
1.00
-
Max Day Demand, MGD
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Projected Max Day Demand
WTP Capacity Interest
Existing Water Use
85% Capacity

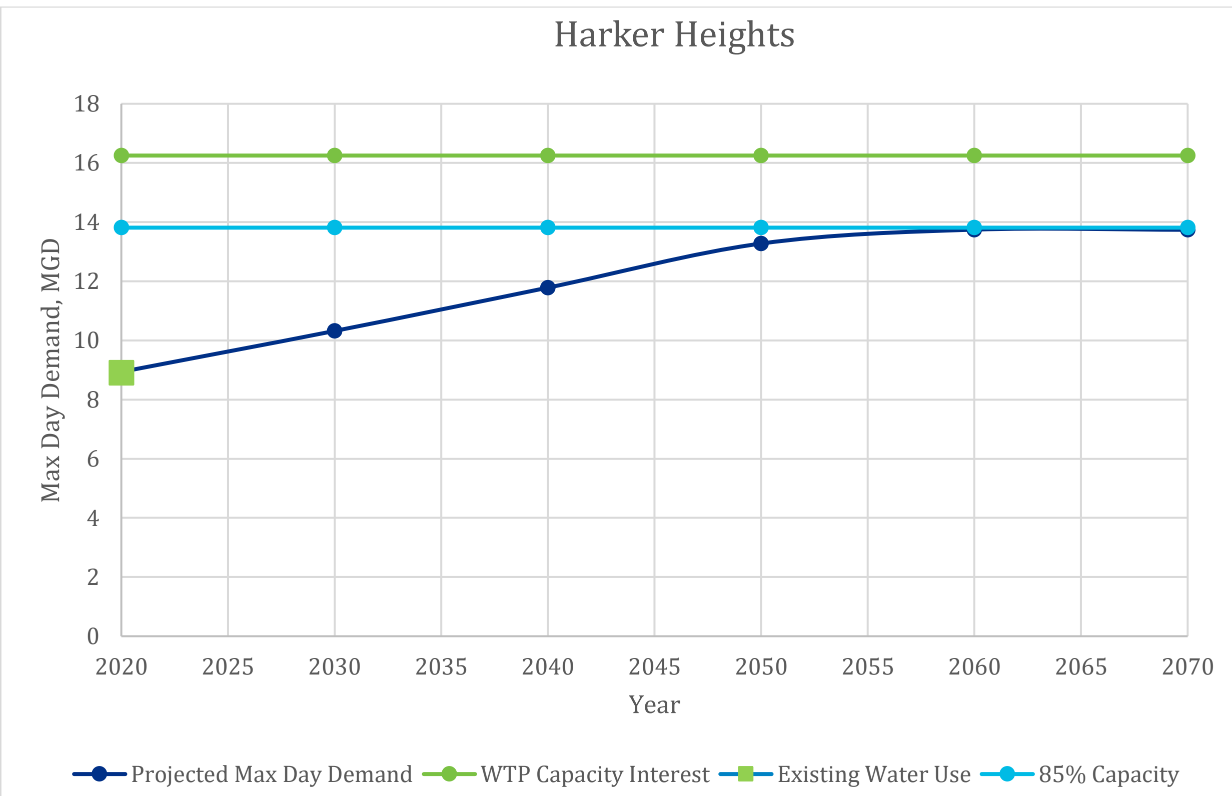

Belton
12000
10000
8000
6000
4000
2000
0
Average Day Demand, AF/Year
2010
2020
2030
2040
2050
2060
2070
Year
Projected Annual Average Demand
Water Supply
Existing Water Use

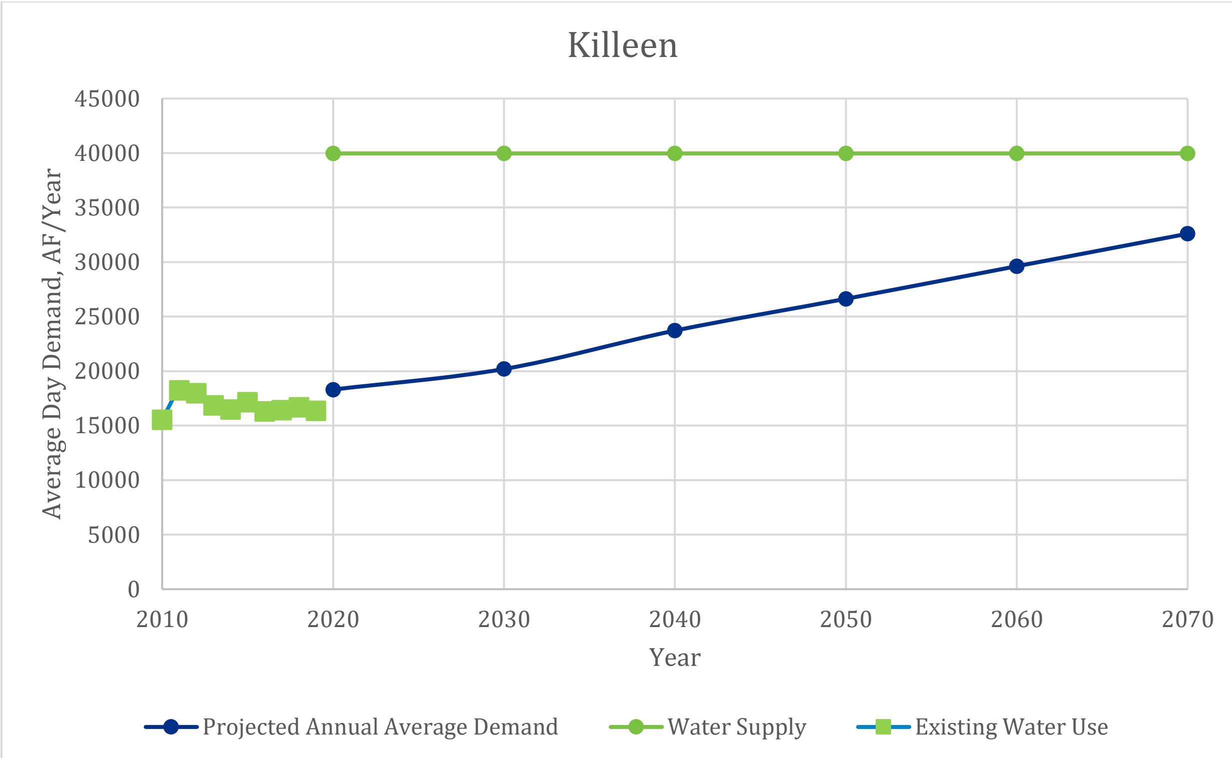

Belton
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
-
Max Day Demand, MGD
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Projected Max Day Demand
WTP Capacity Interest
Existing Water Use
85% Capacity

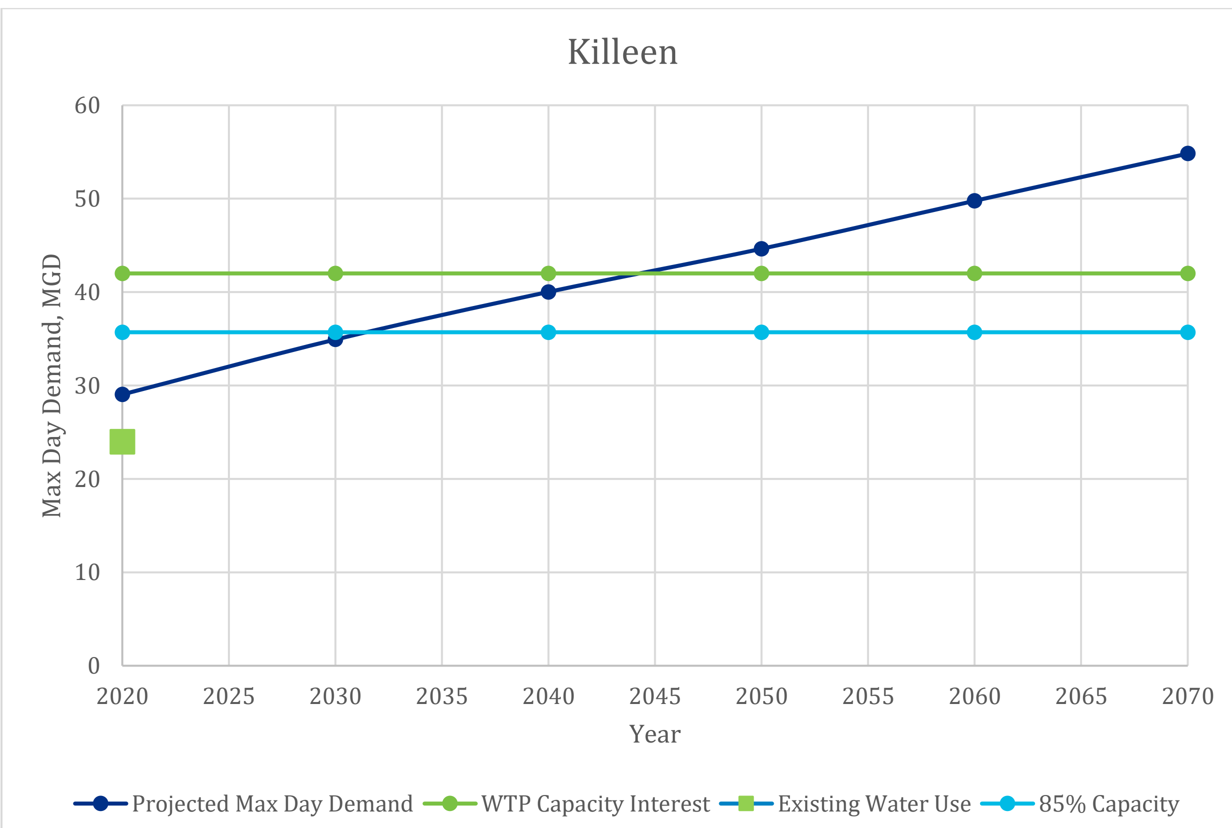

Copperas Cove
Average Day Demand, AF/Year
25,000
20,000
15,000
10,000
5,000
-
2010
2020
2030
2040
2050
2060
2070
Year
Projected Annual Water Demand
Water Supply
Existing Water Use


Copperas Cove
Max Day Demand, MGD
35.00
30.00
25.00
20.00
15.00
10.00
5.00
-
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Projected Max Day Demand
Water Supply
Existing Water Use
85% Capacity


Harker Heights
Average Day Demand, AF/Year
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2010
2020
2030
2040
2050
2060
2070
Year
Projected Annual Average Demand
Water Supply
Existing Water Use


Harker Heights
Max Day Demand, MGD
18
16
14
12
10
8
6
4
2
0
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Projected Max Day Demand
WTP Capacity Interest
Existing Water Use
85% Capacity


Killeen
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Average Day Demand, AF/Year
2010
2020
2030
2040
2050
2060
2070
Year
Projected Annual Average Demand
Water Supply
Existing Water Use


Killeen
60
50
40
30
20
10
0
Max Day Demand, MGD
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Projected Max Day Demand
WTP Capacity Interest
Existing Water Use
85% Capacity

Appendix B

CIP Cost Estimates - Transmission Main/PS

Bell County, TX, WCID 1
DIST CIP 1B
36" Waterline from Belton WTP to Nolanville Wye
Budget Information
Prepared: March 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Right of Way Prep	34,300	LF	$ 3.00	$ 102,900
Erosion Control	34,300	LF	$ 4.00	$ 137,200
Trench Safety	34,300	LF	$ 4.00	$ 137,200
36-inch Water Line	33,050	LF	$ 288.00	$ 9,518,400
36-inch Bored Highway/River Crossing	1,250	LF	$ 792.00	$ 990,000
Pressure/Flow Control/Metering Vault	-	EA	$ 75,000	$ -
Fire Hydrants	-	EA	$ 4,000	$ -
Gate Valves	2	EA	$ 1,750	$ 3,500
Dewatering	34,300	LF	$ 3.00	$ 102,900
Revegetation	34,300	LF	$ 6.00	$ 205,800
Subtotal				***$ 11,197,900***
Mobilization/Demobilization	5%			$ 560,000
Contractor's Overhead and Profit	10%			$ 1,119,750
Contingency	20%			$ 2,239,500
Construction Subtotal				***$ 15,117,150***
Professional Services	15%			$ 2,267,500
Bonding and Insurance	5%			$ 755,750
Easement Acquisition	23.623	acres	$ 20,000	$ 472,452
Project Total				***$ 18,612,852***

Bell County, TX, WCID 1
DIST CIP 1B
36" Waterline from Nolanville Wye to Killeen Sta. 3
Budget Information

Prepared: March 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Right of Way Prep	36,000	LF	$ 3.00	$ 108,000
Erosion Control	36,000	LF	$ 4.00	$ 144,000
Trench Safety	36,000	LF	$ 4.00	$ 144,000
36-inch Water Line	34,750	LF	$ 288.00	$ 10,008,000
36-inch Bored Highway/River Crossing	1,250	LF	$ 792.00	$ 990,000
Pressure/Flow Control/Metering Vault	-	EA	$ 75,000	$ -
Fire Hydrants	-	EA	$ 4,000	$ -
Gate Valves	2	EA	$ 1,750	$ 3,500
Dewatering	36,000	LF	$ 3.00	$ 108,000
Revegetation	36,000	LF	$ 6.00	$ 216,000
Subtotal				***$ 11,721,500***
Mobilization/Demobilization	5%			$ 586,000
Contractor's Overhead and Profit	10%			$ 1,172,250
Contingency	20%			$ 2,344,300
Construction Subtotal				***$ 15,824,050***
Professional Services	15%			$ 2,373,500
Bonding and Insurance	5%			$ 791,250
Easement Acquisition	24.793	acres	$ 20,000	$ 495,868
Project Total				***$ 19,484,668***

Bell County, TX, WCID 1
DIST CIP 2B
48" Waterline from Belton WTP to Surge Tanks
Budget Information
Prepared: March 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Right of Way Prep	48,000	LF	$ 3.00	$ 144,000
Erosion Control	48,000	LF	$ 4.00	$ 192,000
Trench Safety	48,000	LF	$ 4.00	$ 192,000
48-inch Water Line	47,850	LF	$ 384.00	$ 18,374,400
48-inch Bored Highway/River Crossing	150	LF	$ 1,056.00	$ 158,400
Pressure/Flow Control/Metering Vault	-	EA	$ 75,000	$ -
Fire Hydrants	-	EA	$ 4,000	$ -
Gate Valves	2	EA	$ 1,750	$ 3,500
Dewatering	48,000	LF	$ 3.00	$ 144,000
Revegetation	48,000	LF	$ 6.00	$ 288,000
Subtotal				***$ 19,496,300***
Mobilization/Demobilization	5%			$ 974,750
Contractor's Overhead and Profit	10%			$ 1,949,750
Contingency	20%			$ 3,899,250
Construction Subtotal				***$ 26,320,050***
Professional Services	15%			$ 3,948,000
Bonding and Insurance	5%			$ 1,316,000
Easement Acquisition	33.058	acres	$ 20,000	$ 661,157
Project Total				***$ 32,245,207***

Bell County, TX, WCID 1
DIST CIP 2B
54"/48" Waterline from Surge Tanks to Sta. 6
Budget Information
Prepared: March 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Right of Way Prep	30,470	LF	$ 3.00	$ 91,410
Erosion Control	30,470	LF	$ 4.00	$ 121,880
Trench Safety	30,470	LF	$ 4.00	$ 121,880
48-inch Water Line	6,766	LF	$ 384.00	$ 2,598,144
54-inch Water Line	23,704	LF	$ 432.00	$ 10,240,128
54-inch Bored Highway/River Crossing	150	LF	$ 1,188.00	$ 178,200
Pressure/Flow Control/Metering Vault	-	EA	$ 75,000	$ -
Fire Hydrants	-	EA	$ 4,000	$ -
Gate Valves	2	EA	$ 1,750	$ 3,500
Dewatering	30,470	LF	$ 3.00	$ 91,410
Revegetation	30,470	LF	$ 6.00	$ 182,820
Subtotal				***$ 13,629,372***
Mobilization/Demobilization	5%			$ 681,500
Contractor's Overhead and Profit	10%			$ 1,363,000
Contingency	20%			$ 2,725,750
Construction Subtotal				***$ 18,399,622***
Professional Services	15%			$ 2,760,000
Bonding and Insurance	5%			$ 920,000
Easement Acquisition	20.985	acres	$ 20,000	$ 419,697
Project Total				***$ 22,499,319***

Bell County (WCID 1), Texas
Nolanville Wye / Killeen Station #3 (DIST CIP 1A)
Estimated Pump Station Costs
Budget Information
Prepared: March 2021

Description	Flow (mgd)	TDH (ft)	Power (HP)	Construction and Capital Cost Total	Construction	Pump Station	Contingency	Design
Levy Crossing Rd to Killeen Sta 3	53.5		3800	$15,250,000	$13,500,000	$10,800,000	$2,700,000	$1,750,000
Replace 18" with 24"		316		$285,047	>> per mgd			
Killeen Sta 3 to Sta. 6	32.5		900	$6,500,000	$5,750,000	$4,600,000	$1,150,000	$750,000
Leave 18" and 36" as-is		126		$199,877	>> per mgd			

Note: Equivalent Diameter of 36" and 18" parallel pipeline is roughly 40.25"

Note: Equivalent Diameter of 30" and 24" parallel pipeline is roughly 38.42"

Bell County (WCID 1), Texas
Harker Heights/Nolanville (DIST CIP 1A & 2A)
Ground Storage Tank
Budget Information
Prepared: March 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
5.0 MG GST	1	EA	$ 3,000,000	$ 3,000,000
Site Preparation (Clearing, Levelling, Fill…)	1	EA	$ 154,000	$ 154,000
Site Improvements (Stormwater, Security, etc.)	1	EA	$ 191,000	$ 191,000
Right of Way Prep	200	LF	$ 3.00	$ 600
Erosion Control	200	LF	$ 4.00	$ 800
Trench Safety	200	LF	$ 4.00	$ 800
18-inch Water Line	200	LF	$ 160.00	$ 32,000
36-inch Water Line	200	LF	$ 288.00	$ 57,600
Pressure/Flow Control/Metering Vault	1	EA	$ 75,000	$ 75,000
Gate Valves	3	EA	$ 1,750	$ 5,250
Dewatering	200	LF	$ 3.00	$ 600
Revegetation	200	LF	$ 6.00	$ 1,200
Subtotal				***$ 3,518,850***
Mobilization/Demobilization (5%)				$ 176,000
Contractor's Overhead and Profit (10%)				$ 352,000
Contingency (20%)				$ 703,750
Construction Subtotal				***$ 4,750,600***
Professional Services (15%)				$ 712,500
Bonding and Insurance (5%)				$ 237,500
Land Acquisition	2.0	AC	$ 40,000	$ 80,000
Easement Acquisition	6.0	AC	$ 20,000	$ 120,000
Project Total				***$ 5,900,600***

Bell County (WCID 1), Texas
Killeen Station 3 (DIST CIP 1A)
Ground Storage Tank
Budget Information
Prepared: March 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
3.0 MG GST	1	EA	$ 2,000,000	$ 2,000,000
Site Preparation (Clearing, Levelling, Fill…)	1	EA	$ 154,000	$ 154,000
Site Improvements (Stormwater, Security, etc.)	1	EA	$ 191,000	$ 191,000
Right of Way Prep	200	LF	$ 3.00	$ 600
Erosion Control	200	LF	$ 4.00	$ 800
Trench Safety	200	LF	$ 4.00	$ 800
18-inch Water Line	200	LF	$ 160.00	$ 32,000
36-inch Water Line	200	LF	$ 288.00	$ 57,600
Pressure/Flow Control/Metering Vault	1	EA	$ 75,000	$ 75,000
Gate Valves	3	EA	$ 1,750	$ 5,250
Dewatering	200	LF	$ 3.00	$ 600
Revegetation	200	LF	$ 6.00	$ 1,200
Subtotal				***$ 2,518,850***
Mobilization/Demobilization (5%)				$ 126,000
Contractor's Overhead and Profit (10%)				$ 252,000
Contingency (20%)				$ 503,750
Construction Subtotal				***$ 3,400,600***
Professional Services (15%)				$ 510,000
Bonding and Insurance (5%)				$ 170,000
Land Acquisition	2.0	AC	$ 40,000	$ 80,000
Easement Acquisition	6.0	AC	$ 20,000	$ 120,000
Project Total				***$ 4,280,600***

CIP Cost Estimates - Raw Water Delivery & Treatment Projects

Bell County (WCID 1), Texas

Belton Water Treatment Plant Upgrades

Filter Air Scour Flow Control Upgrades (Plant 1 and 2)

Budget Information

Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Flow Meter	1	LS	$ 20,000	$ 20,000
Control Valve	1	LS	$ 25,000	$ 25,000
Installation (30% of Equipment Cost)	1	LS	$ 13,500	$ 13,500
Pipe Modifications	1	LS	$ 50,000	$ 50,000
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 27,000	$ 27,000
Subtotal				***$ 136,000***
OH&P (25%)				$ 34,000
Subtotal				***$ 170,000***
Mobilization/Demobilization (5%)				$ 9,000
Contingency (30%)				$ 51,000
Construction Total				**$ 230,000**
Professional Services (15%)				$ 35,000
Project Total				**$ 265,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
Chlorine Safety Equipment
Budget Information
Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Direct Cost (2016 See Note 1)	1	LS	$ 59,000	$ 59,000
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 15,000	$ 15,000
Subtotal				***$ 74,000***
OH&P (25%)				$ 19,000
Subtotal				***$ 93,000***
Mobilization/Demobilization (5%)				$ 5,000
Contingency (30%)				$ 28,000
Construction Total				**$ 126,000**
Professional Services (15%)				$ 19,000
Project Total				**$ 145,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
Chemical Storage Tanks
Budget Information
Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
6,000 Gal Ammonia Tanks	3	Ea	$ 20,000	$ 60,000
13,500 Gal Coagulant Tanks	3	LS	$ 40,000	$ 120,000
1,200 Gal Ammonia Tanks	3	LS	$ 6,000	$ 18,000
Installation (30% of Equipment Cost)	1	LS	$ 19,800	$ 19,800
Pipe Modifications	1	LS	$ 10,000	$ 10,000
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 24,000	$ 24,000
Subtotal				***$ 252,000***
OH&P (25%)				$ 63,000
Subtotal				***$ 315,000***
Mobilization/Demobilization (5%)				$ 16,000
Contingency (30%)				$ 95,000
Construction Total				**$ 426,000**
Professional Services (15%)				$ 64,000
Project Total				**$ 490,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
Sludge Transfer Pump Replacement
Budget Information
Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Direct Cost	1	LS	$ 47,000	$ 47,000
Installation (30% of Equipment Cost)	1	LS	$ 14,100	$ 14,100
Piping Modifications	1	LS	$ 10,000	$ 10,000
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 18,000	$ 18,000
Subtotal				***$ 42,000***
OH&P (25%)				$ 11,000
Subtotal				***$ 53,000***
Mobilization/Demobilization (5%)				$ 3,000
Contingency (30%)				$ 16,000
Construction Total				**$ 72,000**
Professional Services (15%)				$ 11,000
Project Total				**$ 83,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
Sedimentation Basin Equipment Replacement (Plants 1 and 2)
Budget Information
Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Plant 1 Equipment	1	LS	$ 288,000	$ 288,000
Plant 2 Equipment	1	LS	$ 305,000	$ 305,000
Installation (30% of Equipment Cost)	1	LS	$ 177,900	$ 177,900
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 192,725	$ 192,725
Subtotal				***$ 964,000***
OH&P (25%)				$ 241,000
Subtotal				***$ 1,205,000***
Mobilization/Demobilization (5%)				$ 60,000
Contingency (30%)				$ 362,000
Construction Total				**$ 1,627,000**
Professional Services (15%)				$ 244,000
Project Total				**$ 1,871,000**

Bell County (WCID 1), Texas

Belton Water Treatment Plant Upgrades

Replace Plant 3 Clearwells with New Flocculation/Sedimentation Basins

Budget Information

Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Demolition	1	LS	$ 850,000	$ 850,000
Site Work (5%)	1	LS	$ 730,000	$ 730,000
Administration Building	1	LS	$ 1,500,000	$ 1,500,000
Maintenance Building	1	LS	$ 1,000,000	$ 1,000,000
Flocculation/Sedimentation Basins	1	LS	$ 4,700,000	$ 4,700,000
Chemical Storage and Feed Facilities	1	LS	$ 500,000	$ 500,000
Yard Piping (5%)	1	LS	$ 730,000	$ 730,000
Reroute Piping and Ductwork	1	LS	$ 1,000,000	$ 1,000,000
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 3,680,000	$ 3,680,000
Subtotal				***$ 14,690,000***
OH&P (25%)				$ 3,670,000
Subtotal				***$ 18,360,000***
Mobilization/Demobilization (5%)				$ 920,000
Contingency (30%)				$ 5,510,000
Construction Total				**$ 24,790,000**
Professional Services (15%)				$ 3,720,000
Project Total				**$ 28,510,000**

Bell County (WCID 1), Texas

Belton Water Treatment Plant Upgrades

Rapid Mixer Replacement (Plants 1, 2, and 4)

Budget Information

Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Equipment (from Manufacturer)	4	LS	$ 30,000	$ 120,000
Installation (30% of Equipment Cost)	4	LS	$ 9,000	$ 36,000
Electrical/Instrumentation (25% of Equipment/Install)	4	LS	$ 9,750	$ 39,000
Subtotal				***$ 195,000***
OH&P (25%)				$ 49,000
Subtotal				***$ 244,000***
Mobilization/Demobilization (5%)				$ 12,000
Contingency (30%)				$ 73,000
Construction Total				**$ 329,000**
Professional Services (15%)				$ 49,000
Project Total				**$ 378,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
Backup Power Generation
Budget Information

Prepared: 19 March 2021

Item Description	Quantity	Unit	2009 Unit Price	2021 Total Cost
Emergency Backup Power for Raw Water Pumps	1	LS	$ 766,300	$ 858,000
Emergency Backup Power for Plant No. 4	1	LS	$ 120,900	$ 135,000
Emergency Backup Power for High Service Pumps	1	LS	$ 1,786,200	$ 2,001,000
				$ 2,994,000
OH&P (25%)				$ 749,000
Subtotal				***$ 3,743,000***
Mobilization/Demobilization (5%)				$ 187,000
Contingency (30%)				$ 1,123,000
Construction Total				**$ 5,053,000**
Professional Services (15%)				$ 758,000
Project Total				**$ 5,811,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
Washwater Recovery System
Budget Information

Prepared: 19 March 2021

Item Description	Quantity	Unit	2009 Unit Price	2021 Total Cost
Demolition and Site Preparation	1	LS	$ 632,000	$ 708,000
Miscellaneous Site Improvements	1	LS	$ 579,000	$ 648,000
Yard Piping	1	LS	$ 1,568,000	$ 1,756,000
Washwater Recovery Pump Station	1	LS	$ 1,518,000	$ 1,700,000
Recovered Washwater Pump Station	1	LS	$ 728,000	$ 815,000
Washwater Recovery Basin	1	LS	$ 1,956,000	$ 2,191,000
Electrical, Instrumentation & Control	1	LS	$ 1,264,000	$ 1,416,000
				$ 9,234,000
OH&P (25%)				$ 2,309,000
Subtotal				***$ 11,543,000***
Mobilization/Demobilization (5%)				$ 577,000
Contingency (30%)				$ 3,463,000
Construction Total				**$ 15,583,000**
Professional Services (15%)				$ 2,337,000
Project Total				**$ 17,920,000**

Bell County (WCID 1), Texas

Belton Water Treatment Plant Upgrades

Flocculation Basin Baffle Walls Replacement (Plant 1)

Budget Information

Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Direct Cost	1	LS	$ 195,000	$ 228,000
Subtotal				***$ 228,000***
OH&P (25%)				$ 57,000
Subtotal				***$ 285,000***
Mobilization/Demobilization (5%)				$ 14,000
Contingency (30%)				$ 86,000
Construction Total				**$ 385,000**
Professional Services (15%)				$ 58,000
Project Total				**$ 443,000**

Bell County (WCID 1), Texas
Belton Water Treatment Plant Upgrades
4.0 Mgal Clearwell
Budget Information
Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Clearwell Cost	1	LS	$ 2,800,000	$ 2,800,000
Pipe and valves	1	LS	$ 500,000	$ 500,000
Subtotal				***$ 3,300,000***
OH&P (25%)				$ 825,000
Subtotal				***$ 4,125,000***
Mobilization/Demobilization (5%)				$ 206,000
Contingency (30%)				$ 1,238,000
Construction Total				**$ 5,569,000**
Professional Services (15%)				$ 835,000
Project Total				**$ 6,404,000**

Bell County (WCID 1), Texas

Belton Water Treatment Plant Upgrades

25-MGD Plant Expansion - After Plant 3 Sed. Basin Replacement

Budget Information

Prepared: 15 February 2021

Item Description	Quantity	Unit	Unit Price	Total Cost
Demolition	1	LS	$ 250,000	$ 250,000
Site Work (5%)	1	LS	$ 2,300,000	$ 2,300,000
Flocculation/Sedimentation Basins	1	LS	$ 4,700,000	$ 4,700,000
Chemical Storage and Feed Facilities	1	LS	$ 1,500,000	$ 1,500,000
4.0 MG Clearwell	1	LS	$ 2,800,000	$ 2,800,000
Yard Piping (5%)	1	LS	$ 2,300,000	$ 2,300,000
Reroute Piping and Ductwork	1	LS	$ 650,000	$ 650,000
High Service Pump Station	1	LS	$ 6,100,000	$ 6,100,000
Raw Water Delivery	1	LS	$ 13,700,000	$ 13,700,000
Electrical/Instrumentation (25% of Equipment/Install)	1	LS	$ 11,400,000	$ 11,400,000
Subtotal				***$ 45,700,000***
OH&P (25%)				$ 11,430,000
Subtotal				***$ 57,130,000***
Mobilization/Demobilization (5%)				$ 2,860,000
Contingency (30%)				$ 17,140,000
Construction Total				**$ 77,130,000**
Professional Services (15%)				$ 11,570,000
Project Total				**$ 88,700,000**

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CDM Smith