City of Celina

2015 Water Distribution Master Plan

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EXECUTIVE SUMMARY

The City of Celina, Texas (City) is located primarily in the far northwest corner of Collin County, with portions of the City in northeast Denton County. The existing City limits encompass approximately 22 square miles and an expected ultimate build-out area of 77 square miles. The projected population is 339,000 people, with an ultimate maximum peak water distribution system demand of 14.4 MGD. From 2000 to 2010, the U. S. Census population of Celina grew from 1,861 to 6,028 people, a 325% increase. The City currently receives all of their treated water from the Upper Trinity Regional Water District (UTRWD), which accounted for 70% of the water supply for Celina in 2013. The City plans to receive additional treated water from the North Texas Municipal Water District (NTMWD) within the next 5-15 years.

The existing water system has 2,509 connections as of January 1, 2014 and functions with two pressure planes: the lower plane in the eastern sector (Zone 1) and the upper plane in the western sector (Zone 2). These two pressure planes are currently interconnected, but act almost independently of each other and are analyzed as two separate systems.

The future planning area was split into three separate pressure planes: the upper, middle and lower pressure planes. The original pressure plane Zone 1 is the new middle and the additional Zone 3 pressure plane is to accommodate the low elevations in the south west quadrant. All three pressure planes will be independently fed from a delivery point: Zones 1 and 3 from UTRWD, and Zone 2 from NTMWD.

The modeling effort and recommended capital improvements for the 2015 Water Distribution Master Plan was split into two phases: Phase 1, 2015-2030 and Phase 2, Ultimate Built Out.

For Phase 1 improvements, 3 additional pumps are recommended in the system. Two additional pumps at the Celina Road Pump Station (CRPS), similar size to the existing pumps, one in 2018 and another in 2025. At the Downtown Pump station, one additional pump, similar size to largest pump is recommended in 2019. In addition to the pump station upgrades, two 2 Mgal elevated storage tanks (EST) are recommended. First, a 2 Mgal EST off Coit Rd east of the Carter Ranch development is proposed in 2017. The following year, 2018, a new 2 Mgal Downtown EST is proposed. In conjunction with the pump station improvements and additional elevated storage, approximately 90,000 feet of additional waterline is proposed throughout the south and south east sector of the service area. These recommendations are only sufficient for the estimated demands through 2030 and from water supplied by the UTRWD through the CRPS.

For Phase 2 improvements for ultimate built out, there is a projected 202,797 connections in the distribution system. Due to minimum requirements from TCEQ, the City if Celina will need 40.56 Mgal of total storage, with 20.28 Mgal of that being in elevated storage tanks. To keep the tanks full and cycling, the City will need to construct a new pump station at the NTMWD delivery point to feed Zone 2. Significant reconfiguration and upsizing of the CRPS will be necessary to create the new lower pressure plane, Zone 3. This new pressure plane will be supplied via the UTRWD delivery point at the CRPS when the pumps and waterlines exiting the facility are separated.

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Section 1
General Information

1.1 Introduction

The City of Celina, Texas (City) is located primarily in the far northwest corner of Collin County, with portions of the City in northeast Denton County. The existing City limits encompass approximately 22 square miles. According to the City of Celina 2013 Comprehensive Plan, the ultimate build-out area is expected to be 77 square miles. The projected population is 339,000 people, with an ultimate maximum peak water distribution system demand of 14.4 MGD. From 2000 to 2010, the U. S. Census population of Celina grew from 1,861 to 6,028 people, a 325% increase.

The City currently receives all of their treated water from the Upper Trinity Regional Water District (UTRWD), which accounted for 70% of the water supply for Celina in 2013. The remainder comes from City owned wells that is blended with the UTRWD water at the Downtown Pump Station (DTPS).

Several new subdivisions and retail and commercial businesses are being planned and will be constructed in the immediate future in Celina. This 2015 Water Distribution Master Plan will serve as a guide as to how the existing and future water systems will be managed for the City of Celina.

1.2 2003 Water Distribution Master Plan

In 2003, a water master plan was developed for the City, titled “2003 Water Distribution Master Plan” (2003 WDMP). At that time, it was anticipated that the majority of the City’s future water would be purchased from both the UTRWD and North Texas Municipal Water District (NTMWD).

The 2003 WDMP used a service area of 69,000 acres and an estimated population of 335,334 at build-out.

1.3 Changes Since 2003

There have been many changes and improvements to the City and its water system since 2003. The strong population increases have been previously mentioned. Several large subdivisions have also been planned for inside the City limits and in the extra territorial jurisdiction (ETJ).

In December of 2006, Celina became a participating member in the Northeast Regional Water Reclamation System which is owned and controlled by the UTRWD. The contract between Celina and the UTRWD describes the terms and conditions whereby the UTRWD provides treated water and wastewater treatment for Celina.

In 2009, about 18,000 linear feet of 18 inch water line and a one million gallon elevated storage tank was constructed by Collin County Municipal Utility District No. 1 to serve the Light Farms subdivision as part of the City's water distribution system. More detailed description of new tank and waterline is provided in Section 2.1.1.2.

1.4 Purpose and Scope

The primary purpose of this report is to provide an update to the 2003 WDMP suitable for infrastructure planning and budgeting purposes. The 2015 Water Distribution Master Plan (2015 WDMP) is expected to be utilized as the basis for the water projects proposed for the 2015 Capital Improvement Program (CIP) and 2015 Water Impact Fee Analysis. Additionally, the results of the 2015 WDMP are divided into two phases. Phase 1 models the growth for the planned development in the South East Sector through 2030. Phase 2 models the ultimate development for the extents of the City's water distribution system under complete build out.

The following steps outline the major scope items for this plan update:

- review of the 2003 WDMP
- review of changes to the water system since 2003
- receive and analyze planned changes to the existing system from discussions with City staff
- evaluate the existing water system to determine flow capacity and potential capacity problems
- prepare a revised Water Distribution System Map based upon new analysis
- model future water flows from the land use assumptions and population projections in the 2013 Comprehensive Plan
- provide preliminary sizes and facility recommendations for Phase 1 improvements
- provide preliminary sizes and facility recommendations for Phase 2 improvements

This information will be the guide for all future analysis and design of the water system for the next five years and for the ultimate build-out of all water systems for Celina.

Section 2
Existing System

2.1 Components of Existing Water System

The existing water system has 2,509 connections as of January 1, 2014 and functions with two pressure planes: the lower plane in the eastern sector (Zone 1) and the upper plane in the western sector (Zone 2). These two pressure planes are currently interconnected, but act almost independently of each other and are analyzed as two separate systems.

2.1.1 Zone 1 – Lower Pressure Plane

2.1.1.1 Celina Road Pump Station & Ground Storage Tank

Currently, all the treated water in Celina is purchased from the UTRWD. The water is pumped from the UTRWD system to the City's Celina Road Pump Station (CRPS) located at Celina Road and FM 428. All water enters the CRPS through a 1 Mgal ground storage tank (GST) and then pumped to the City's water distribution system. The CRPS is modeled in WaterGEMS by a combination of a reservoir, tank and pumps.

The CRPS's operation controls are based on the operating water levels at the Downtown elevated storage tank (DTEST). The size of the existing booster pumps are shown in Table 2-1 and the pump performance curves for the three pumps at the CRPS are shown in Figure 2-1. All three pumps in the CRPS are the same size. Combined pump performance curves are shown in Figure 2-2.

Table 2-1 Existing Celina Road Pump Station Description

Pump No.	Pump Manufacture	Configured Curve	Impeller Diameter (Inches)	Best Efficiency Point	Design Point			Electric Motor Description
					NPSHr (ft H_2O)	TDH(ft H_2O)	Flow (gpm)	
1	PACO Pumps	KP 4012-7/8	8.67	1271 gpm @70.91%	32.16	225	1340	125HP @ 3500 rpm, SF 1.15, 240/460 V 3Ø, 60Hz
2								
3								

Figure 2-1 Celina Road Pump Station Performance Curves

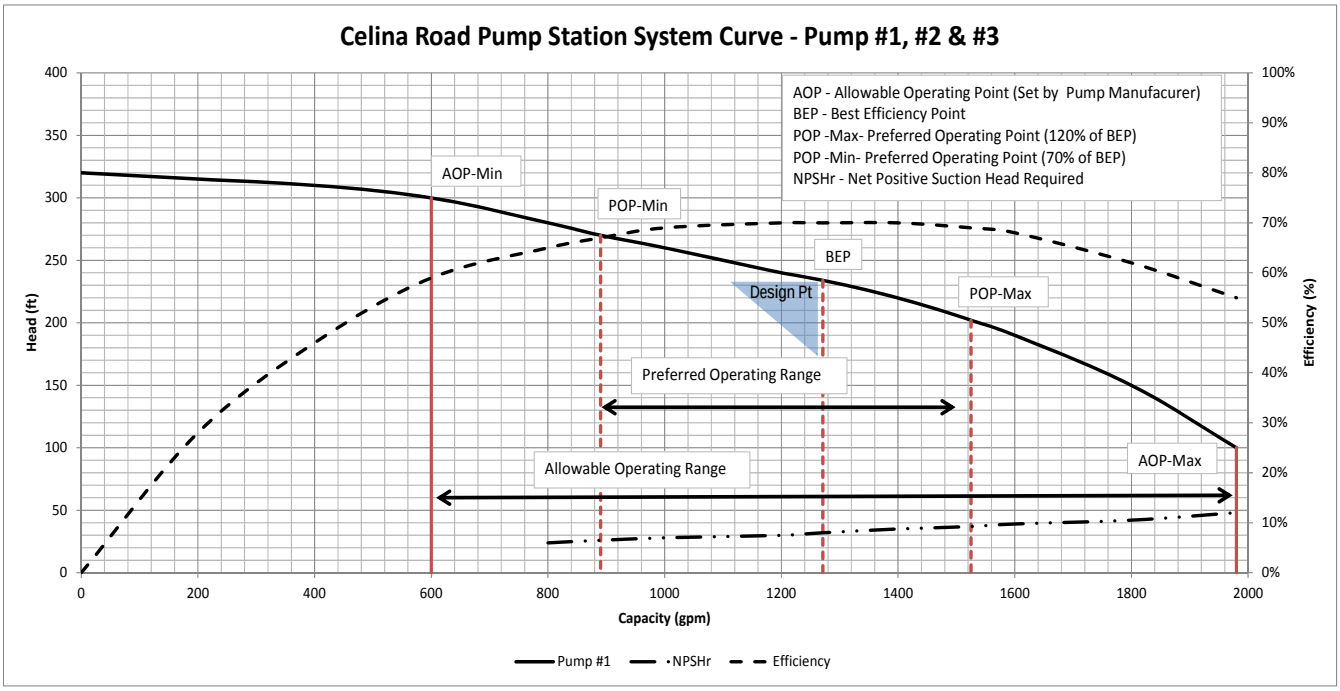
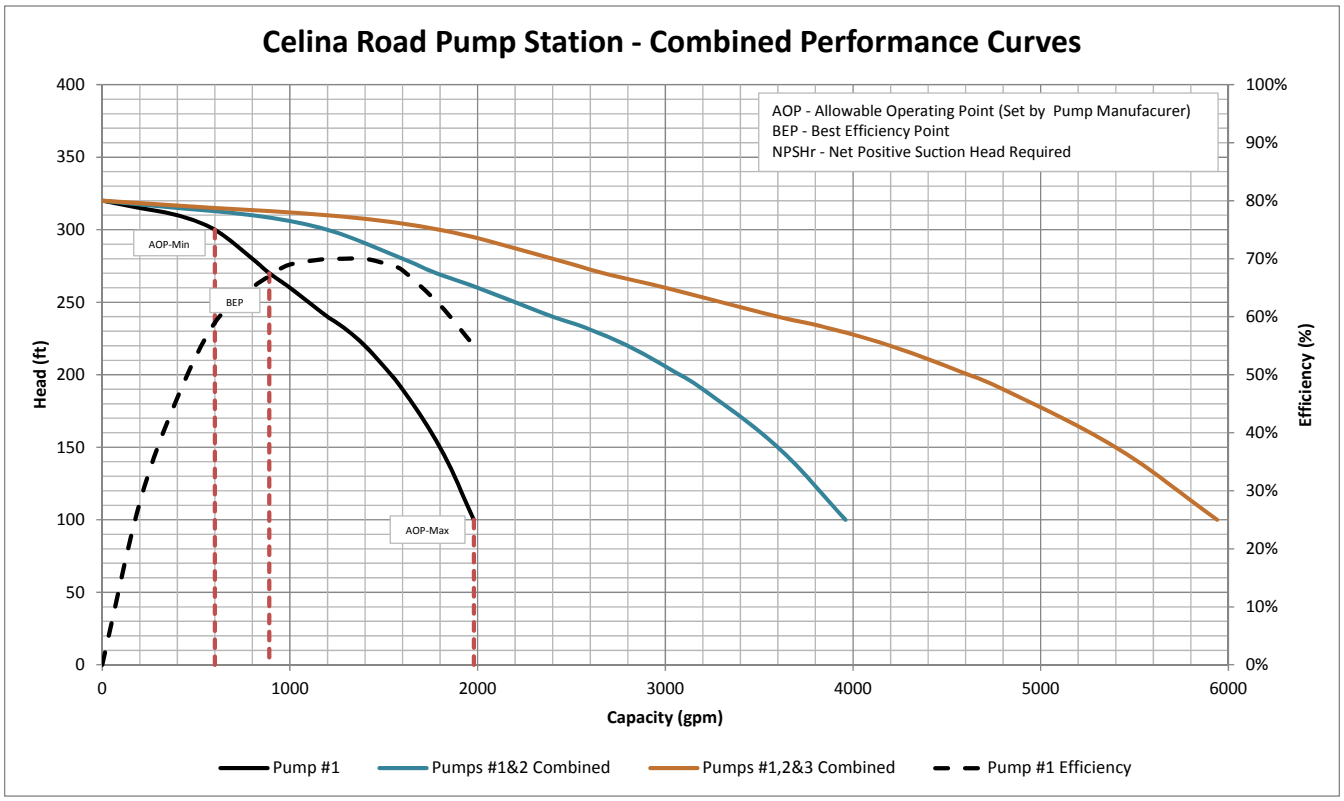


Figure 2-2 Celina Road Pump Station Combine Performance Curves



The ground storage tank (GST) at the CRPS has an estimated capacity of 1,000,000 gallons. The actual diameter of the tank is 70 ft. The overflow elevation is 672 ft mean sea level (msl) and the operating side water depth (draft) is 35 ft.

From the CRPS, the water is then pumped approximately 4 miles to the west to the City's DTEST through an 18-inch line. Additionally, water is pumped by the CRPS 5 miles to the south through an 18-inch line into the Light Farms elevated storage tank (LFEST). CRPS operation controls are based on the operating water levels at the DTEST.

The pumps at the CRPS are controlled by a supervisory control and data acquisition (SCADA) system at the DTPS. It is an industrial control system where a computer system is monitoring and controlling a process.

2.1.1.2 Light Farms Elevated Storage Tank

The LFEST is located in the lower pressure plane distribution system and it is supplied by the CRPS. It is located at the end of an 18-inch line at Light Farms Way and North Dallas Pkwy. The LFEST has a volume of 1,140,000 gallons with a diameter of 69.8 feet, an overflow elevation of 835 msl and a tank bowl base elevation of 795.08 feet msl. The tank levels float on the downtown system, which means that it fills and empties based on demand in the system.

2.1.2 Zone 2 – Upper Pressure Plane

2.1.2.1 The Downtown Pump Station & Elevated Storage Tank

The DTEST at the DTPS along with the LFEST and the CRPS provides the pressure and supply of water for the lower pressure plane of the distribution system. The DTEST is approximately 90,000 gallons in volume. The GST, supplied by the CRPS, at the DTPS has a capacity of 150,000 gallons and is connected to the booster pumps that supply water to the upper pressure plane.

Three groundwater wells are located at the DTPS, but due to their size and condition they were not included in this analysis. The City infrequently uses these wells and leaves them available for emergency purposes only.

The DTPS only services the upper pressure plane of the water distribution system. It pumps water approximately 3.5 miles north through a 12-inch line to the Morgan Lakes EST (MLEST) located in the upper pressure plane of the water distribution system. Pump operation controls are based on the operating water levels at the MLEST monitored by SCADA. The existing DTPS pump operating parameters are detailed in Table 2-2. Pump performance curves are shown in Figure 2-3 through Figure 2-7.

Table 2-2 Existing Celina Downtown Pump Station Description

Pump No.	Pump Manufacture	Configured Curve	Impeller Diameter (inches)	Best Efficiency Point	Design Point			Electric Motor Description
					Flow (gpm)	TDH (ft H_2O)	NPSHr (ft H2O)	
1	PACO Pumps	LF - 20953	7.98	339 gpm @ 66.51%	278	214	8.37	30HP @ 3500 rpm, SF 1.15, 240/460 V 3Ø, 60Hz
2		LF - 30957	7.92	766 gpm @ 72.09%	556	214	10.27	50HP @ 3500 rpm, SF 1.15, 240/460 V 3Ø, 60Hz
3		LF - 30957	8.58	841 gpm @ 80.00%	833	228	20.48	75HP @ 3500 rpm, SF 1.15, 240/460 V 3Ø, 60Hz
4		VL-5095-9	8.7	1124 gpm @ 72.05%	1124	241	19.25	100HP @ 3530 rpm, SF 1.15, 240/460 V 3Ø, 60Hz

Figure 2-3 Downtown Pump Station Pump #1 Performance Curve

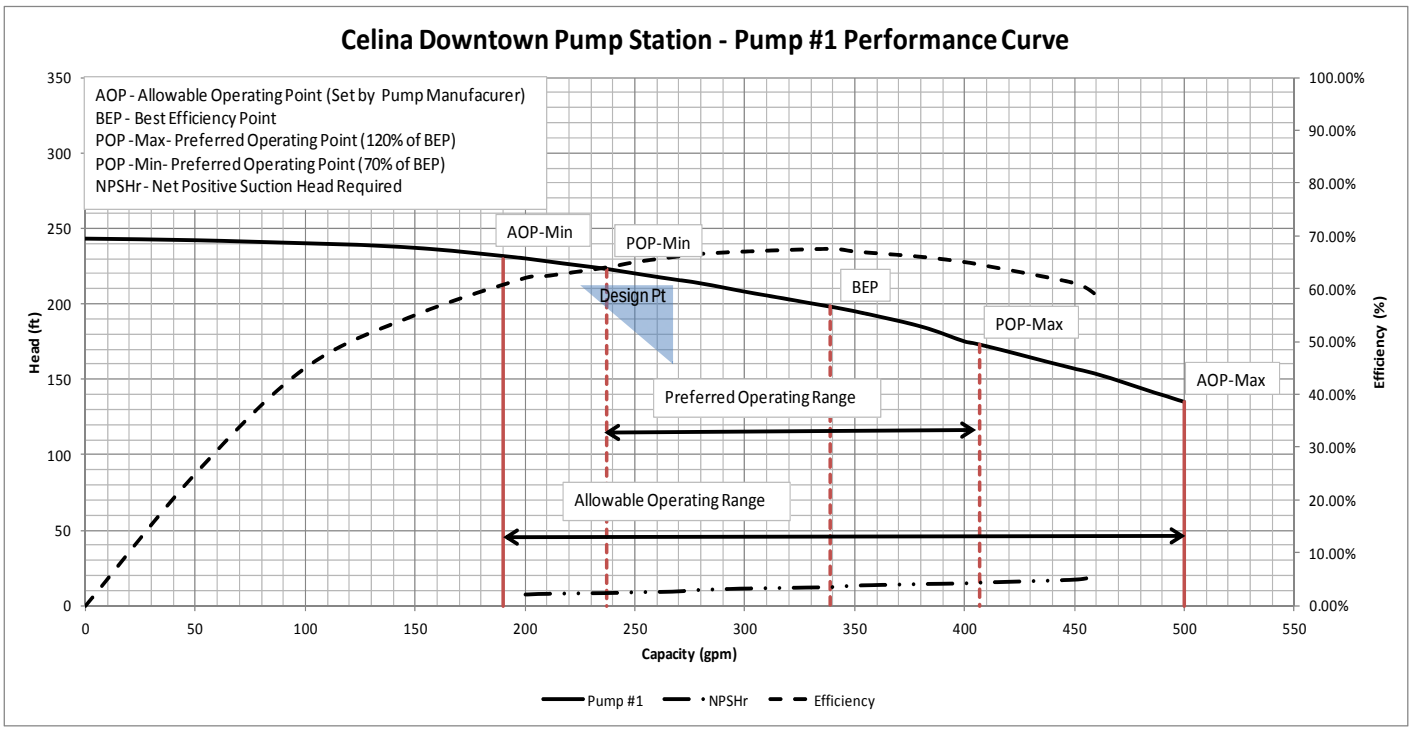


Figure 2-4 Downtown Pump Station Pump #2 Performance Curve

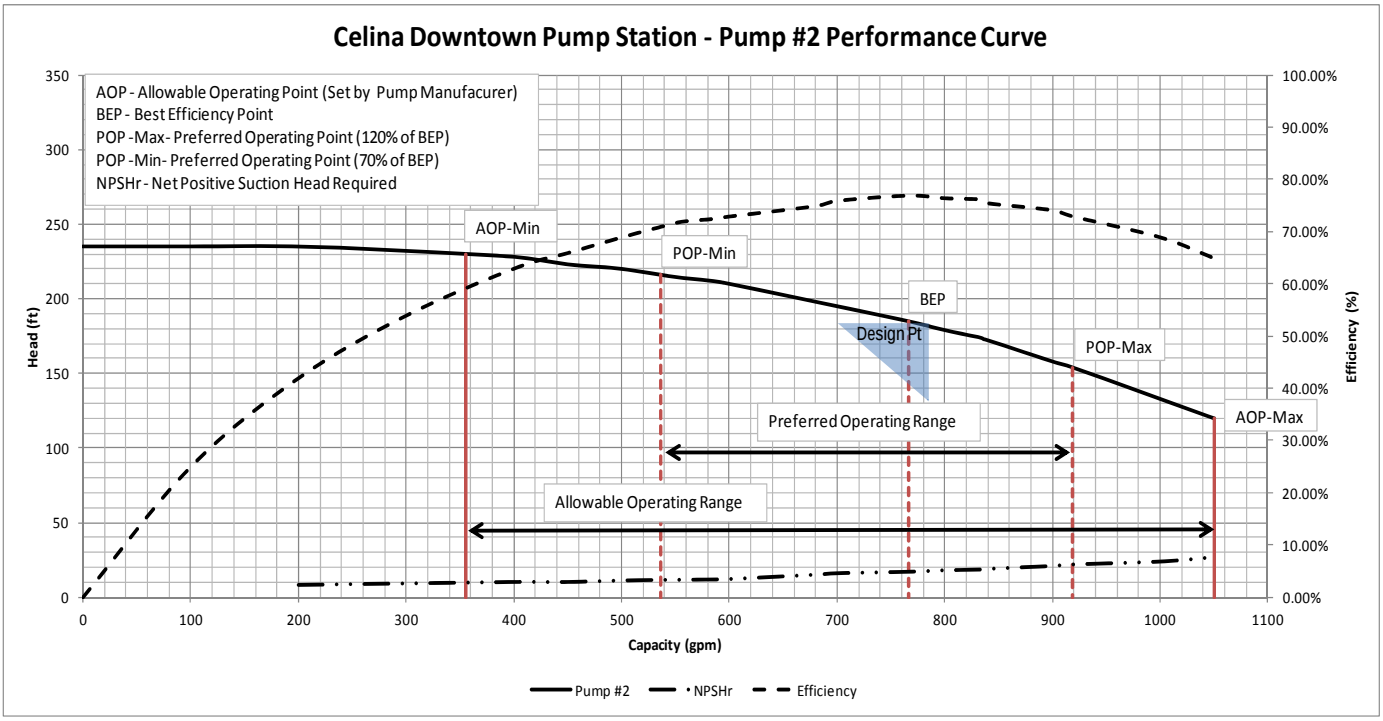


Figure 2-5 Downtown Pump Station Pump #3 Performance Curve

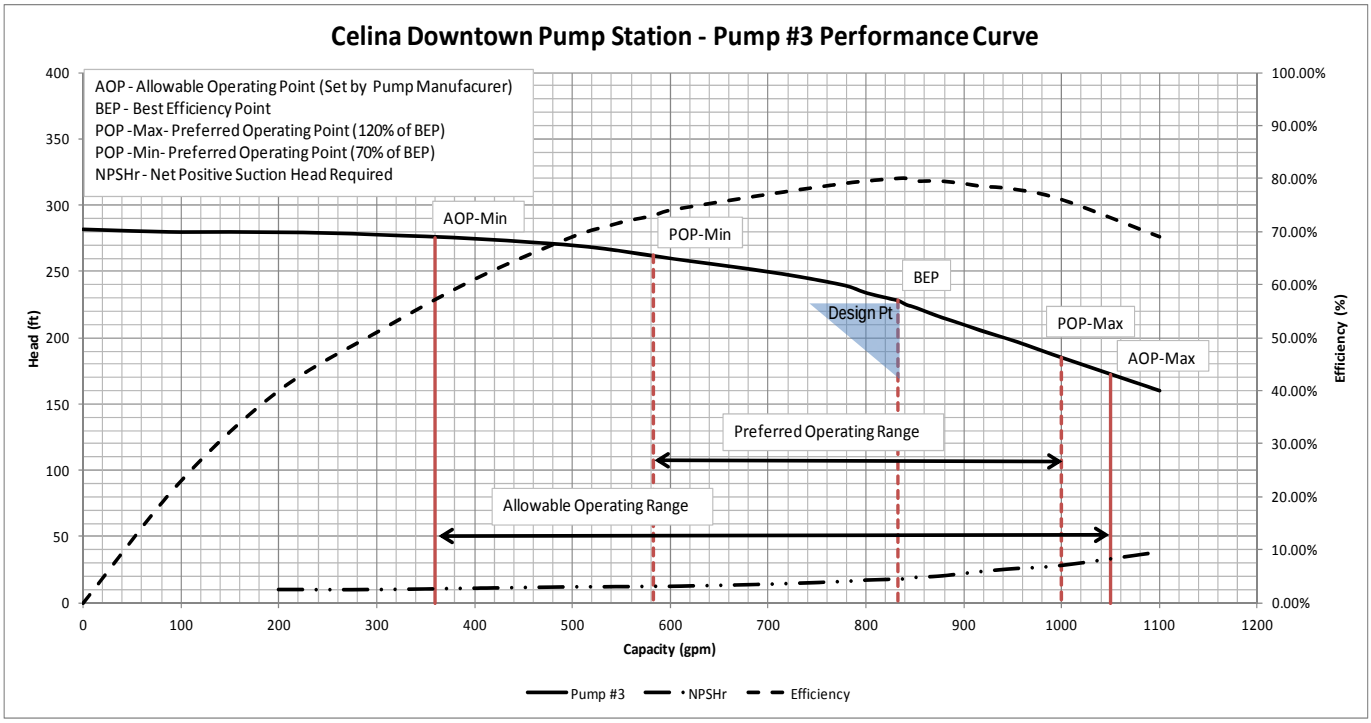


Figure 2-6 Downtown Pump Station Pump #4 Performance Curve

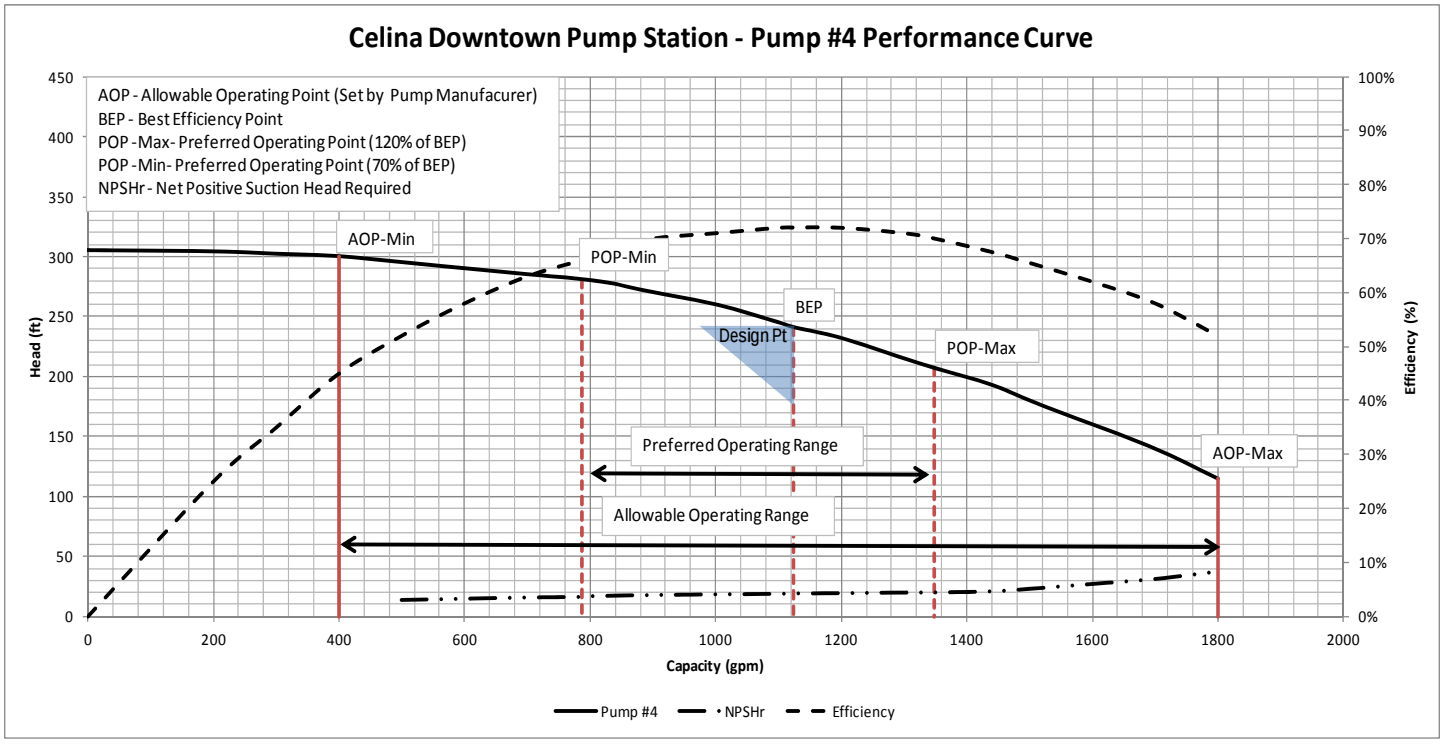
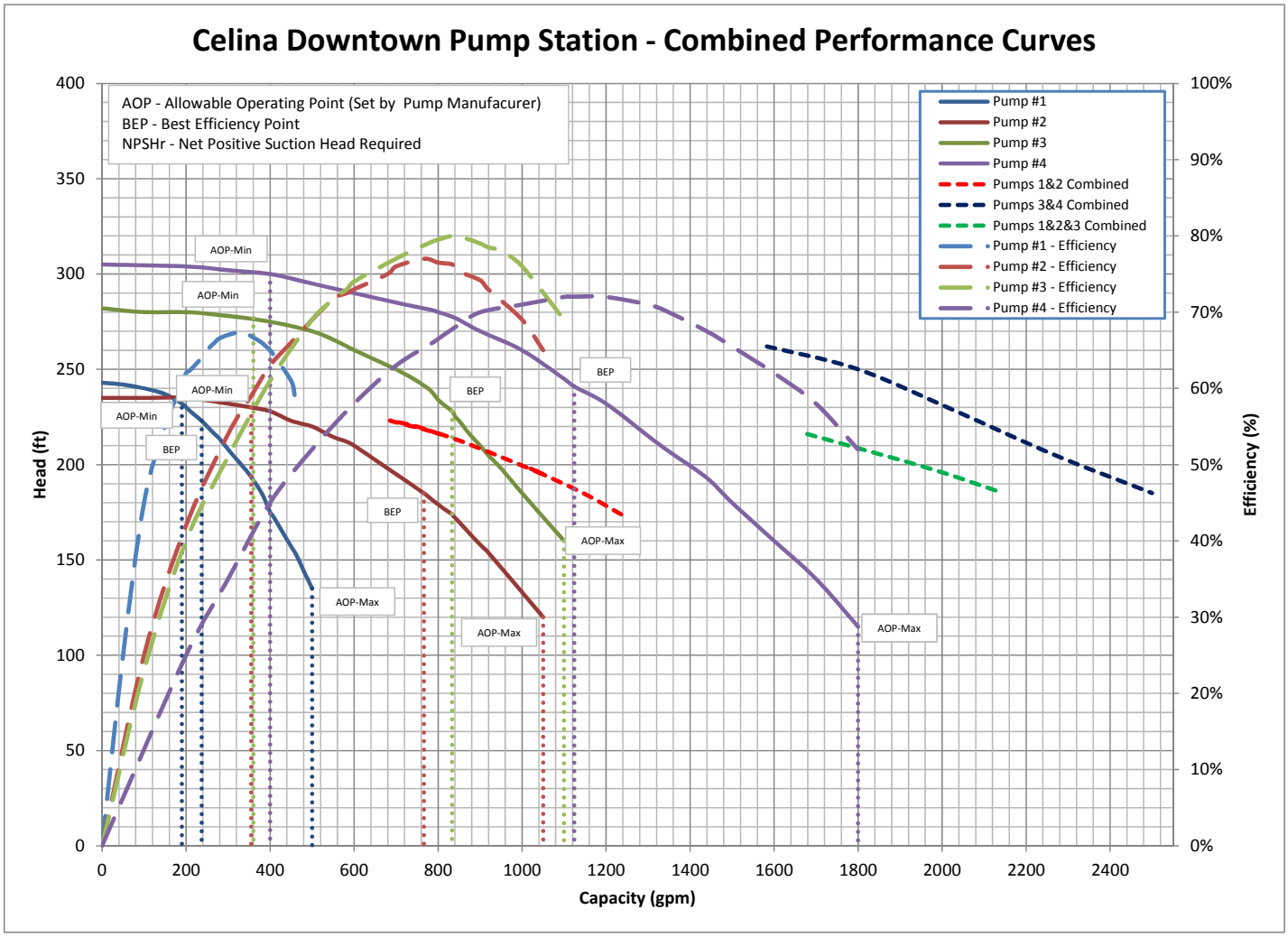


Figure 2-7 Downtown Pump Station Combined Performance Curves



The DTEST at the DTPS along with the LFEST provide the pressure and supply of water for the lower pressure plane of the distribution system. It also serves suction equalization storage for the DTPS.

2.1.2.2 Morgan Lake Elevated Storage

MLEST has a volume of 540,000 gallons with a diameter of 50 feet, an overflow elevation of 917 ft msl, and a tank bowl base elevation of 880 ft msl. The tank levels float on the system, which means that it fills and empties based on demand in the system being supplied by the DTPS. DTPS pump operation controls are based on the operating water levels at the MLEST, controlled and monitored by the SCADA system located at the DTPS.

Also located at Morgan Lakes is a stand pipe that is supplied by a 300 gpm groundwater well. The standpipe has a total volume of 210,000 gallons. The booster pumps at the Morgan Lake

standpipe are activated and controlled by the levels in the MLEST. The Morgan Lake standpipe and well pumps were not modeled in the simulation because the City indicated future plans to discontinue the use of the well for operation simplicity and reduced maintenance cost.

Section 3
Methodology

3.1 Planning Area

The current ultimate growth boundary for Celina is 77 square miles, which includes the existing City limits, ETJ, and future City land that is based upon current and proposed boundary line agreements with adjacent cities. This boundary was obtained from Celina's 2013 Comprehensive Plan. The planning area is shown in Exhibit 1.

For the future planning scenario, the area was split into three separate pressure planes: the upper, middle and lower pressure planes. The original pressure planes Zone 1 & 2, the new middle and upper pressure planes, respectively, are separated by Preston Road. Due to much lower elevations in the south west quadrant, the ultimate layout creates a new lower pressure plane (Zone 3). Zone 3 is separated from Zone 1 by Dallas Pkwy to Celina Rd, then west along Celina Rd to the planned thoroughfare, then north to CR-9. The addition of Zone 3 is discussed further in Section 4.2

3.2 Methodology

The water system was modeled using Bentley Systems' WaterGEMS V8i software. Development of the water model started with collecting data on the existing City facilities from construction plans and exhibits, and discussions with City staff. Data collected from City staff was used to obtain storage tank volumes and the capacity and system head of booster pumps and well pumps.

A site visit was conducted at the CRPS and DTPS to verify existing facilities and to obtain the operation settings of the pumps. The analysis included establishing an inventory of existing facilities and their characteristics from the following:

- Distribution System – diameter, length and pipe material
- Storage Facilities – volume, tank dimensions and water surface elevations
- Booster Pump Stations – capacity, system head and pump operational characteristics
- Water Wells – pumping capacity, system head and pump operational characteristics

The next step was to enter the City's water demands to the model's facility characteristics. This included the following tasks:

- reviewing water consumption records
- determining water demands – average daily demand, maximum daily demand, peak hourly demands and fire flow demands
- developing a diurnal pattern demand
- creating a calibrated hydraulic model for the analysis of the various demands

- phasing water system infrastructure in a pipe grid to simulate a potential system with distributed demands
- projecting demands through Phase 1 (2015-2030) and Phase 2 (ultimate build out)
- analyzing secondary water source and interconnect alternatives for future water system expansion

3.3 Determination of Water Demands

The water demands for the system were entered into the model based on the assumption that one connection or equivalent residential unit (ERU) will have a base demand of 1 gpm per connection. In the model, connections are converted from gpm per connection into demand by using a demand adjustment factor. Demand adjustment factors of 0.486, 0.791 and 0.4 was used for existing, Phase 1 and Phase 2 future connections, respectively. The Phase 1 adjustment factor is greater than the existing and ultimate adjustment factors because the known planned developments are going to be very high density residential areas.

3.3.1 Existing Demand

Historical water usage data was obtained from City records. Water usage for non-residential users was also reviewed and analyzed. The average residential water usage was determined by the difference between the amount of water metered from UTRWD and the non-residential water usage.

3.3.1.1 Average Daily Demand

The average water usage was determined from water production data and billing records for the various commercial tracts by subtracting these from total supply. The existing City's average water usage as of September 2013 is a total of approximately 920,000 gpd with an existing 2,509 ERUs.

The City currently uses an average of 377 gpd per ERU. The average daily demand is based upon the TCEQ monthly operating reports for the time period of January 2011 to September 2013.

3.3.1.2 Maximum Daily Demand

The maximum daily demand is 1711 gpd per ERU, making the current maximum daily demand approximately 4.17 MGD with an existing 2,509 ERUs.

3.3.1.3 Diurnal Demand Pattern

The American Water Works Association (AWWA) standard diurnal curve pattern for residential, commercial and industrial users were used for the evaluations. This pattern was applied to a 24, 48 and 72 hour model the water cycling in the storage tanks.

3.3.2 Future Demand Projections

3.3.2.1 Phase 1 Demand Projections

Phase 1 Development consists of the estimated 15-year growth projections associated with the known platted and pending plat developments in the City. These Phase 1 Developments along with existing City demands were used in the model to develop the recommended near term capital improvements. Future developments include Light Farms, Ownsby Farm, Swisher Tract, Carter Ranch, Hillwood, the Lakes at Mustang Ranch, Wellspring Estates, Creeks of Legacy, and the Parks at Wilson Creek.

Phasing site plans for the developments were not available when building the model, only projected connections. Therefore, using the ultimate proposed site layouts, an assumed phasing was used. This was done by activating the appropriate number of demand nodes starting near major thoroughfares and moving out. The demand scheduling was based on the projected connections listed in Table 3-1.

Table 3-1 Total Projected Connections for Future Celina Developments

Year	Carter Ranch	Light Farms	Creeks of Legacy	Ownsby Farm	Swisher Tract	Hillwood	Parks at Wilson Creek	Well-spring Estates	Lakes at Mustang Ranch	Other
2015	700	370	20	0	0	0	0	131	25	0
2016	863	610	64	25	0	50	0	131	25	136
2017	863	850	192	50	10	200	0	262	150	368
2018	863	1,090	320	100	20	400	0	262	300	480
2019	863	1,330	448	200	80	650	25	262	550	572
2020	863	1,480	570	397	80	750	50	262	700	570
2025	863	2,980	965	397	80	1,010	1,216	262	700	1,375
2030	863	3,185	1,031	397	80	1,010	1,993	262	1,661	1,661

3.3.2.2 Phase 2 Demand Projections

Phase 2 water demands for the ultimate build out of the system was calculated based on the future land use presented in the 2013 Comprehensive Plan. Using ArcGIS, the spatial distribution of the land use types was reclassified into smaller demand zones. The areas for each demand type were totaled by zone.

It was assumed that there would be 8 connections per acre for commercial properties and 6.2 connections per acre for residential areas. The total number of connections within each demand zone were imported into the Phase 2 WaterGEMS model. Lastly, a future development

adjustment factor of 0.4 gpm was applied to these nodes. The future projected ultimate connections for each pressure plane is listed in Table 3-2.

Table 3-2 Ultimate Future Connections

Zone	Total Area (acres)	Future Connections
1	18,717	89,403
2	19,601	84,331
3	11,104	29,062
Total	49,422	202,797

3.4 TCEQ Requirements for Water Distribution Systems

3.4.1 Minimum Water Storage

All proposed City facilities must meet the capacity requirements found in the Texas Administrative Code (TAC) Chapter 290.45. According to TAC Chapter 290.45(b) (1) (D) (ii); a community water system consisting of more than 250 connections must have a total storage capacity of 200 gallons per connection.

Based on the future land use plan, the total number of connections will be 202,797 requiring a total 40.56 Mgal of storage. This storage can be achieved with both elevated and ground storage. TAC Chapter 290.45(1) (b) (1) (D) (iv) requires 100 gallons of elevated storage per connection therefore of the 40.56 Mgal of required total storage, at least 20.28 Mgal must be elevated storage. The capacity requirements are shown below in Table 3-3.

Table 3-3 Water Storage Requirements

Zone	Projected Connections	Total Required Storage (gal)	Required Elevated Storage (Mgal)
1	89,403	17.88	8.94
2	84,331	16.87	8.43
3	29,062	5.81	2.91
Total	202,797	40.56	20.28

3.4.2 Minimum Pumping Capacity

The Texas Commission on Environmental Quality (TCEQ) also requires a minimum booster pump capacity of 2.0 gpm per connection or the ability to meet peak demands while the largest

pump is offline. The model evaluation will provide the pump capacity based on the peak demands.

3.5 Calibration

The City's water demands were entered into the model for analysis of the existing system. The model was calibrated to match field readings obtained during the fire hydrant flow tests conducted in the City. The calibrated model was then used to analyze existing demands and demands at ultimate build out.

A fire hydrant flow test was performed on June 14, 2012. The data collected was used to calibrate the water model to the existing field conditions. Three locations were selected for the flow tests:

1. a location near the CRPS
2. in the North Preston Lakes subdivision (farthest north from the CRPS in Zone 1)
3. in the Rolling Meadows subdivision (farthest south from the CRPS in Zone 2)

The flow tests were performed twice, once in the morning and once in the evening, at each fire hydrant location.

During the flow test, a static pressure is taken at the first hydrant ("Hydrant 1"). A nearby fire hydrant to Hydrant 1 ("Hydrant 2") is opened and water is blown off. Once the pressures are stabilized, the residual pressure at Hydrant 1 and the flow at Hydrant 2 are recorded. Simultaneously during the flow test, SCADA water level elevations are observed and recorded at the Downtown Pump Station. Booster pumps that are turning on and off are also recorded for analysis. After Hydrant 2 is turned off, the test is repeated again at each selected location.

The SCADA graphs were then compared to the model level changes as part of the calibration. The model did not vary significantly from the field data or SCADA graphs that were provided and therefore, no adjustments were required to the model.

3.6 Model

3.6.1 Existing System Model

The results of the water modeling analysis of the City's existing average daily demand and maximum daily demand showed two concerns with the existing system. The system was able to maintain pressure above 35 psi on the Zone 1 of the distribution system except for the 18 inch supply line that connects the CRPS to the DTPS. The pressure dropped below 35 psi in this line during maximum day scenarios.

The second issue is in Zone 2 of the distribution system. During the calibration testing it was noted that the pressure in the system dropped to 0 psi in the North Preston Lakes neighborhood. According to TCEQ, the minimum pressure required in a distribution system during an emergency situation must stay above 20 psi. The main reason the pressure drops below 20 psi is

because there is only one line providing water into the neighborhood and if a hydrant is opened up on the one line all of the flow is directed out of the hydrant. Two possible fixes to this problem is a second source line into the neighborhood or constructing an EST within the neighborhood. These issues were taken into account in the future water system analysis.

3.6.2 Future Development Model

While running the future system hydraulic model there are several criteria to consider:

- maintain a pressure of 40 psi or greater in the system at all times during peak hour demands
- maintain pressure below 100 psi so as not to damage equipment and household fixtures
- maintain water velocities above 2 feet per second in the pipes
- maintain water velocities below 8 feet per second where practical
- no water line below 8 inches in diameter are recommended

3.6.2.1 Phase 1 Model Development (Through 2030)

Developing the Phase 1 model required projecting a pipe network for the planned subdivisions. Using the most recent site development plans, waterlines were drawn along the planned roads. Waterlines along collectors were typically assigned 12-inch, while waterlines along minor arterials were typically assigned 8-inch. If there was no site plan available, the thoroughfare plan was used to draw 12-inch waterlines. Then lastly, if no planned thoroughfare crossed the site, an assumed distribution grid lines was drawn.

Demand nodes along the assumed pipe networks were activated based on the connection projection discussed earlier in Section 3.3.2.1.

Using a combination of the assumed pipe network and connection projections, the Phase 1 model was able to test scenarios for each year from 2015-2020, then 2025 and 2030.

3.6.2.2 Phase 2 Model Development (Ultimate)

Developing the Phase 2 model involved creating larger waterlines along the planned thoroughfare routes and a grid of model pipes in between. Model pipes ranged from 12-inch to 8-inch to create a network of waterlines along assumed collector streets and minor arterial streets. In Zone 2, there was a section of 2-inch pipeline that was replaced with 8-inch and 12-inch waterlines for the ultimate development model.

Demands determined from the demand zones, discussed in Section 3.3.2.2, were distributed across the nodes for these model pipes.

Additionally, high pressures in the southwest quadrant warranted the separation into a third pressure plane, Zone 3. Zone 3 is further discussed in Section 4.2

Section 4
Recommended Capital Improvements

4.1 Phase 1 – 2015 to 2030

In order to meet the increased demands projected from the new developments in the southeast sector, there are recommended improvements to the existing pump stations, additional elevated storage, and new waterline construction.

4.1.1 Pump Station Improvements

4.1.1.1 Celina Road Pump Station Improvements

The existing CRPS meets the system needs thru 2017, at which time additional elevated storage is required Downtown in Zone 1. An additional pump of similar size to the existing CRPS pumps is also required to meet total system demands. Figure 4-1 and Figure 4-2 show projected 2018 flow and pressure during the 72 hour simulation. The CRPS is initially controlled by LFEST. Once the proposed 2 Mgal Downtown EST comes on line, the controls for CRPS should be based on elevations in this new tank. The existing suction line to the CRPS pumps appears to be undersized. With the addition of a new pump, the suction line size should be analyzed and the diameter increased if warranted.

Figure 4-1 Celina Road Pump Station Flow Results for 2018

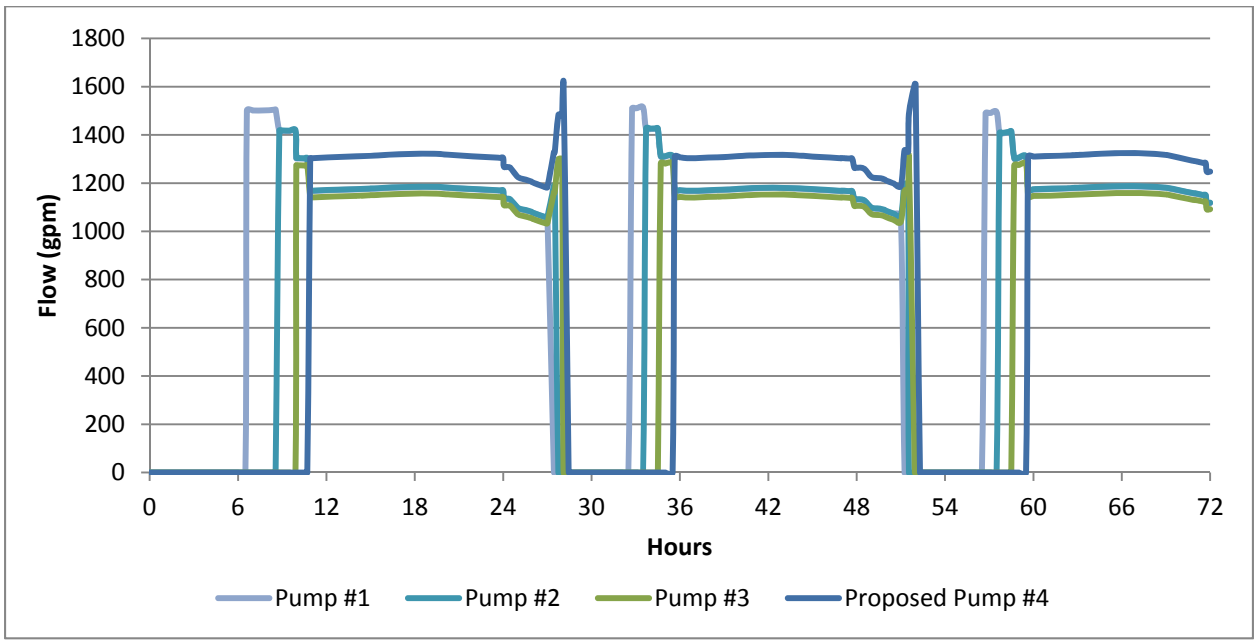
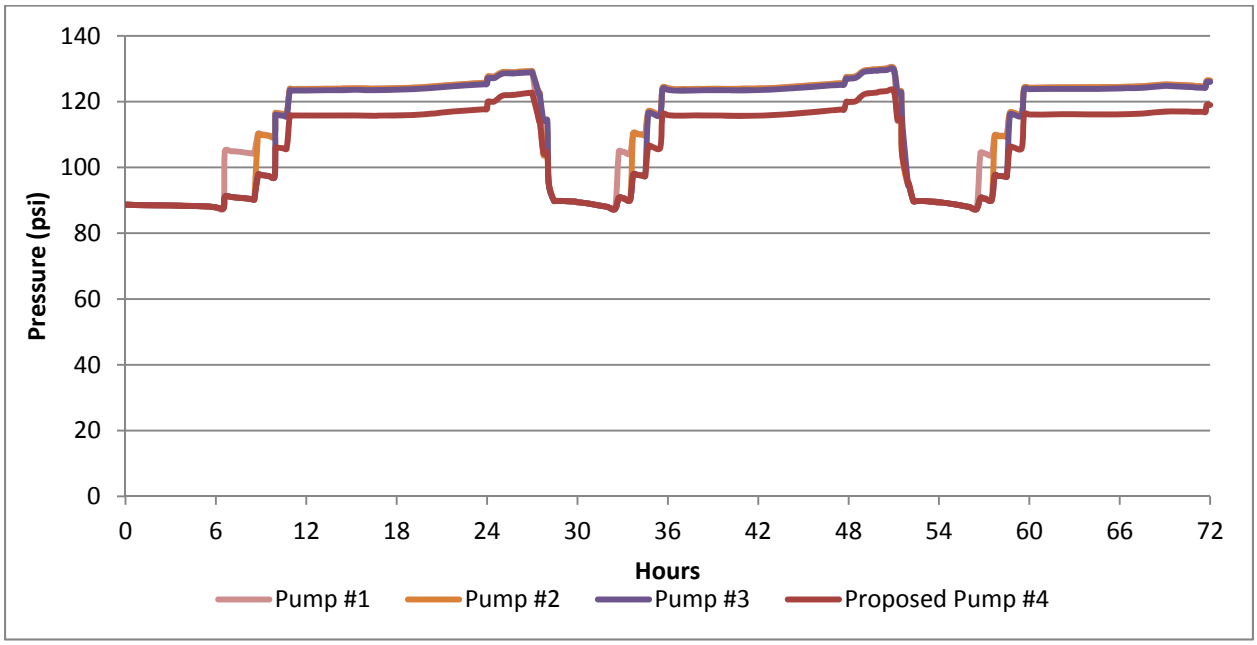


Figure 4-2 Celina Road Pump Station Pressure Results for 2018



In 2025 a 5th pump is required to continue supplying the increased demand. Again, the proposed pumps are modeled as the same size as the existing CRPS pumps. Figure 4-3 and Figure 4-4 show the flow and pressure simulation results for 2025.

Figure 4-3 Celina Road Pump Station Flow Results for 2025

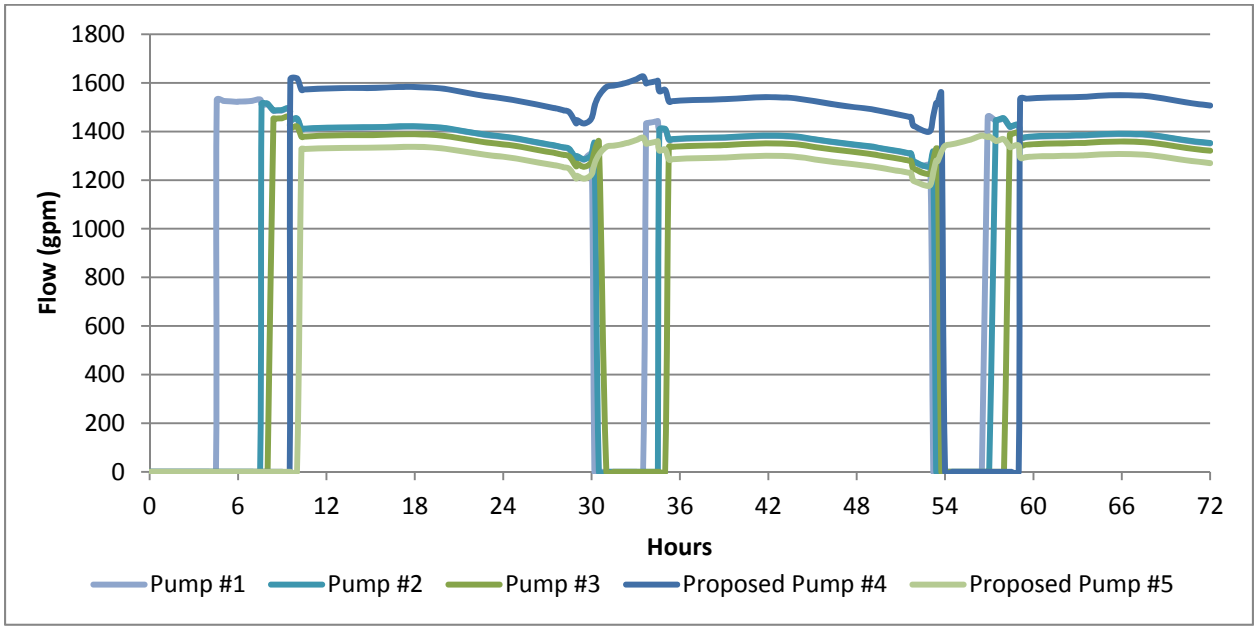
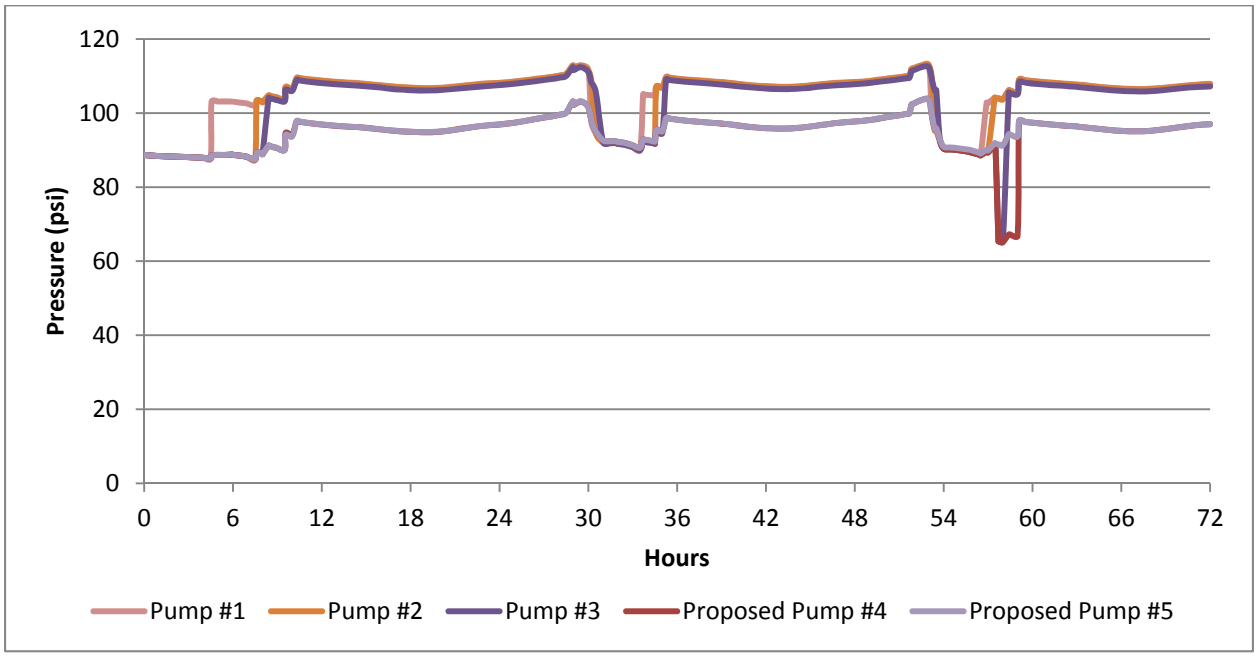


Figure 4-4 Celina Road Pump Station Pressure Results for 2025



The drop in pressure at hour 58 shown in Figure 4-4 is due to multiple pumps switching on at both the CRPS and the DTPS at the same time. The model controls were optimized as much as possible to reduce the pressure spikes and drops by lagging the pump controls but could not be entirely eliminated. Further optimization can be obtained when the actual pumps are installed and field tests are run.

4.1.1.2 Downtown Pump Station Improvements

The existing DTPS is capable of meeting the Zone 2 system needs until 2019. With projected growth beyond 2019, the existing DTEST does not have enough capacity to meet the Zone 2 demands via the DTPS while maintaining minimum pressures. For Zone 2 demands beyond 2019, one additional pump is required. The proposed pump was modeled as the same size as the existing DTPS pump #4. The DTPS is controlled by the MLEST levels until 2017 when it switches to the proposed 2 Mgal Carter Ranch EST (CREST). Figure 4-5 and Figure 4-6 show the flow and pressure simulation results for 2019.

Figure 4-5 Downtown Pump Station Flow Results for 2019

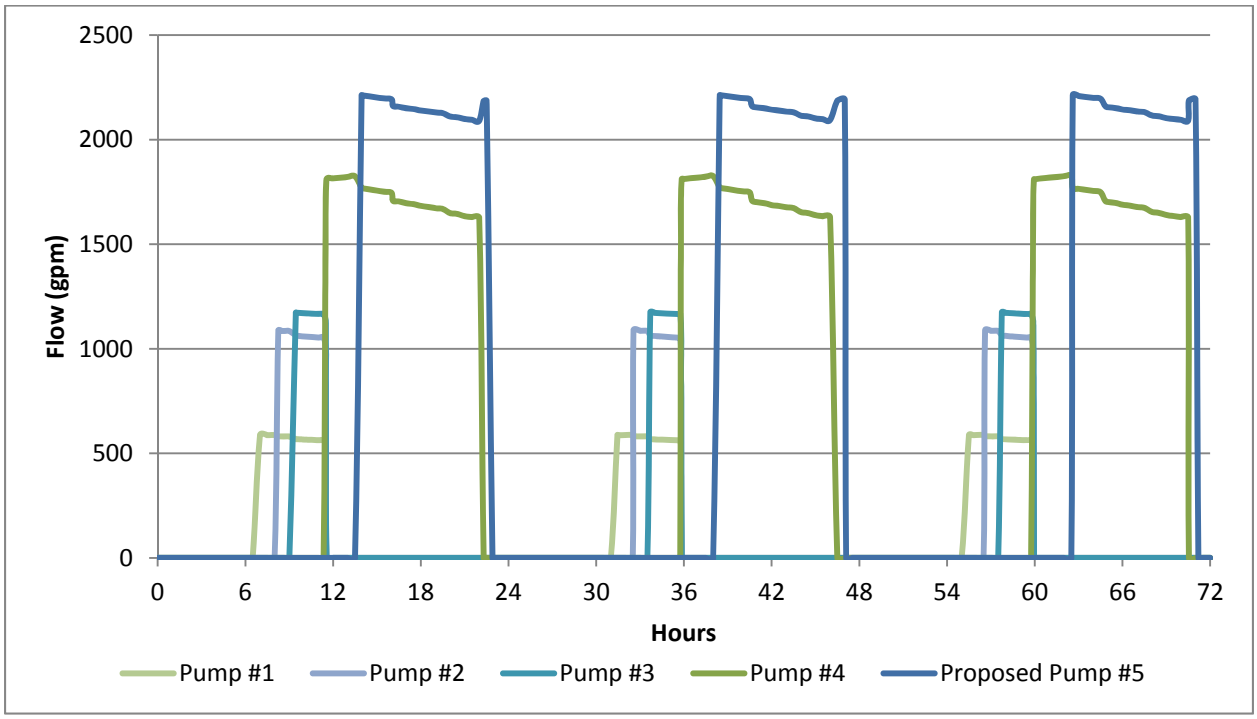
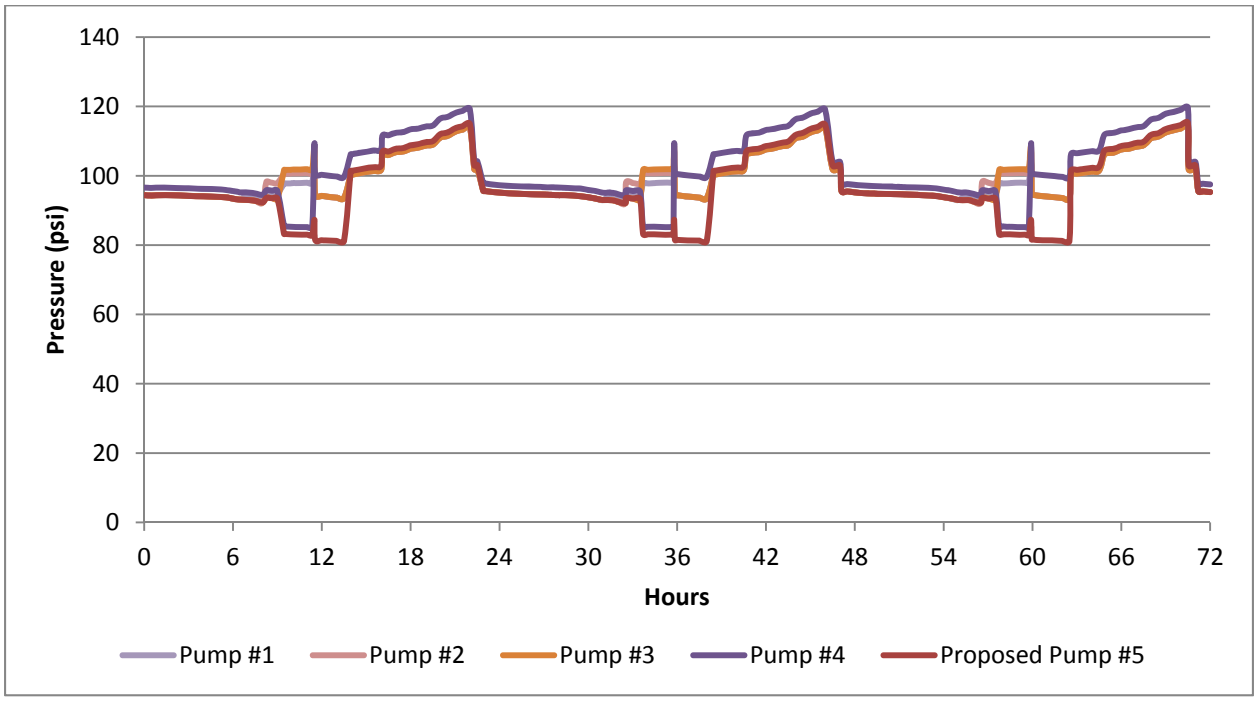


Figure 4-6 Downtown Pump Station Pressure Results for 2019



4.1.1.3 Pump Station Improvement Summary

Based on the simulation scenarios, installation of three additional pumps is recommended. Two pumps should be installed at the CRPS, one in 2018 and another in 2025. The third pump should be installed in the DTPS in 2019. The pump station improvements are contingent on the additional recommended capital improvements to the elevated storage and waterlines described in the next sections.

4.1.2 Storage Tanks

4.1.2.1 Proposed Zone 2 Elevated Storage Tank

During the 2017 development scenario, additional elevated storage is needed in the southeast sector (Zone 2). The peak demand drains the existing LFEST and existing DTEST to keep the MLEST filled. There is wide spread low pressures in the SE sector as well as Downtown. The proposed 2 Mgal CREST location is off of the recommended 24-inch waterline along Coit Rd between Sunset Blvd and CR-84, east of the Carter Ranch development. This tank is modeled with the same overflow elevation as the MLEST, 917 ft msl. Figure 4-7 and Figure 4-8 show the model results in 2017 without and with the proposed 2 Mgal CREST. Once the proposed tank is added to Zone 2, the DTPS does not drain the tanks in Zone 1 (LFEST and DTEST) in order to feed the MLEST.

Figure 4-7 2017 EST Model Results, Scenario 1: Existing EST Levels

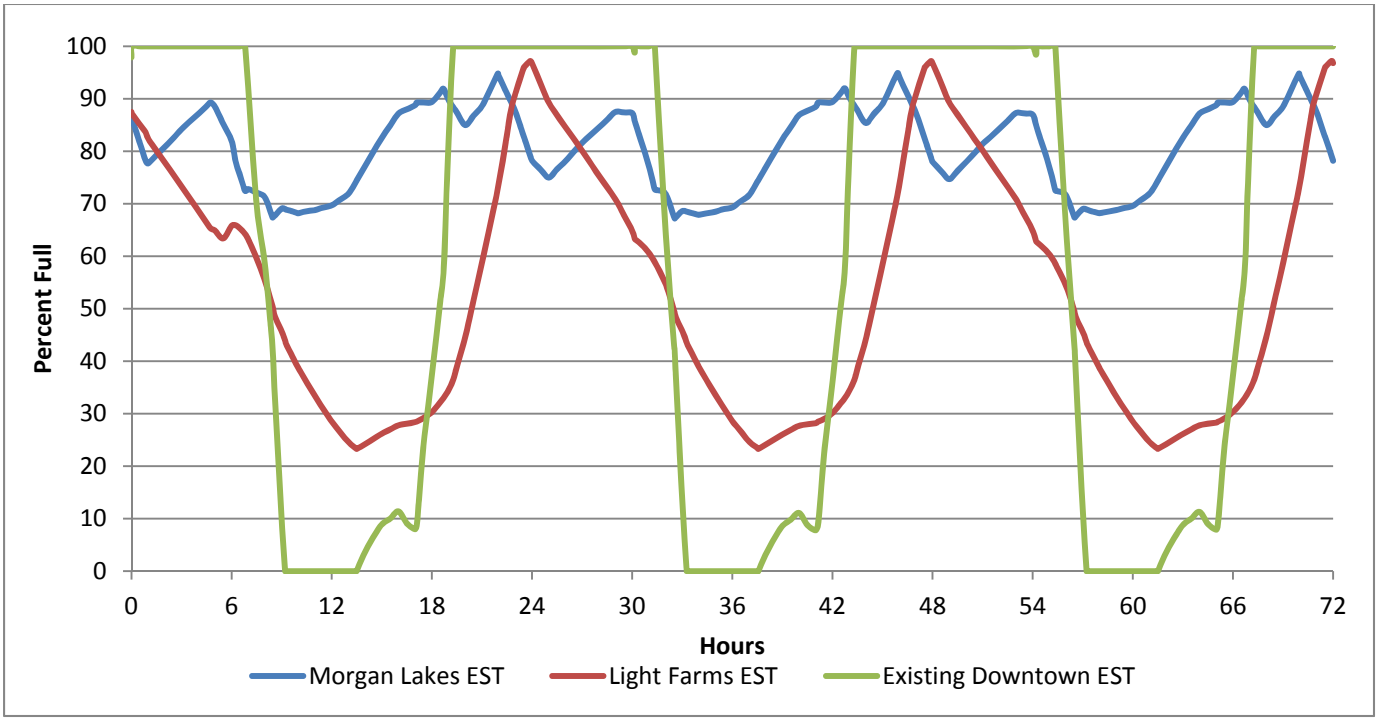
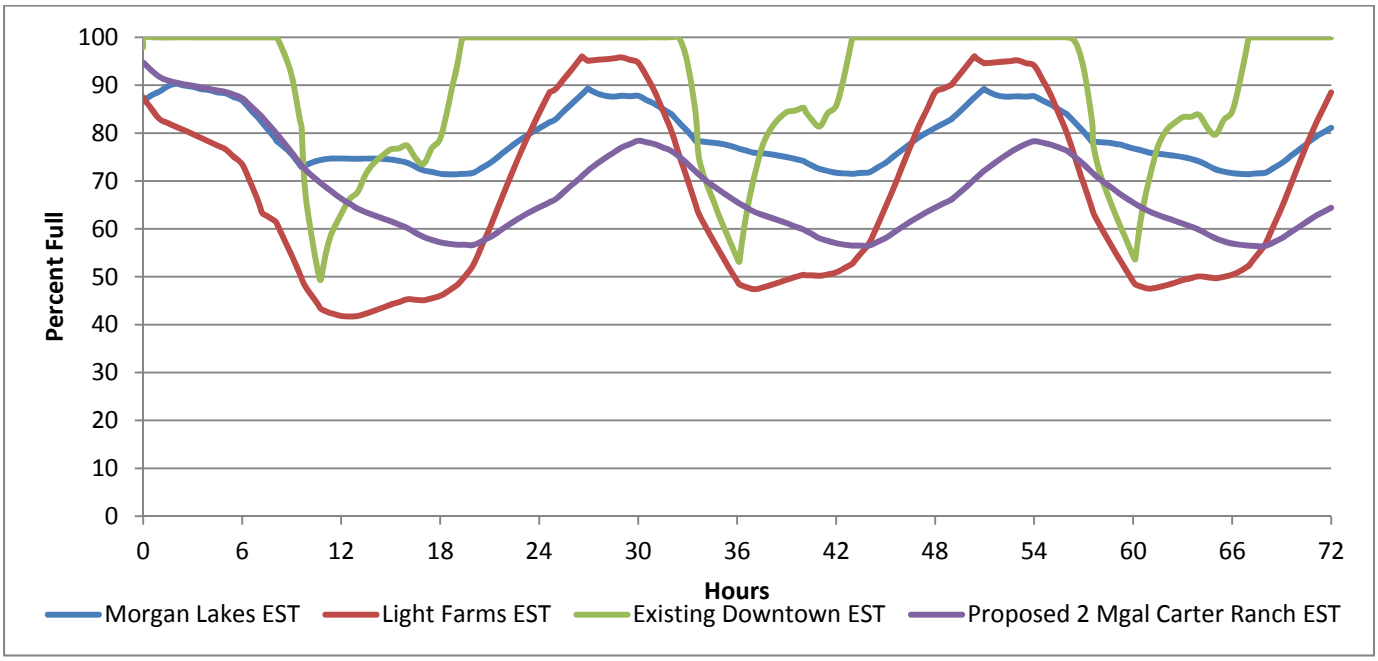


Figure 4-8 2017 EST Model Results, Scenario 2: Proposed 2 Mgal CREST



As shown in the figures above, the proposed 2 Mgal CREST assists the entire distribution system in both the upper and lower pressure planes. Without the new tank, the LFEST dips to almost 20% capacity and the existing DTEST is completely drained. The increased demands in Zone 2 cause the DTPS to pump constantly, effectively draining Zone 1. Adding the proposed storage east of Carter Ranch provides the necessary flow equalization that allows the DTPS to run less often and keeps both pressure planes above minimum allowable pressures.

4.1.2.2 Proposed Downtown Elevated Storage

Even after the proposed 2 Mgal CREST is online, the existing DTEST does not have enough capacity to maintain minimum pressures in Zone 1. The increased demands in 2018 drain the DTEST. During the simulations, it was determined that a new 2 Mgal Downtown EST, replacing the existing DTEST, would be required in 2018 to feed the DTPS and provide flow equalization for Zone 1. The proposed EST was modeled with the same overflow elevation as the existing LFEST at 835 ft msl. Figure 4-9 and Figure 4-10 show the model results with and without the proposed 2 Mgal Downtown EST. Once the proposed 2 Mgal Downtown EST is online, Zone 1 can feed Zone 2 without creating low pressures and critically low tank levels.

Figure 4-9 2018 EST Model Results, Scenario 1: Existing Downtown EST

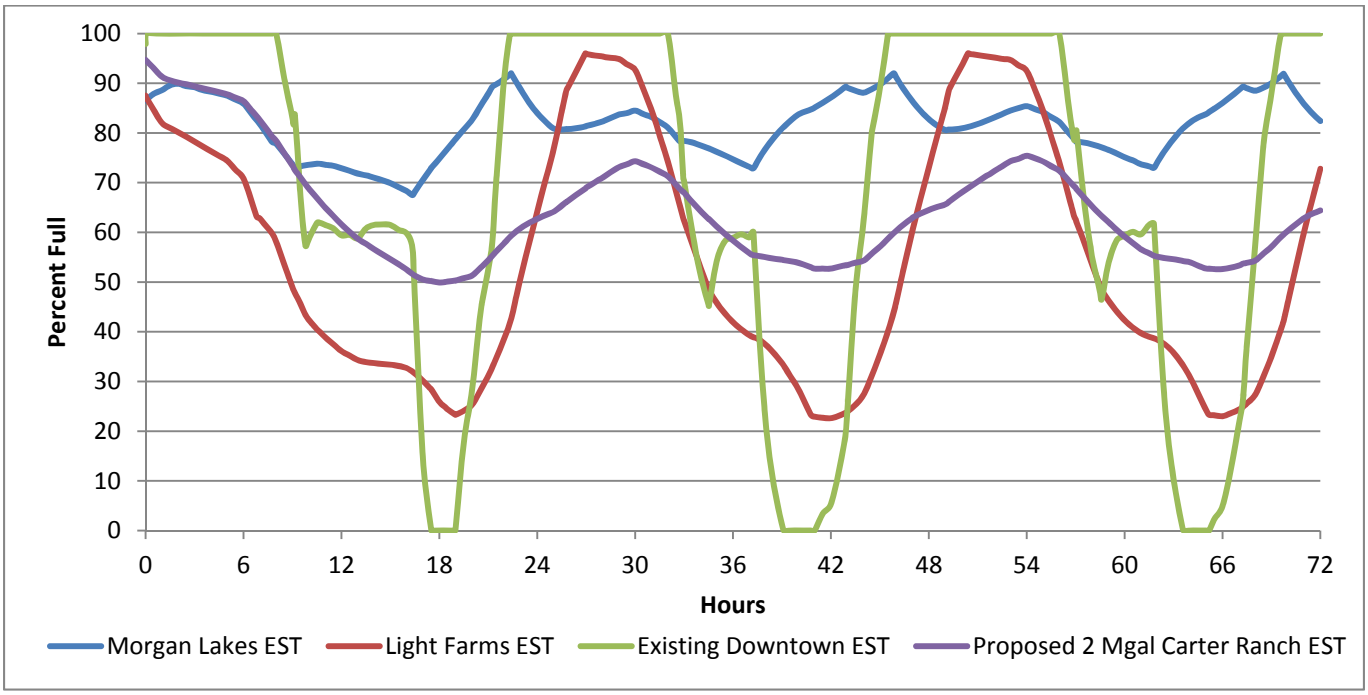
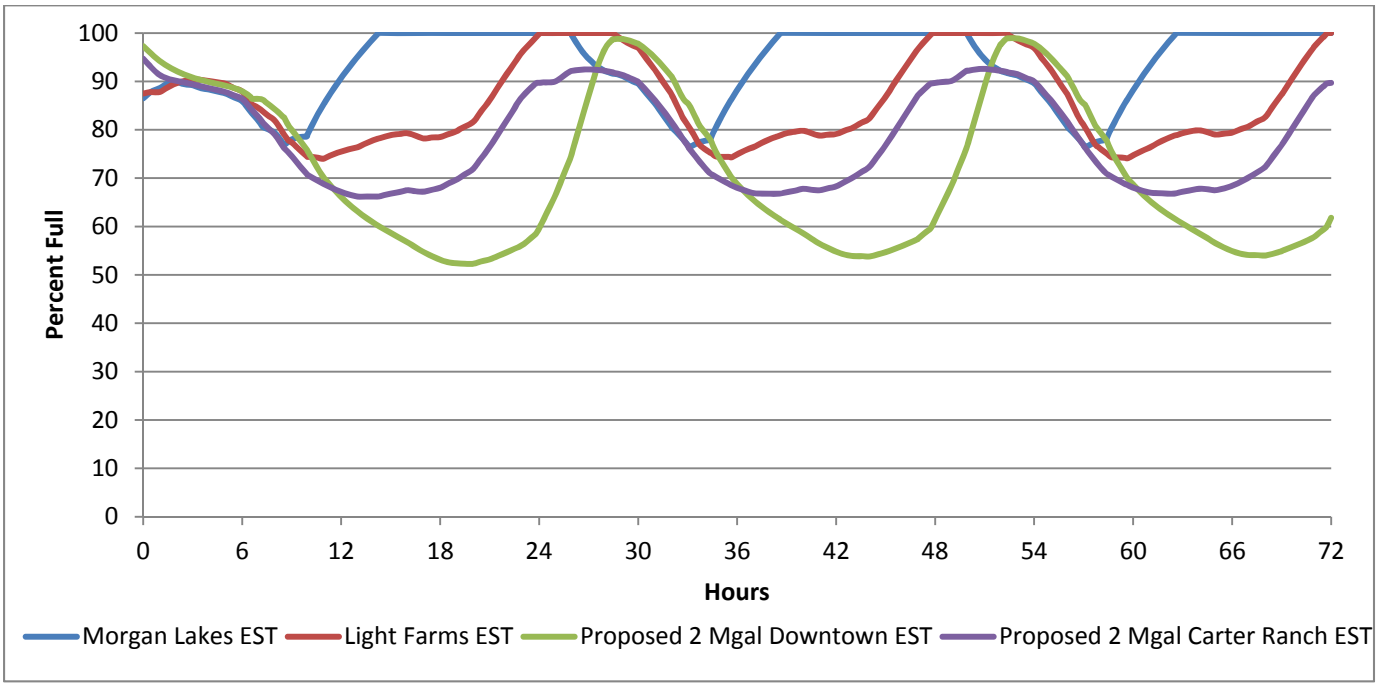


Figure 4-10 2018 EST Model Results, Scenario 2: Proposed 2 Mgal Downtown EST

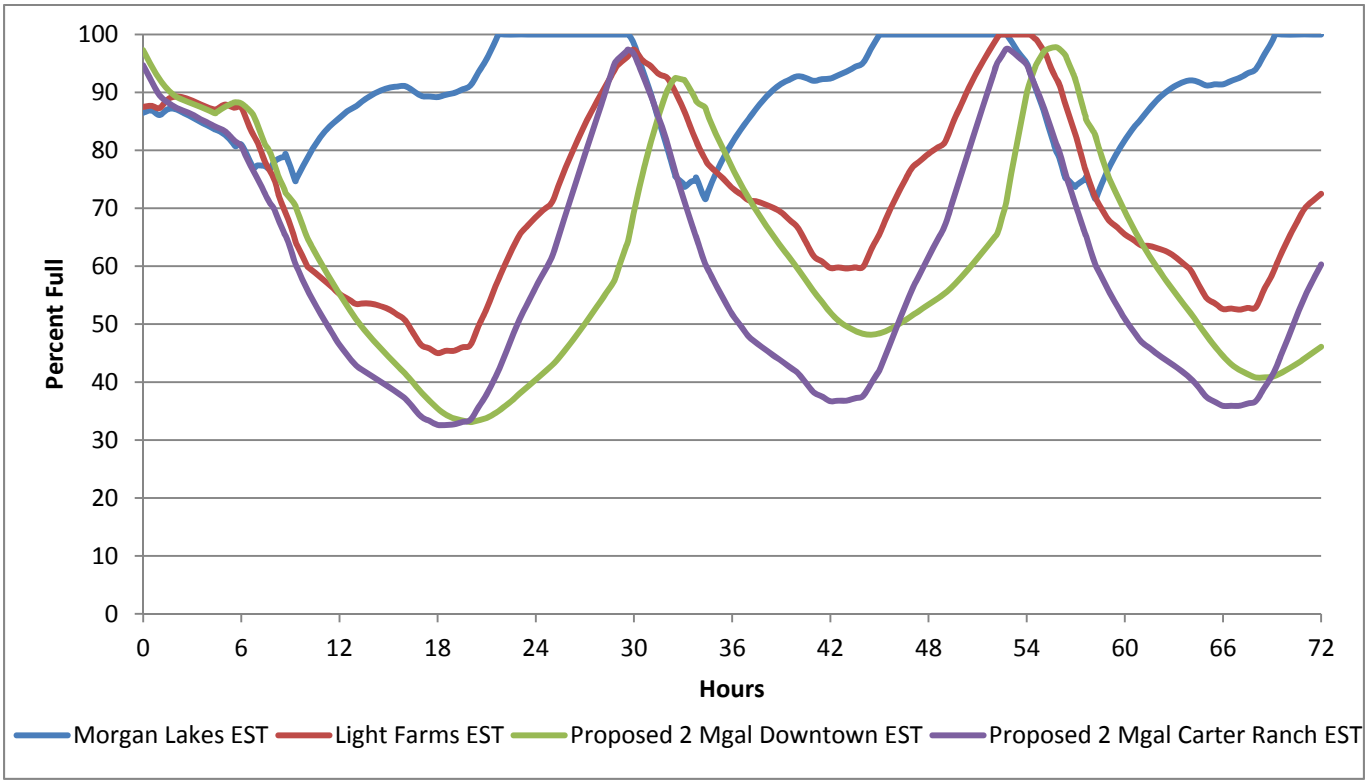


Note: The Existing DTEST is decommissioned in Scenario 2

4.1.2.3 Elevated Storage Results Summary

With the proposed tank improvements, the system is able to support the projected developments through 2030 as shown in Figure 4-11.

Figure 4-11 EST Model Results for 2030



During the scenario modeling, maintaining pressures and tank levels was only achieved when both the proposed 2 Mgal CREST and proposed 2 Mgal Downtown EST are online. Scenarios where only a single, larger EST at each location were simulated but were not successful. This is because both pressure planes need additional capacity and flow equalization in order to support the increased demand from the developments.

4.1.3 Waterline Improvements

4.1.3.1 Pressures & Velocity

The Light Farms, Carter Ranch, and Creeks at Legacy developments had high static pressures in the evening when demand is low. The pressures range from 90 psi during high demand to 115 psi during low demand. If the high nighttime pressures are an issue with the residents, a pressure reducing valve (PRV) can be installed on the line feeding these developments, or individual PRVs at each connection.

Velocity in the pipes leaving the CRPS and entering the DTPS can reach above 5 fps, but does not exceed 8 fps. Future high velocity issues are alleviated when a parallel line between CRPS and DTPS is constructed (proposed for 2019).

4.1.3.2 Proposed Waterlines

Various alternative waterline improvements were modeled to keep the tanks filled, yet cycling for mixing, without creating either high or low pressures in the system. For example, in Zone 2 two alternatives were modeled to keep the MLEST filled and the pressures above minimum. Extending the 24-inch Coit Rd waterline north from Sunset Blvd to the MLEST generated pressure issues and still needed improvements to the waterline leaving the DTPS to be successful. Whereas the other alternative, a parallel line from the DTPS to MLEST following the existing route was successful in filling the EST through 2030.

Modeling waterline alternatives used the following priorities:

1. shortest route and smallest diameter
2. increase diameter
3. alternate route

The chosen Phase 1 waterline capital improvements are shown in Exhibit 2. Table 4-1 in the next section lists the minimum pipe sizes along the shortest necessary routes.

Along with the increased capacity, improvements to the existing waterlines are recommended. In Zone 2 the waterline along Sunset Blvd. (12-inch diameter), Coit Rd (18-inch diameter) and CR-84 (12-inch diameter) currently being designed should be upsized. The timing of the delivery of water to Celina from NTMWD is key to the sizing of the waterline in Coit Road. During the analysis this waterline was unable to supply the proposed 2 Mgal CREST in 2025. Since this line is still in the design phase, it is recommended the diameter be increased to a minimum of 20-inch along Sunset Blvd and Coit Rd, to 16-inch along CR-84 and kept at 12-inch across the Bridle Bend cul-de-sac. However, with the uncertainly of NTMWD's timing on the delivery water to Celina and the potential for substantial development along Coit Road prior to the availability of water from NTMWD, it is recommended that the waterline along Coit Road be sized as a 24-inch. Increasing the waterline size should be a priority because it is the main line feeding the proposed 2 Mgal CREST and the southeast sector developments. Not to mention, as a main thoroughfare, Coit Rd will likely attract additional substantial developments in the near future.

In Zone 2 a parallel waterline from the DTPS to the MLEST is recommended in 2016. Alternate routes were simulated, but ultimately the best option for keeping the MLEST filled and cycling for mixing is a 12-inch parallel waterline along the existing route. It is recommended that a new line be built from the DTPS along E. Ash St where it can tie in and align with the existing 12-inch waterline along Preston Rd. From there, the parallel 12-inch will continue to Settlers Ridge Rd then east to the MLEST. Since this waterline is intended to supply the upper pressure plane, no connections should tie into the line along E. Ash St.

As the southeast sector expands, the waterline between the CRPS and the DTPS is eventually unable to supply the DTEST. Therefore in 2019, it is recommended that a parallel 20-inch waterline along Celina Rd to the DTPS be constructed. Additionally, in 2025 an 18-inch parallel waterline south along Dallas Pkwy to the LFEST is needed. A few other waterline extensions and parallel waterlines are proposed to maintain pressures, increase equivalencies, and supply the future developments.

4.1.4 Phase 1 Capital Improvements Summary

Table 4-1and Exhibit 2 summarize the recommended water capital improvements identified from the modeling efforts for Phase 1 – 2015 through 2030.

Table 4-1 Phase 1 Recommended Capital Improvements

Year	#	Size	Approximate Length (ft)	Capital Improvement Needs
2015	1	24"	5,500	Waterline along Sunset Blvd from CR-89 to Coit Rd (W1)
	2	24"	14,700	Waterline along Coit Rd from Sunset Blvd to CR-84 (W2)
	3	16"	1,500	Waterline along CR-84 to tie-in with 12" through Bridle Bend cul-de-sac
	4	12"	1,200	Waterline from CR-84 through Bridle Bend cul-de-sac
2016	1	12"	12,500	Parallel Waterline from Downtown Pump Station: Across E Ash St to Preston Rd, then to Settlers Ridge Rd to Morgan Lakes EST
	2	12"	1,500	Connection between Light Farms and Ownsby Farms
	3	12"	8,000	Connection between Light Farms and Creeks at Legacy
2017	1	2 Mgal		Carter Ranch EST (overflow elevation 917 ft msl)
	2	16"	3,800	Parallel Waterline along CR-84 from 12" tie-in north of Bridle Bend to Frontier Pkwy
	3	16"	1,400	Waterline along CR-84 from CR-83 to Coit Rd
	4	24"	1,200	Waterline from Coit Rd into Carter Ranch EST
2018	1			Additional Pump at Celina Rd PS (Same Size as Existing Pumps)
	2	2 Mgal		New Downtown EST (overflow elevation 835 ft msl)
2019	1			Additional Pump at Downtown PS (Same Size as Existing Pump #4)
	2	20"	20,800	Parallel Waterline from Celina Rd PS to Downtown EST
	3	16"	2,000	Parallel Waterline from Coit Rd along CR-84
	4	12"	1,800	Parallel Waterline along Preston Rd from E Ash St to Sunset Blvd
2025	1			Additional Pump at Celina Rd PS (Same Size as Existing Pumps)
	2	18"	13,000	Parallel Waterline along S Dallas Pkwy from FM-428 to Light Farms EST
2030	1	16"	1,500	Parallel Waterline along Sunset Blvd from Preston Rd to CR-89

Upon completion of this analysis, 3 additional pumps are needed in the system. The CRPS requires a 4th pump, similar size to the existing pumps, in 2018, and then a 5th pump is needed in 2025. At the DTPS, a 5th pump, similar size to existing pump #4, is needed in 2019.

However, upgrading the pump stations alone cannot meet the dramatically increasing demands. Therefore, additional capital improvements including new elevated storage and increased pipeline capacity are recommended in conjunction with the pump station improvements in order to satisfy the projected demands.

Two 2 Mgal ESTs are also recommended. First, a 2 Mgal EST off the 24-inch Coit Rd waterline east of the Carter Ranch development is recommended in 2017. The following year, 2018, a new 2 Mgal Downtown EST is recommended. The CREST is recommended in order to maintain pressures in the southeast sector as demand increases. The existing MLEST is unable to support the southeast sector beyond 2016 and cannot maintain pressures above 35 psi. With the increased demand and storage in the southeast sector, the existing DTEST is drained and unable to recover creating low pressures in the entire system. The proposed 2 Mgal Downtown EST is recommended to provide sufficient storage to keep downtown pressures above minimum while the pumps are supplying the proposed 2 Mgal CREST and existing MLEST.

Lastly, approximately 90,000 ft of additional waterline is recommended throughout the south and southeast sector as development expands. The timing of the proposed waterlines is based on the projected phasing of the planned developments but could be needed sooner depending on actual construction.

The recommended sizes for the tanks, pumps and waterlines are only sufficient for the estimated demands through 2030 and from water supplied by the UTRWD through the CRPS.

4.2 Phase 2 – Ultimate Development

Projecting and distributing ultimate build out demand across the entire service area requires drastic improvements. The ultimate plan assumes that there is a pipe network providing pipe equivalencies supplying the ESTs and meeting demands. However, depending on the timing of the actual expansion, these recommended improvements will need to be reevaluated during the design process. The pump, tank, and waterline sizes may need to be increased or decreased depending on the growth patterns.

For instance, if a developer plans to build in the far north quadrant, where there is currently no infrastructure to provide equivalencies, the line sizes will need to be increased due to lack of a grid. Likewise, if an extensive grid is already built, the development could be supplied by smaller waterlines than recommended in this section.

The model assumed a standard waterline grid in order to feed the entire service area. These smaller grid pipes are not shown in Exhibit 1.

4.2.1 Pump Station Improvements & Additional Storage

4.2.1.1 Zone 1

Currently, water is delivered to the CRPS where it is pumped to the DTPS and LFEST. In order for this pump station to supply the demands in the ultimate built out Zone 1, the pumps will need to be replaced with 4 much larger pumps. The current pumps, described previously in Section 2.1.1.1, are capable of pumping up to 3,000 gpm. To meet the ultimate demands, the CRPS pumps will need to have a total pumping capacity of 44,000 gpm.

Two additional EST are needed for ultimate build out to meet the minimum storage requirements. The storage is split between two, 3 Mgal tanks adjacent to the planned thoroughfares. The lines feeding these tanks are sized using a model grid. The actual size of these water lines will be determined on the growth pattern of the developments and the pipe equivalencies. The ESTs and preliminary water line sizes are shown in Exhibit 1.

The CRPS will need additional ground storage as the number of connections increases. This site should include at least two, 5 Mgal GSTs.

4.2.1.2 Zone 2

The City has plans to purchase water from NTMWD in the near future. When this happens, a new delivery point pump station and ground storage tanks will need to be built. The delivery point was modeled in order to meet ultimate build demands. These pumps will need to have a total pumping capacity of 50,000 gpm. When the new NTMWD delivery point pump station is online, the existing DTPS should be decommissioned. The DTPS which currently feeds Zone 2 is only capable of pumping 1,800 gpm. The NTMWD delivery point will also need 10 Mgal of storage split between two 5 Mgal GSTs in order to meet minimum storage requirements.

Zone 2 has the existing 0.5 Mgal MLEST and a proposed 2 Mgal CREST. Additional connections will require an additional 6 Mgal which was split into two 3 Mgal ESTs in the far north east quadrant located along planned thoroughfares. The lines feeding these tanks are sized using a model grid. The actual size of these water lines will be determined on the growth pattern of the developments and the pipe equivalencies. The ESTs and preliminary water line sizes are shown in Exhibit 1.

4.2.1.3 Zone 3

If the City decides to move forward with a third pressure plane in the future, the existing CRPS can be modified to supply both Zone 1 and Zone 3. The pumps and waterlines supplying the respective pressure planes will need to function independently. However, the pumps can be in the same building and be supplied from the same GSTs. The Zone 3 pumps will need to have a total pumping capacity of 27,000 gpm.

A 3 Mgal EST is required if the City decides to create the new pressure plane. The main benefit of the third pressure plane is reducing water pressures below 100 psi. This area has an elevation

as low as 550 ft msl, where Zone 1 has elevations reaching 720 ft msl. The EST in the new pressure plane was modeled with an overflow elevation of 785 ft msl, as opposed to 835 ft msl in the middle pressure plane. Lowering the overflow elevation reduces the pressures in the quadrant to more acceptable ranges.

4.2.2 Waterline Improvements

Future pipe locations were primarily located to follow the proposed roadway alignments on the City 2013 Thoroughfare Map. These pipes range from 8 inches to 42 inches in diameter. ESTs were added at high points in the system near the planned thoroughfares.

As mentioned, waterlines were laid out according to the thoroughfare plan and a hypothetical pipe network grid was used in the model to simulate actual development. A layout of the proposed system and elevated storage tank locations is shown on Exhibit 1.

4.2.3 Phase 2 Capital Improvements Summary

For the ultimate build out of the City's water distribution system, the following capital improvements listed in Table 4-2 are proposed for consideration as expansion and development continues in the service area.

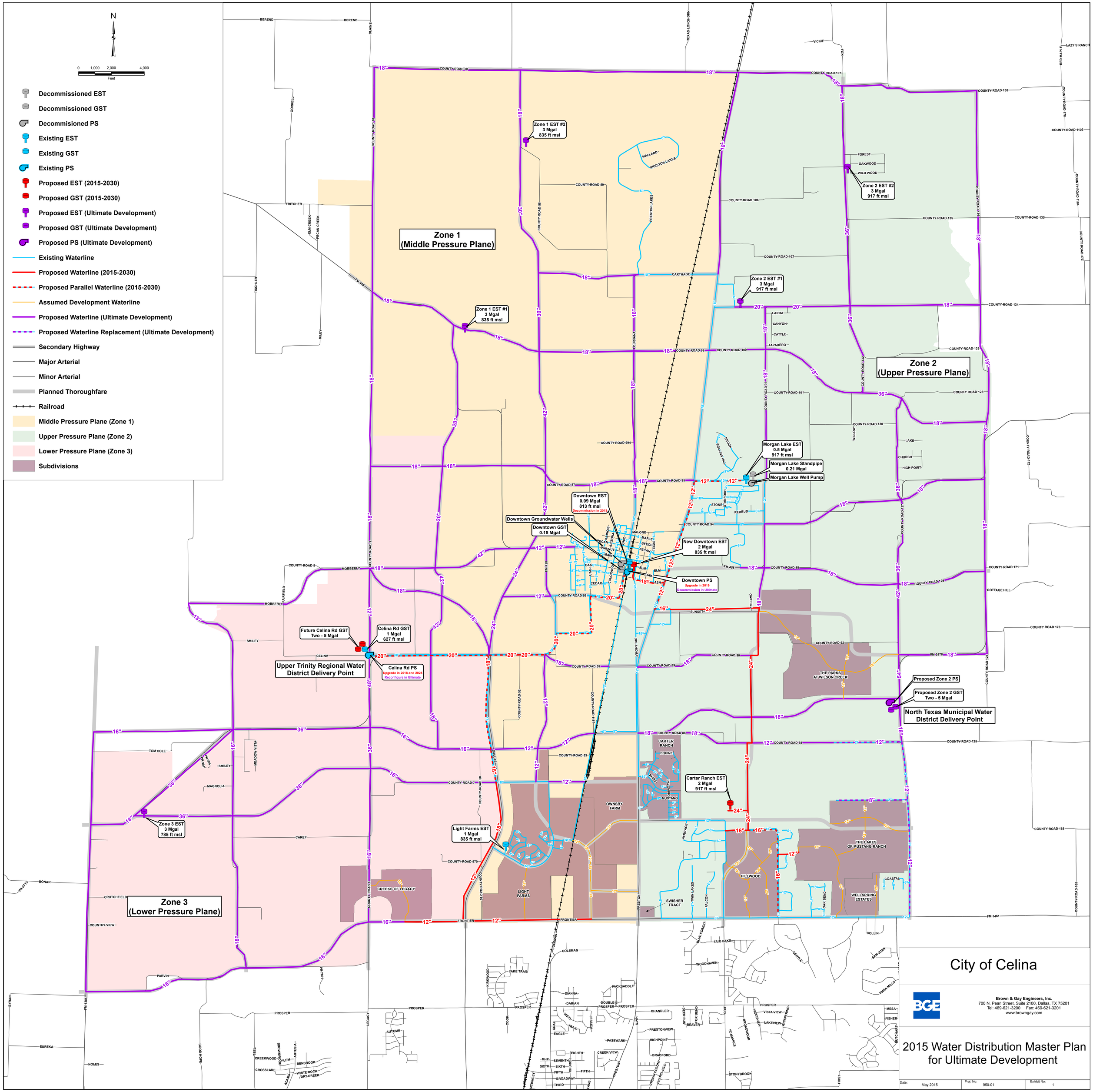
Table 4-2 Phase 2 Recommended Capital Improvements

Item	Size	Quantity			
		Zone 1	Zone 2	Zone 3	Total
Waterline	8"	0	4,300	0	4,300
	12"	25,100	19,900	5,300	50,300
	16"	400	0	74,800	75,200
	18"	113,800	173,800	59,400	347,000
	20"	14,400	6,700	6,200	27,300
	24"	7,000	300	0	7,300
	30"	12,600	0	0	12,600
	36"	0	27,600	34,200	61,800
	42"	24,100	4,300	0	28,400
	48"	0	0	3,300	3,300
Elevated Storage Tank	3 Mgal	2	2	1	5
Ground Storage Tank	5 Mgal	2	2		4
Pumps	TBD	4	5	3	12

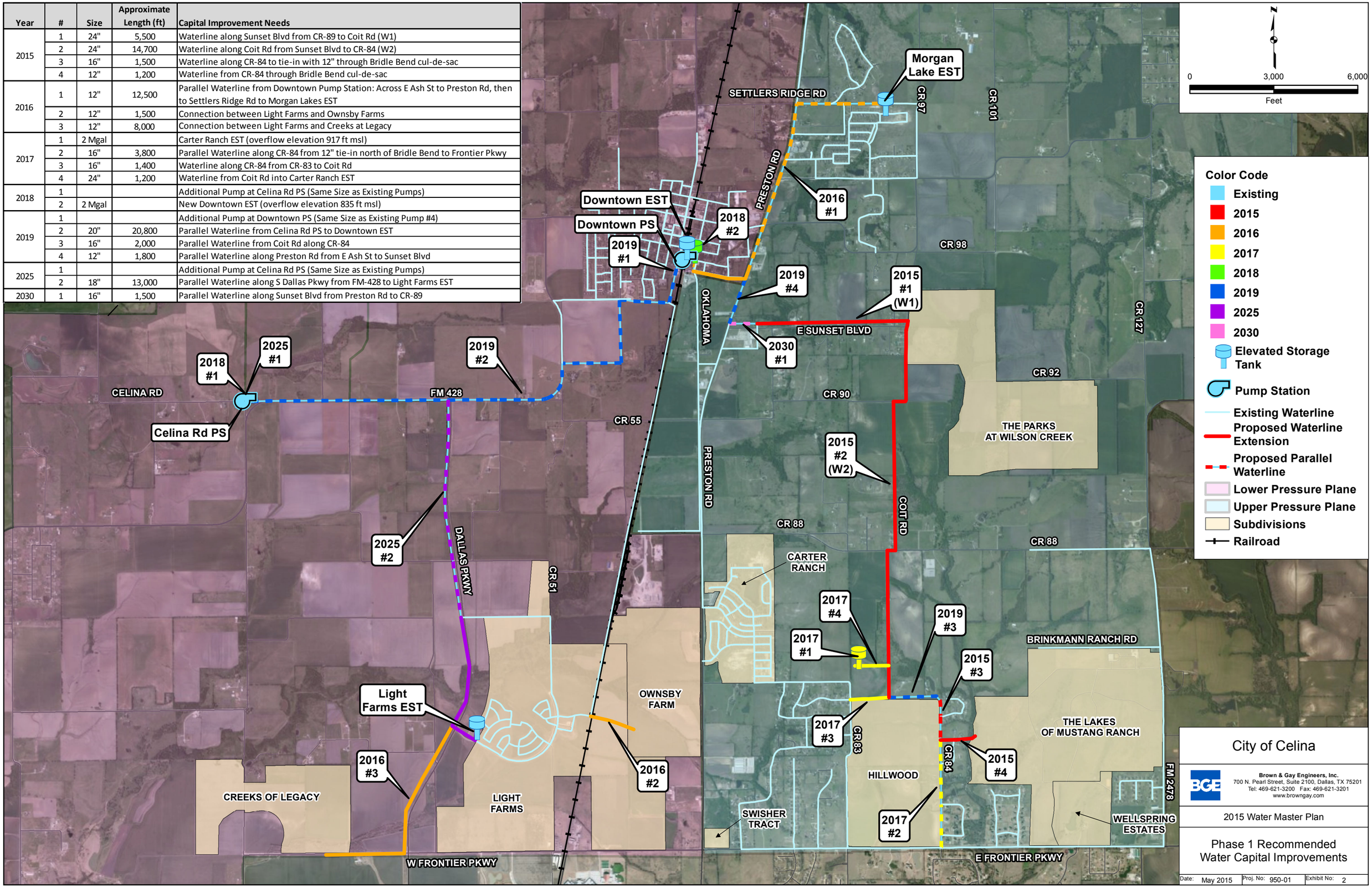
4.3 Conclusion

These recommended improvements are dependent on the timing and distribution of new development throughout the service areas. Two milestone projects to consider when planning these capital improvements in the addition of NTMWD water supply and the creation of a third

pressure plane. New development in Zone 2 will be impacted when supply is switched from the DTPS to the new NTMWD delivery point and waterline sizes might need to be larger or smaller depending on that timing. New development in Zone 3 will be impacted on the timing of the reconfiguration of the existing CRPS in order to supply both Zone 1 and Zone 3. Until this reconfiguration is complete, new development in the southwest quadrant will be supplied through the Zone 2 water distribution.


N
0 1,000 2,000 4,000
Feet
Decommissioned EST
Decommissioned GST
Decommisioned PS
Existing EST
Existing GST
Existing PS
Proposed EST (2015-2030)
Proposed GST (2015-2030)
Proposed EST (Ultimate Development)
Proposed GST (Ultimate Development)
Proposed PS (Ultimate Development)
Existing Waterline
Proposed Waterline (2015-2030)
Proposed Parallel Waterline (2015-2030)
Assumed Development Waterline
Proposed Waterline (Ultimate Development)
Proposed Waterline Replacement (Ultimate Development)
Secondary Highway
Major Arterial
Minor Arterial
Planned Thoroughfare
Railroad
Middle Pressure Plane (Zone 1)
Upper Pressure Plane (Zone 2)
Lower Pressure Plane (Zone 3)
Subdivisions
Zone 1
(Middle Pressure Plane)
Zone 2
(Upper Pressure Plane)
Zone 3
(Lower Pressure Plane)
Zone 1 EST #2
3 Mgal
835 ft msl
Zone 1 EST #1
3 Mgal
835 ft msl
Zone 2 EST #2
3 Mgal
917 ft msl
Zone 2 EST #1
3 Mgal
917 ft msl
Morgan Lake EST
0.5 Mgal
917 ft msl
Morgan Lake Standpipe
0.21 Mgal
Morgan Lake Well Pump
Downtown EST
0.09 Mgal
813 ft msl
Decommission in 2018
Downtown Groundwater Wells
Downtown GST
0.15 Mgal
New Downtown EST
2 Mgal
835 ft msl
Downtown PS
Upgrade in 2019
Decommission in Ultimate
Future Celina Rd GST
Two - 5 Mgal
Celina Rd GST
1 Mgal
627 ft msl
Celina Rd PS
Upgrade in 2018 and 2025
Reconfigure in Ultimate
Upper Trinity Regional Water District Delivery Point
Proposed Zone 2 PS
Proposed Zone 2 GST
Two - 5 Mgal
North Texas Municipal Water District Delivery Point
Carter Ranch EST
2 Mgal
917 ft msl
Zone 3 EST
3 Mgal
785 ft msl
Light Farms EST
1 Mgal
835 ft msl
City of Celina
BGE
Brown & Gay Engineers, Inc.
700 N. Pearl Street, Suite 2100, Dallas, TX 75201
Tel: 469-621-3200 Fax: 469-621-3201
www.browngay.com
2015 Water Distribution Master Plan
for Ultimate Development
Date: May 2015
Proj. No: 950-01
Exhibit No: 1

Year	#	Size	Approximate Length (ft)	Capital Improvement Needs
2015	1	24"	5,500	Waterline along Sunset Blvd from CR-89 to Coit Rd (W1)
	2	24"	14,700	Waterline along Coit Rd from Sunset Blvd to CR-84 (W2)
	3	16"	1,500	Waterline along CR-84 to tie-in with 12" through Bridle Bend cul-de-sac
	4	12"	1,200	Waterline from CR-84 through Bridle Bend cul-de-sac
2016	1	12"	12,500	Parallel Waterline from Downtown Pump Station: Across E Ash St to Preston Rd, then to Settlers Ridge Rd to Morgan Lakes EST
	2	12"	1,500	Connection between Light Farms and Ownsby Farms
	3	12"	8,000	Connection between Light Farms and Creeks at Legacy
2017	1	2 Mgal		Carter Ranch EST (overflow elevation 917 ft msl)
	2	16"	3,800	Parallel Waterline along CR-84 from 12" tie-in north of Bridle Bend to Frontier Pkwy
	3	16"	1,400	Waterline along CR-84 from CR-83 to Coit Rd
	4	24"	1,200	Waterline from Coit Rd into Carter Ranch EST
2018	1			Additional Pump at Celina Rd PS (Same Size as Existing Pumps)
	2	2 Mgal		New Downtown EST (overflow elevation 835 ft msl)
2019	1			Additional Pump at Downtown PS (Same Size as Existing Pump #4)
	2	20"	20,800	Parallel Waterline from Celina Rd PS to Downtown EST
	3	16"	2,000	Parallel Waterline from Coit Rd along CR-84
	4	12"	1,800	Parallel Waterline along Preston Rd from E Ash St to Sunset Blvd
2025	1			Additional Pump at Celina Rd PS (Same Size as Existing Pumps)
	2	18"	13,000	Parallel Waterline along S Dallas Pkwy from FM-428 to Light Farms EST
2030	1	16"	1,500	Parallel Waterline along Sunset Blvd from Preston Rd to CR-89



City of Celina

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2015 Water Master Plan

Phase 1 Recommended Water Capital Improvements

Date: May 2015 | Proj. No: 950-01 | Exhibit No: 2

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