HOLLISTER URBAN AREA WATER AND WASTEWATER MASTER PLAN

APPENDIX H - HOLLISTER URBAN AREA WATER DISTRIBUTION SYSTEM, WATER QUALITY ANALYSIS

Introduction

The existing dynamic water distribution model was utilized by HDR for the purpose of analyzing existing water quality components and to assist with the determination of the appropriate methodology for delivering uniform water quality throughout the system.

This technical memorandum describes the alterations and additions made to the existing distribution model in order to model the water quality in the distribution network for the following three scenarios:

- Existing Conditions,
- Phased Demineralization 2013, and
- Full Demineralization 2023

All modeling work was performed using the water distribution model within the modeling package H2OMap Water GIS Suite 8.0, developed by MWH Soft.

Hydraulic Model Alterations

Two key components were upgraded through the review of the hydraulic model. First, the original model was upgraded to the most recent software version, H2OMap Water GIS Suite 8.0, thereby facilitating the use of the latest model functionality. Second, the existing operational logic within the distribution model was reviewed for conformance with actual operation. In addition to these upgrades, the model was updated to incorporate system improvements made since the last model update.

In order to accurately represent the water quality components throughout the distribution system, it was important to confirm the operational conditions of the system. Therefore, HDR had discussions with staff from both the City of Hollister as well as Sunnyslope County Water District (SSCWD) to confirm the operational set points used for the pumps at the wells within the distribution network.

Without altering the pump curves utilized within the existing model, flow control valves were added in order to limit flows from individual wells such that they would match with historical data provided by both the City and SSCWD from April through June 2008..

Additionally, for the Existing Conditions scenario, the flow rate from the Lessalt Water Treatment Plant was reduced from 3.0-million gallons per day (MGD) to 1.8-MGD, reflecting the existing hydraulic limitation at Lessalt. Future flows from Lessalt were modeled at 3.0-MGD for the years 2013 and 2023 based on the assumption that the limitation will be corrected.

Finally, three new wells were added to the distribution network. These wells are either under construction or significantly along in the planning stage and have been included to best replicate the planned future conditions of the system. The new wells, being developed by SSCWD, are as follows:

- Well 11 (Lico)
- Well 12 (Bray)
- New Well to be located near Ridgemark Well 8

The information used for the hydraulic model is included in Table 1.

Table 1. Hydraulic Modal Data

Owner	Well ID	Zone	Tank	Pump On (ft)	Pump Off (ft)	Flow Control (gpm)
City	Memorial Booster	Middle	Fairview	21	26	
City	Memorial Booster Upgrade	Middle	Fairview	Does not exist		
SSCWD	Airline Highway	High	Ridgemark	Operated manually, if necessary		

	Booster					
City	Well 6 (Airline)	Middle	Fairview	24	28	435
City	Lessalt	Middle	N/A	N/A	N/A	1250/2100
SSCWD	Well 11 (Lico)*	Middle	Fairview	24	29	1300
SSCWD	Well 12 (Bray)*	Middle	Fairview	23.5	28.5	2000
City	Well 2 (Bunderson)	Low	Park Hill	31	34	1425
City	Well 3 (Fallon)	Low	Park Hill	27	30	930
City	Well 4 (South Street)	Low	Park Hill	31	34	1670
City	Well 5 (Nash)	Low	Park Hill	31	34	1825
City	Wright Road	Low	Park Hill	Turned off in 2002		
SSCWD	Well 1 (Southside)	Middle	Fairview	Off		
SSCWD	Well 2 (Southside)	Middle	Fairview	23	28	950
SSCWD	Well 4 (Ridgemark)	High	Ridgemark	Off		
SSCWD	Well 5 (Ridgemark)	High	Ridgemark	17	21	850
SSCWD	Well 6 (Enterprise)	Middle	Fairview	Off		
SSCWD	Well 7 (Enterprise)	Middle	Fairview	22	27	550
SSCWD	Well 8 (Ridgemark)	High	Ridgemark	18	22	800
SSCWD	New Well near Well 8 (Ridgemark)	High	Ridgemark	19	23	2000

The Sally Flat tank was previously incorporated into the hydraulic model, as well as its hydraulic connection to the low zone. This area has source water provided by the Cienaga Wells, which were not included with the original model, and effectively operates as an independent distribution network, as it is physically valved off from the rest of the distribution network south of the City. For the model, the pipeline connected to the Sally Flat tank was altered to include a check valve so that the tank would not supply or be fed water from the low zone.

Water Quality Analysis

Extended period simulations were utilized to replicate water quality conditions throughout the distribution network. The simulations were allowed to run for an extended period at either average day (ADD) or maximum day (MDD) demands in order to fully allocate source waters. Each water source within the distribution system, either a well or Lessalt, was assigned a hardness and total dissolved solids (TDS) concentration which was used to calculate the blended values, respectively, at each node in the system for the ADD and MDD simulations.

Period of Analysis

Hardness and TDS concentrations were modeled for three scenarios, Existing Conditions, Phased Demineralization 2013, and Full Demineralization 2023. Each scenario was modeled for both the ADD and MDD conditions. The key operational characteristics of each analysis are detailed below.

Existing Conditions

This scenario is based on existing water demands and well operations, and a flow rate from Lessalt limited to 1.8-MGD due to its existing hydraulic restriction.

Phased Demineralization 2013

This scenario is based on water demands projected for 2013 and the capacity of Lessalt has been restored to 3.0-MGD. Additionally, this scenario includes the three new SSCWD wells. With respect to water quality, this scenario includes SSCWD's planned softening and demineralization projects, including softening at Ridgemark Well No. 8 and demineralization at the new well near Ridgemark Well No. 8. Finally, this scenario includes demineralization at three of the City's wells in the Low Zone, including Well 2 (Bunderson), Well 4 (South Street) and Well 5 (Nash).

Full Demineralization 2023

This scenario is based on water demands projected for 2023. In addition to the improvements stated for the Phased Demineralization 2013 scenario, this scenario adds additional sites for demineralization in order to achieve the water quality goals for hardness and TDS throughout the distribution system. For the purposes of modeling, the following wells were assumed to have demineralization:

- City Well 3 (Fallon),
- SSCWD Well 2 (Southside),
- SSCWD Well 5 (Ridgemark),

- SSCWD Well 7 (Enterprise),
- SSCWD Well 11 (Lico), and
- Well 12 (Bray).

Additionally, City Well 6 (Airline) has been turned off for the Full Demineralization 2023 scenario in order to both limit the number of wells requiring demineralization and prevent water with high hardness and TDS concentrations from influencing the localized area near the well.

The water quality components for each of the three scenarios are included in Table 2.

Table 2. Water Quality Components

		Hardness (mg/L)			Total Dissolved Solids (mg/L)		
Owner	Well	Existing	Phased 2023	Full 2023	Existing	Phased 2023	Full 2023
City	Lessalt	110	110	110	300	300	300
City	Well 2 (Bunderson)	400	60	60	948	275	275
City	Well 3 (Fallon)	367	367	60	739	739	275
City	Well 4 (South Street)	434	60	60	876	275	275
City	Well 5 (Nash)	410	60	60	826	275	275
City	Well 6 (Airline)	341	341	Off	688	688	Off
SSCWD	Well 2 (Southside)	400	400	60	950	950	275
SSCWD	Well 5 (Ridgemark)	390	390	60	850	850	275
SSCWD	Well 7 (Enterprise)	420	420	60	550	550	275
SSCWD	Well 8 (Ridgemark)	400	110	110	800	555	555
SSCWD	New Well near Well 8 (Ridgemark)	400	60	60	800	275	275
SSCWD	Well 11 (Lico)*	110	110	60	550	550	275
SSCWD	Well 12 (Bray)*	110	110	60	550	550	275

Results of Analysis

The existing water quality results for ADD and MDD, for 2006, 2013 and 2023 are included in Figure 1 through Figure 6 for hardness and Figure 7 through Figure 12 for TDS.

Within the distribution system, the associated area of influence from each well would fluctuate based on demand as well as the operational status of adjacent wells. A prime example is the comparison of the Phased Demineralization 2013 results for hardness as shown in Figure 3, for ADD, and Figure 4, for MDD. In the high zone, the influence of SSCWD Well 5 (Sunnyslope) propogates further to the east and north under ADD conditions than under MDD conditions. In the low and middle zones, the effects of the fluctuation in the demands and the ability to meet those demands through the operation of the City’s Well 6 (Airline) yields a sphere of influence that has reduced water quality closer to the well and better water quality, due to blending with other water supply sources, further from the well head.

Augmentation to Previous Planning Efforts

Alternatives presented in the draft Hollister Urban Area Water and Wastewater Master Plan (February 2007) included a new loop transmission pipeline to aide system blending and deliver uniform water quality. However, using the hydraulic model to analyze the water quality in the distribution system, it was determined that the existing distribution system in combination with wellhead demineralization is sufficient to meet the water quality goals and provide uniform water quality.

City of Hollister Water Distribution System

Modeling of Water Quality - Hardness (mg/L)

Modeled Conditions:
2006 Projected Average Day Demands
Existing Field Conditions

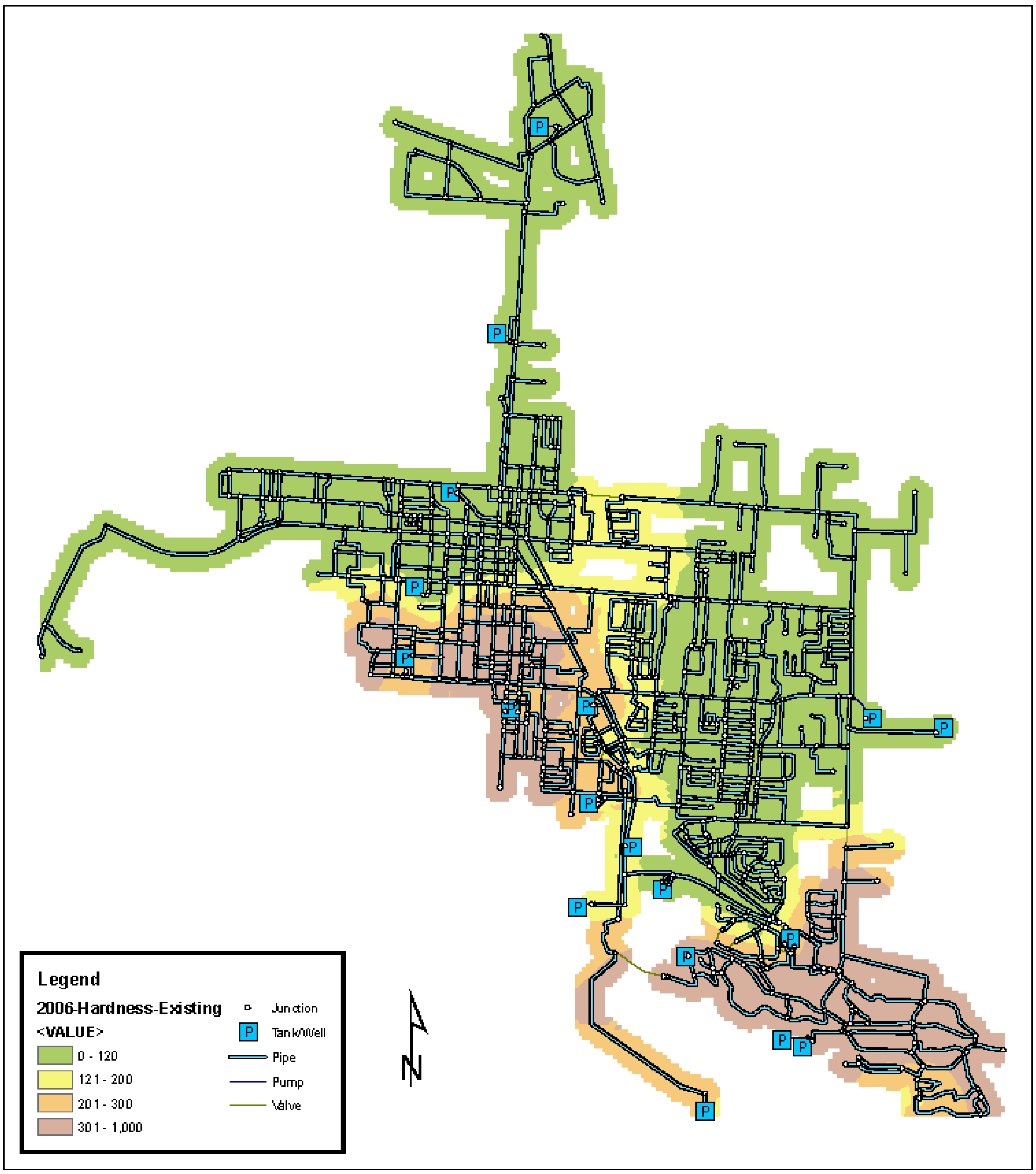


Figure 1. Existing Water Quality Results, Hardness, ADD

City of Hollister Water Distribution System

Modeling of Water Quality - Hardness (mg/L)

Modeled Conditions:
2006 Projected Maximum Day Demands
Existing Field Conditions

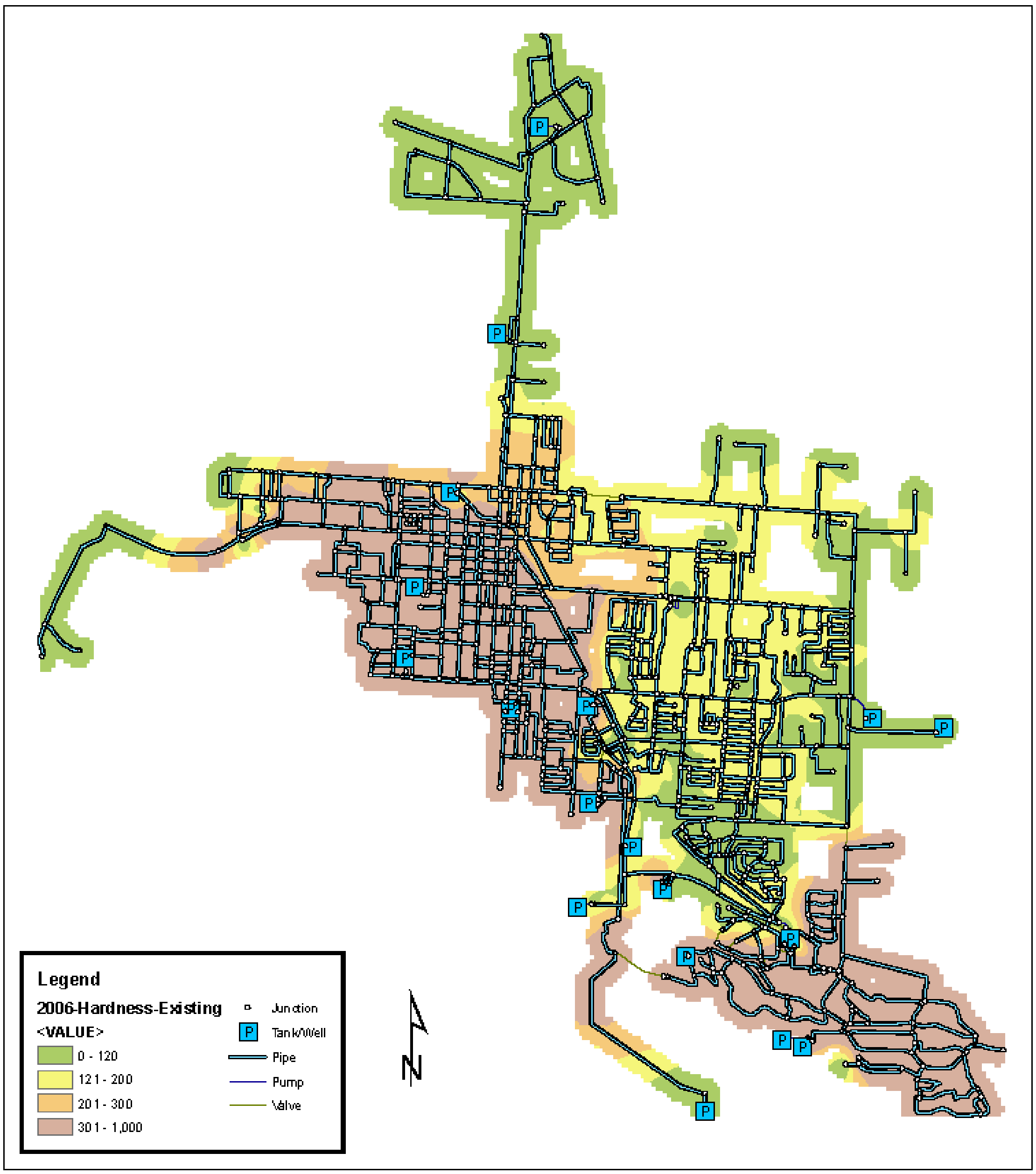


Figure 2. Existing Water Quality Results, Hardness, MDD

City of Hollister Water Distribution System

Modeling of Water Quality - Hardness (mg/L)

Modeled Conditions:
2013 Projected Average Day Demands
Existing Field Conditions
+ Improvements in SSCWD (Softening at Ridgemark Well 8; Demineralization at New Well near Ridgemark Well 8)
+ Phased Demineralization (Bunderson, Nash and South Street Wells)

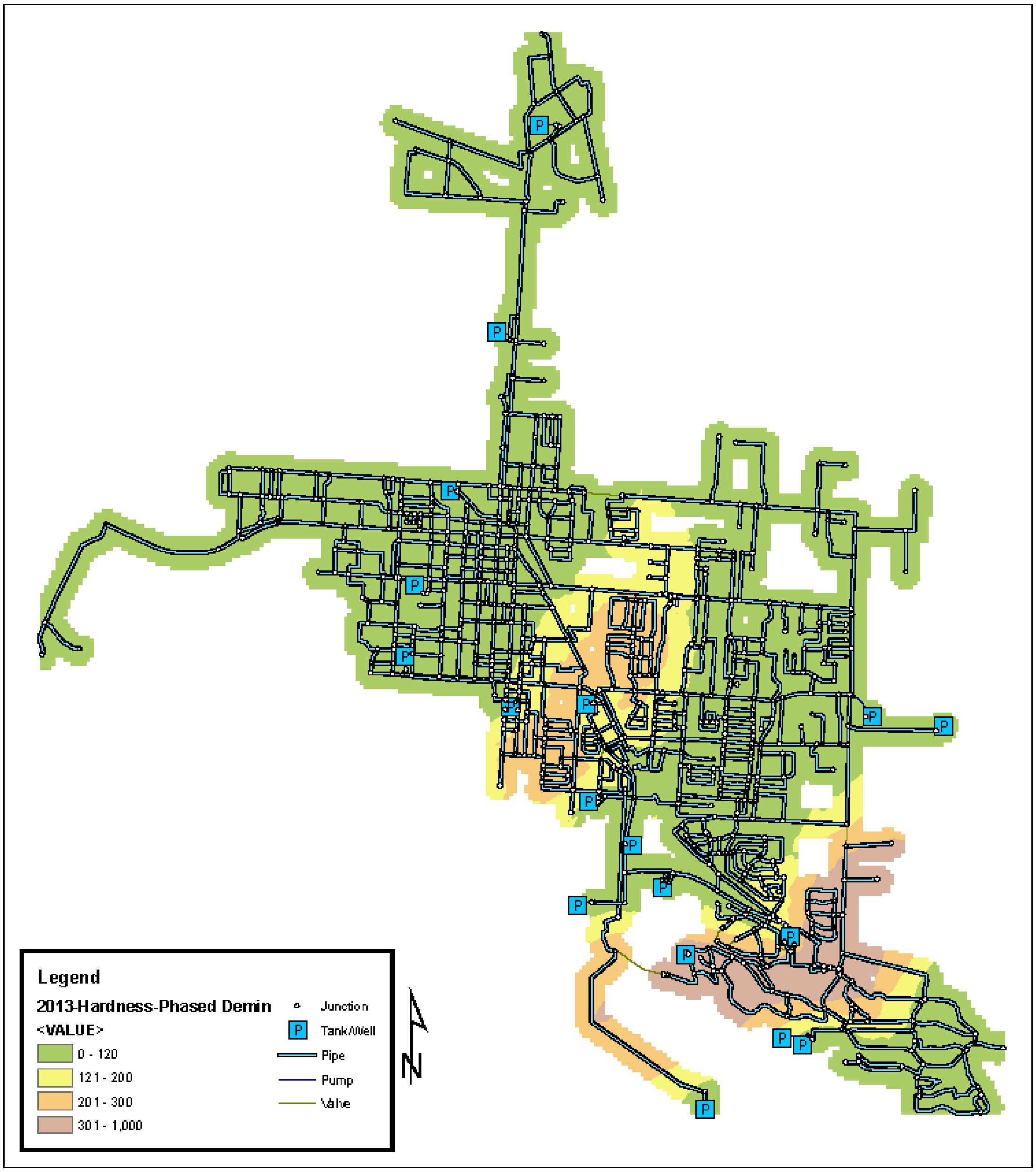


Figure 3. 2013 Water Quality Results, Hardness, ADD

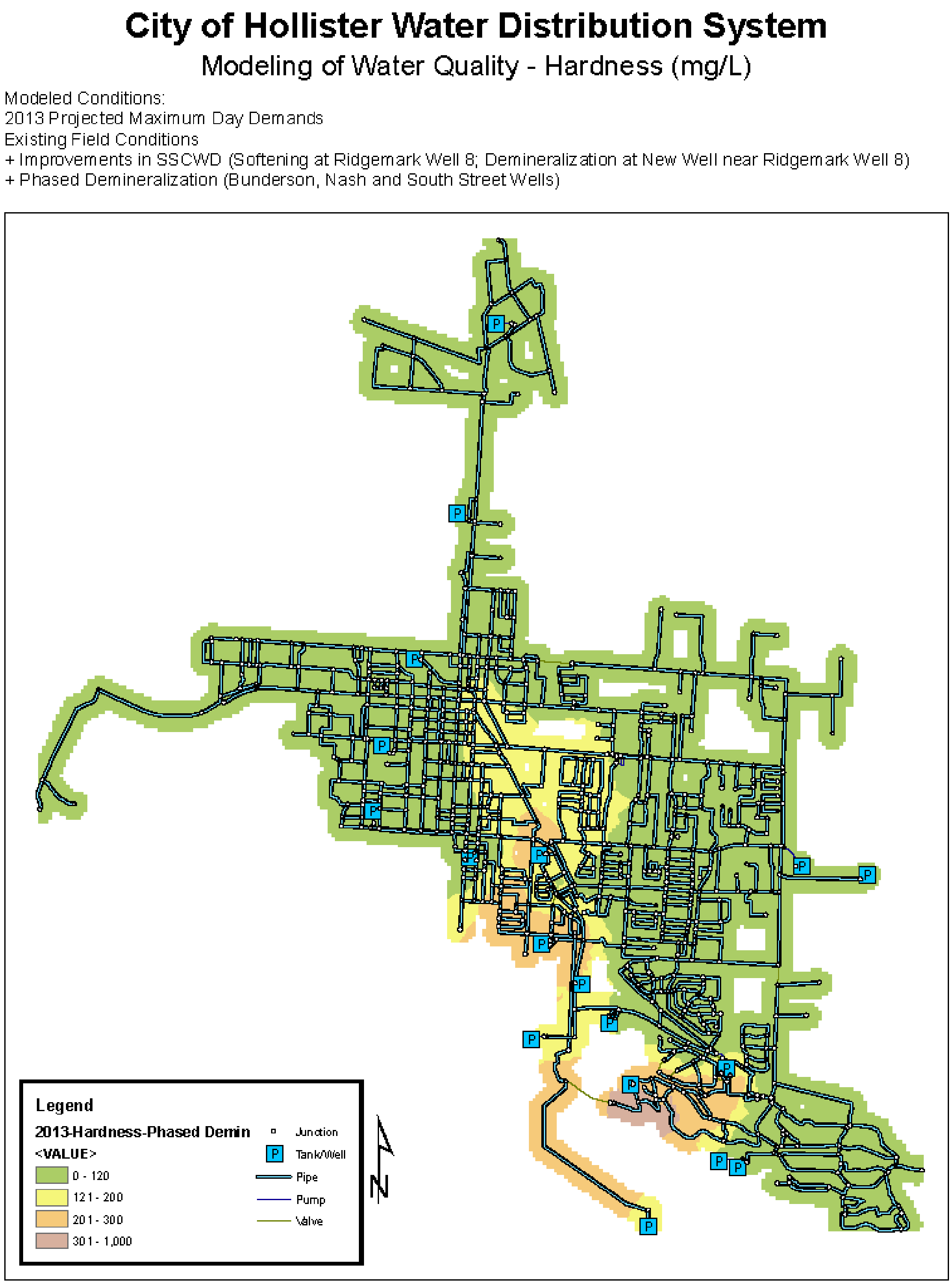


Figure 4. 2013 Water Quality Results, Hardness, MDD

City of Hollister Water Distribution System

Modeling of Water Quality - Hardness (mg/L)

Modeled Conditions:
2023 Projected Average Day Demands
Existing Field Conditions
+ Improvements in SSCWD (Softening at Ridgemark Well 8; Demineralization at New Well near Ridgemark Well 8)
+ Phased Demineralization (Bunderson, Nash and South Street Wells)
+ Full Demineralization

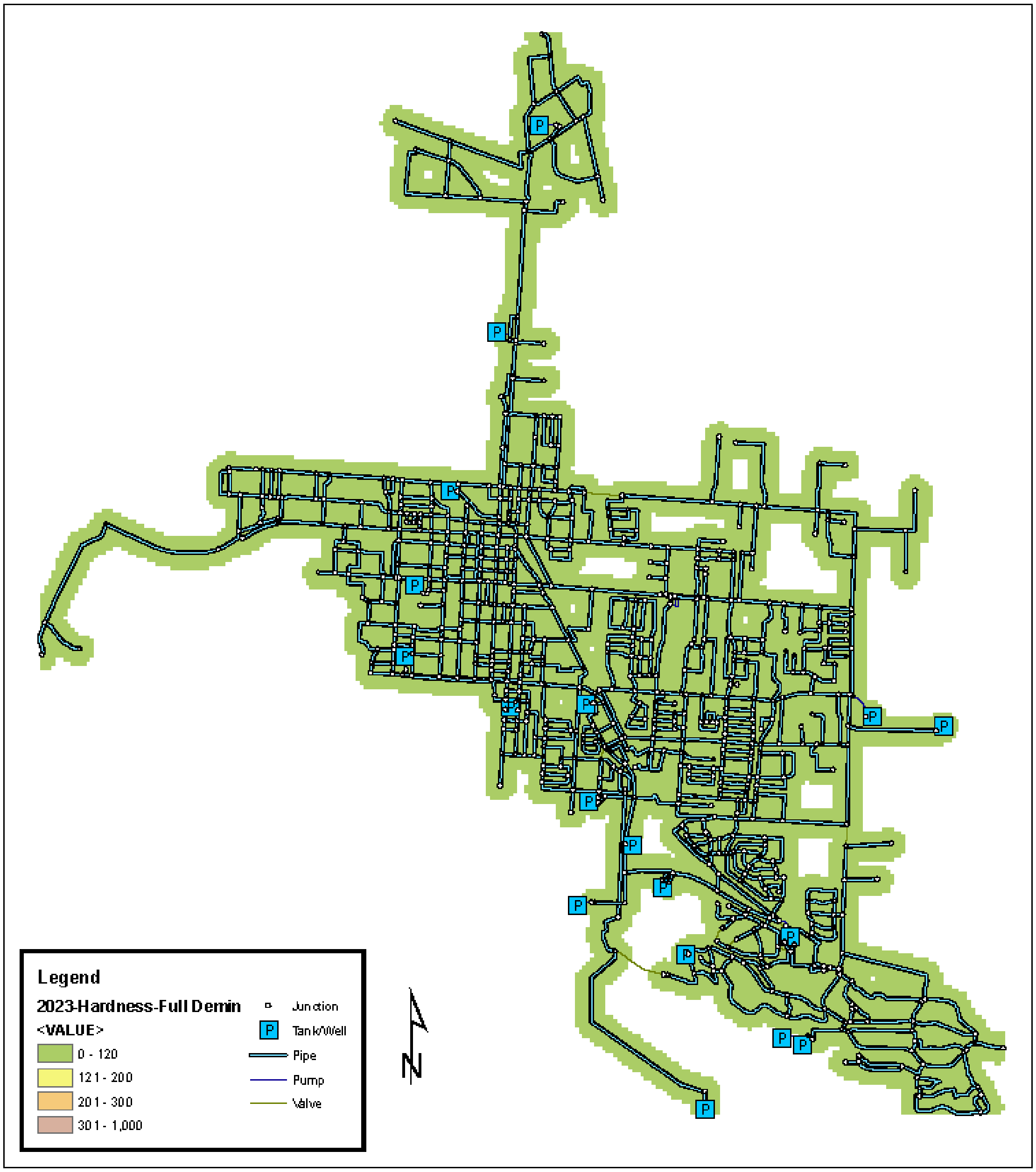


Figure 5. 2023 Water Quality Results, Hardness, ADD

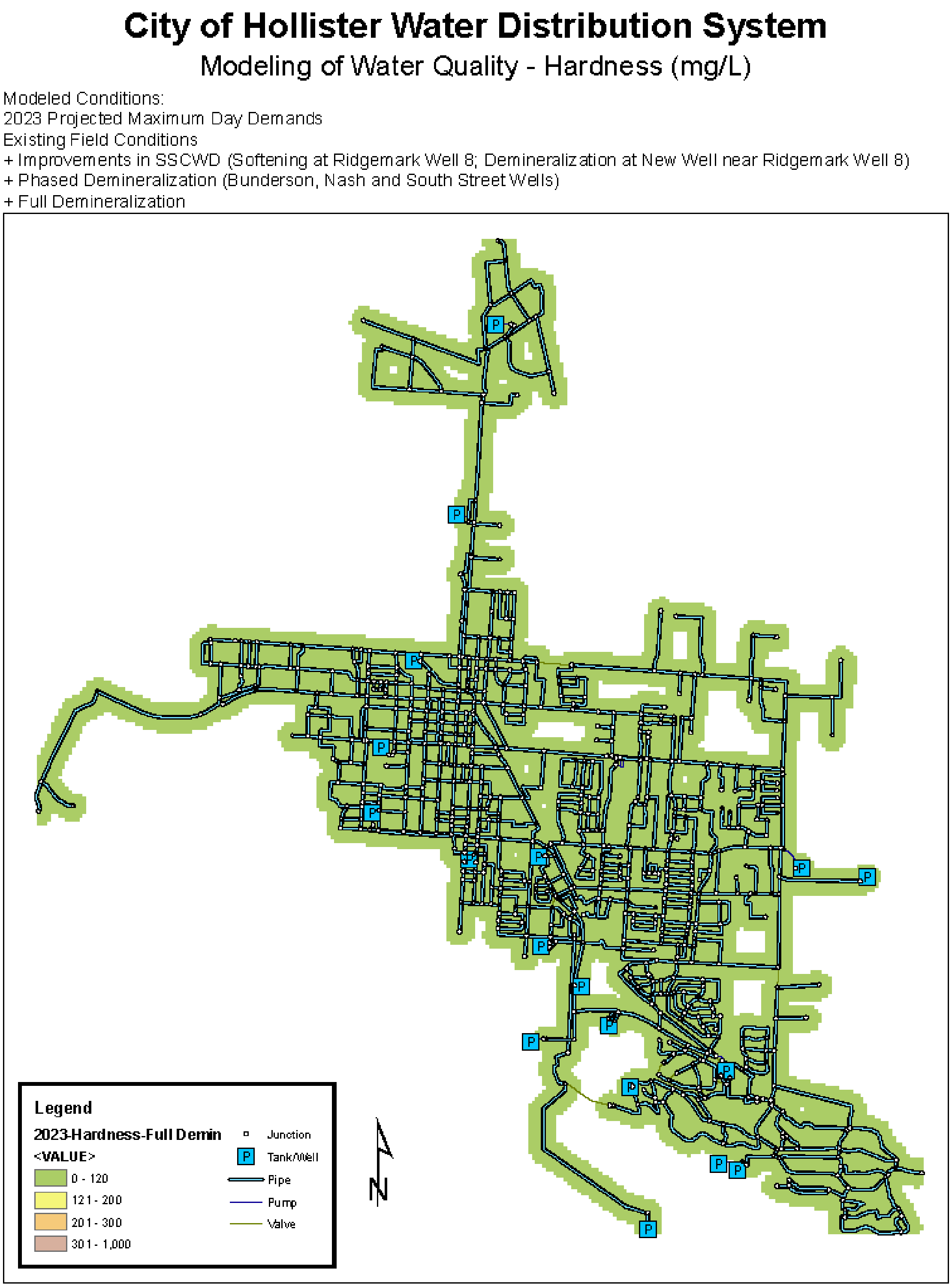


Figure 6. 2023 Water Quality Results, Hardness, MDD

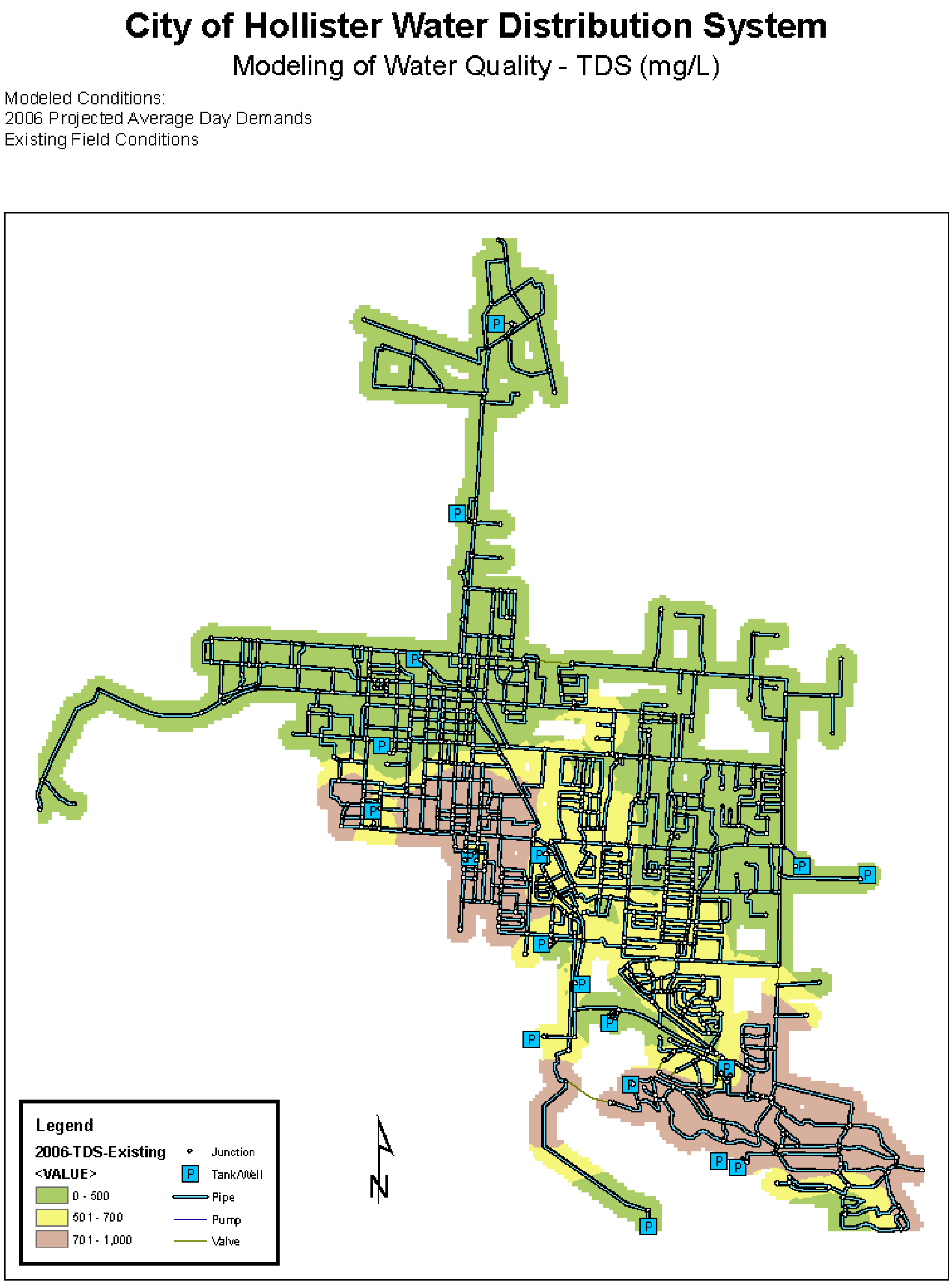


Figure 7. Existing Water Quality Results, TDS, ADD

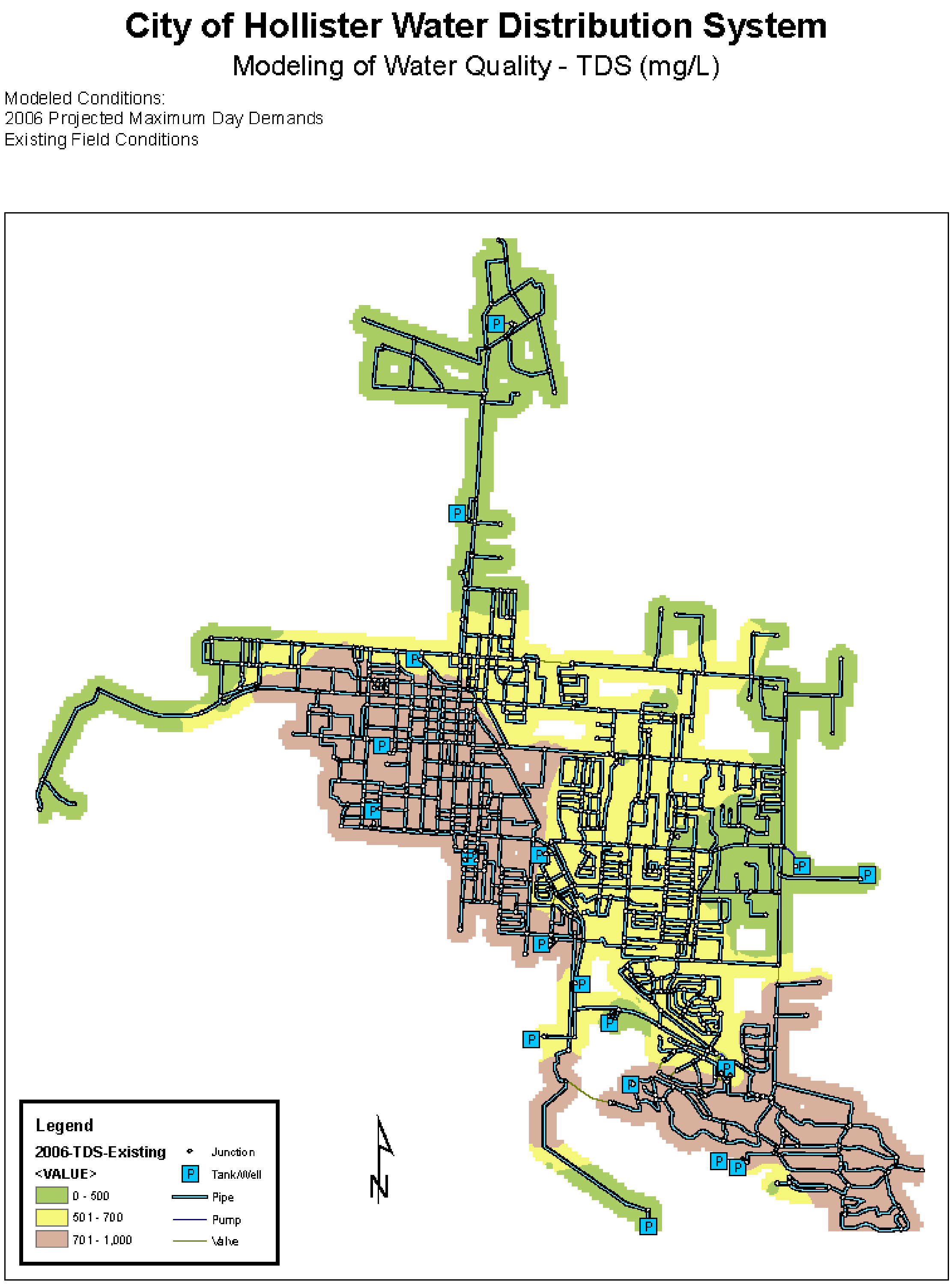


Figure 8. Existing Water Quality Results, TDS, MDD

City of Hollister Water Distribution System

Modeling of Water Quality - TDS (mg/L)

Modeled Conditions:
2013 Projected Average Day Demands
Existing Field Conditions
+ Improvements in SSCWD (Softening at Ridgemark Well 8; Demineralization at New Well near Ridgemark Well 8)
+ Phased Demineralization (Bunderson, Nash and South Street Wells)

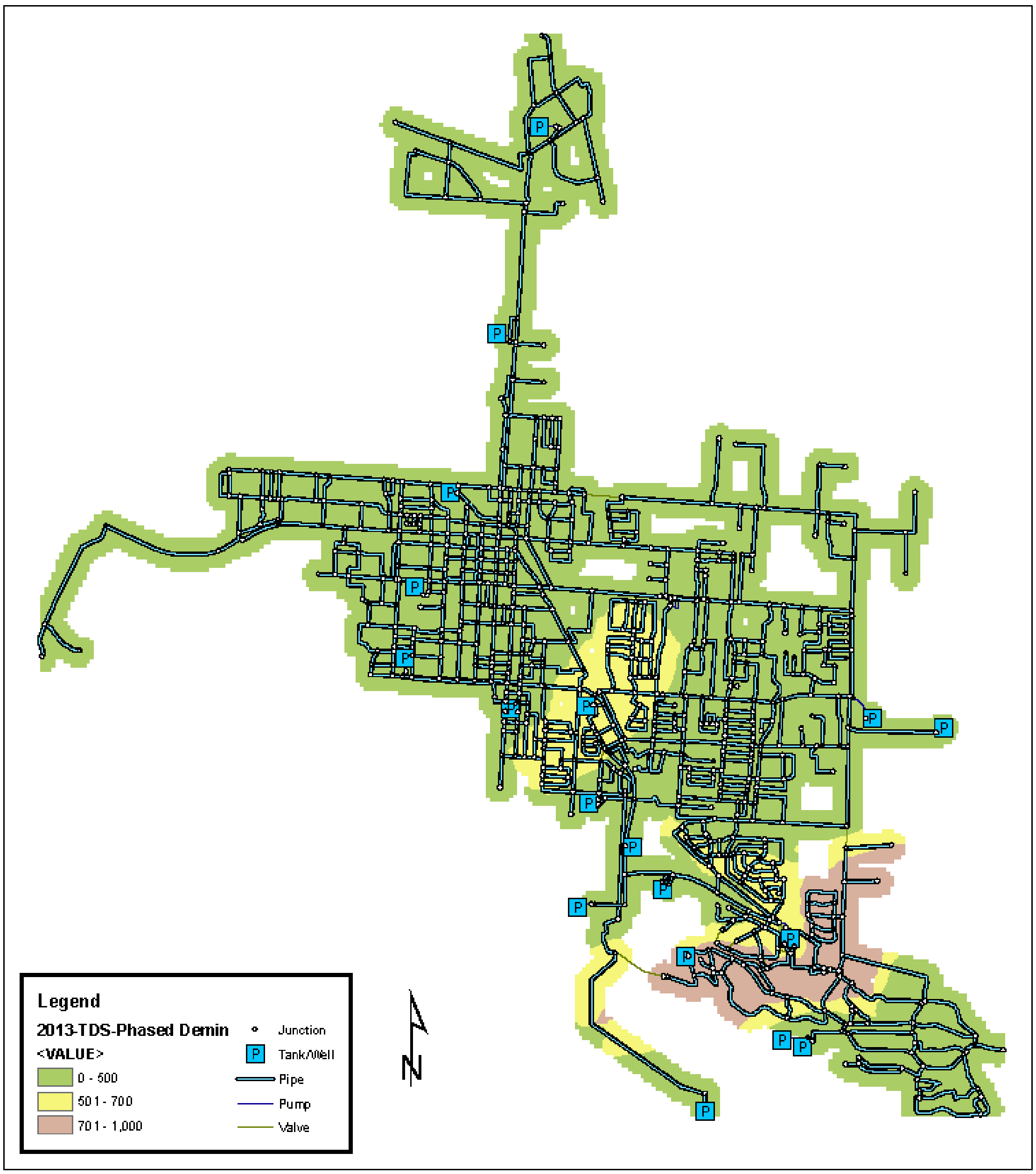


Figure 9. 2013 Water Quality Results, TDS, ADD

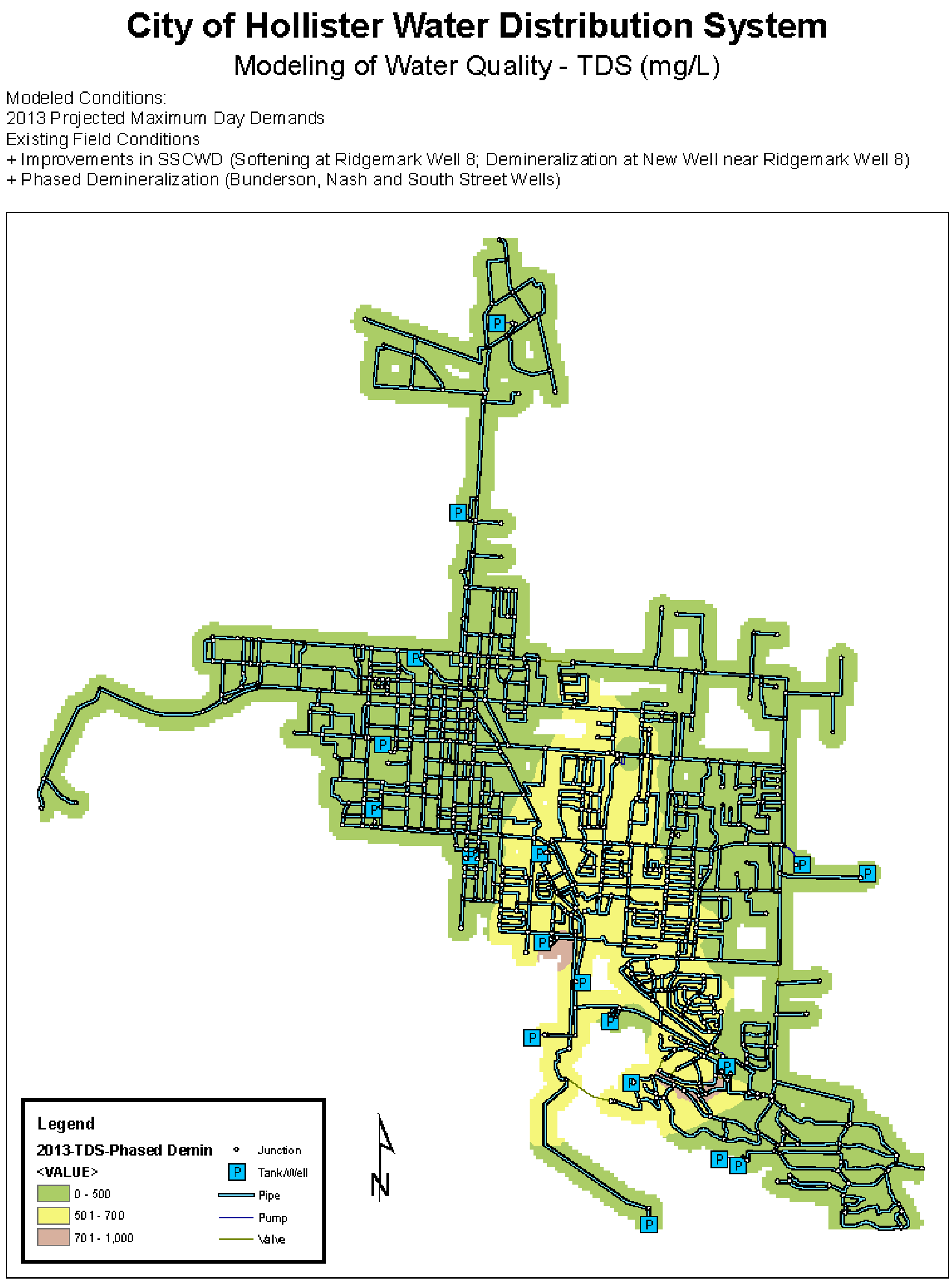


Figure 10. 2013 Water Quality Results, TDS, MDD

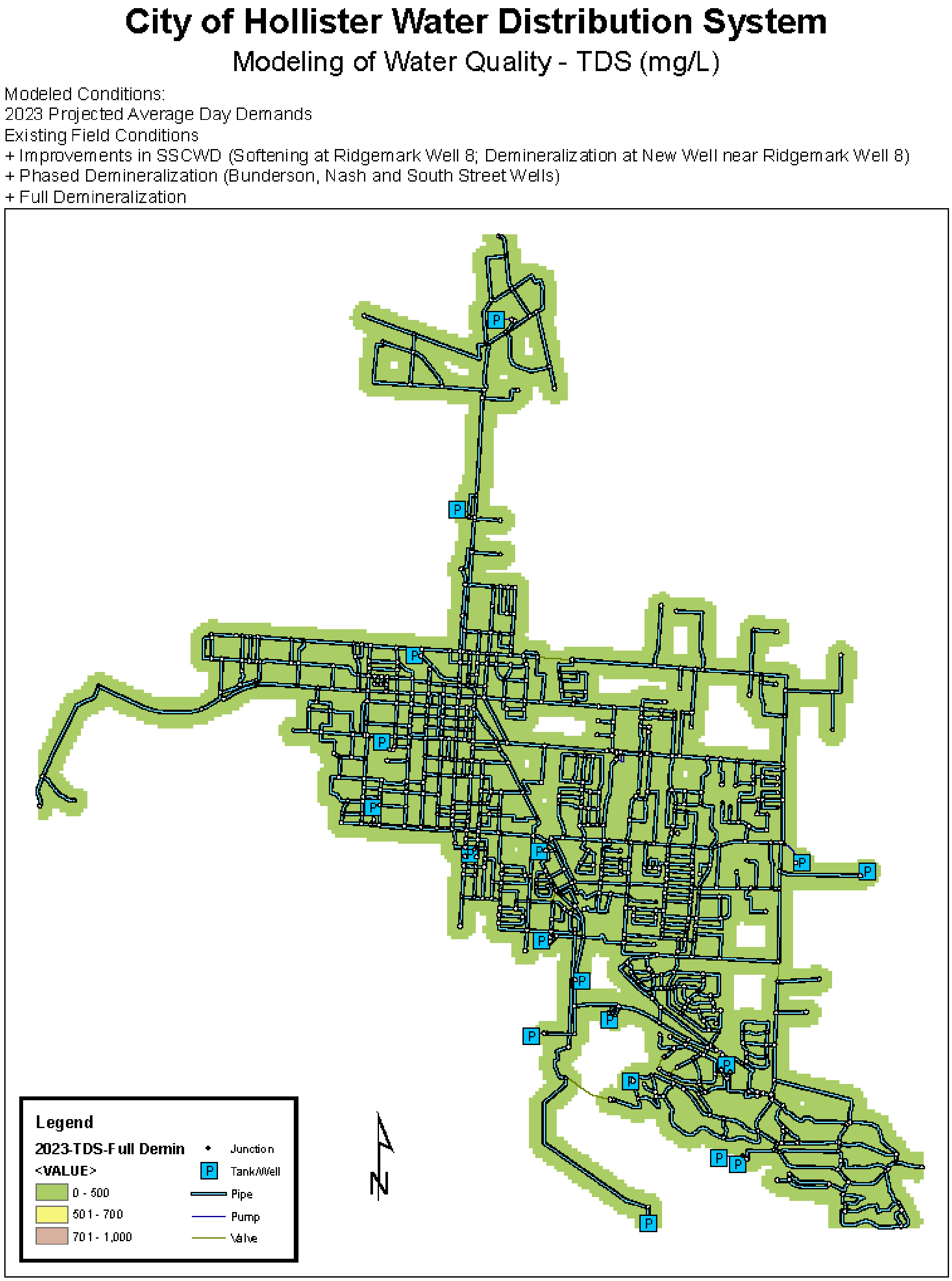


Figure 11. 2023 Water Quality Results, TDS, ADD

City of Hollister Water Distribution System

Modeling of Water Quality - TDS (mg/L)

Modeled Conditions:
2023 Projected Maximum Day Demands
Existing Field Conditions
+ Improvements in SSCWD (Softening at Ridgemark Well 8; Demineralization at New Well near Ridgemark Well 8)
+ Phased Demineralization (Bunderson, Nash and South Street Wells)
+ Full Demineralization

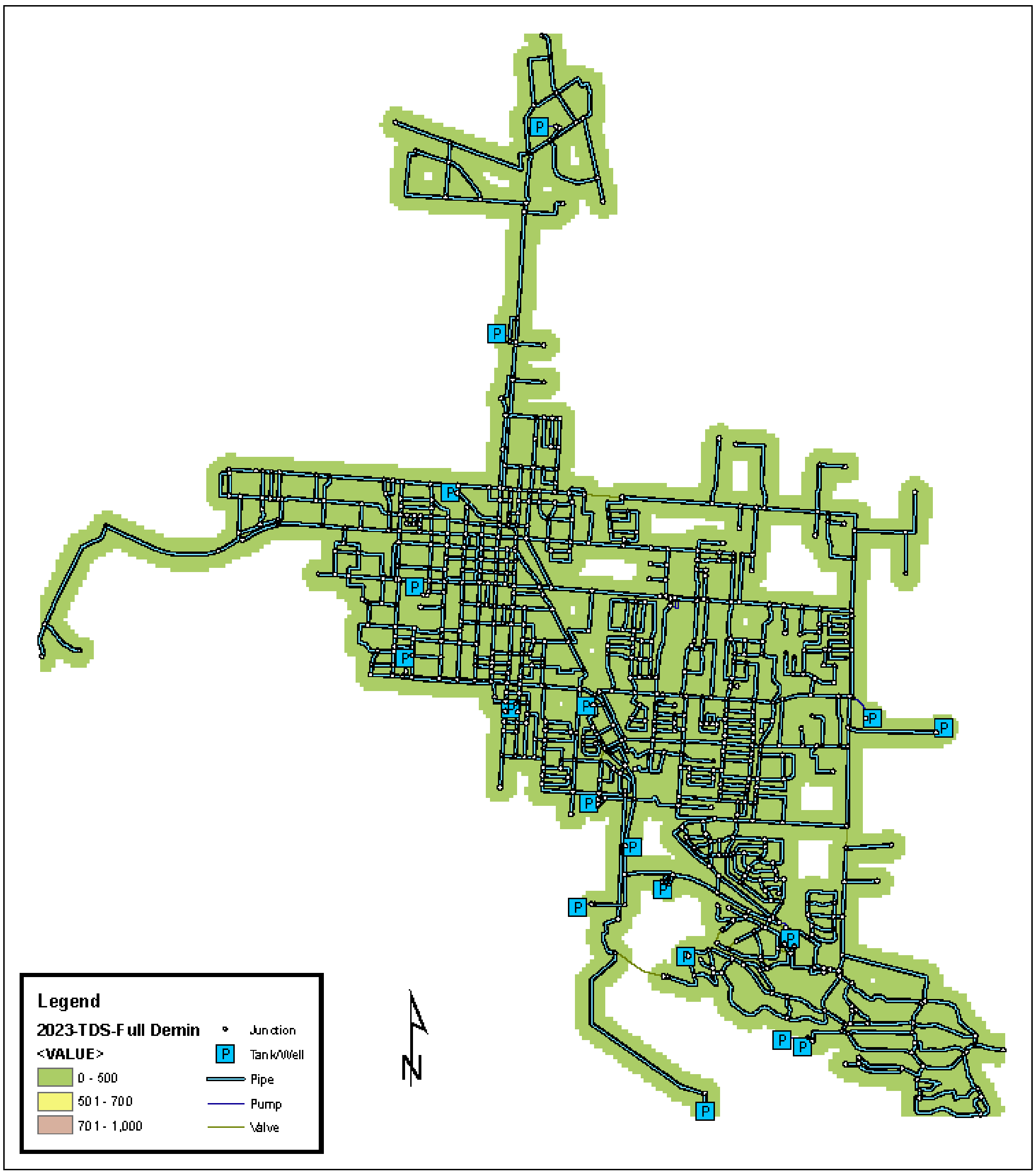


Figure 12. 2023 Water Quality Results, TDS, MDD

HOLLISTER URBAN AREA WATER WASTEWATER MASTER PLAN

APPENDIX H - HOLLISTER URBAN AREA WATER DISTRIBUTION SYSTEM, MODELING UPDATE

Introduction

This Technical Memorandum (TM) has been prepared to describe the status of the hydraulic modeling task as of August 8, 2006. A later TM will be developed to describe the water quality analysis.

Data Collection

Both the Sunnyslope County Water District (Sunnyslope) and the City of Hollister (Hollister) have provided the data we requested during the July 5, 2006 meeting. They met the deadlines set at the meeting and at this time the information provided appears to be adequate for the calibration of the model.

If additional information is needed, HDR will be contacting the appropriate person at the two Utilities.

Hydraulic Modeling

Methodology

HDR received a copy of the Hollister/Sunnyslope hydraulic model from the City of Hollister in April 2006. The model received uses H2ONet software and was converted to H2OMAP by staff at MWH Soft, the software developer.

The model was reviewed for understanding of the setup of the model, controls for pumps, reservoir information, and other pertinent information.

System Components

The H2OMAP software allows all of the pipes and junction nodes to be entered into one complete model, which consists of approximately 1,000 pipes, 673 junction nodes, along with pressure reducing stations, reservoirs, water treatment plant, wells, and pump stations. The number of system components in the model are different from the actual number that are found in the Hollister/Sunnyslope water system because some operations are simulated differently in the model than they are in the existing system and not all small diameter pipes are included. All of the system data information such as pipe diameters, reservoir areas, and node elevations were entered into the original model based on water system maps.

Current System Demand

Total demand in the current model is 4,505 gpm (6.49 mgd). The demand allocation was completed by Karen Johnson. My only input was the Theissen polygons from the model.

A diurnal curve was installed in the model during the initial creation of the model and has not been changed. The curve appears to be appropriate for peak day demands and shows two peaks, one at 9:00 am approximately 60 percent higher than the daily average and one at 8:00 pm approximately 40 percent higher than the daily average. The minimum demand occurs at 4:00 am and is 35 percent of the daily average.

This curve was discussed at the July 5, 2006 meeting and was determined to be as accurate as possible by Hollister and Sunnyslope staff without additional research. For modeling during lower demand times, another curve should be developed.

Data has been received from both Hollister and Sunnyslope that will enable a system-wide diurnal curve to be developed for July and December conditions. The diurnal curve will be completed during the week of August 14.

Calibration

A number of hydrant flow tests throughout the system to determine flow, static and residual pressure, and pressure drop in known segments of pipe were performed. For the calibration analysis, a single “snapshot” (steady-state) simulation was used which calculates flow throughout the system for a single point in time. This simulation assumes that the system reaches equilibrium with respect to flows instantaneously. The information from the model run was used to compare the static and residual pressures associated with the model simulations and each hydrant test to determine the accuracy of the model. Successful calibration of the static pressure indicates that the network components are operating correctly, demand is appropriately allocated, and the reservoir levels are correct. Successful calibration of the residual pressure and pressure drop during the hydrant tests indicates that the pipe roughness coefficients are set at the appropriate level similar to actual conditions.

Six hydrant flow tests that cover the full system area were performed in the field and were simulated with the model. Table 1 shows the results of each hydrant flow test along with the results of the model simulations at each location.

Based on the data shown in Table 1 steady-state calibration for static conditions is quite good. Some additional work will be completed on friction factors to improve the match between the field and model during hydrant flow using the "Calibrator" feature of H2OMAP.

Test number 5 was completed on a section of looped piping. Information provided from Hollister did not indicate whether a valve was closed to eliminate the loop or not, so both conditions were simulated. This needs to be confirmed prior to completing steady-state calibration.

No attempt has been made to perform extended period calibration. Information has been provided by both Sunnyslope and Hollister that will enable HDR to perform extended period calibration, but no work has taken place as of this date. It is anticipated that work will be done on reducing the data to usable form for calibration during the week of August 14.

Future System Demand

Future demands can be developed and allocated to the junction nodes in the model using the same procedure as was used for current demands.

Upcoming Work

The following work remains to be completed to develop a model that can be used for extended period simulations. An estimated schedule for this work is also listed below:

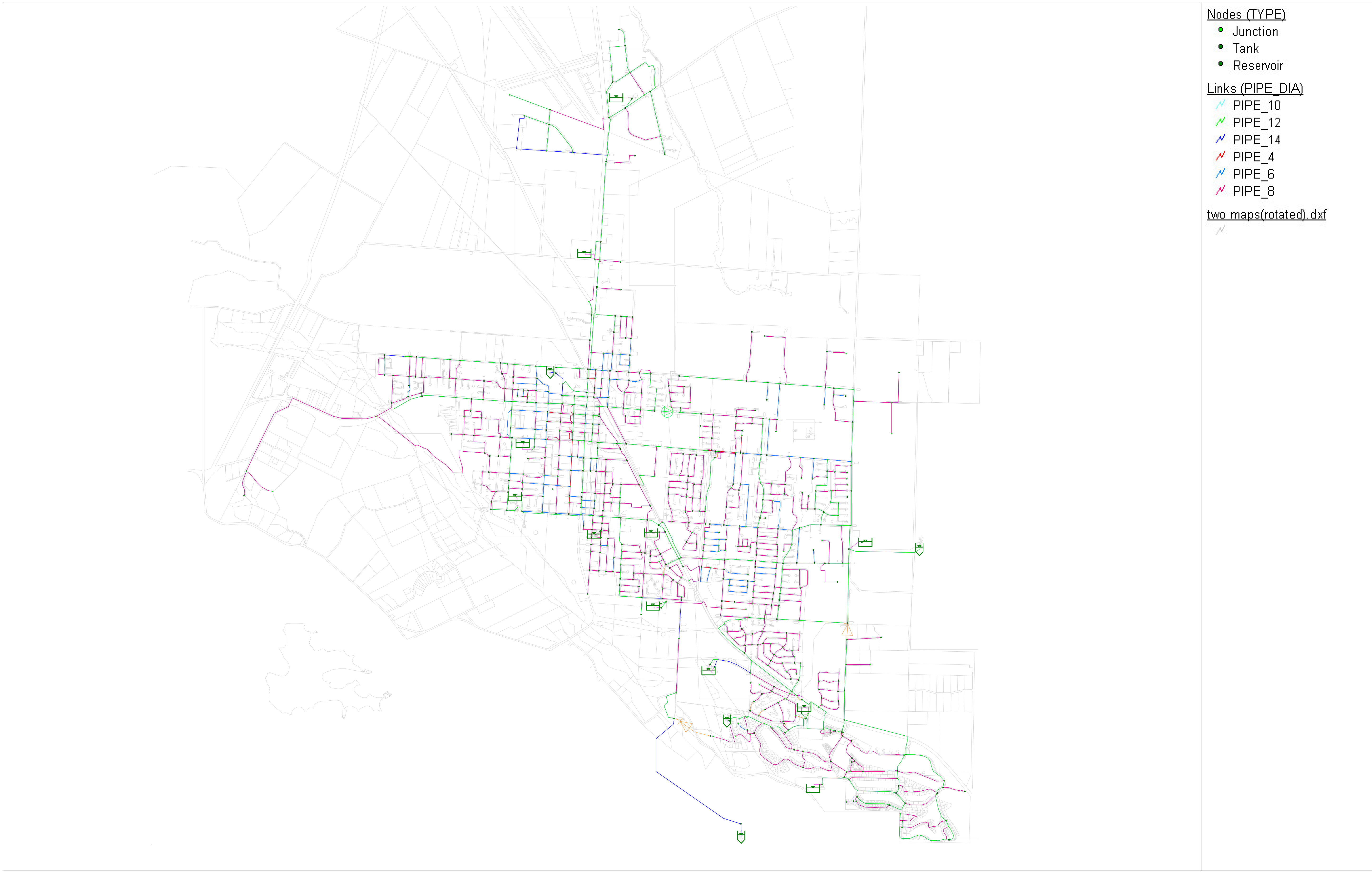
Description	Schedule
Complete Steady-State Calibration	August 10, 2006
Finalize Extended-period Calibration data	August 18, 2006
Finalize Diurnal Curves	August 18, 2006
Complete Extended-period Calibration	August 25, 2006
Model ready for Trace and Water Age Analysis	August 25, 2006

Table 1
Hollister/Sunnyslope Hydraulic Modeling
Results of Calibration

Test No.	Location	Pressure Zone	Flowing Node: Node	Flowing Node: Flow (gpm)	Residual Node: Residual Node	Static Pressure (PSI): Field	Static Pressure (PSI): Model	Static Pressure (PSI): Difference	Residual Pressure (PSI): Field	Residual Pressure (PSI): Model	Residual Pressure (PSI): Difference
1	3052 Lemmon Ct	Middle	5,338	1,332	501	98.00	98.00	-	79.00	74.93	(4.07)
2	1491 McDonald Ct	Middle	507	1,163	509	67.00	67.72	0.72	65.00	64.44	(0.56)
3	181 Marinantha	High	1,001	1,106	311	69.00	69.60	0.60	62.00	57.87	(4.13)
4	540 Helen Ct.	High	503	919	505	54.00	54.79	0.79	50.00	44.90	(5.10)
5A	61 Ranchito Ct	Low	52	1,087	511	66.00	64.05	(1.95)	60.00	61.21	1.21
5B	61 Ranchito Ct	Low	52	1,087	511	66.00	64.05	(1.95)	60.00	60.25	0.25
6	Lot 22 Airway Parkway	Low	416	1,222	415	79.00	81.37	2.37	68.00	65.88	(2.12)
							Average Difference	0.42			(2.46)

Note: All nodes used in the fire flow analysis have FF at start of name.

HOLLISTER WATER BASE MAP



Prepared By:

Date: Friday, September 08, 2006