Stantec

2022 WATER MASTER PLAN

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City of Newman

Prepared by:
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Executive Summary

Introduction

The City of Newman (City) currently serves 11,784 people with 3,531 water service connections. Water service is provided to residential, commercial, and industrial sites. The primary purpose of this 2022 Water Master Plan is to develop a capital improvement plan to meet the current and future growth of the City of Newman.

The agreement for professional services for the 2022 Water Master Plan for the City of Newman was authorized on 18th October 2021. The overall project scope of work and study activities, are summarized as follows:

- Collect and review system data (system maps, system operations, facility information, supply and demands, previous hydraulic model, etc.).
- Perform a preliminary water system evaluation (review previous master plan, new wells, etc.).
- Develop an updated, calibrated hydraulic model of the water distribution system.
- Evaluation of existing and future system supply, pumping, and storage capacities as well as distribution system pressure, velocity, and available fire flow,
- Recommend system improvements to address deficiencies related to low or high pressures, high headloss, and fire flow deficiencies for both the existing and future system.
- Prepare a system evaluation technical report.

Planning Criteria

The level of service criteria used for the current and future system analyses was developed in accordance AWWA 32 (AWWA, 2017) and CCR 22 (OAL, 2022). This includes criteria related to:

- Existing System Analysis such as pressure, velocity, and fire flow.
- Sprinklered and Unsprinklered Buildings,
- Storage Requirements, and
- Well Capacity.

Existing System

Existing Wells

Water supply for the City is currently supplied from five active wells, Wells 1R, 5, 6R, 8 and 10 as detailed in Table 3-1. A number of the wells listed in the previous master plan (Eco:Logic, 2008) have since been deactivated or abandoned due to water quality deterioration. The locations of these active wells are shown on Figure 3-1.

The current active wells range in depth from 465 to 645 feet and range in capacity from 1,000 to 2,500 gpm. A previous groundwater conditions study conducted by Kenneth D. Schmidt and Associates, reported that the City of Newman overlies two aquifers that are separated by the Corcoran Clay, a regional confining layer that locally occurs at depths ranging from 220 to 275 feet below ground surface and with a thickness between 20 to 115 feet. All current active wells within the system tap both aquifers for their groundwater source. Static groundwater levels vary from 24 to 77 feet mean sea level

All well water supplies are chlorinated prior to entry into the distribution system. The water system has no interconnections with other water systems and is operated as a single pressure zone. A summary of the existing well capacities is listed in Table 3-1.

Pump Stations

The City of Newman currently has a pump installed at each of the five wells along with a booster pump station at Well 10.

Storage Tanks

The City of Newman currently has two storage tanks. The first on is a 100,000 gallon elevated storage tank located next to Well 1R and the second is a 1.0 MG ground storage tank located next to Well 10.

Distribution System

The water distribution pipe network is comprised of approximately 40 miles of mains with a diameter ranging from 2-inch to 16-inch. The majority of the pipelines within the City of Newman water distribution system are PVC followed by Asbestoses Cement and a small amount of ductile iron, HDPE, and steel. The majority of the pipelines were installed before 2000 as detailed in Table 3-9, but as of the write of this report, the exact date is still unknown.

Water Demands

Water Production

The production rates from the City’s existing wells were determined based on historical data. Production data represents the amount of water pumped into the distribution system. The majority of that water is sold and accounted for; however, a portion of the water is unaccounted. Review of the production data is useful to establish water demand trends, peaking factors, and to quantify the unaccounted water.

Daily meter readings are collected at each active well site and were used to calculate annual, monthly, and maximum monthly production volumes. The City reads customer's water meters on a monthly basis and that information is used to determine water use. A summary of historical water production and water use data from 2009 through 2021 was used for this analysis while the 2003 through 2006 was used as a comparison.

The combined annual water production from all of the domestic supply wells is included Table 4-1 and illustrated in Figure 4-1. As noted in the previous master plan, water production previously increased over time as the City's population has grown. However, in the more recent data (2009 to 2021), water usage has not increased in line with water production data. This could be due to various water saving policies implemented by the State to reduce water consumption in both residential and commercial buildings.

Monthly water production from January 2009 through December 2021 is detailed in Table 4-2 and illustrated in Figure 4-2. The maximum month is during the summer season, with July 2020 having the highest demand of all the years analyzed. The minimum month was January with an average of 30 MGD.

Existing Water Demand

The average day demand for the City of Newman was calculated by taking the average monthly water production over the previous 5-years and converting this to gallons per minute. Based on the well production data provided by the City of Newman, an average day demand of 2.05 MGD or 1,425 gpm was selected as that was the highest year in the last 5-years of data provided.

To calculate maximum day and peak hour water demands from usage data, 22 CCR (OAL, 2022) requires the past ten years of daily data. Since this was not available, Stantec used a ratio of average day demand to maximum day demand of 2.25 and a maximum day to peak hour ratio to 1.5.

The table below summarizes the existing water demand factors for the 2022 Water Master Plan. These ratios are similar to the 2008 Water Master Plan (Eco:Logic, 2008) (Table 4-5), however, the average day demand has decreased by around 15%. This is due to a number of state policies that encourage water reduction such as low flow faucets and toilets, lawn replacement along with general outdoor water restrictions during drought years. Stantec has assumed based on increased frequency and severity of draughts that this downward trend will continue into the future.

Summary of Existing Water Factors and Demands

Scenario	Ratio to ADD	Demands	
		MGD	gpm
Average Day	1.00	2.05	1,426
Maximum Day	2.25	4.62	3,209
Peak Hour	3.38	6.93	4,813

Future Water Demand

There are a number of future developments that are proposed over the next 10-years for the City of Newman including: T-Street, Mattos Ranch, Caton Ranch and Agriana Development. Demands for these developments were based on a combination of the demand factors from the previous Water Master Plan and development drawings which show a breakdown of the proposed future land use. Based on these calculations, the existing average day demand is expected to increase from 1,426 gpm to 3,801 gpm in the future. The below table summarizes the future demands based on the proposed developments. There is a degree of uncertainty around the actual future demands, especially the proposed demands for the light industrial zone that is part of the Agriana Development. The demands that are going to be used in the future model are on the conservative side, therefore, the City should update and re-run the future scenarios once the demands for these developments have been confirmed.

Summary of Future Water Factors and Demands

Scenario	Ratio to ADD	Demands	
		MGD	gpm
Existing Average Day	1.00	2.05	1,426
T Street		0.01	4
Mattos Ranch		0.05	37
Canton Ranch		0.06	39
Agriana Development		2.14	1,489
Northwest Newman Master Plan		1.16	806
Future Average Day		5.47	3,801
Future Maximum Day	2.25	12.31	8,551
Future Peak Hour	3.38	18.47	12,827

Hydraulic Model

A hydraulic model of the water distribution system was used to simulate existing demand scenarios and to evaluate the system performance under these scenarios to pressure, velocities, and available fire flow for existing and future scenarios. A new model for the City of Newman was built in WaterGEMS 10.03 using AutoCAD drawings of the distribution system combined with AsBuilts of subdivisions added since 2005 and well pump station information. The roughness coefficients for the new hydraulic mode were based on a combination of material and installation year.

Scenario Summary

A large number of scenarios were added to the new model that cover calibration of the SCADA data, including analysis of the system under both existing and future demand scenarios. These included fire under maximum day demand and pressure, velocity and headloss under peak hour conditions.

Calibration

The hydraulic model for the City of Newman has been calibrated against two 3-day periods in July and October 2021. The results from the calibration show that the while the model is outside the flow tolerances, the general flow patterns and discharge pressures represent the SCADA data provided. Therefore, we confirm that the model is sufficient to move forward with the existing and future system evaluation. We also recommend that new pump tests be performed at each of the wells, especially Well 6, so that the model can be refined in the future. This, along with other recommendations are detailed below:

- Undertake pump tests on existing wells (1R, 5, 6 & 8).
- Installation of a flow meter on the elevated tank so that an accurate mass balance of the system can be achieved.
- Undertake hydrant tests at key locations throughout the distribution system to identify closed valves.

Water System Evaluation

An evaluation of the City of Newman water system was performed to determine the adequacy of the system to supply existing water needs and to supply water for fire protection purposes.

Overall, the drinking water system was evaluated based on the following criteria:

- Pressure, velocity, and headloss gradient
- Available Fire flow

The water system evaluation was based on compliance with the service level criteria defined in Section 2. The water system evaluation for the existing water system pressures, fire flow capacities, headloss gradient and pipe flow velocities was performed using the updated hydraulic model.

Existing Water System

The flat topology and looped water network, pressures generally range from 45 psi under existing peak hour demand to 60 psi during a no demand scenario. Some areas of the City do experience velocities and headloss above 5 ft/s and 10 ft/1,000 ft, respectively, however, this does not seem to adversely affect system pressures. Of the 298 hydrants evaluated in the existing scenario, only six of them do not meet the criteria. The hydrants that do not meet the residential criteria were found to be on either 4-inch main or dead end mains while the hydrants that do not meet the Industrial/Other Business District criteria were located on a 6-inch main between L and M street. These low (less than 1,000 gpm fire flow) should be field verified to determine if they are accurate before any pipeline improvements are proposed. The storage analysis, based on a peak hour demand analysis show that the City of Newman system currently has a deficit of approximately 500,000 gallons. Currently, no storage capital improvement has been proposed, however, additional storage should be considered if and when new development are proposed.

Future Water System

The analysis of the City of Newman water system under future conditions has indicated that the system in its current form would not be able to provide the needed supply or storage. However, with the addition of four new wells and 4.0 MG of additional storage, the future system could provide the same level of service as the existing system. The flat topology and looped water network, pressures generally range from 43 psi under existing peak hour demand to 64 psi during a no demand scenario. Due to system upgrades, there are now no parts of the distribution system that experience velocities and headloss above 5 ft/s and 10 ft/1,000 ft, respectively. Of the 362 hydrants evaluated in the existing scenario, only five of them do not meet the criteria. The hydrants that do not meet the residential criteria were found to be on either 4-inch main while the hydrants that do not meet the Industrial/Other Business District criteria were located on a 6-inch main between L and M street. The storage analysis, based on a peak hour demand analysis show that the City of Newman system currently has a projected surplus of approximately 1.60 million gallons. This means that some of the new well may not require storage or could be built when additional developments occur in the south of the system.

Capital Improvement Projects

Total project costs were developed for all projects based on rough order cost estimates. A Class 5 Opinion of Probable Total Construction Cost (OPCC) was developed for those projects that the City of Newman chooses to move forward with. The rough order cost estimates include excavation, pipe, backfill and restoration. Since the projects have not been confirmed, the following has been omitted from the rough cost estimate: traffic control, contractor, and subcontractor overhead, markups, and profit. An additional 40% was added to the construction costs to allow for soft costs such as design, project management, and environmental assessment.

The system improvements defined in Section 7 and 8 have been categorized as either New Wells and Storage ($56 million) or Fire flow improvements ($700k).

Conclusions

The 2022 Water Master Plan Update analysis has provided the City of Newman with a greater understanding of their system. The previous 2008 hydraulic model was updated based on AutoCAD drawings and developments that were added since 2015 using WaterGEMS Connection Edition 10.03.05.05. The hydraulic model was calibrated against pressure and flow data over two three-day periods in July and October 2021. The results from the calibration show that the while the model is outside the flow tolerances, the general flow patterns and discharge pressures represent the SCADA data provided. Therefore, we confirm that the model is sufficient to move forward with the existing and future system evaluation. We also recommend that new pump tests be performed at each of the wells, especially Well 6, so that the model can be refined in the future.

The existing system was evaluated and found to have pressures and velocities in acceptable ranges with high head loss and velocity around Well 5. The available fire flow for most of the City exceeds 1,000 gpm apart from along Sydney Avenue and the alley between Fig Lane and R Street due to existing 4-inch mains. The existing storage based on the PHD analysis shows a deficit of around 500,000 gallons based on the current two tanks in the system.

The future system was analyzed based on the addition of the five known developments of T Street, Mattos and Caton Ranch, Agriana Development and the Northwest Newman Master Plan. Three new wells and 2.0 MG of additional storage to meet the future demands. Even with these additions, pressures did drop by around 3 psi from the existing system. However, this is considered in the margin of error at which the model was calibrated and the uncertainty around the actual water usage of these future developments. High velocities and head loss persisted around Well 5 but were not increased due to the addition of the three new wells. The available fire flow for most of the City continued to exceed 1,000 gpm apart from along Sydney Avenue and the alley between Fig Lane and R Street which were identified in the existing system analysis. The future storage analysis, based on a peak hour demand analysis show that the City of Newman system currently has a projected surplus of approximately 1.60 million gallons. This means that some of the new well may not require storage or could be built when additional developments occur in the south of the system.

A total of just under $57 million of capital improvements have been proposed and have been broken down into New Wells and Storage ($56 million) and fire flow improvements ($700k).

Recommendations

The following are a list of recommendation based on the outcomes of this master plan:

- Obtain estimates of proposed water usage for each of the proposed developments, especially those that contain either business parks or industrial developments,
- Implement proposed capital improvement projects,
- Identify future wells sites so that the land for them can be set aside,
- Undertake pump tests at each of the existing wells (1R, 5, 6 & 8) in order to establish a 3-point pump curve to limit the number of assumptions during subsequent calibration,
- Install an electromagnetic flow meter on the elevated tank that records both forward and reverse flow so that an accurate mass balance of the system can be achieved,
- Prepare filed test plan and undertake hydrant tests at key locations throughout the distribution system to identify closed valves,
- Undertake pipe C-Factor tests, and
- Establish the age of the pipes in the system.

Capital Improvement Projects – New Wells

Project ID	Improvement Description	CIP Type	Number	Total Construction Costs	Total including Soft Costs
Well 10 Storage Tank	Barrington Ave and Sherman Parkway	Tank	1	$5,000,000	$7,000,000
New Well 11, Booster Pump Station and Storage Tank	Barrington Ave and Sherman Parkway	Combination	1	$10,000,000	$14,000,000
New Well 12, Booster Pump Station and Storage Tank	Hover and Upper Road	Combination	1	$10,000,000	$14,000,000
New Well 13	Stuhr and Villa Manucha Road	Well	1	$5,000,000	$7,000,000
New Well 14, Booster Pump Station and Storage Tank	Inyo Ave and Canal School Road	Combination	1	$10,000,000	$14,000,000
Total				**$40,000,000**	**$56,000,000**

Capital Improvement Projects – Fire flow

Project ID	Improvement Description	CIP Type	Diameter (inches)	Length (feet)	Total Construction Costs	Total including Soft Costs
FF_01	700-ft of new 8-inch main to the replace the existing 4-inch main along Sydney Avenue between Inyo Avenue and Patchett Drive	Fire flow	8	700	$224,000	$313,600
FF_02	800-ft of new 8-inch water main along alley between Fig Lane and R Street north of Yolo Street	Fire flow	8	800	$256,000	$358,400
Total					**$480,000**	**$672,000**

Acronyms / Abbreviations

ADD	Average Day Demand
AWWA	American Water Works Association
gpm	Gallons per minute
MDD	Maximum Day Demand
MG	Millions of gallons
MGD	Millions of gallons per day
PHD	Peak Hour Demand
PVC	Polyvinyl chloride
SCADA	Supervisory Control and Data Acquisition

1 Introduction

The City of Newman (City) located in Stanislaus County, California (Figure 1-1) currently serves 11,784 people with 3,531 water service connections. Water service is provided to residential, commercial, and industrial sites. The City of Newman retained Stantec to update their Water System Master Plan (WMP), which was completed in 2008.

1.1 Purpose

The purpose of this study was to update the previous 2008 WaterGEMS hydraulic model of the water distribution system and evaluate the capacity and performance of the existing and future systems. An analysis of the developed model was used to identify system repairs to improve flow, velocities, pressure and evaluate storage, pumping and supply capacity.

1.2 Scope

The agreement for professional services for the 20222 Water Master Plan for the City of Newman was authorized on 18th October 2021. The overall project scope of work and study activities, are summarized as follows:

- Collect and review critical data (system maps, system operations, facility information, supply and demands, previous hydraulic model, etc.).
- Perform a preliminary water system evaluation (review previous master plan, new wells, etc.).
- Develop an updated, calibrated hydraulic model of the water distribution system.
- Evaluation of existing and future system pressure, velocity and available fire flow,
- Recommend system improvements to address deficiencies related to low or high pressures, high headloss, and fire flow deficiencies for both the existing and future system.
- Prepare a system evaluation technical report.

1.3 Data Collection

A summary of the data provided by City of Newman for this project is provided in Table 1-1.

Table 1-1: Data Sources

Use	Source	Formant
5-years of water meter data to determine the average day demand for each customer in the City of Newman system.	UB Meter Reads 5 Years.xlsx	Excel
Well production from 2009 to 2021 to determine average day demand	Water Pump Data 2009 - 2021.pdf	PDF
New Well (10) that was installed	11215-4_0_Booster Pumps O&M - (COCO 117).pdf AsBuilt072221REV3.pdf 2021-1-14 GMI O&M Data 04986-01B.pdf Submittal # 117 - Booster Pumps O&M.pdf ShopDrawingReview_11215-3.0 Booster Pump O&MM.pdf	PDF
Well 5 pump tests to update the pump curve in the model	Well 5 pump.pdf	PDF
“The Tank” at Well 1R Site	Reservoir Data Sheet.pdf	PDF
General distribution system information	Water Distribution Data Sheet 11-13-19.pdf	PDF
General well information	Wells Data Sheets.pdf	PDF
Updating the hydraulic model	New-Water-Mp-xfr.DWG	DWG
T Street – Future Developments	T Street Subdivision (Aspen Survey Company, 2018)	PDF
Mattos Ranch – Future Development	Mattos Ranch (Aspen Survey Company, 2015)	PDF
Caton Ranch – Future Development	Caton Ranch (Associated Engineering Group, 2021)	PDF
Agriana – Future Development	Agriana Conceptual Plan (Hearthstone Builders, Inc., 2021)	PDF
Northwest Newman Master Plan – Future Development	NWN Master Plan (Community Development Department, 2017)	PDF
Used to assign demands to the model	Parcel database	.shp

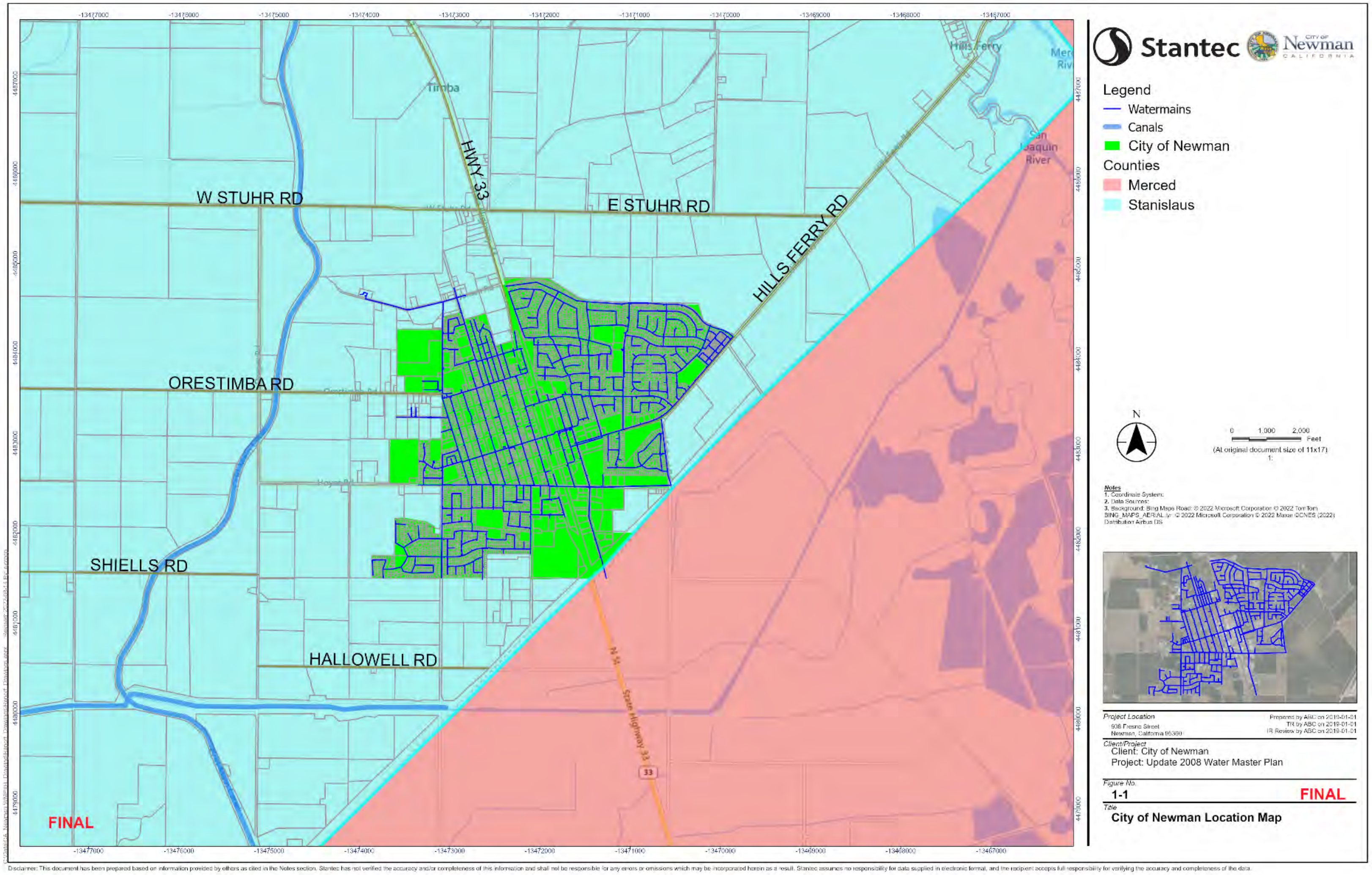

Figure 1-1: City of Newman Location Map

2 Planning and Evaluation Criteria

2.1 Distribution System

Table 2-1 contains the level of service criteria used to evaluate the City of Newman water distribution system.

Table 2-1: Water System Level of Service Criteria

Evaluation Criteria	Value	Units[1]	Evaluation Demand Conditions[2]
System Pressure			
Maximum Pressure	100	psi	ADD
Target Water System Pressure[3]	60 – 80	psi	MDD
Minimum Pressure[4]	40	psi	PHD
Minimum Pressure, Emergency Operating Conditions[4]	20	psi	MDD + FF
Pipeline Velocity[3]			
Maximum pipeline velocity during peak hour demand	5	fps	PHD
Maximum pipeline velocity during a fire flow event	10	fps	MDD
Pipeline Headloss[3]			
Maximum pipeline headloss for pipes less than 16-inches	7	feet/1,000 feet	PHD
Maximum pipeline headloss for pipes greater than 16-inches	3	feet/1,000 feet	PHD

(1) psi = pounds per square inch, fps = feet per second, gpm = gallons per minute

(2) PHD = peak hour demand, MDD = maximum day demand, ADD = average day demand, FF = fire flow

(3) AWWA Manual M32 (AWWA, 2017)

(4) 22 CCR (OAL, 2022)

2.2 Fire Flow Requirements

22 CCR § 64602 (OAL, 2022) requires:

a) *Each distribution system shall be operated in a manner to assure that the minimum operating pressure in the water main at the user service line connection throughout the distribution system is not less than 20 pounds per square inch at all times.*

Table 2-2 contains the level of service criteria used to evaluate the City of Newman distribution system which is also illustrated in Figure 2-1.

Table 2-2: Fire flow Requirement (Design Community and Environment, 2007)

Fire flow Standard	Duration (hours)	Fire flow (gpm)
Residential	2	1,000
Multi-Family Residential	2	1,500
Downtown	3	1,800
Industrial/Other Business District	3	1,800

2.3 Storage Requirement

22 CCR § 64554 (OAL, 2022) requires system systems with 1,000 or more service connections, the system shall be able to meet four hours of peak hourly demand (PHD) with source capacity, storage capacity, and/or emergency source connections. Therefore, the four hours of peak hour demand will be used.

2.4 Well Capacity

22 CCR § 64554 (OAL, 2022)New and Existing Source Capacity.

c) *Community water systems using only groundwater shall have a minimum of two approved sources before being granted an initial permit. The system shall be capable of meeting MDD with the highest-capacity source offline.*

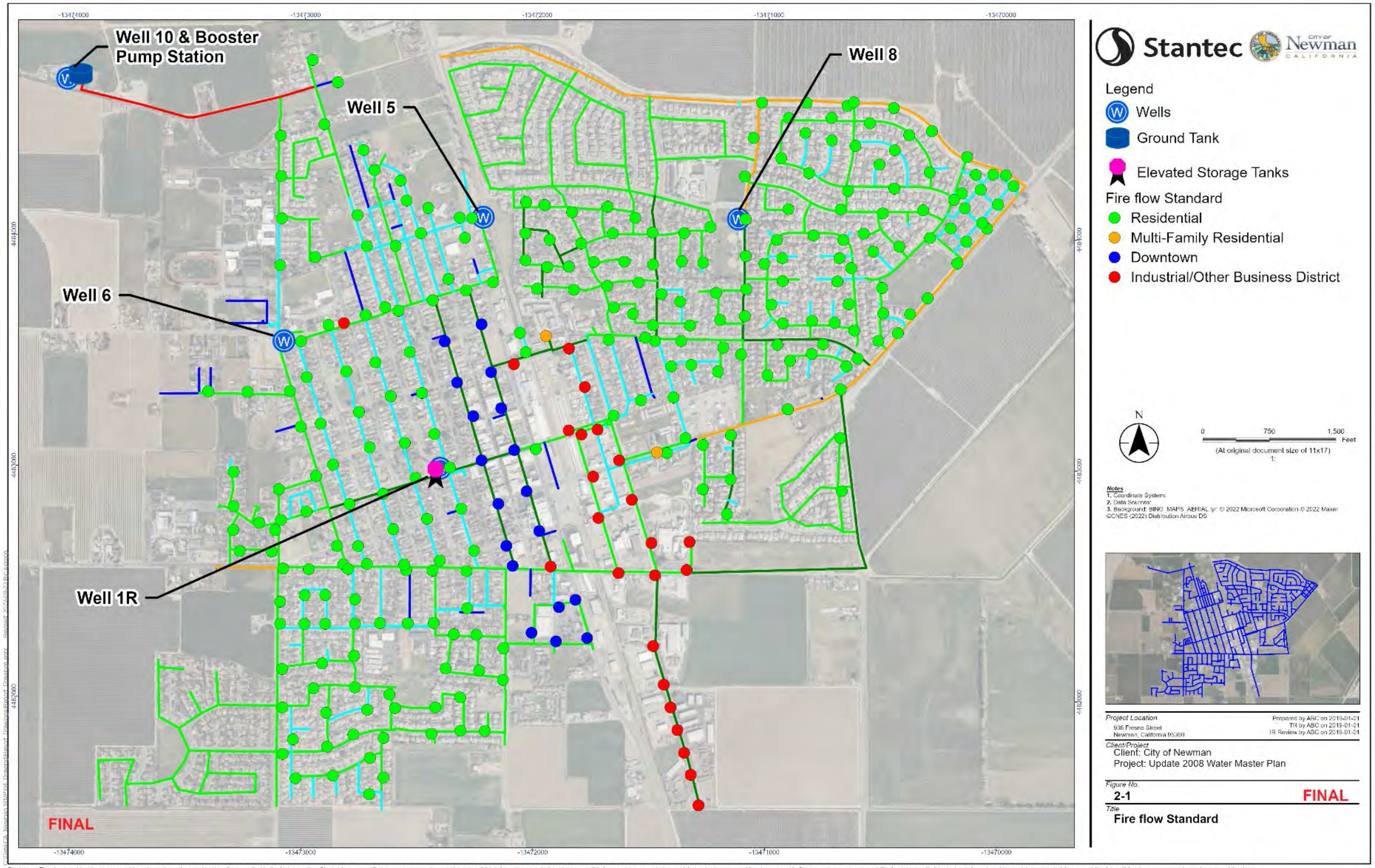

Figure 2-1: Fire flow Standard

3 Existing System

3.1 Existing Wells

Water supply for the City is currently supplied from five active wells, Wells 1R, 5, 6R, 8 and 10. A number of the wells listed in the previous master plan (Eco:Logic, 2008) have since been deactivated or abandoned due to water quality deterioration. The locations of these active wells are shown on Figure 3-1.

The wells have a total capacity of 8,300 gpm and a firm capacity (largest well out of service) of 5,800 gpm as detailed in Table 3-1. For design purposes, the firm capacity of the wells should equal or greater than the maximum day demand for the system. The City of Newman currently has a maximum day demand of 4,500 gpm while the firm capacity of the wells is 5,800 gpm mean they have an excess capacity of approximately 1,300 gpm.

The current active wells range in depth from 465 to 645 feet and range in capacity from 1,000 to 2,500 gpm. A previous groundwater conditions study conducted by Kenneth D. Schmidt and Associates, reported that the City of Newman overlies two aquifers which are separated by the Corcoran Clay a regional confining layer found locally at depths ranging from 220 to 275 feet below ground surface and with a thickness ranging from 20 to 115 feet. All current active wells within the system tap both aquifers for their groundwater source. Static water levels vary from 24 to 77 feet mean sea level

All well water supplies are chlorinated prior to entry into the distribution system. The water system has no interconnections with other water systems and is operated as a single pressure zone, however, four of the five existing well do have backup generators. A summary of the existing well capacities is listed in Table 3-1 while and summarize the well pump and motor information.

Table 3-1: City of Newman Well Summary

Well	Address	Drill Date	Well Size	Total Depth (ft)	Cased Depth (ft)	Sanitary Seal	Perforations (ft)	Backup Generator	Capacity without backup generator		Capacity with backup generator	
									gpm	MGD	gpm	MGD
Well 1R	1125 Fresno Street	1994	16	645		0 - 50	340 - 620	Yes	1,600	2.3	1,600	2.3
Well 5	876 N Street	1969	14	465	450	0 - 51	162 - 450	No	1,000	1.4		
Well 6R	1002 T Street	1990	16	500	500	Yes	150 - 230 365 - 385 430 - 480	Yes	1,200	1.7	1,200	1.7
Well 8	1051 Barrington Avenue	2004	16	485	485	0 - 100	180 - 480	Yes	2,500	3.6	2,500	3.6
Well 10	925 Jensen Road	2019	20	570	55	Yes	300 – 325 415 – 495 525 – 550	Yes	2,000	2.9	2,000	2.9
Total Capacity									**8,300**	**12.0**	**7,300**	**10.5**
Firm Capacity									**5,800**	**9.1**		

Table 3-2: Well Pump Information

Pump Name	Manufacturer	Tag	Size	Impeller Diameter (inches)	Type	Head (feet)	Flow (gpm)
Well_1R_PS_01	Peabody Floway				Turbine		1,600
Well_5_PS_01	B & J	12EMM/12M90A			Turbine		1,000
Well_6_PS_01	APW	14KKL			Vertical Turbine	262	1,200
Well_8_PS_01	Floway				Vertical Turbine		2,500
Well_10_PS_01	Floway	Trillium Floway 14 DKH	SM14M	10.94		310	2,100
Total							**8,300**

Table 3-3: Well Pump Motor Information

Pump Name	Manufacturer	Frame	Horsepower	RPM	Hertz	Voltage	VFD
Well_1R_PS_01			150				Yes
Well_5_PS_01			100	1,770			Yes
Well_6_PS_01	US Motors	404TP	100	1,775	60	460	Yes
Well_8_PS_01			300				Yes
Well_10_PS_01		SM14M	250	1,780	60	460	No

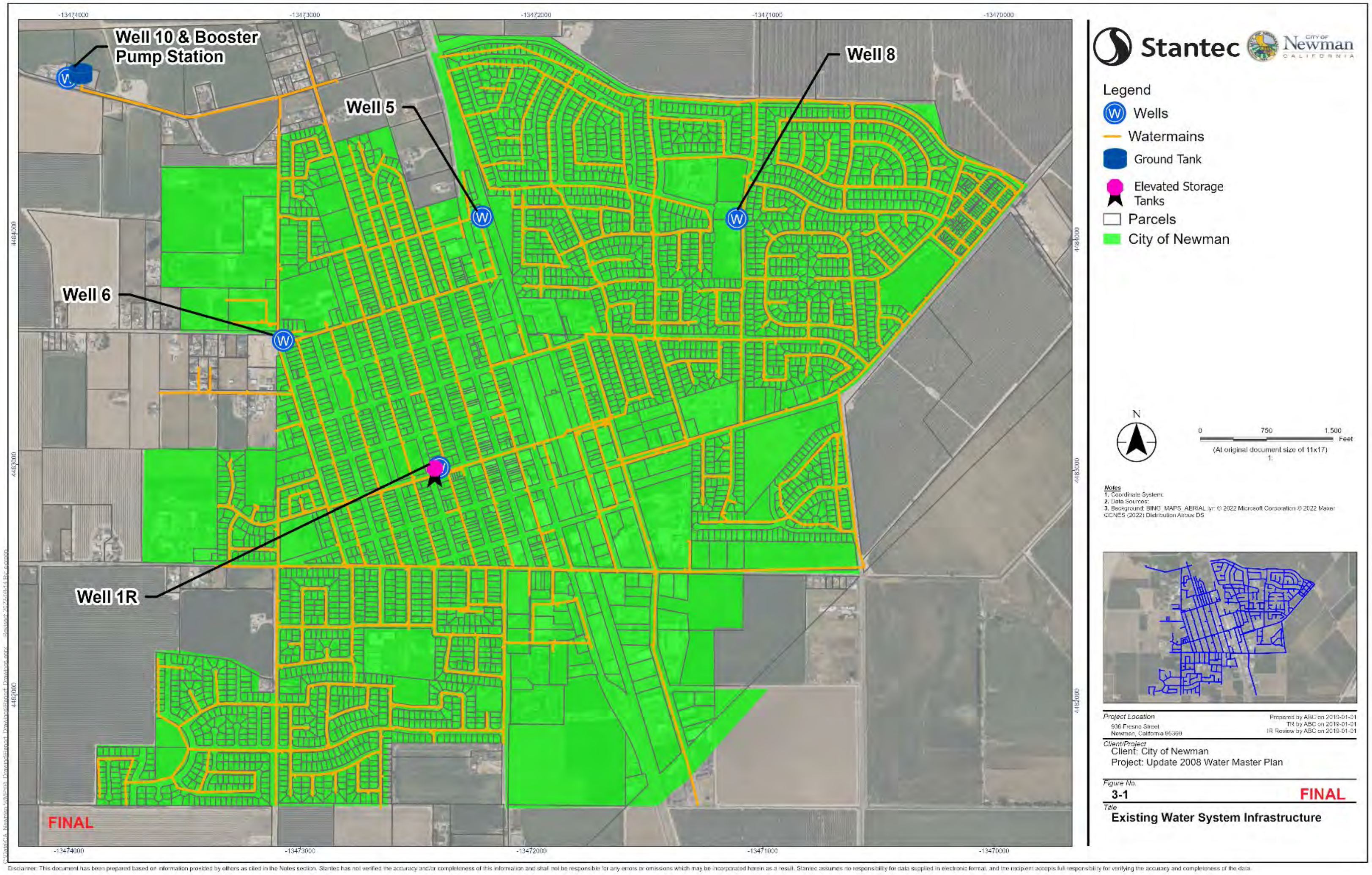

Figure 3-1: Existing Water System Infrastructure

3.2 Pump Stations

The City of Newman currently has a pump installed at each of the five wells along with a booster pump station at Well 10. Table 3-4 and Table 3-5 summarize the booster pump and motor information.

Table 3-4: Booster Pump Information

Pump Name	Manufacturer	Tag	Size	Impeller Diameter (inches)	Type	Head (feet)	Flow [1] (gpm)
Well_10_BPS_01	Girelich-Mitchell Inc	50HP VHS 1800RPM WP1	SP11L 3 stage	8.93	Vertical Turbine	160	1,000
Well_10_BPS_02						160	1,000
Well_10_BPS_03						160	1,000
Total							**2,000**

Notes
1. Total booster pump station is only 2,000 gpm as one of the pumps is standby only.

Table 3-5: Booster Pump Station Motor Information

Pump Name	Manufacturer	Frame	Horsepower	RPM	Hertz	Voltage	VFD
Well_10_BPS_01	Nidec Motor Corporation	326TP	50	1,800	60	460	Yes
Well_10_BPS_02							Yes
Well_10_BPS_03							Yes

3.3 Storage Tanks

The City of Newman currently has two storage tanks. One is a 100,000 gallon elevated storage tank located next to Well 1R and the other is a 1.0 MG ground storage tank located next to Well 10. This gives the City a combined storage volume of 1.1 MG as detailed in Table 3-6.

Table 3-6: Storage Tank

Reservoir	Construction Date	Ground Elevation (feet)	Tank Base (feet)	Depth (feet)	Diameter (feet)	Capacity (MG)
Elevated Water Storage Tank	1909 (reinforced in the 1960s	90	125	40	21	0.103
Ground Storage Tank	2021	106.32	106.32	32	77	1.0
Total						**1.1**

3.4 Distribution System

The water distribution pipe network is comprised of approximately 40 miles of mains with diameters ranging from 2-inch to 16-inch as detailed in Table 3-7. The majority of the pipelines within the City of Newman water distribution system are polyvinyl chloride (PVC) followed by asbestos cement and a small amount of ductile iron, high density polyethylene (HDPE), and steel as detailed in Table 3-8. The majority of the pipelines were installed before the year 2000 as detailed in Table 3-9 but as of the write of this report the exact date is still unknown. Figure 3-2 to Figure 3-4 display the distribution of pipe diameter, material, and installation date throughout the system, while Table 3-10 and Table 3-11 presents a summary of the pipe network characteristics.

Table 3-7: Water Main by Pipe Diameter

Diameter (inches)	Total Length (ft.)	Total Length (miles)	Percentage
2	4,053	0.77	1.78%
2.5	565	0.11	0.25%
4	3,562	0.67	1.55%
6	60,070	11.38	26.28%
8	118,569	22.46	51.86%
10	24,692	4.68	10.81%
12	14,087	2.67	6.16%
16	2,994	0.57	1.32
Total	**228,592**	**43.31**	**100%**

Table 3-8: Water Main by Pipe Material

Material	Total Length (ft.)	Total Length (miles)	Percentage
Asbestos Cement	85,666	16.22	37.47%
Ductile Iron	8,268	1.57	3.63%
HDPE	1,007	0.19	0.44%
PVC	131,698	24.94	57.61%
Steel	1,953	0.37	0.85%
Total	**228,592**	**43.29**	**100%**

Table 3-9: Water Main by Installation Year

Year	Total Length (ft.)	Total Length (miles)	Percentage
Unknown	187,747	35.56	82.14%
2001	8,940	1.69	3.90%
2003	614	0.12	0.28%
2005	23,135	4.38	10.12%
2019	2,070	0.39	0.90%
2020	3,823	0.72	1.66%
2022	2,263	0.43	0.99%
Grand Total	**228,592**	**43.29**	**100.00%**

Table 3-10: Water Main Size and Material (feet)

Diameter/ Material	<4 (in)	4 (in)	6 (in)	8 (in)	10 (in)	12 (in)	16 (in)	Total Length (feet)
Asbestos Cement	2,635	2,492	35,339	31,460	13,097	643	0	85,666
Ductile Iron	0	0	7,423	37	440	96	272	8,268
HDPE	1,007	0	0	0	0	0	0	1,007
PVC	976	257	16,168	87,072	11,155	13,348	2,722	131,698
Steel	0	813	1,140	0	0	0	0	1,953
Total	**4,618**	**3,562**	**60,070**	**118,569**	**24,692**	**14,087**	**2,994**	**228,592**

Table 3-11: Water Main Size and Material (miles)

Diameter/ Material	<4 (in)	4 (in)	6 (in)	8 (in)	10 (in)	12 (in)	16 (in)	Total Length (miles)
Asbestos Cement	0.50	0.47	6.69	5.96	2.48	0.12	0.00	16.22
Ductile Iron	0.00	0.00	1.41	0.01	0.08	0.02	0.05	1.57
HDPE	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.19
PVC	0.18	0.05	3.06	16.49	2.11	2.53	0.52	24.94
Steel	0.00	0.15	0.22	0.00	0.00	0.00	0.00	0.37
Total	**0.87**	**0.67**	**11.38**	**22.46**	**4.68**	**2.67**	**0.57**	**43.29**

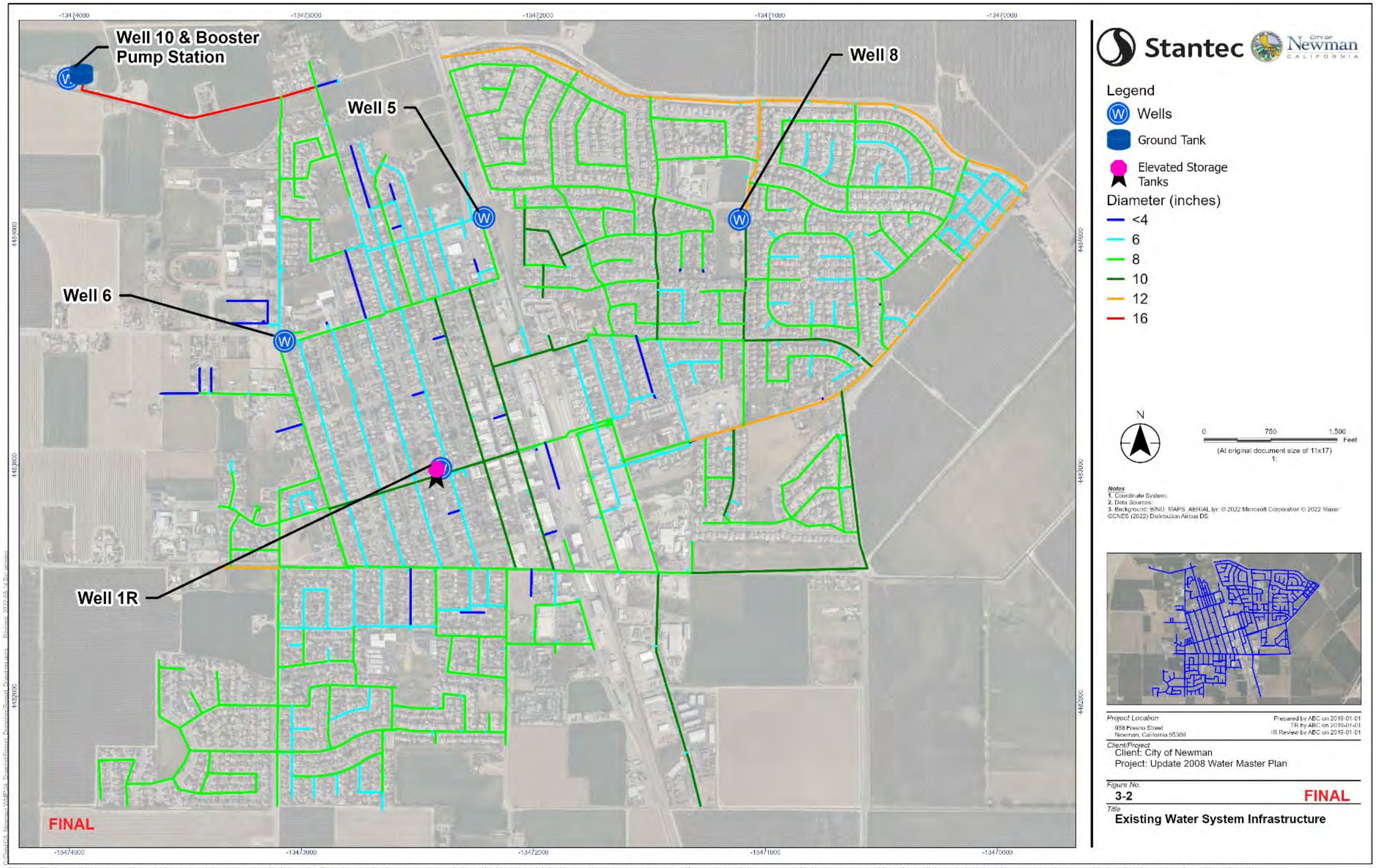

Figure 3-2: Water System Pipe Diameter

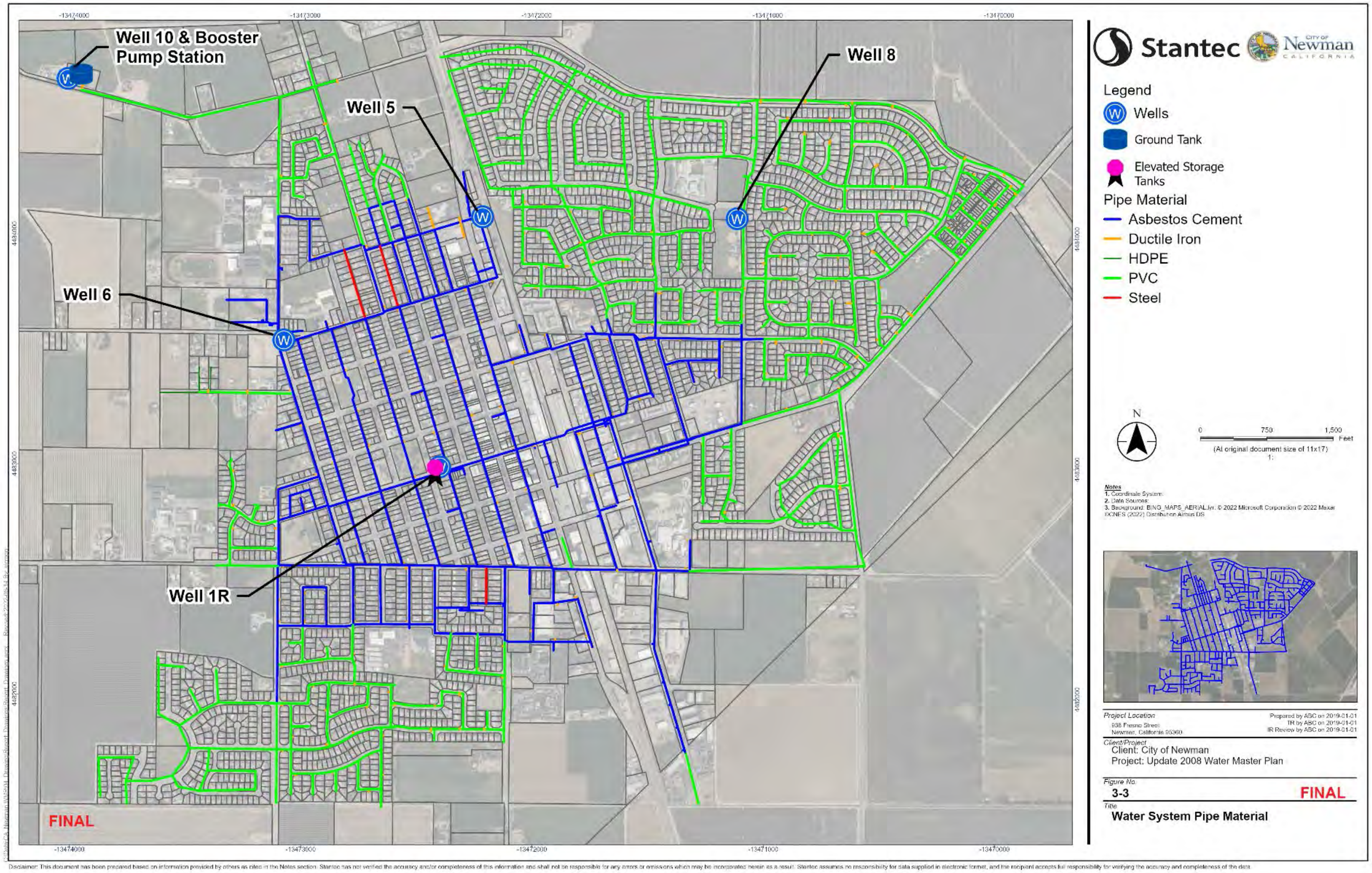

Figure 3-3: Water System Pipe Material

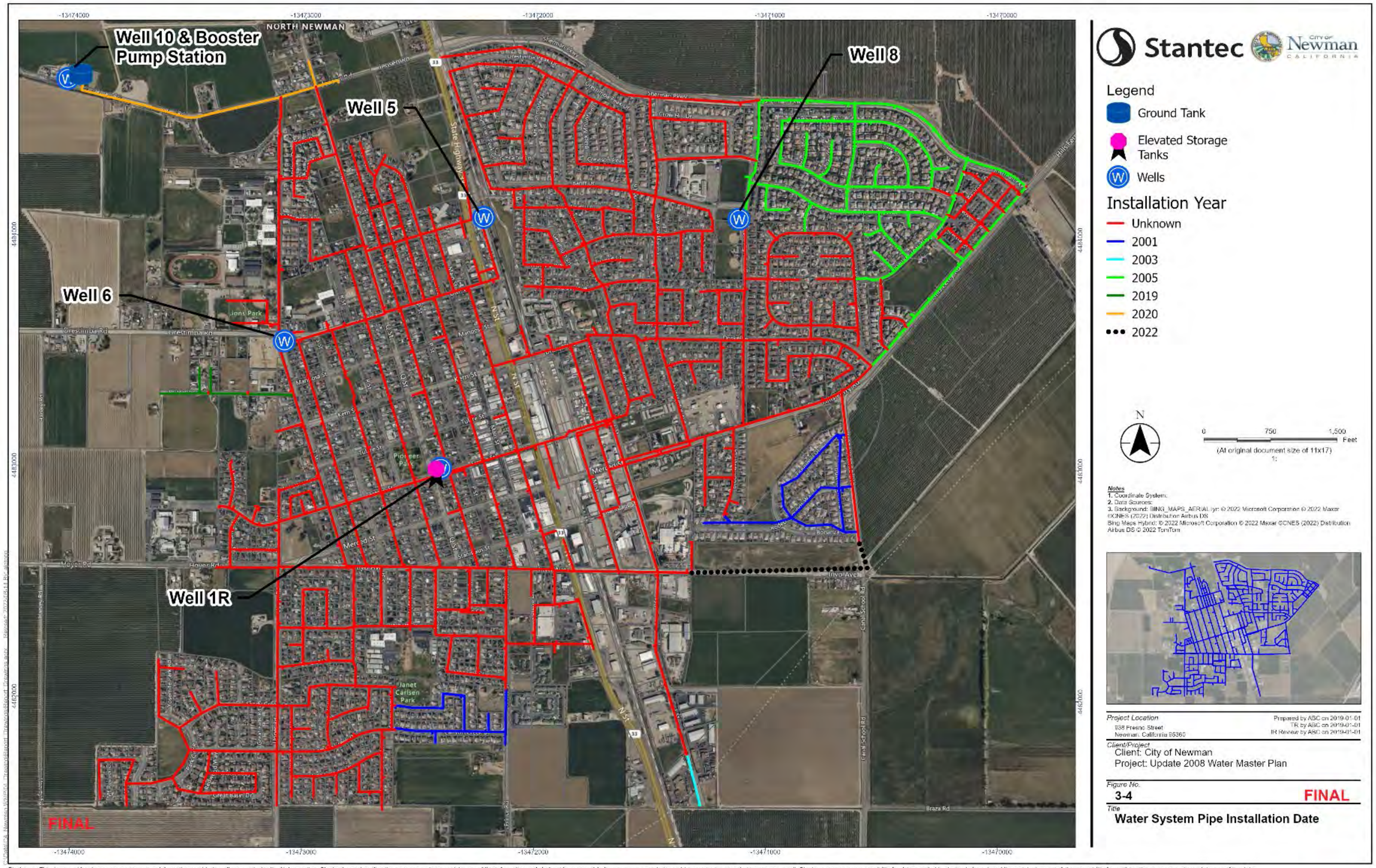

Figure 3-4: Water System Pipe Installation Date

4 Water Demand

4.1 Water Production

The production rates from the City's existing wells were determined based on historical data. Production data represents the amount of water pumped into the distribution system. The majority of that water is sold and accounted for; however, a portion of the water is unaccounted. Review of the production data is useful to establish water demand trends, peaking factors, and quantify the unaccounted-for water.

4.1.1 HISTORICAL WATER PRODUCTION

Daily meter readings are collected at each active well site and were used to calculate annual, monthly, and maximum monthly production volumes. The City reads customer's water meters on a monthly basis and that information is used to determine water use. A summary of historical water production and water use data from 2009 through 2021 was used for this analysis while the 2003 through 2006 data was used as a comparison.

4.1.1.1 Annual Production

The combined annual water production from all of the domestic supply wells is included Table 4-1 and illustrated in Figure 4-1. As noted in the previous master plan, water production previously increased over time as the City's population has grown. However, in the more recent data (2009 to 2021), water usage has not increased in line with population growth. For instance, the average per connection usage peaked in 2012 with 56 gpm/connection compared with 44 gpm/connection for 2021. This could be due to various water saving policies implemented by the State to reduce water consumption in both residential and commercial buildings.

4.1.1.2 Monthly Water Production

Monthly water production from January 2009 through December 2021 is detailed in Table 4-2 and illustrated in Figure 4-2. The maximum month is during the summer season (July to September) with July 2020 having the highest demand of all the years analyzed. The minimum month was January with an average of 30 MGD.

Table 4-1: Annual Water Production

Year	Water Production (MG)	Population[1]
2003	698	7,808
2004	755	8,449
2005	833	9,481
2006	865	9,759
2009	786	10,177
2010	723	10,275
2011	746	10,530
2012	850	10,586
2013	838	10,639
2014	722	10,723
2015	606	10,849
2016	648	11,076
2017	714	11,307
2018	749	11,658
2019	679	11,800
2020	737	12,351[2]
2021	742	11,784[3]

Notes

1. (Data Commons, 2022)
2. (U.S. Census Bureau, 2022)
3. Provided by the City

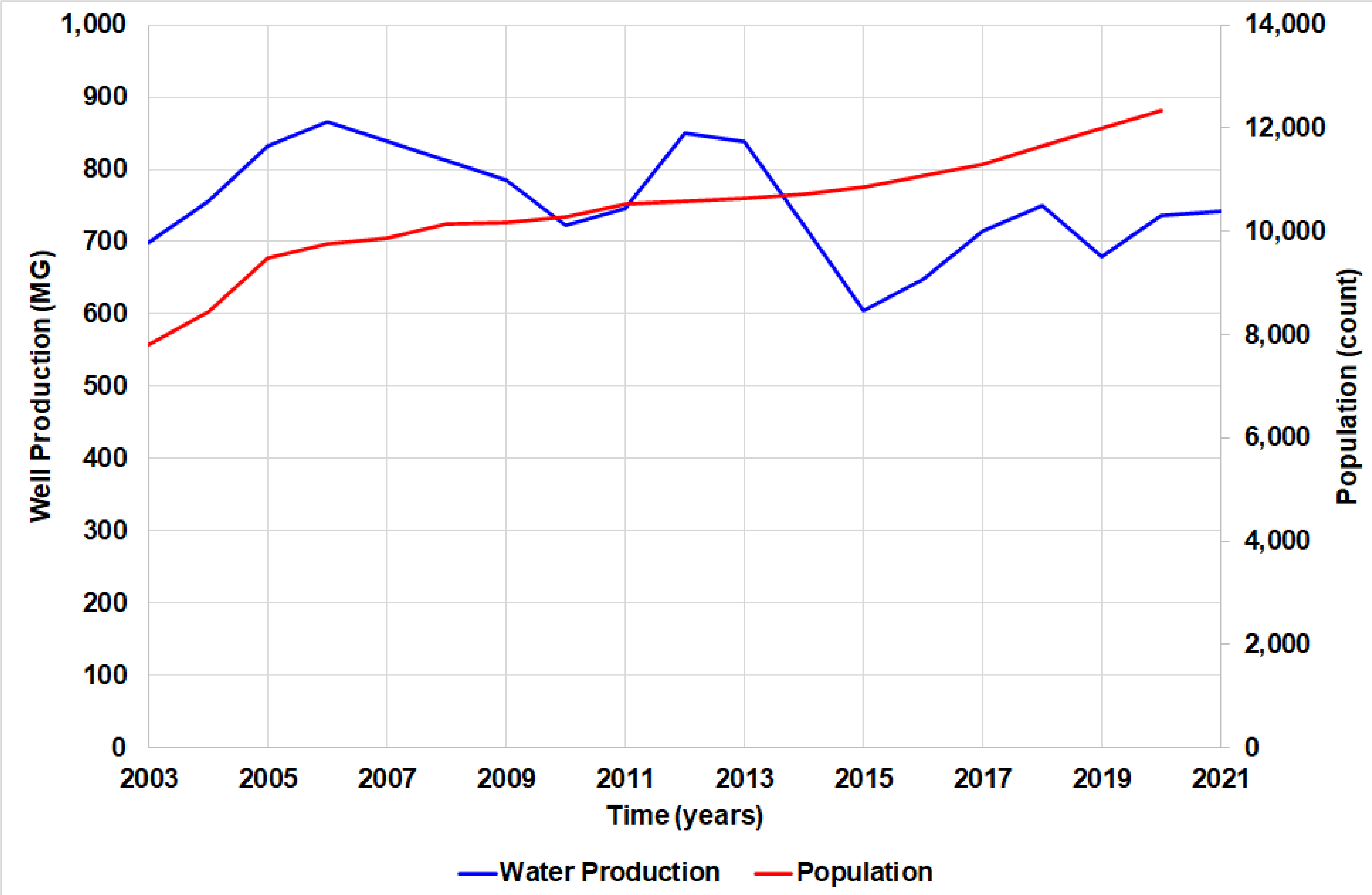

Figure 4-1: Annual Well Water Production Data

Table 4-2: Monthly Well Water Production Data (MGD)

	Years													
Month	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Average**
January	33.44	30.09	5.59	41.44	32.91	43.59	30.17	32.16	31.23	43.48	31.80	0.00	37.22	30.24
February	32.17	29.09	33.57	42.40	37.92	33.75	28.08	31.97	28.60	39.10	30.85	39.51	31.61	33.74
March	45.61	39.88	34.84	54.00	58.90	37.89	48.91	35.40	36.99	39.97	36.91	46.30	47.10	43.28
April	69.11	49.18	59.36	59.18	70.21	53.85	52.69	45.32	43.86	48.41	54.29	56.03	66.37	55.99
May	88.22	65.29	74.76	92.79	97.65	75.47	55.83	67.68	73.65	76.62	66.21	82.23	83.48	76.91
June	90.62	95.55	81.79	104.54	93.41	86.58	66.73	79.41	87.16	88.49	80.10	87.11	82.88	86.49
July	107.84	108.40	104.03	101.47	104.19	91.38	61.60	84.05	89.07	94.61	86.85	95.40	91.30	93.86
August	89.67	93.48	103.16	114.63	91.26	91.27	69.77	78.77	88.36	87.52	86.26	90.83	86.07	90.08
September	82.33	83.89	94.17	79.75	79.13	70.94	64.07	70.35	77.28	74.06	54.14	76.76	74.75	75.51
October	61.49	45.56	58.81	72.02	75.01	68.45	56.62	52.64	69.55	69.47	65.94	70.78	60.96	63.64
November	45.08	44.40	49.03	51.04	57.56	34.51	36.96	37.85	45.20	53.29	51.70	50.45	41.42	46.04
December	39.95	38.37	47.03	37.25	40.17	34.05	34.28	32.17	43.48	34.33	33.83	41.73	38.72	38.10
Minimum	**32.17**	**29.09**	**5.59**	**37.25**	**32.91**	**33.75**	**28.08**	**31.97**	**28.60**	**34.33**	**30.85**	**0.00**	**31.61**	**30.24**
Average	**65.46**	**60.26**	**62.18**	**70.87**	**69.86**	**60.14**	**50.48**	**53.98**	**59.53**	**62.45**	**56.57**	**61.43**	**61.82**	**61.16**
Maximum	**107.84**	**108.40**	**104.03**	**114.63**	**104.19**	**91.38**	**69.77**	**84.05**	**89.07**	**94.61**	**86.85**	**95.40**	**91.30**	**93.86**

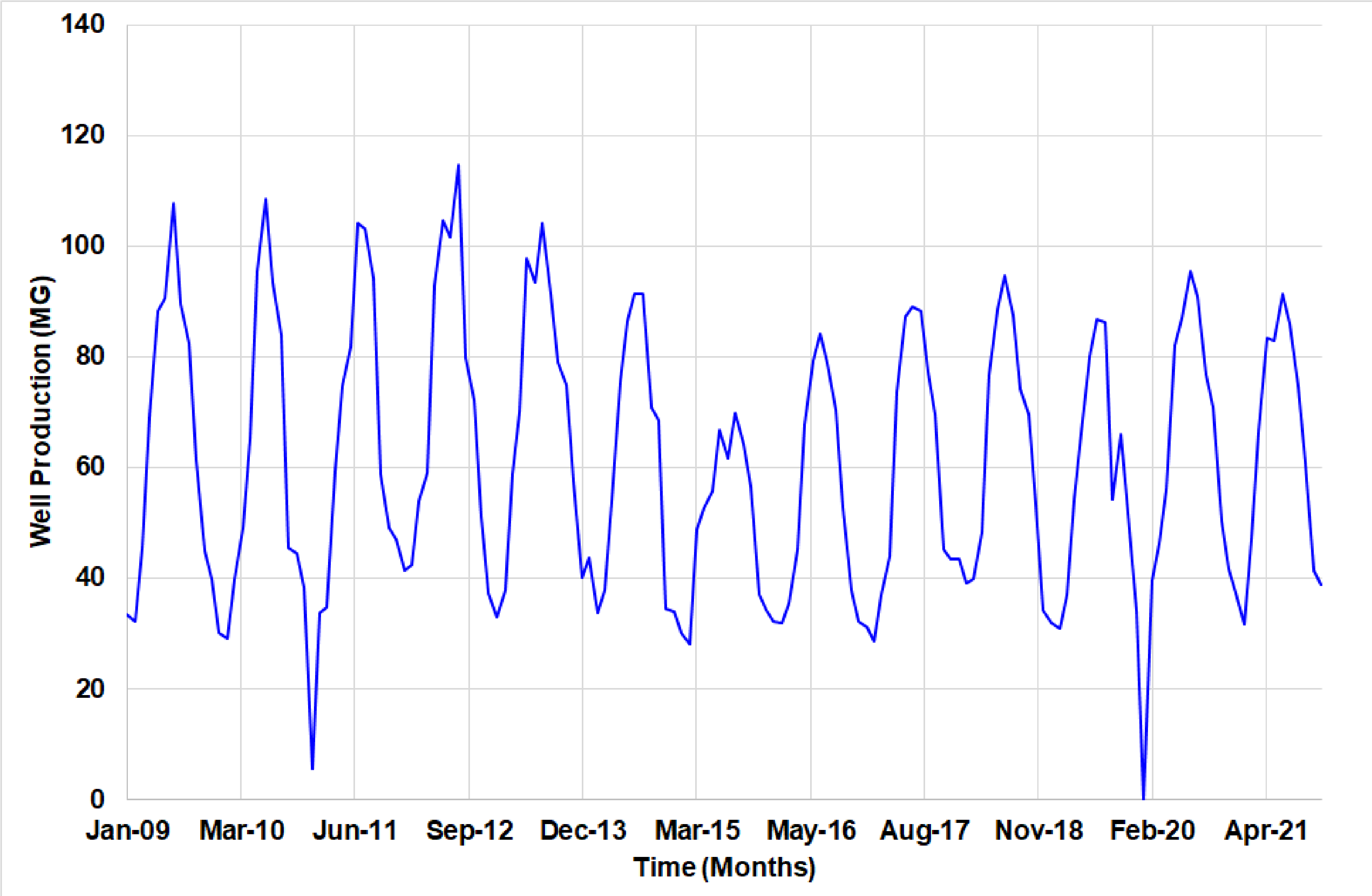

Figure 4-2: Monthly Well Water Production Data

4.2 Existing Water Demands

4.2.1 AVERAGE DAY WATER DEMANDS

The average day demand for the City of Newman was calculated by taking the average monthly water production over the previous 5-years and converting this to gallons per minute. Based on the well production data provided by the City of Newman, an average day demand of 2.05 MGD or 1,425 gpm was selected as that was the highest year in the last 5-years of data provided.

Table 4-3: Annual Water Production

Year	Water Production	Average Production	
	MG	MGD	gpm
2017	714	1.96	1,359
2018	749	2.05	1,426
2019	679	1.86	1,292
2020	737	2.02	1,402
2021	742	2.03	1,411

4.2.2 MAXIMUM DAY AND PEAK HOUR WATER DEMANDS

To calculate maximum day and peak hour water demands from usage data, 22 CCR (OAL, 2022) requires the past ten years of daily data. Since this was not available, Stantec used a ratio of average day demand to maximum day demand of 2.25 and a maximum day to peak hour ratio to 1.5.

4.2.3 EXISTING DEMAND SUMMARY

Table 4-4 summarizes the existing water demand factors for the 2022 Water Master Plan. These ratios are similar to the 2008 Water Master Plan (Eco:Logic, 2008) (Table 4-5), however, the average day demand has decreased by around 15%. This is due to a number of state policies that encourage water reduction such as low flow faucets and toilets, lawn replacement along with general outdoor water restrictions during drought years. Stantec has assumed based on increased frequency and severity of draughts that this downward trend will continue into the future.

Table 4-4: Summary of 2022 Water Master Plan Water Factors and Demands

Scenario	Ratio to ADD	Demands	
		MGD	gpm
Average Day	1.00	2.05	1,426
Maximum Day	2.25	4.62	3,209
Peak Hour	3.38	6.93	4,813

Table 4-5: Summary of 2008 Water Master Plan (Eco:Logic, 2008) Water Factors and Demands

Scenario	Ratio to ADD	Demands	
		MGD	gpm
Average Day	1.00	2.40	1,667
Maximum Day	2.70	6.48	4,500
Peak Hour	4.05	9.72	6,750

4.3 Future Water Demands

A number of future developments are currently proposed over the next 10-years for the City of Newman, these include (Figure 4-3):

- T-Street
- Mattos Ranch
- Caton Ranch
- Agriana Development

4.3.1 WATER DEMANDS BY SERVICE TYPE

Demand factors used as part of this water master plan for future developments is based on the previous Water Master Plan (Eco:Logic, 2008), Appendix F of the Northwest Newman Master Plan (Community Development Department, 2017) (NV5, 2013) and are summarized in Table 4-6. Residential average demands were calculated as by taking the total residential demand over the past 5-years (2016 – 2021) divided by the total number of residential connections (3,316 connections). This resulted in an average residential demand of 377 gal/day/connection while multi-family was calculated as 715 gal/day/connection. Since the average of these is fairly close to 500 gal/day/connection no changes were made to the average demands from the previous master plan.

Parks and recreation areas were removed from the demand scenarios as the City is planning to serve these via non-potable sources. While this will reduce the demand on the potable water system once it is implemented, the City should undertake a non-potable water resources master plan to understand both the pros and cons of this approach.

Table 4-6: Water Demands by Service Type

Service Type	Average Demand
Residential	500 gal/day/unit
Multi-family Residentials	500 gal/day/unit
Parks	2,000 gal/day/acre
Schools	2,000 gal/day/acre
Commercial	4,900 gal/day/acre
Industrial	9,500 gal/day/acre

Notes

1. Parks removed due to being served by non-potable water

4.3.2 T STREET

T Street (Aspen Survey Company, 2018) is a ten lot subdivision near the intersection of T Street and Orestimba Road. The subdivision is entirely residential with a and is proposed for a vacant land parcel.

Table 4-7: T Street Proposed Demands

Model ID	Lot Number	Type	Water Demand Factor[1]	Count	Demand (gpm)
4919	1 – 10	Residential	500	10	3.5

Notes

1. Table 4-6

4.3.3 MATTOS RANCH

Mattos Ranch (Aspen Survey Company, 2015) is a 106 lot subdivision west of Prince Road. The subdivision is entirely residential with a and is proposed for a vacant land parcel.

Table 4-8: Mattos Ranch Proposed Demands

Model ID	Lot Number	Type	Water Demand Factor[1]	Count	Demand (gpm)
4951	1 - 13 & 59 - 67	Residential	500	22	7.64
4958	14 - 18 & 41 - 58	Residential	500	23	7.99
4952	19 - 40	Residential	500	22	7.64
4955	68 - 80	Residential	500	13	4.51
4956	81 - 93	Residential	500	13	4.51
4954	94 - 106	Residential	500	13	4.51
Total				**106**	**36.8**

Notes

1. Table 4-6

4.3.4 CATON RANCH

Caton Ranch (Associated Engineering Group, 2021) is a 112 lot subdivision between Canyon Creek and Prince Road. The subdivision is entirely residential with a single parcel set aside for a park and is proposed for a parcel that is currently occupied by a farm.

Table 4-9: Caton Ranch Proposed Demands

Model ID	Lot Number	Type	Water Demand Factor[1]	Count	Demand (gpm)
4963	1 - 4	Residential	500	4	1.39
4974	5 - 11	Residential	500	7	2.43
4966	12 - 18	Residential	500	7	2.43
4981	19 - 25	Residential	500	7	2.43
4960	26 - 31	Residential	500	6	2.08
4967	32 - 38	Residential	500	7	2.43
4975	39 - 44	Residential	500	6	2.08
5151	45 - 51	Residential	500	7	2.43
4969	52 - 58	Residential	500	7	2.43
4967	59 - 69	Residential	500	11	3.82
4973	70 - 77	Residential	500	8	2.78
4972	78 - 85	Residential	500	8	2.78
4972	86 - 92	Residential	500	7	2.43
4981	93 - 101	Residential	500	9	3.13
4965	102 - 112	Residential	500	11	3.82
Total				**112**	**38.89**

Notes

1. Table 4-6

4.3.5 AGRIANA DEVELOPMENT

Agriana (Hearthstone Builders, Inc., 2021) is a proposed 504 acre mixed use development located north of Sherman Parkway on mainly existing agricultural land. The development consists of multi-family (MF) apartments, single family detached (SFD) homes, an industrial and business park along with parks and open spaces.

Table 4-10: Agriana Proposed Demands

Model ID	Development Type	Type	Water Demand Factor[1]	Count or Area (acre)	Demand (gpm)
5154	SFD (10 DU/A)	Residential	500	131	45.49
4995	SFD (50x105)	Residential	500	105	36.46
4995	SFD (10 DU/A)	Residential	500	108	37.5
4995	SFD (50x105)	Residential	500	61	21.18
4996	SFD (70x105)	Residential	500	111	38.54
4996	SFD (70x105)	Residential	500	128	44.44
5157	MF	Residential	500	198	68.75
5157	SFD (50x105)	Residential	500	55	19.1
5160	SFD (60x105)	Residential	500	106	36.81
5160	SFD (60x105)	Residential	500	10	3.47
4998	MF	Residential	500	199	69.1
4998	SFD (60x105)	Residential	500	112	38.89
4999	SFD (70x105)	Residential	500	84	29.17
4999	AA (60x105)	Residential	500	95	32.99
4989	AA (50x105)	Residential	500	134	46.53
5163	AA (60x105)	Residential	500	170	59.03
5166	AA (50x105)	Residential	500	130	45.14
5154	SFD (10 DU/A)	Residential	500	131	45.49
4995	SFD (50x105)	Residential	500	105	36.46
4995	SFD (10 DU/A)	Residential	500	108	37.5
4995	SFD (50x105)	Residential	500	61	21.18
4996	SFD (70x105)	Residential	500	111	38.54
4996	SFD (70x105)	Residential	500	128	44.44
5157	MF	Residential	500	198	68.75
5157	SFD (50x105)	Residential	500	55	19.1
5160	SFD (60x105)	Residential	500	106	36.81
5160	SFD (60x105)	Residential	500	10	3.47
4998	MF	Residential	500	199	69.1
4998	SFD (60x105)	Residential	500	112	38.89
4999	SFD (70x105)	Residential	500	84	29.17
4999	AA (60x105)	Residential	500	95	32.99

Model ID	Development Type	Type	Water Demand Factor[1]	Count or Area (acre)	Demand (gpm)
4989	AA (50x105)	Residential	500	134	46.53
5163	AA (60x105)	Residential	500	170	59.03
5166	AA (50x105)	Residential	500	130	45.14
Subtotal					**672.59**
Model ID	**Development Number**	**Type**	**Water Demand Factor[1]**	**Area (acre)**	**Demand (gpm)**
5154	Business Park	Commercial	4,900	43.88	149.31
4999	Amenity Center	Commercial	4,900	4	13.61
5163	Light Industrial	Industrial	9,500	97.02	640.06
5166	Amenity Center	Commercial	4,900	4	13.61
Subtotal					**816.59**
Total					**1489.18**

Notes

1. Table 4-6

4.3.6 NORTHWEST NEWMAN MASTER PLAN

The Northwest Newman Master Plan (Community Development Department, 2017) consists of a mix of residential, business park, community commercial, office, parks, and school uses. The subdivision covers an area of approximately 362-acres which was previously farmland.

Table 4-11: Northwest Newman Master Plan Proposed Demands

Model ID	Development Type	Type	Water Demand Factor[1]	Count	Demand (gpm)
4920	PMR 1	Residential	500	160	55.56
5141	PMR 2	Residential	500	121	42.01
4927	PMR 3	Residential	500	104	36.11
4921	PMR 4	Residential	500	131	45.49
4924	PMR 5	Residential	500	53	18.4
4934	PMR 6	Residential	500	74	25.69
4925	PMR 7	Residential	500	106	36.81
4928	PMR 8	Residential	500	96	33.33
4933	PMR 9	Residential	500	83	28.82
4946	PMR 10	Residential	500	37	12.85
10439	PMR 12	Residential	500	153	53.13
4941	VLD	Residential	500	55	19.1
4940	HDR	Residential	500	180	62.5

Subtotal					469.80
Model ID	**Development Type**	**Type**	**Water Demand Factor[1]**	**Area (acre)**	**Demand (gpm)**
4931	Business Park 1	Commercial	4,900	18.9	64.31
4939	Business Park 2	Commercial	4,900	12.8	43.56
4948	Business Park 3	Commercial	4,900	27.5	93.58
9796	Professional Office	Commercial	4,900	8.3	28.24
4939	Community Commercial 1	Commercial	4,900	4.7	15.99
4939	Community Commercial 2	Commercial	4,900	22.6	76.9
4927	School	School	2,000	10	13.89
Subtotal					**336.47**
Total					**806.27**

Notes

1. Table 4-6

4.3.7 SUMMARY OF FUTURE WATER DEMANDS

Table 4-12 summarizes the future demands based on the proposed developments outlined in Sections 4.3.2 to 4.3.6. There is a degree of uncertainty around the actual future demands, especially the proposed demands for the light industrial zone that is part of the Agriana Development. The demands that are going to be used in the future model are on the conservative side, therefore, the City should update and re-run the future scenarios once the demands for these future developments have been confirmed.

Table 4-12: Summary of Future Water Factors and Demands

Scenario	Ratio to ADD	Demands	
		MGD	gpm
Existing Average Day	1.00	2.05	1,426
T Street		0.01	4
Mattos Ranch		0.05	37
Canton Ranch		0.06	39
Agriana Development		2.14	1,489
Northwest Newman Master Plan		1.16	806
Future Average Day		5.47	3,801
Future Maximum Day	2.25	12.31	8,551
Future Peak Hour	3.38	18.47	12,827

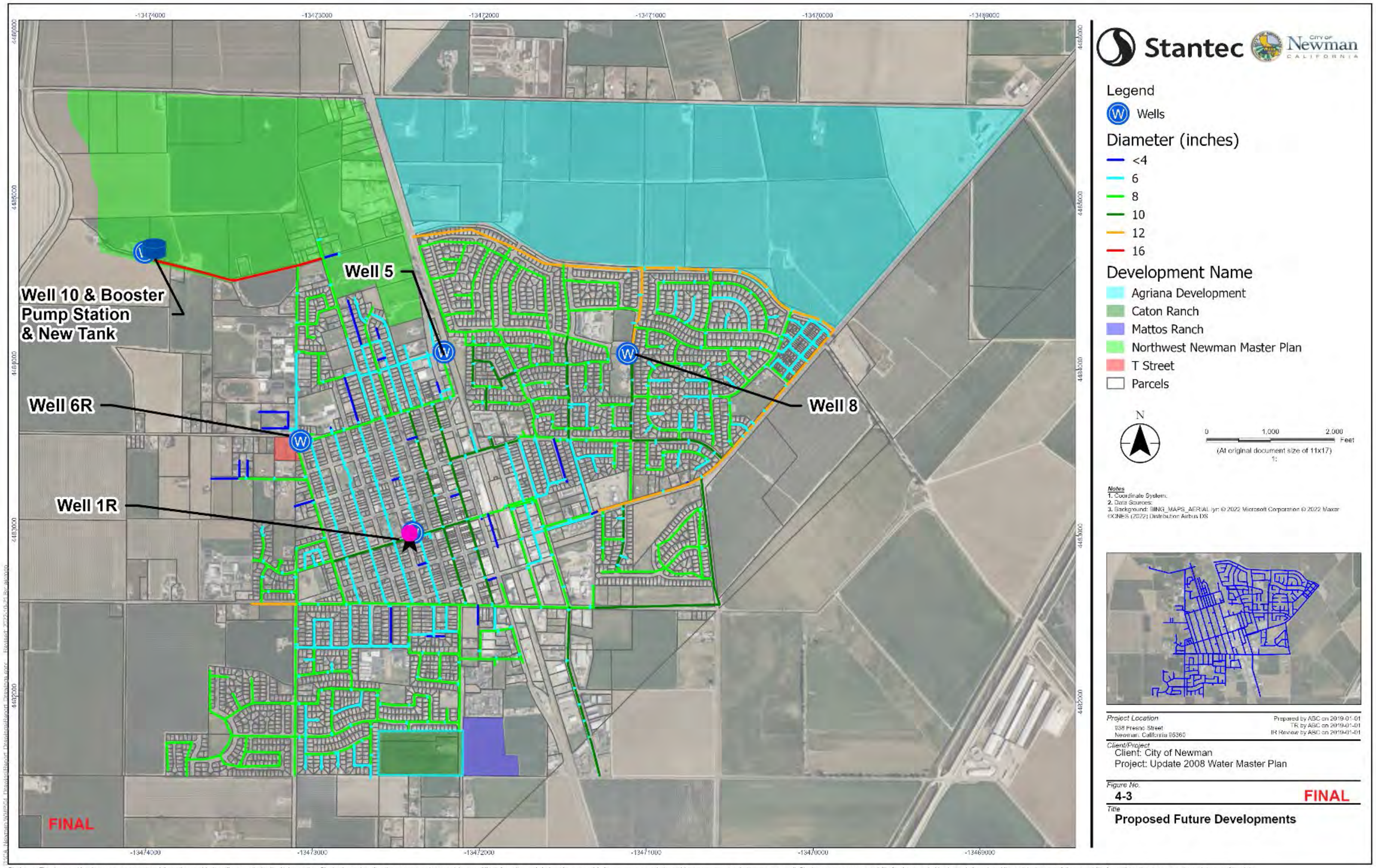

Figure 4-3: Proposed Future Developments

5 Hydraulic Model

5.1 Introduction

A hydraulic model of the water distribution system was used to evaluate to junction pressures, pipe velocities and available fire flow under existing and future demand scenarios. The previous 2008 hydraulic model was updated based on AutoCAD drawings and developments that were added since 2015 using WaterGEMS Connection Edition 10.03.05.05.

5.2 Model Development

The City of Newman water system hydraulic model was built as part of the 2008 Master Plan by Eco: Logic (Eco:Logic, 2008) to evaluate the existing demand scenarios as well as to identify and evaluate potential improvement projects. Stantec used the City's Water Infrastructure Map, along with AsBuilts of recently completed subdivisions, to update the existing model with new infrastructure/updated information.

5.2.1.1 Roughness Coefficients

The roughness coefficients for the distribution mains and service lines were based on a combination of material (Table 3-8) and installation date (Table 3-9) as detailed in Table 5-1 and Table 5-2.

Table 5-1: Pipeline Roughness Coefficients

Material		Hazen William C-Factor
Asbestos Cement	AC	140
Ductile Iron, cement lined	DI	140
High Density Polyethene	HDPE	130
Polyvinyl chloride	PVC	130
Steel (assumed cement lined)	ST	140
Unknown	UKN	Assumed to be unlined cast iron, see Table 5-2

Table 5-2: Pipe Roughness Coefficient - Cast Iron

Material	Average Hazen William C-Factor	Model C-Factor
Cast Iron - new	130	130
Cast Iron - 10-years old	107 - 113	110
Cast Iron - 20-years old	89 - 100	95
Cast Iron - 30-years old	75 - 90	83
Cast Iron - 40-years old	64 - 83	74

5.2.1.2 Model Representation of Storage Tanks

The tanks in the model were represented as either an elevated storage tank with a generic 500,000 gallon tank curve or ground storage tanks with a base elevation at ground level as detailed in Table 5-3.

Table 5-3: Modeled representation of Elevation Storage Tank

Reservoir	Ground Elevation (ft)	Minimum Level (ft)	Initial Elevation (ft)	Maximum Level (ft)
Elevated Water Storage Tank	90.00	175	200	215
Ground Storage Tank	106.32	0	20	32

5.3 Existing Water Demand Distribution

The existing system water demand was allocated to the model by linking the billing data to the parcel APN number in ArcGIS Pro using the County parcel shapefiles. The parcels were then linked to the closest model junction creating a link between the billing data and model. These initial billing data demands were then scaled to match the average day, maximum day and peak hour.

5.4 Scenario Summary

A number of scenarios were created as part of the 2022 Water Master Plan, and these are detailed below. They cover scenarios related to calibration along with existing and future system analysis of maximum day and peak hour demand.

- 2022 Update
  - 2022 Calibration
    This scenario was used for model calibration the model
    - 2021 July
      This scenario was used to calibrate the model for the 6th to 9th July 2021
    - 2021 October
      This scenario was used to calibrate the model for the 12th to 15th October 2021
- Existing System
  - Maximum Day plus Fire flow
    This scenario was used to simulate the fire flows under existing maximum day demands
  - Maximum Day plus fire flow with Capital Improvement Projects
  - Peak Hour
    Future peak hour demand under steady state analysis
- Future System
  - Maximum Day plus Fire flow
    This scenario was used to simulate the fire flows under future maximum day demands
  - Maximum Day plus fire flow with CIPS
  - Peak Hour
    Future peak hour demand under steady state analysis

6 Calibration

Model Calibration is the process of validating the model by comparing Supervisory Control and Data Acquisition (SCADA) data (pressure, flow and tank levels) to simulated model results under the same boundary conditions and adjusting model parameters until the model results reflect field conditions. This process will include collecting and comparing SCADA data to model results under extended period simulation (EPS).

6.1 Calibration Guidelines

The American Water Works Association Computer Modeling of Water Distribution Systems M32 (AWWA M32) (AWWA, 2017) Manual states that there are no established standards for hydraulic calibration. However, AWWA does provide the following general guidelines which are summarized in Table 6-1.

Table 6-1: AWWA General Guidelines for Calibration

Data Type	Criteria
Flow (pumps, meter stations, PRV's)	5 to 10%
Pressure (head) (suction and discharge pressure from pump stations, PRV set points, temporary pressure loggers, meter station system pressures)	5 to 10 feet
Tank level	3 to 6 feet

AWWA M32 manual suggests that the higher accuracy guidelines (if the model HGL is within 5 feet of the recorded field values) represents a model that is calibrated for design and operational evaluations. A model with lower accuracy guidelines (if the model HGL is within 10 feet of the recorded field values) represents models suitable for long range planning. The criteria assumes that at least 80 percent of the of the modeled data matching the recorded pressure/flow data for a given time interval. In the case of the City, the time intervals were selected as 5-minutes as this was the recording interval of the flow data. During the extended period simulation (EPS) calibration, each data point (pump station flow and pressure data) was assigned to a category of either:

1. Meets operational calibration guidelines.

2. Meets planning level calibration guidelines; or

3. Does not meet calibration guidelines

Stantec then refined Table 6-1 to create Operational, Planning Level and Does Not Meeting Calibration Guidelines as detailed in Table 6-2. A planning level of calibration was selected for the City of Newman hydraulic model for the following reasons:

- No field test was planned as part of this project,

- Elevated tank curve needed to be estimated and the absence of a flow meter at the elevated tank, and
- The end use of the model was a master plan.

Table 6-2: Calibration Guidelines

Data Type	Calibration Guidelines		
	Operational Calibration Guidelines	Planning Level Calibration Guidelines	Does Not Meet Calibration Guidelines
Flow	<= 5%	<= 10%	> 10%
Pressure (head)	<= 5 feet	<= 10 feet	> 10 feet
Tank Level	<= 3 feet	<= 6 feet	> 6 feet

6.2 Calibration Day Selection

Pressure and flow data was provided by the City of Newman from Saturday July 7th to Saturday July 10th, 2021; and Saturday October 9th to Saturday October 16th, 2021. For instance, since only one week of data was provided for both July and October, the calibration days that were selected were:

- Tuesday July 6th to Thursday July 9th, 2021
- Tuesday October 12th to Thursday October 14th, 2021.

These days were selected for the following reasons:

- Saturday July 7th and Saturday October 9th both had missing data, and
- They are a typical day and not a Friday to Monday,

Figure 6-1 and Figure 6-2 illustrates the total flows from all the City of Newman wells during the July and October 2021 calibration period, respectively. Total flows in July average 1,800 gpm with a maximum flow of around 3,500 gpm. Flows for October are slightly less, averaging around 1,200 gpm with a maximum flow of around 2,800 gpm.

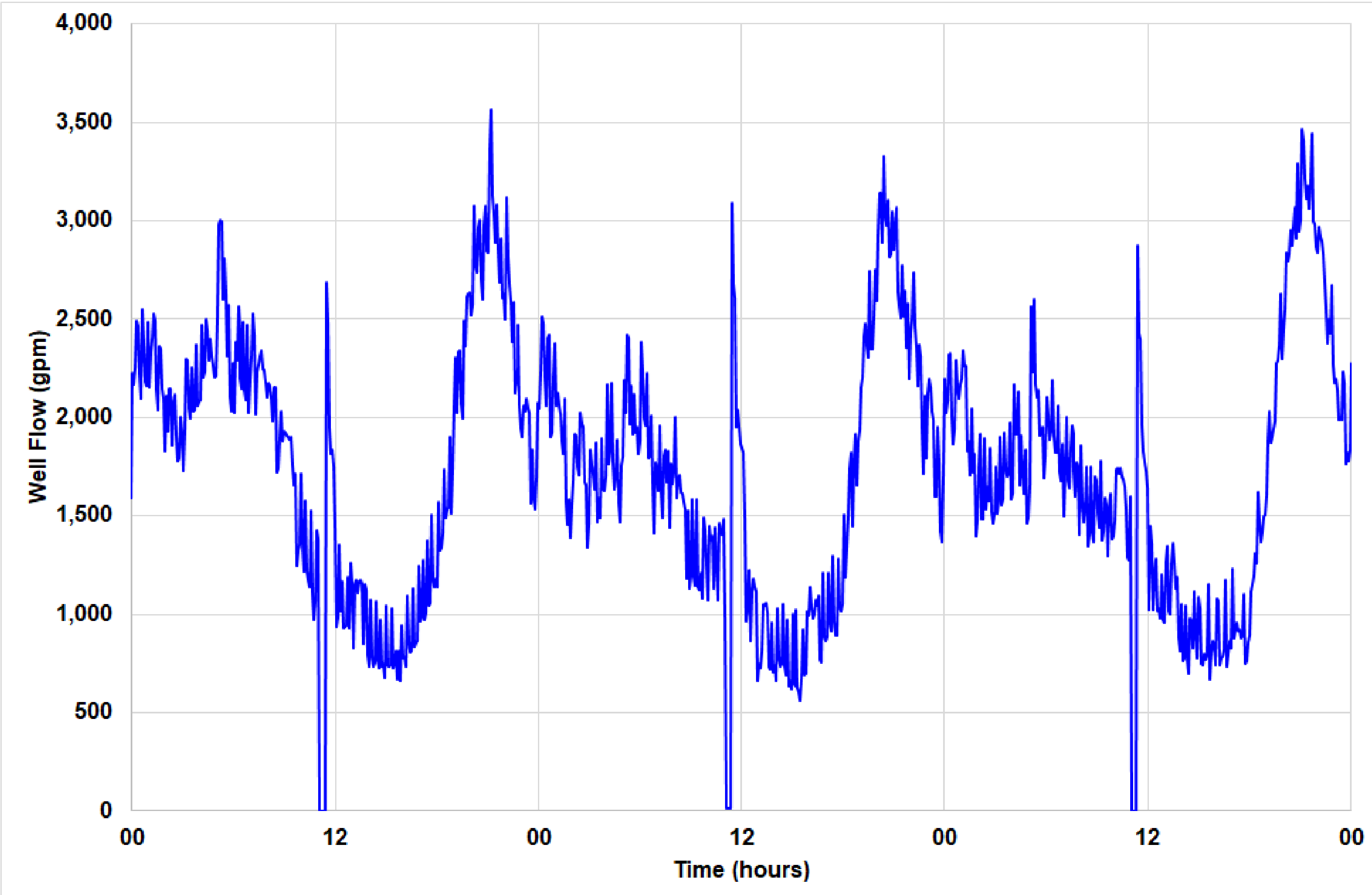

Figure 6-1: July Flow Data

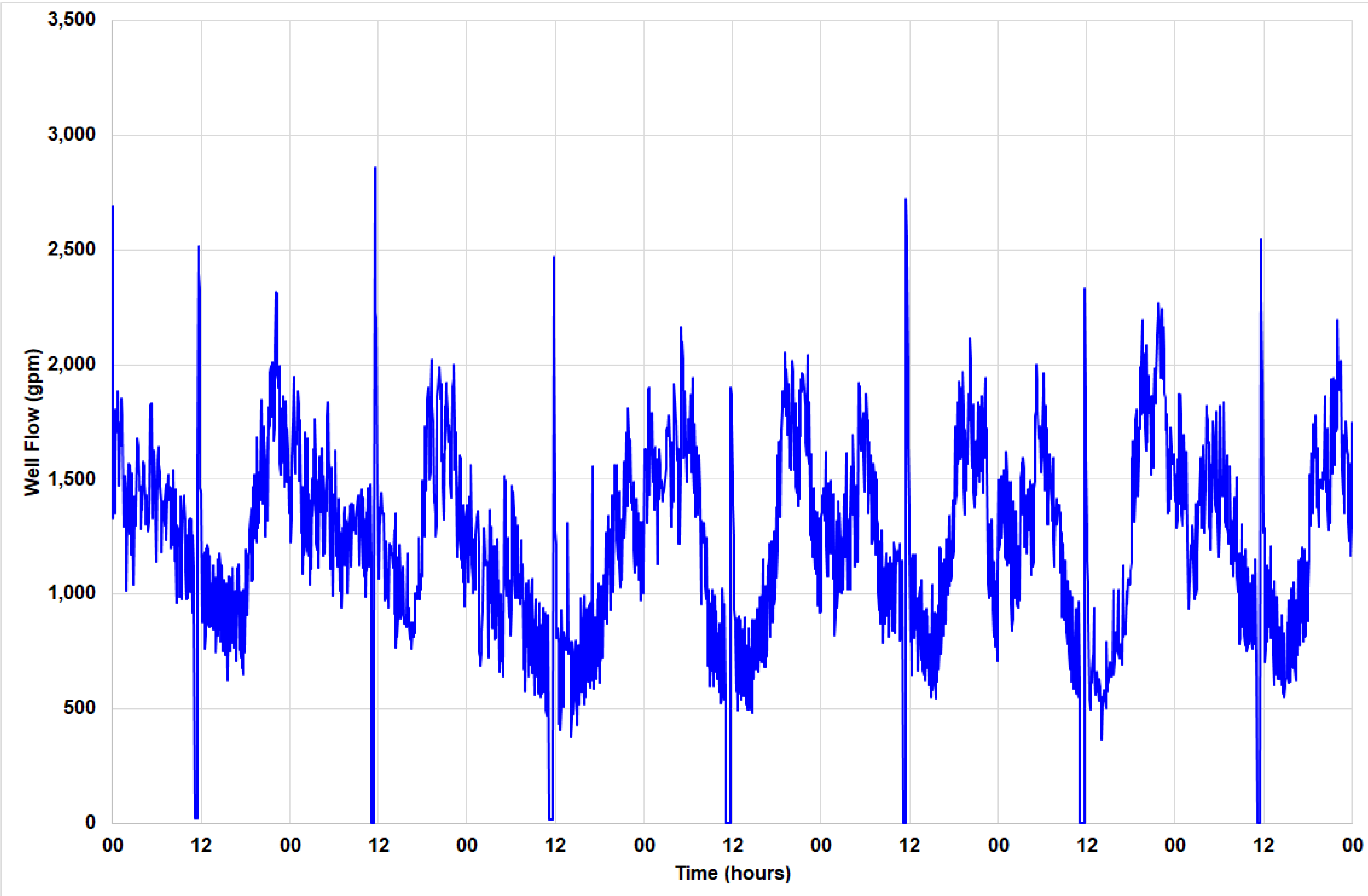

Figure 6-2: October Flow Data

6.3 Demand Patterns

The demand pattern for the City of Newman hydraulic model was developed based on the averaging the total flows from all the wells for the July and October period of data provided. These patterns were then smoothed to remove any significant variations in flows (spikes) and then applied to the model. This created a unique pattern for July and October that is illustrated in Figure 6-3. The elevated tank in the system currently does not have a level sensor or a flow meter on the outlet pipe so it was excluded from the water balance equation.

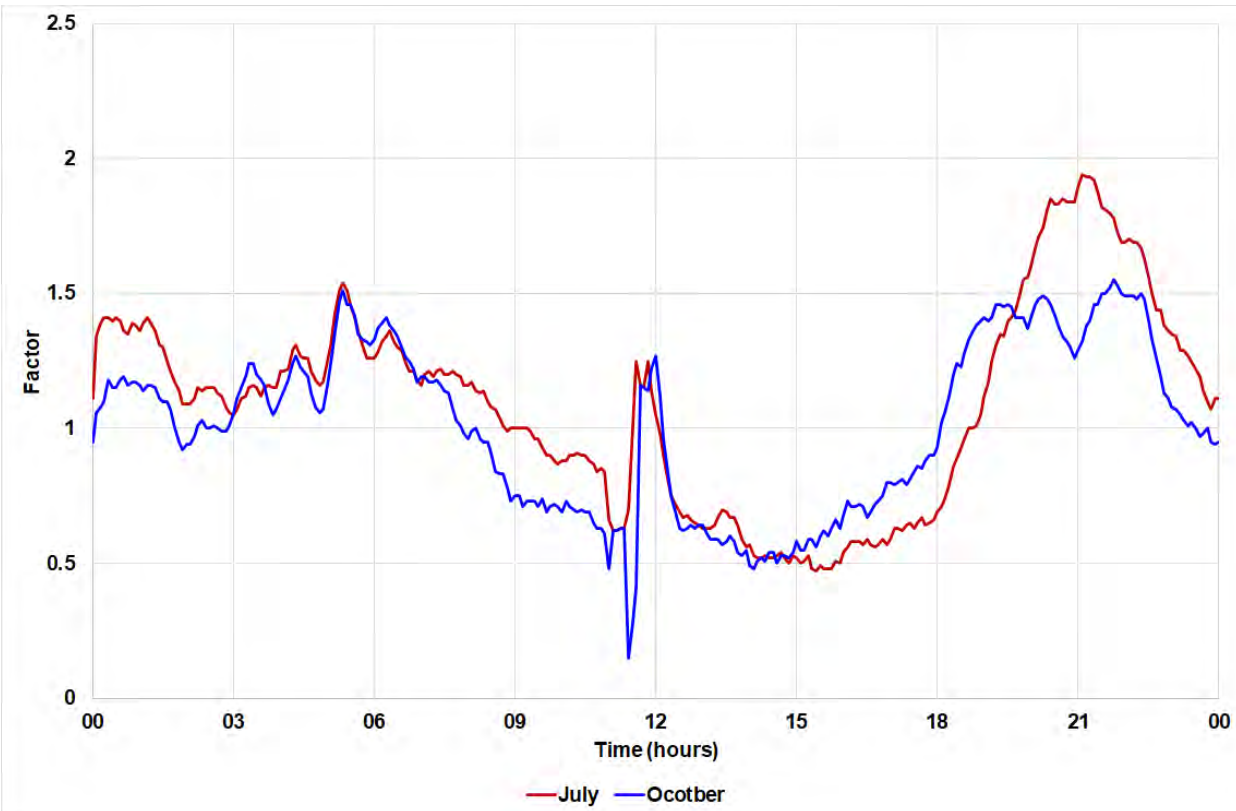

Figure 6-3: July Demand Patterns

6.4 Calibration

The calibration of the City of Newman hydraulic model was undertaken using a 72-hour extended period simulation (EPS) calibration. A number of the well pumps in the system did not have pump curves, therefore, the pump curves from the previous master plan were used as an initial starting point. The final well pump settings are detailed in Table 6-3 and Table 6-4 while well depths were adjusted to calibrate the model.

Table 6-3: Well Set Points During July 2021

Well	Set Point	Average Flow (gpm)
Well 1R	Off	0
Well 5	Always on	207
Well 6R	VFD set point 52	366
Well 8	VFD set point 55	1,160
Well 10	Under construction	Under construction

Table 6-4: Well Set Points During October 2021

Well	Set Point	Average Flow (gpm)
Well 1R	Off	0
Well 5	Off	0
Well 6R	VFD set point 52	405
Well 8	VFD set point 55	804
Well 10	Under construction	Under construction

6.4.1 JULY 6TH TO 9TH, 2021

The model was calibrated against flows and pressures at four well locations. The model results are compared with the field data to determine if the model reflects the actual system operating conditions over a 72-hour period. Calibration was achieved by adjusting the depth of wells, adjusting the starting level in the elevated storage tank and adjust the total demand in the system. A summary of the calibration results is presented in Table 6-5 and Table 6-6. Detailed results are presented in Appendix B.

The results of the calibration show that all the wells apart from Well 6 are within calibration tolerances for pressure and volume but are outside calibration tolerances for flow. This is most likely a combination of the very flat topology and the accuracy of the representation of Well 6 pump curve and well depth. Stantec recommends that to improve calibration, pump tests should be performed at Well 6 along with confirming how the depth of the well varies between summer and winter.

Table 6-5: Summary of Flow Calibration Results

Flow Meter	Percentage of data points within		Volume Difference	Comments
	5%	10%		
Well 1R	-	-	-	Well did not operate during the calibration period
Well 5	0%	8%	21%	
Well 6R	24%	37%	27%	
Well 8	37%	61%	-4%	

Table 6-6: Summary of Pressure Calibration

Pressure Loggers	Percentage of data points within		Comments
	5 ft.	10 ft.	
Well 1R	100%	100%	
Well 5	100%	100%	
Well 6R	12%	100%	
Well 8	100%	100%	

6.4.2 OCTOBER 12TH TO 15TH, 2021

The model was calibrated against flows and pressures at four well locations. The model results were compared with the SCADA data to determine if the model reflects the actual system operating conditions over a 72-hour period. Calibration was achieved by adjusting the depth of wells, adjusting the starting level in the elevated storage tank, and adjusting the total demand in the system. A summary of the calibration results is presented in Table 6-5 and Table 6-8. Detailed results are presented in Appendix B.

The results of the calibration so that all the wells apart from Well 6 are within calibration tolerances for pressure and volume but are outside calibration tolerances for flow. This is most likely to a combination of the very flat topology and the accuracy of the representation of Well 6 pump curve and well depth. Stantec recommends that to improve calibration, pump tests should be performed at Well 6 along with confirming how the depth of the well varies between summer and winter.

Table 6-7: Summary of Flow Calibration Results

Flow Meter	Percentage of data points within		Volume Difference	Comments
	5%	10%		
Well 1R	-	-	-	Well did not operate during the calibration period
Well 5	-	-	-	Well did not operate during the calibration period
Well 6R	12%	57%	4%	
Well 8	14%	24%	3%	

Table 6-8: Summary of Pressure Calibration

Pressure Loggers	Percentage of data points within		Comments
	5 ft.	10 ft.	
Well 1R	100%	100%	
Well 5	100%	100%	
Well 6R	63%	100%	
Well 8	100%	100%	

6.5 Calibration Summary and Recommendations

The hydraulic model for the City of Newman has been calibrated against two 3-day periods in July and October 2021. The results from the calibration show that the while the model is outside the flow tolerances, however, the general flow patterns and discharge pressures represent the SCADA data provided. Due to not undertaking hydrant flow tests, we confirm that the model is sufficient to move forward with the existing and future system evaluation, but caution should be exercised when looking at available fire flow predicted by the model compared to results achieved in the field.

We do recommend that a number of additional follow up actions be taken by the City during the next iteration of the master plan:

- Undertake pump tests at each of the existing wells (1R, 5, 6 & 8) in order to establish a 3-point pump curve to limit the number of assumptions during subsequent calibration,
- Install an electromagnetic flow meter on the elevated tank that records both forward and reverse flow so that an accurate mass balance of the system can be achieved.
- Prepare filed test plan and undertake hydrant tests at key locations throughout the distribution system to identify closed valves,
- Undertake pipe C-Factor tests, and
- Establish the age of the pipes in the system.

7 Existing Water System Evaluation

This section summarizes the findings from the evaluation of the existing water system for the City of Newman. An evaluation of the City’s water system was performed to determine the adequacy of the system to supply existing water needs and to supply water for fire protection purposes.

Overall, the drinking water system was evaluated based on the following criteria:

- Junction Pressure, Pipe Velocity and Headloss gradient
- Available Fire Flow

The water system evaluation was completed using the service level criteria defined in Section 2. The water system evaluation for the existing water system pressures, fire flow capacities, headlosses and pipe flow velocities was performed using the newly updated hydraulic model.

7.1 Existing Model Setup

Following the calibration of the hydraulic model as detailed in Section 6, the controls for Well 10, Well 10 Tank and Well 10 Booster Pump Station were added to the model as detailed in Table 7-1. The controls for Well 1R, 5, 6R and Well 8 remained the same as those stated in Table 6-3.

Table 7-1: Well 10 Pump Station Operational Controls

Pump Name	On Set Point	Off Set Point	Control Location
Well 10	>30 ft.	<30 ft.	Well 10 Tank
Well 10 – BPS1	51		Maintain 51 psi at discharge of booster pump station
Well 10 – BPS2	51		
Well 10 – BPS3	51		Since only two of the three booster pumps can be one at any one time, the pumps are rotated to ensure equal wear and tear.

7.2 Existing Pressure

The City of Newman water system hydraulic model was used to evaluate existing water distribution system characteristics and identify deficiencies with respect to pressures. Water system pressure varies around the City of Newman based on differences in topographic elevations, as well as water supply rates and user demands. In general, as water demand increases, water system pressure decreases. Areas higher in topographic elevation exhibit lower water system pressures.

A water distribution system must be designed to provide pressure within a range of minimum and maximum allowable conditions. When system pressures are too low, water users may complain of inadequate water supply, and available fire flow may be limited. Pressures that are too high may cause problems with water system operation and maintenance (O&M) and may result in higher water consumption by users. High water system pressures can also increase the amount of water loss, as leakage rates will increase proportional to increases in water system pressure.

The water system pressure throughout the City of Newman ranges from a minimum of 45 psi under peak hour demand conditions as detailed in Table 7-2 and illustrated in Figure 7-1. This fairly flat pressure profile is consistent with the topography of the City which ranges from 74 feet to 108 feet (226 feet to 204 feet HGL) combined with the lopped nature of the distribution system. Under a no demand scenario, the maximum pressure in the system is 60 psi which is below the maximum pressure criteria of 100 psi.

Table 7-2: Existing System Summary

Summary	
Elevation Range (ft)	74 - 108
Hydraulic Grade Line Range (ft) under AD	226 - 204
Minimum Pressure (psi) at PHD	45
Maximum Pressure (psi) under no demand scenario	60

7.3 Existing Velocity

One important element of any hydraulic system analysis is to evaluate the distribution system network for pipes that are at or near capacity. High velocity or headloss pipes are indicators of potential capacity problems. Velocities in excess of five feet per second (fps) and headloss gradient of 7 feet per 1,000 feet for pipelines less than 16-inch during peak hour demand (Section 2) could result in low system pressure or available fire flow, or increased energy costs to operate the system. Figure 7-2 and Figure 7-3 present the velocity and headloss gradient throughout the system during peak hour demands. The results of this analysis indicate that there are some locations with velocities over 5 ft/s and a headloss gradient exceed 10 ft/1,000 ft. These locations (Figure 7-2) are:

- Along Barrington Avenue near Well 8, and
- Between Jensen Road and Yolo Street between Wells 10 and 6R.

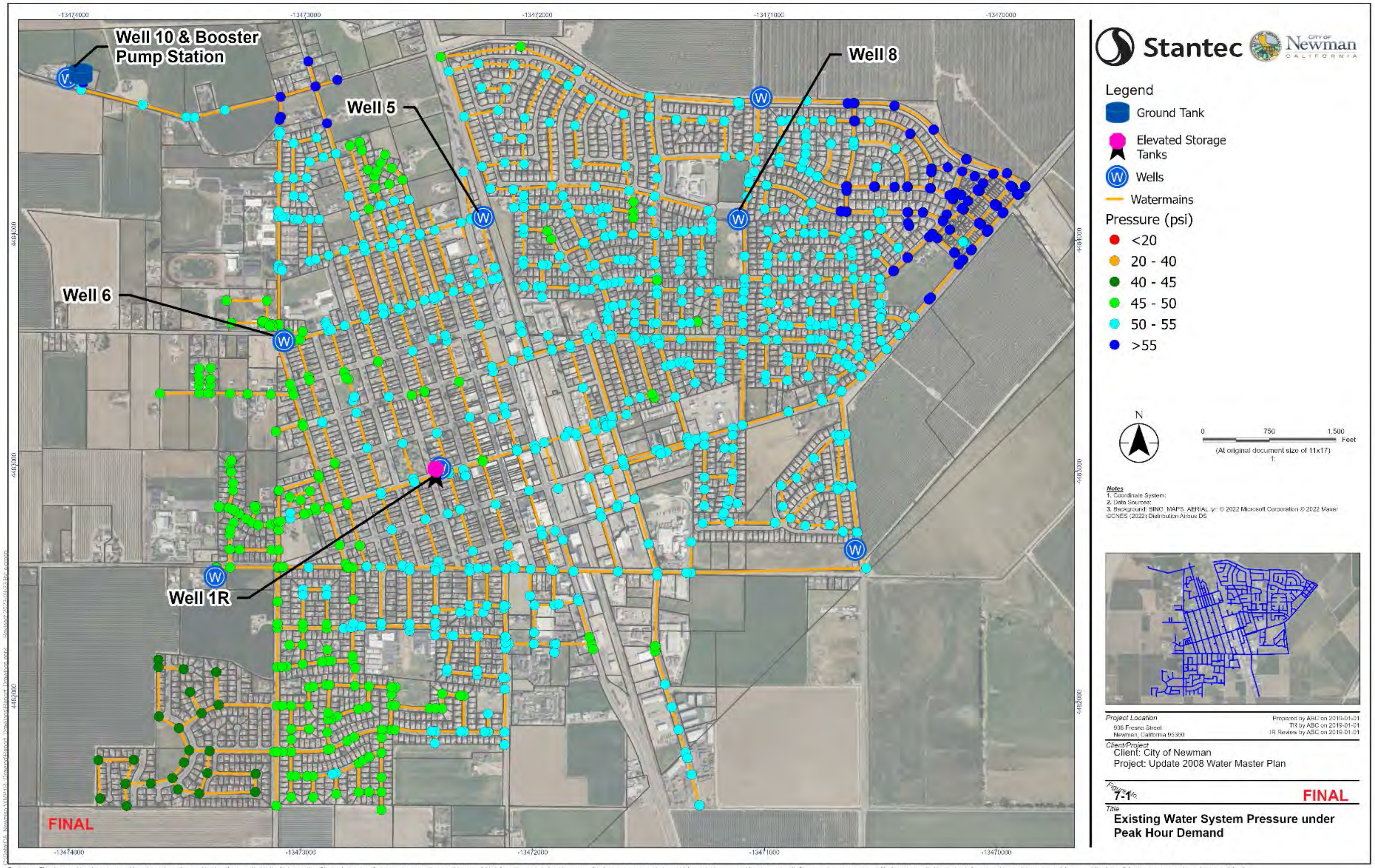

Figure 7-1: Existing Water System Pressure under Peak Hour Demand

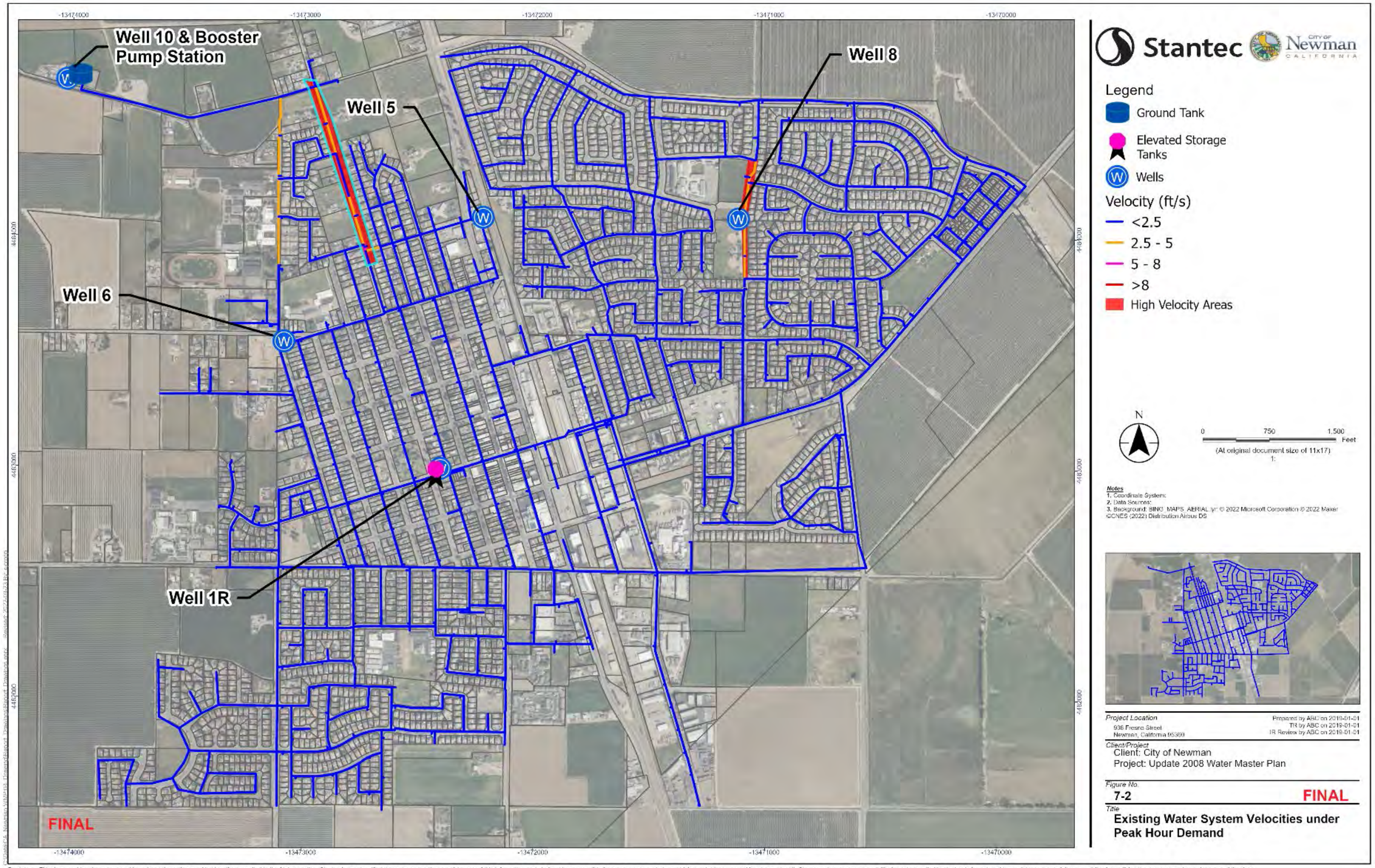

Figure 7-2: Existing Water System Velocities under Peak Hour Demand

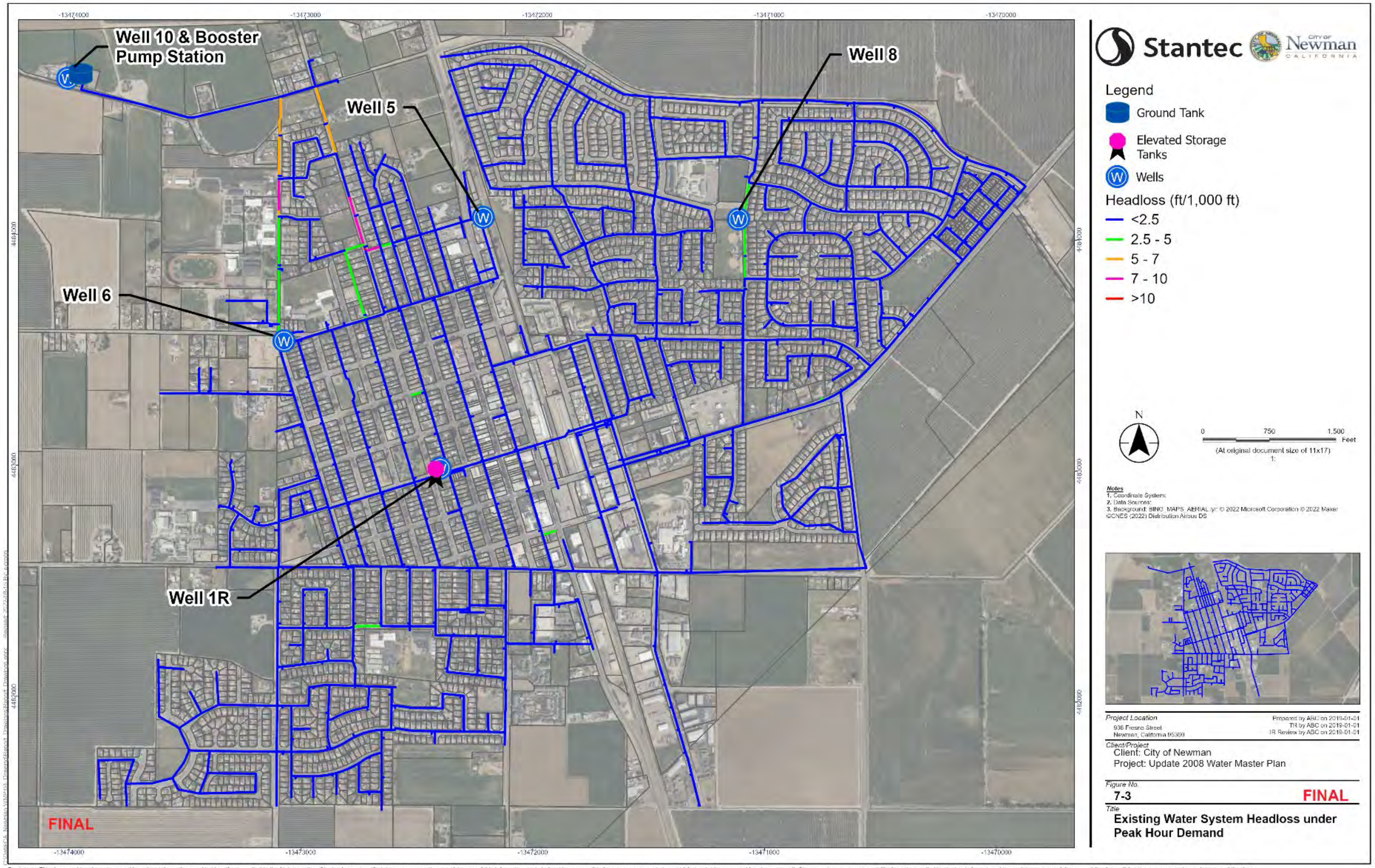

Figure 7-3: Existing Water System Headloss under Peak Hour Demand

7.4 Existing Available Fire flow

Water system planning for fire protection is an important consideration. In most instances, water main sizes are designed specifically to supply desired fire flows. The criteria for evaluating fire flow capacities of the water system are presented in Section 2. To evaluate the available capacity of the water system for fire protection, the available fire flow to each fire hydrant was predicted. Figure 7-4 indicates the available fire flow at each hydrant within the model under maximum day demand.

Using the hydraulic model, the maximum available fire flow at each fire hydrant, while maintaining a residual system pressure of 20 psi throughout the system, was calculated. Of the 298 hydrants evaluated in the existing scenario, only six of them do not meet the criteria. The hydrants that do not meet the residential criteria were found to be on either 4-inch main or dead end mains while the hydrants that do not meet the Industrial/Other Business District criteria were located on a 6-inch main between L and M street.

Table 7-3: Available Fire flow

Type	Meet or exceed Fire flow Criteria	Do Not Meet Fire flow Criteria	Total
Residential	250	4	254
Multi-Family Residential	2	0	2
Downtown	18	0	18
Industrial/Other Business District	22	2	24
Total	**292**	**6**	**298**

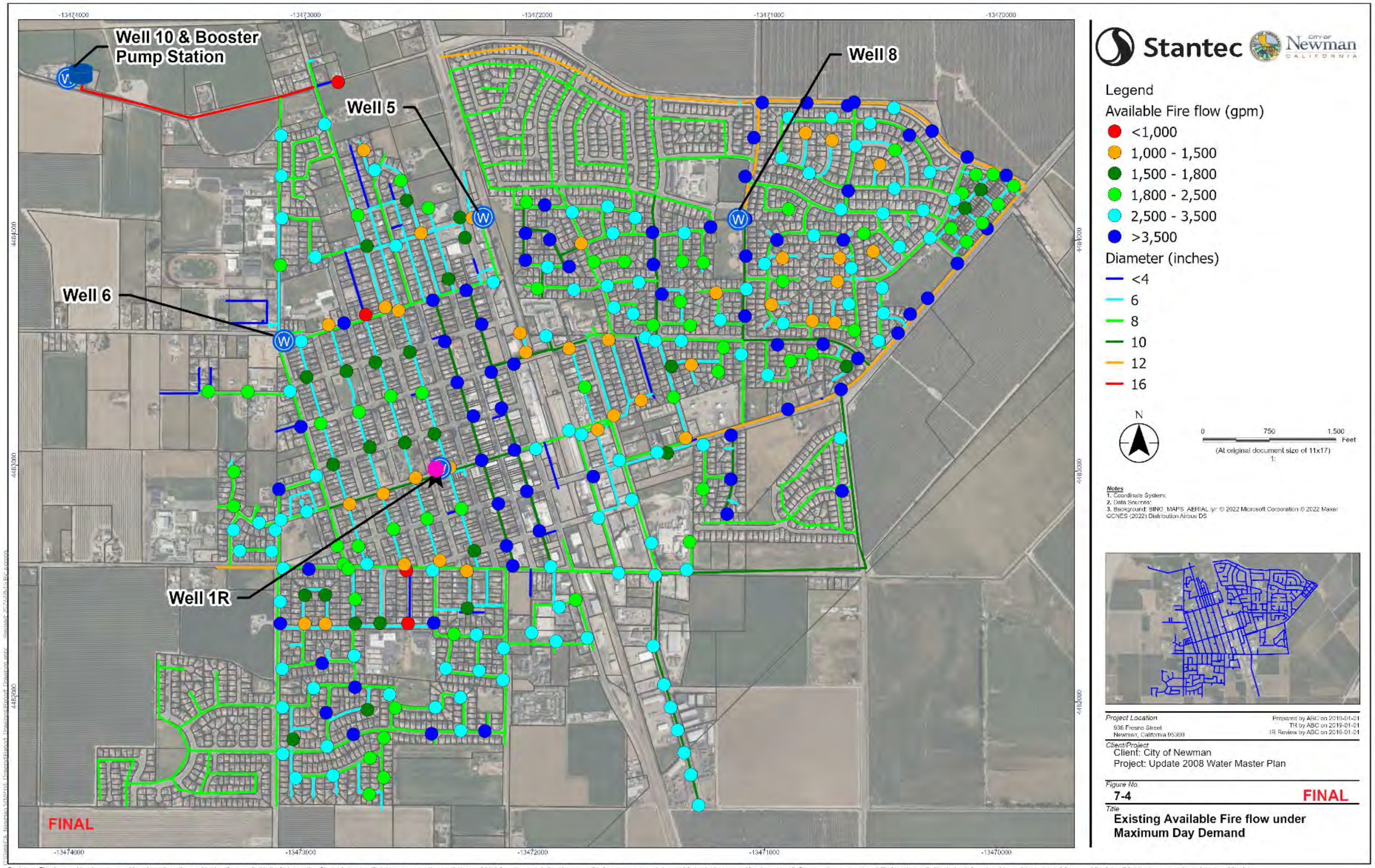

Figure 7-4: Existing Available Fire flow under Maximum Day Demand

7.5 Existing Storage Evaluation

The total storage required for the City of Newman water system is based on 22 CCR § 64554 (OAL, 2022)which states that any system systems with 1,000 or more service connections shall be able to meet four hours of peak hourly demand (PHD) with source capacity, storage capacity, and/or emergency source connections. Therefore, the four hours of peak hour demand will be used. The existing peak hour demand for the City of Newman is 4,762 gpm. In addition, the water system should have storage equal to the largest fire flow in the system. Based on Section 2, the largest current fire flow requirement is 1,800 gpm with a duration of 4-hours. Therefore, the total storage requirement for the City of Newman is 1.36 MG as detailed in Table 7-4. This means that Stantec would recommend at least an additional 0.5 MG of storage capacity be added to the existing system.

Table 7-4: Summary of Fire flow Storage

Scenarios	Summary
Peak Hour Demand (gpm)	4,813
Four times PHD (MG)	1.16
Maximum Fire flow (MG)	0.43
Required Storage (MG)	**1.59**
Available Storage (MG)	1.10
Projected Surplus/Deficit (MG)	**-0.49**

7.6 Existing Well Evaluation

The overall capacity of the system with all the active pumps operating is approximately 11.95 MGD or about 8,300 gpm as detailed in Table 7-5. Good practice for water systems is to provide reliable capacity based on the overall capacity with the largest source of supply out of service due to maintenance or some unforeseen emergency during a maximum day. Currently, Well 8 has a capacity of approximately 2,500 gpm and is the largest production well. With Well 8 out of service, the system capacity is reduced to about 6,800 gpm (9.07 MGD). This is greater than the existing maximum day demand of 2,825 gpm.

Table 7-5: Existing Well Capacity

Well Name	Capacity	
	gpm	MGD
Well 1R	1,600	2.3
Well 5	1,000	1.44
Well 6R	1,200	1.73
Well 8	2,500	3.6
Well 10	2,000	2.88
Total Capacity	**8,300**	**11.95**
Firm Capacity	**5,800**	**9.07**

7.7 Existing System Summary

The flat topology and looped water network, pressures generally range from 45 psi under existing peak hour demand to 60 psi during a no demand scenario. Some areas of the City do experience velocities and headloss above 5 ft/s and 10 ft/1,000 ft, respectively, however, this does not seem to adversely affect system pressures. Of the 298 hydrants evaluated in the existing scenario, only six of them do not meet the criteria. The hydrants that do not meet the residential criteria were found to be on either 4-inch main or dead end mains while the hydrants that do not meet the Industrial/Other Business District criteria were located on a 6-inch main between L and M street. These low (less than 1,000 gpm fire flow) should be field verified to determine if they are accurate before any pipeline improvements are proposed. The storage analysis, based on a peak hour demand analysis show that the City of Newman system currently has a deficit of approximately 500,000 gallons. Currently, no storage capital improvement has been proposed, however, additional storage should be considered if and when new development are proposed.

8 Future Water System Evaluation

This section summarizes the findings from the evaluation of the future water system for the City of Newman. An evaluation of the City's future water system was performed to determine the adequacy of the system to supply existing water needs and to supply water for fire protection purposes.

Overall, the drinking water system was evaluated based on the following criteria:

- Pressure, Velocity and Headloss
- Available Fire Flow

The water system evaluation was completed using the service level criteria defined in Section 2. The water system evaluation for the future water system pressures, fire flow capacities, headloss gradient and pipe flow velocities was performed using the new hydraulic model.

8.1 Future Model Setup

8.1.1 FUTURE DEVELOPMENTS

Following the existing system evaluation, proposed future developments were added to the system. This comprised of the proposed developments at (Figure 8-1):

- T-Street,
- Mattos Ranch,
- Canton Ranch,
- Agriana Developments, and
- Northwest Newman Master Plan.

Table 8-1: Summary of Future Water Factors and Demands

Scenario	Ratio to ADD	Demands	
		MGD	gpm
Existing Average Day	1.00	2.05	1,426
T Street		0.01	4
Mattos Ranch		0.05	37
Canton Ranch		0.06	39
Agriana Development		2.14	1,489
Northwest Newman Master Plan		1.16	806
Future Average Day		5.47	3,801
Future Maximum Day	2.25	12.31	8,551
Future Peak Hour	3.38	18.47	12,827

8.1.2 NEW DISTRIBUTION MAINS

Since the provided developments did not include proposed pipe layouts, sizing all material, the following assumptions were made:

- All new pipe material would be PVC with a roughness coefficient of 130,
- Pipelines would follow proposed road layouts and would be looped to avoid dead end mains, and
- Minimum pipe size would be 8-inch mains and would be increased to meet velocity and fire flow criteria.

8.1.3 NEW FUTURE WELLS

The proposed developments will increase the existing average day demand from 2.03 MGD to 5.45 MGD once all the developments are completed as summarized in Table 8-1. Based on a current total well capacity of 12.0 MGD, additional wells would be required to meet peak hour. The current strategy used by the City of new wells is to have a ground storage tank and then a booster pump station to supply the system. This is approach follows the newly installed Well 10, storage and booster pump station. Therefore, four new wells (Table 8-2) along with four new 1.0 MG storage tank (Table 8-4) were added to the model before undertaking the future system analysis. The initial storage capacity was based on duplicating the configuration of Well 10 (1.0 MG storage, three times 1,000 gpm booster pump station). This was confirmed as 1.0 MG per site based on storage requirements as calculated in Section 8.5. The location chosen for each of these new wells which is detailed in Table 8-2 and Table 8-3 and illustrated in Figure 8-1, was based on the following:

- Availability of open land for new well site (All wells),
- Proximity to known or proposed developments (New Well 11, 13 and 14),

- Similar alignment to existing wells (New Well 11 and 13).

Table 8-2: Proposed New Wells

Name	Location	Flow	
		gpm	MGD
New Well 11	Barrington Ave and Sherman Parkway	1,000	1.44
New Well 12	Hover and Upper Road	1,000	1.44
New Well 13	Stuhr and Villa Manucha Road	1,000	1.44
New Well 14	Inyo Ave and Canal School Road	1,000	1.44
Total		**4,000**	**5.76**

Table 8-3: Proposed New Well and Booster Pumps

Pumps	Location	Head	Flow	
		feet	gpm	MGD
New Well 11 Pump	Barrington Ave and Sherman Parkway	262	1,000	1.44
New Well 11 Booster Pump Station	Barrington Ave and Sherman Parkway	160	2,000	2.88
New Well 12 Pump	Hover and Upper Road	262	1,000	1.44
New Well 12 Booster Pump Station	Hover and Upper Road	160	2,000	2.88
New Well 13 Pump	Stuhr and Villa Manucha Road	262	1,000	1.44
New Well 14 Pump	Inyo Ave and Canal School Road	262	1,000	1.44
New Well 14 Booster Pump Station	Inyo Ave and Canal School Road	160	2,000	2.88

Table 8-4: Proposed Future Storage Tank

Reservoir	Construction Date	Tank Base (feet)	Depth (feet)	Diameter (feet)	Capacity (MG)
Well 10 Storage Tank	2025	106.32	32	77	1.0
Well 11 Storage Tank	2025	88	32	115	1.0
Well 12 Storage Tank	2025	88	32	115	1.0
Well 14 Storage Tank	2025	88	32	115	1.0
Total					**4.0**

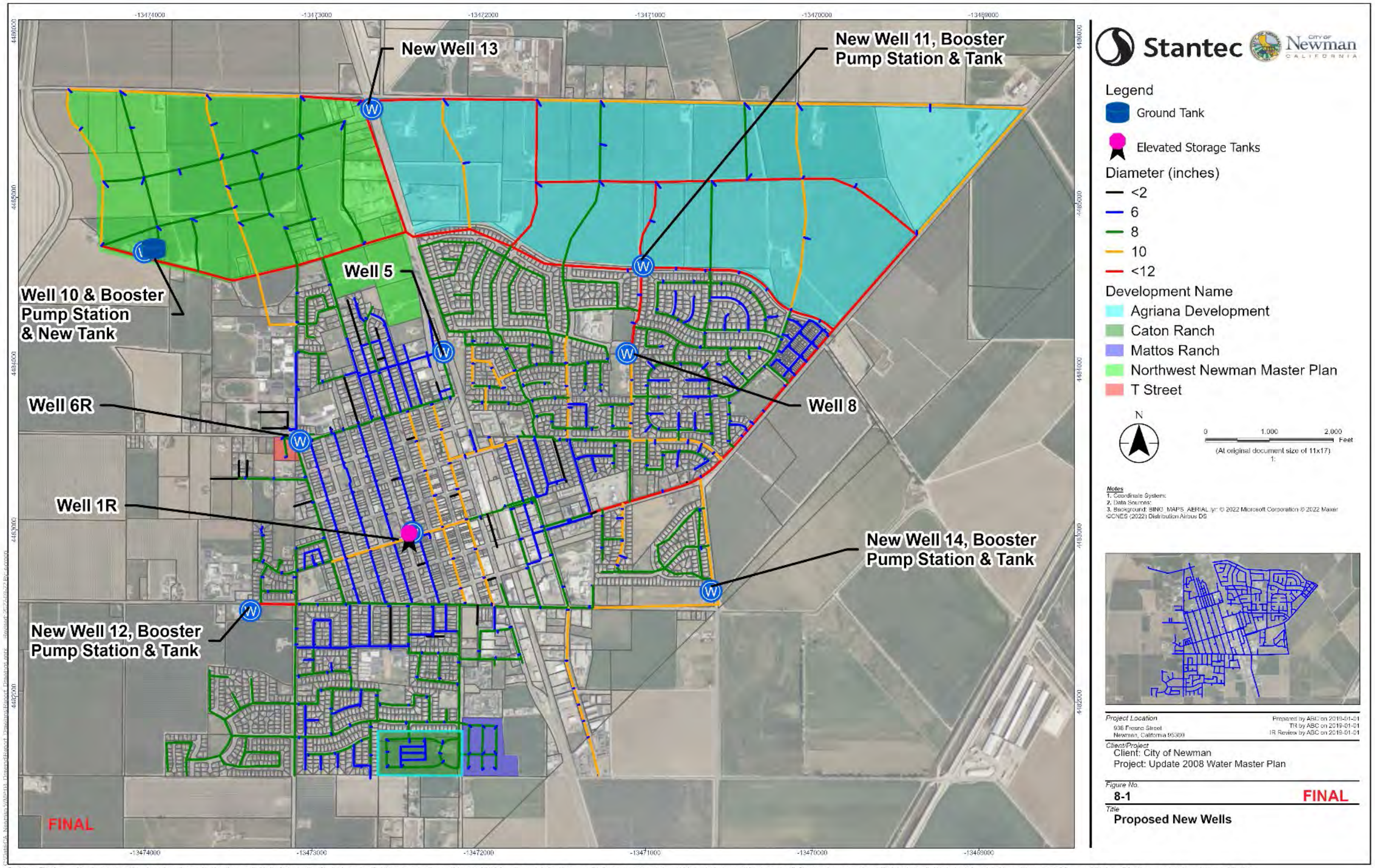

Figure 8-1: Proposed New Wells

8.2 Future Pressure

The City of Newman water system hydraulic model was used to evaluate future water distribution system characteristics and identify deficiencies with respect to pressures. Water system pressure varies around the City of Newman based on differences in topographic elevations, as well as water supply rates and user demands. In general, as water demand increases, water system pressure decreases. Areas higher in topographic elevation exhibit lower water system pressures.

A water distribution system must be designed to provide pressure within a range of minimum and maximum allowable conditions. When system pressures are too low, water users may complain of inadequate water supply, and fire protection may be limited. Pressures that are too high may cause problems with water system operation and maintenance (O&M) and may result in higher water consumption rates by users. High water system pressures can also increase the amount of water loss, as leakage rates will increase proportional to increases in water system pressure.

The water system pressure throughout the City of Newman ranges from a minimum of 43 psi under peak hour demand conditions as detailed in Table 8-5 and illustrated in Figure 8-2. Under a no demand scenario, the maximum pressure in the system is 64 psi which is below the maximum pressure criteria of 100 psi.
This is similar to the existing system which has a minimum peak hour pressure of 45 and maximum pressure under a no demand scenario of 60 psi. As stated previously, this is due to the generally flat topography of the City which ranges from 72 feet to 108 feet (211 feet to 201 feet HGL) combined with the lopped nature of the distribution system.

Table 8-5: Future Summary

Summary	
Elevation Range (ft)	72 – 108
Hydraulic Grade Line Range (ft) under PHD	211 – 201
Minimum Pressure (psi) at PHD	43
Maximum Pressure (psi) under no demand scenario	64

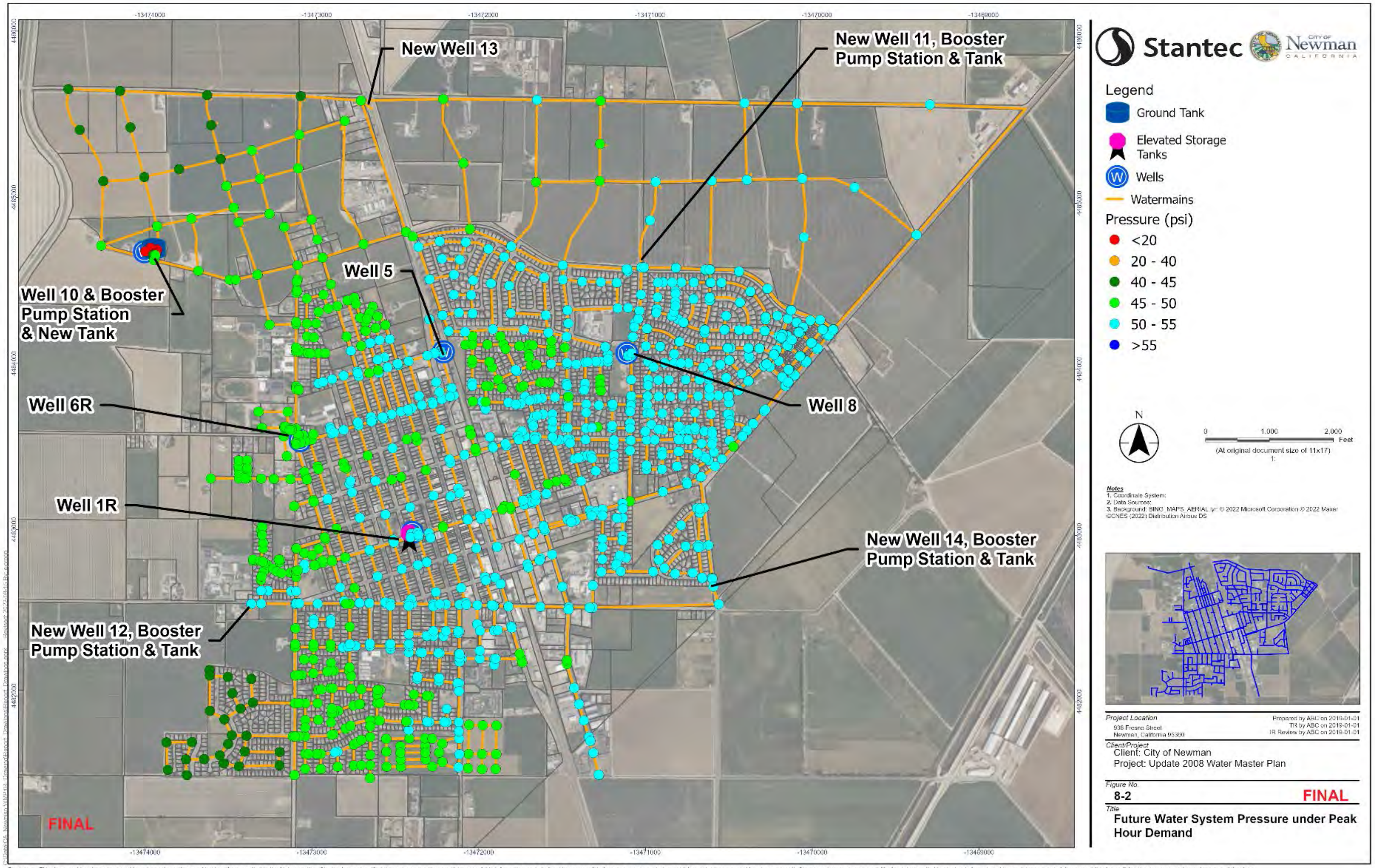

Figure 8-2: Future Water System Pressure under Peak Hour Demand

8.3 Future Velocity

One important element of any hydraulic system analysis is to evaluate the distribution system network for pipes that are at or near capacity. High velocity or headloss pipes are indicators of potential capacity problems. Velocities in excess of five feet per second (fps) and head losses of 7 feet per 1,000 feet for pipelines less than 16-inch during peak hour demand. This could be contributing to low system pressure or fire flows, or increased energy costs to operate the system. Figure 8-3 and Figure 8-4 present velocity and headloss throughout the system during peak hour demands. There has been a slight decrease in the maximum velocity and headloss due to a better distribution of the new wells resulting in all velocities below 5 ft/s and headloss below 7 feet per 1,000 feet.

While these high velocities and headlosses are currently not causing any loss of services through low pressures, the City should look at upsizing these pipes when it comes time to replace them.

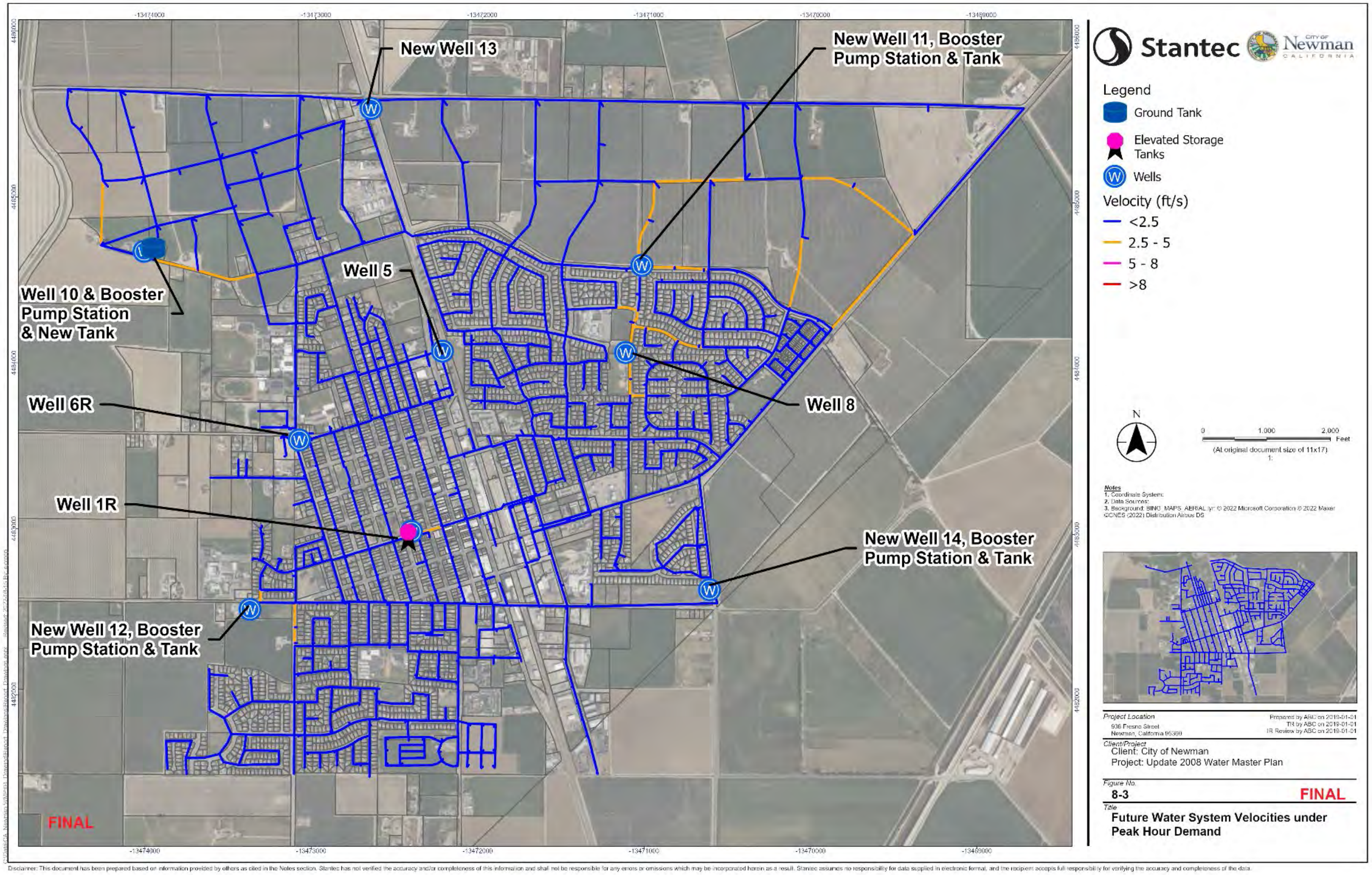

Figure 8-3: Future Water System Velocities under Peak Hour Demand

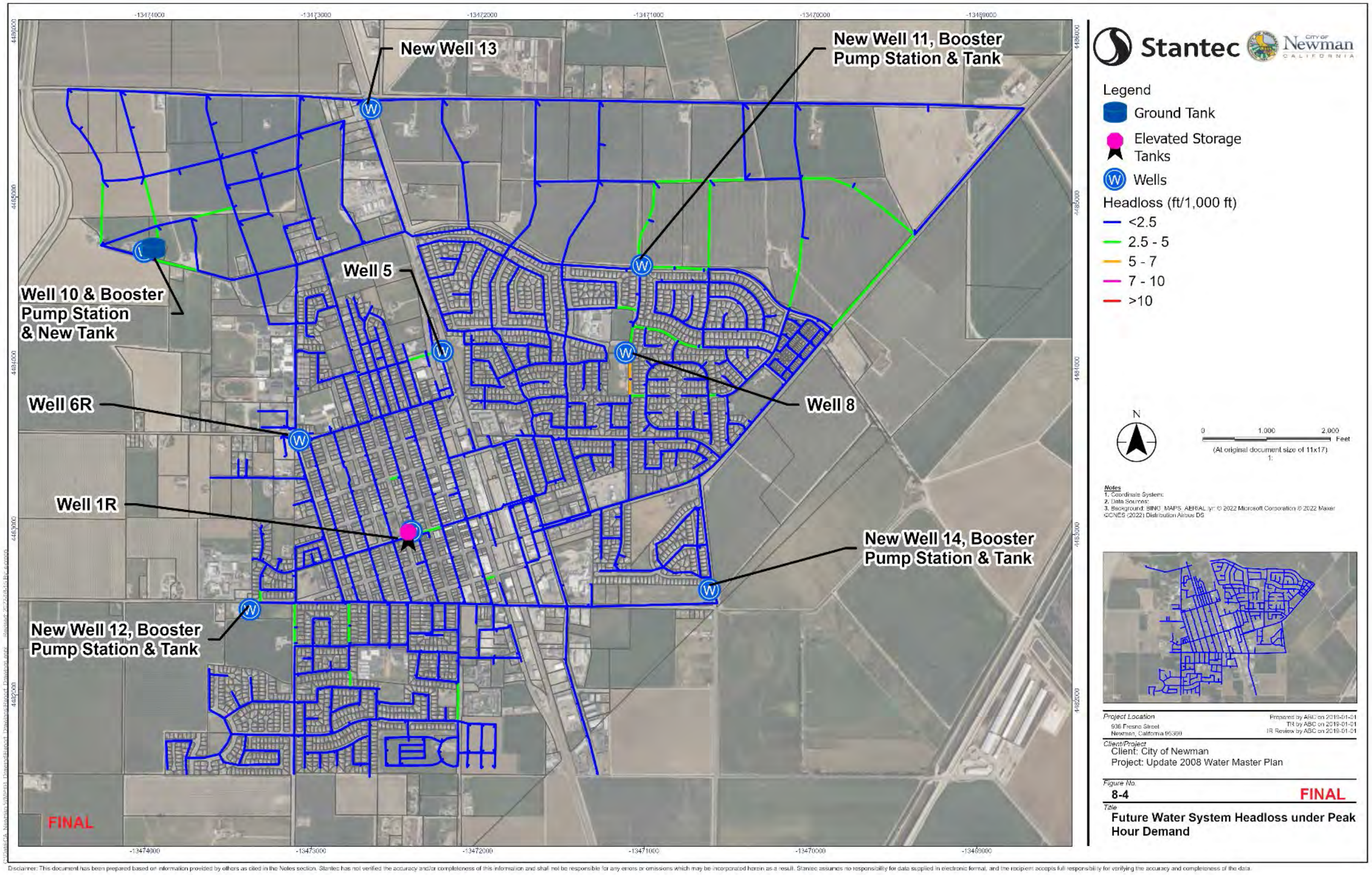

Figure 8-4: Future Water System Headloss under Peak Hour Demand

8.4 Future Available Fire flow

Water system planning for fire protection is an important consideration. In most instances, water main sizes are designed specifically to supply desired fire flows. The criteria for evaluating fire flow capacities of the water system are presented in Section 2. To evaluate the available capacity of the water system for fire protection, the available flow to each fire hydrant was predicted. Figure 8-5 indicates the available fire flow for each hydrant within the model under maximum day demand.

Using the hydraulic model, the maximum available fire flow at each fire hydrant, while maintaining a residual system pressure of 20 psi throughout the system, was calculated. Of the 362 hydrants evaluated in the existing scenario, only five of them do not meet the criteria. The hydrants that do not meet the residential criteria were found to be on either 4-inch main while the hydrants that do not meet the Industrial/Other Business District criteria were located on a 6-inch main between L and M street.

Table 8-6: Available Fire flow

Type	Meet or exceed Fire flow Criteria	Do Not Meet Fire flow Criteria	Total
Residential	294	3	297
Multi-Family Residential	5	0	5
School	5	0	5
Commercial	9	0	9
Downtown	18	0	18
Industrial/Other Business District	26	2	28
Total	**357**	**5**	**362**

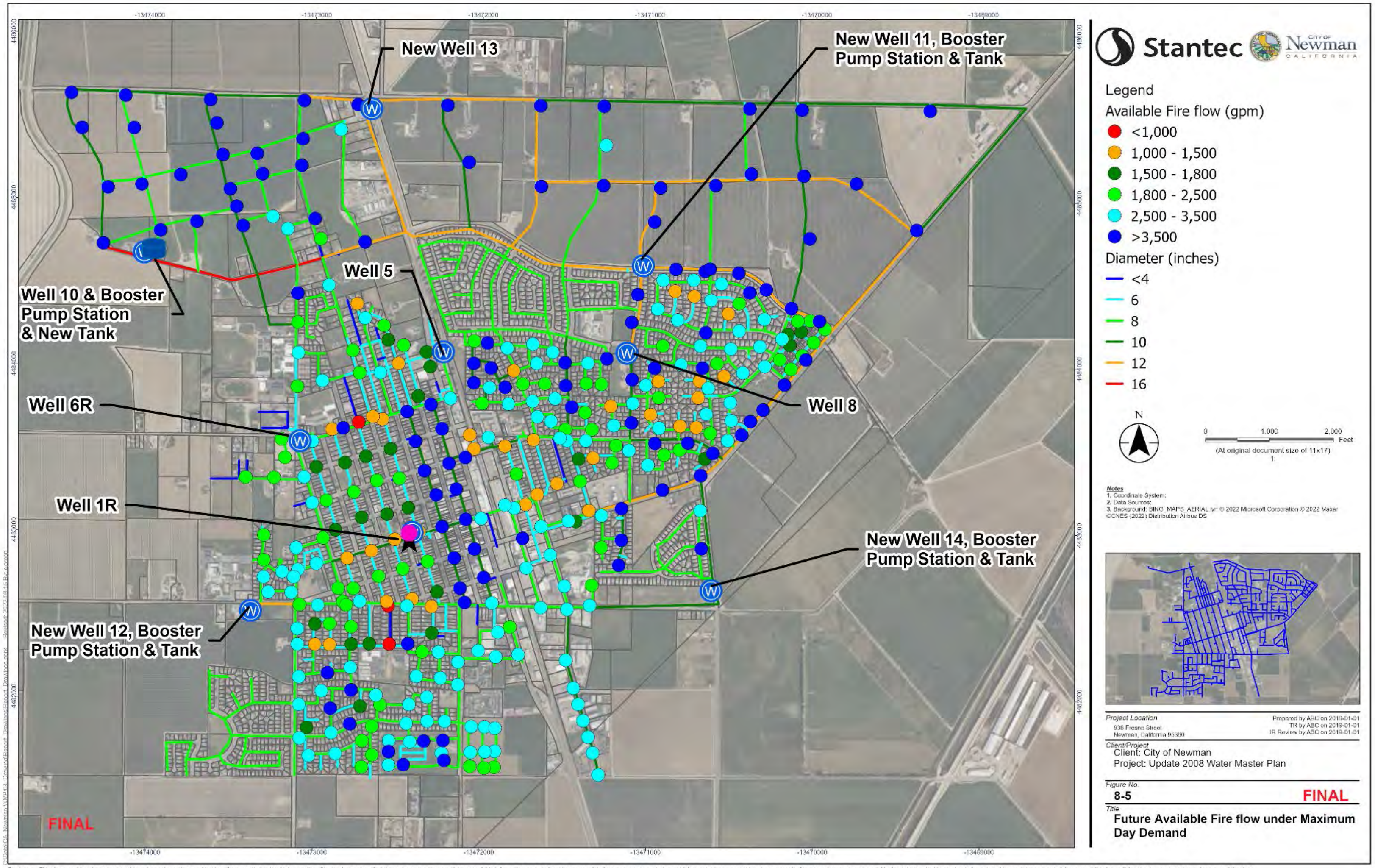

Figure 8-5: Future Available Fire flow under Maximum Day Demand

8.5 Future Storage Evaluation

The total storage required for the City of Newman water system is based on 22 CCR § 64554 (OAL, 2022) which states that any system systems with 1,000 or more service connections shall be able to meet four hours of peak hourly demand (PHD) with source capacity, storage capacity, and/or emergency source connections. Therefore, the four hours of peak hour demand will be used. The future peak hour demand for the City of Newman is 12,827 gpm. In additional, water system should have storage equal to the largest fire flow in the system. Based on Section 2, the largest current fire flow requirement is 1,800 gpm with a duration of 4-hours. Therefore, the total storage requirement for the City of Newman is 3.51 MG as detailed in Table 8-7. With the addition of 4.0 MG of storage at the new well sites (Section 8.1), there is now a surplus of approximately 1.6 MG of storage capacity. This means that some of the new well may not require storage or could be built when additional developments occur in the south of the system.

Table 8-7: Summary of Storage

Scenarios	Summary
Peak Hour Demand (gpm)	12,827
Four times PHD (MG)	3.08
Maximum Fire flow (MG)	0.43
Required Storage (MG)	**3.51**
Existing Storage (MG)	1.10
Proposed Storage (MG)	4.00
Total Future Storage (MG)	5.10
Projected Surplus/Deficit (MG)	**1.59**

8.6 Future Well Evaluation

The overall future capacity of the system with all the active well pumps operating is approximately 17.70 MGD or about 12,300 gpm to meet the future maximum day demand of 12.31 MGD as detailed in Table 8-8. Good practice for water systems is to provide reliable capacity based on the overall capacity with the largest source of supply out of service due to maintenance or some unforeseen emergency during a maximum day. Currently, Well 8 has a capacity of approximately 2,500 gpm and is the largest production well. With Well 8 out of service, the system capacity is reduced to about 9,800 gpm (14.10 MGD). This is greater than the future maximum day demand of 8,551 gpm.

Table 8-8: Future Well Capacity

Well Name	Capacity	
	gpm	**MGD**
Well 1R	1,600	2.3
Well 5	1,000	1.44
Well 6R	1,200	1.73
Well 8	2,500	3.6
Well 10	2,000	2.88
New Well 11	1,000	1.44
New Well 12	1,000	1.44
New Well 13	1,000	1.44
New Well 14	1,000	1.44
Total Capacity	**12,300**	**17.7**
Firm Capacity	**9,800**	**14.1**

8.7 Future System Summary

The analysis of the City of Newman water system under future conditions has indicated that the system in its current form would not be able to provide the needed supply or storage. However, with the addition of four new wells and 4.0 MG of additional storage, the future system could provide the same level of service as the existing system. The flat topology and looped water network, pressures generally range from 43 psi under existing peak hour demand to 64 psi during a no demand scenario. Due to new wells and pipelines, none of the water distribution system in the future scenario experiences velocities and headloss above 5 ft/s and 10 ft/1,000 ft, respectively. Of the 362 hydrants evaluated in the existing scenario, only five of them do not meet the criteria. The hydrants that do not meet the residential criteria were found to be on either 4-inch main while the hydrants that do not meet the Industrial/Other Business District criteria were located on a 6-inch main between L and M street. The storage analysis, based on a peak hour demand analysis show that the City of Newman system currently has a projected surplus of approximately 1.60 million gallons. This means that some of the new well may not require storage or could be built when additional developments occur in the south of the system.

9 Capital Improvement Projects

This section describes the recommended Capital Improvement Program (CIP) for the City of Newman potable water distribution system. This CIP identifies the improvements necessary to address system deficiencies to provide continued reliable water service into the future and are illustrated in Figure 9-1.

9.1 Project Costs

Total project costs were developed for all projects based on rough order cost estimates. A Class 5 Opinion of Probable Total Construction Cost (OPCC) was developed for those projects that the City of Newman chooses to move forward with. An additional 40% was added to the construction costs to allow for soft costs such as design, project management, and environmental assessment. Table 9-1 summarizes the basis for the cost estimates for the City of Newman.

Table 9-1: Cost Estimate Basis

Cost Estimate	Cost Basis	Comments
Pipelines	$40 diameter-inch/linear foot	Recent projections undertaken throughout California
Tanks		Recently completed Well 10 project
Wells		Recently completed Well 10 project

9.2 Capital Improvement Projects

The system improvements defined in Section 7 and 8 have been categorized as either New Wells and Storage (Table 9-2) or Fire flow improvements (Table 9-3).

Table 9-2: Capital Improvement Projects – New Wells and Storage

Project ID	Improvement Description	CIP Type	Number	Total Construction Costs	Total including Soft Costs
Well 10 Storage Tank	Barrington Ave and Sherman Parkway	Tank	1	$5,000,000	$7,000,000
New Well 11, Booster Pump Station and Storage Tank	Barrington Ave and Sherman Parkway	Combination	1	$10,000,000	$14,000,000
New Well 12, Booster Pump Station and Storage Tank	Hover and Upper Road	Combination	1	$10,000,000	$14,000,000
New Well 13	Stuhr and Villa Manucha Road	Well	1	$5,000,000	$7,000,000
New Well 14, Booster Pump Station and Storage Tank	Inyo Ave and Canal School Road	Combination	1	$10,000,000	$14,000,000
Total				**$40,000,000**	**$56,000,000**

Table 9-3: Capital Improvement Projects – New Wells and Storage

Project ID	Improvement Description	CIP Type	Diameter (inches)	Length (feet)	Total Construction Costs	Total including Soft Costs
FF_01	700-ft of new 8-inch main to the replace the existing 4-inch main along Sydney Avenue between Inyo Avenue and Patchett Drive	Fire flow	8	700	$224,000	$313,600
FF_02	800-ft of new 8-inch water main along alley between Fig Lane and R Street north of Yolo Street	Fire flow	8	800	$256,000	$358,400
Total					**$480,000**	**$672,000**

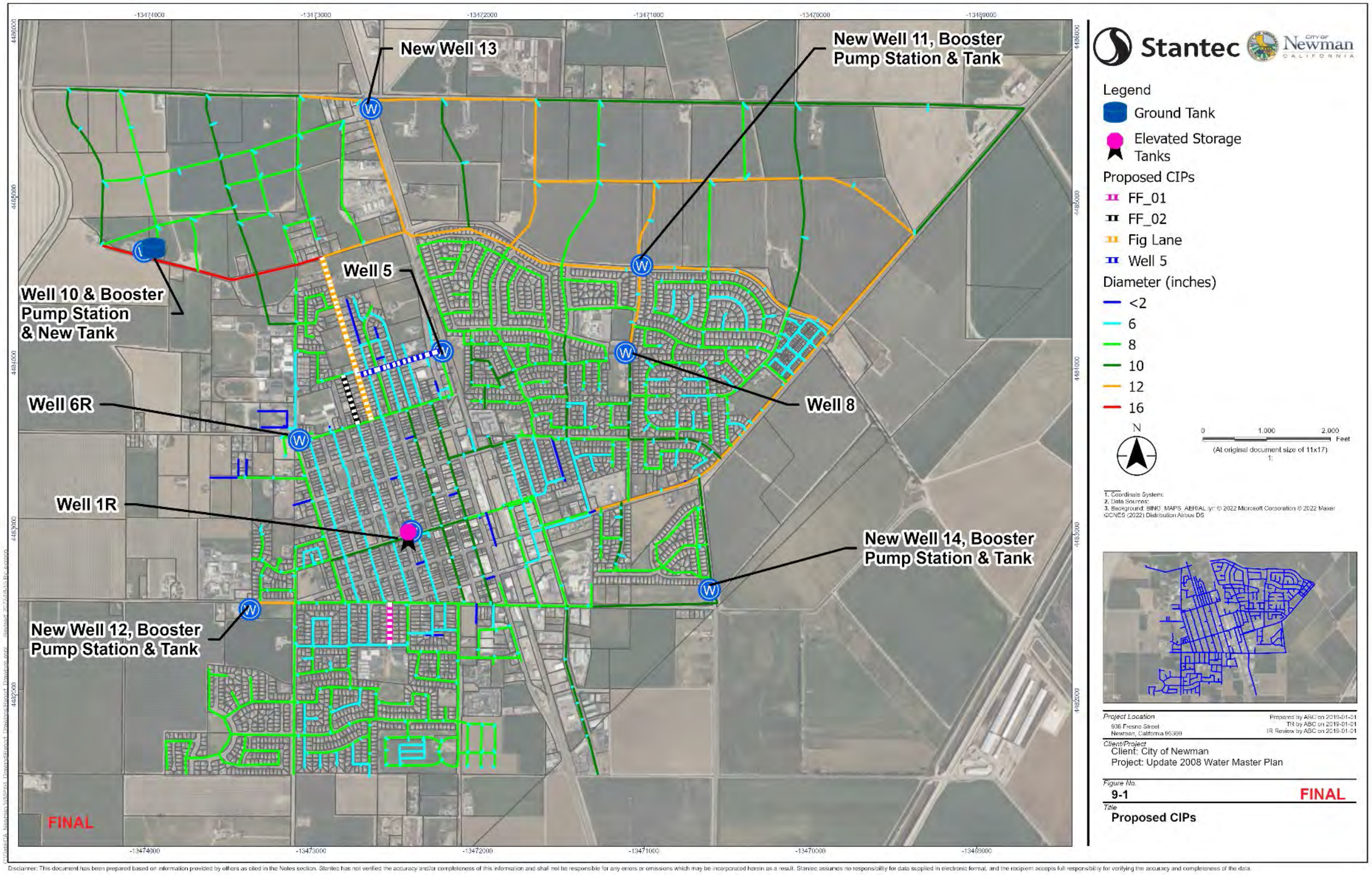

Figure 9-1: Proposed CIPs

10 Conclusions and Recommendations

10.1 Conclusions

The 2022 Water Master Plan Update analysis has provided the City of Newman with a greater understanding of their system. The previous 2008 hydraulic model was updated based on AutoCAD drawings and developments that were added since 2015 using WaterGEMS Connection Edition 10.03.05.05. The hydraulic model was calibrated against pressure and flow data over two three-day periods in July and October 2021. The results from the calibration show that the while the model is outside the flow tolerances, the general flow patterns and discharge pressures represent the SCADA data provided. Therefore, we confirm that the model is sufficient to move forward with the existing and future system evaluation. We also recommend that new pump tests be performed at each of the wells, especially Well 6, so that the model can be refined in the future.

The existing system was evaluated and found to have pressures and velocities in acceptable ranges with high head loss and velocity around Well 5. The available fire flow for most of the City exceed 1,000 gpm apart from along Sydney Avenue and the alley between Fig Lane and R Street due to existing 4-inch mains. The existing storage based on the PHD analysis shows a deficit of around 500,000 gallons based on the current two tanks in the system.

The future system was analyzed based on the addition of the five know developments of T Street, Mattos and Caton Ranch, Agriana Development and the Northwest Newman Master Plan. Three new wells and 2.0 MG of additional storage to meet the future demands. Even with these additions, pressures did drop by around 3 psi from the existing system. However, this is considered in the margin of error at which the model was calibrated and the uncertainty around the actual water usage of these future developments. High velocities and head loss persisted around Well 5 but were not increased due to the addition of the three new wells. The available fire flow for most of the City continued to exceed 1,000 gpm apart from along Sydney Avenue and the alley between Fig Lane and R Street which were identified in the existing system analysis. The future storage analysis, based on a peak hour demand analysis show that the City of Newman system currently has a projected surplus of approximately 1.60 million gallons.

A total of just under $57 million of capital improvements have been proposed and have been broken down into New Wells and Storage ($56 million) and fire flow improvements ($700k).

10.2 Recommendations

The following are a list of recommendation based on the outcomes of this master plan:

- Obtain estimates of proposed water usage for each of the proposed developments, especially those that contain either business parks or industrial developments,
- Implement proposed capital improvement projects (Table 10-1 and Table 10-2),
- Identify future wells sites so that the land for them can be set aside,
- Undertake pump tests at each of the existing wells (1R, 5, 6 & 8) in order to establish a 3-point pump curve to limit the number of assumptions during subsequent calibration,
- Install an electromagnetic flow meter on the elevated tank that records both forward and reverse flow so that an accurate mass balance of the system can be achieved,
- Prepare filed test plan and undertake hydrant tests at key locations throughout the distribution system to identify closed valves,
- Undertake pipe C-Factor tests, and
- Establish the age of the pipes in the system.

Table 10-1: Capital Improvement Projects – New Wells

Project ID	Improvement Description	CIP Type	Number	Total Construction Costs	Total including Soft Costs
Well 10 Storage Tank	Barrington Ave and Sherman Parkway	Tank	1	$5,000,000	$7,000,000
New Well 11, Booster Pump Station and Storage Tank	Barrington Ave and Sherman Parkway	Combination	1	$10,000,000	$14,000,000
New Well 12, Booster Pump Station and Storage Tank	Hover and Upper Road	Combination	1	$10,000,000	$14,000,000
New Well 13	Stuhr and Villa Manucha Road	Well	1	$5,000,000	$7,000,000
New Well 14, Booster Pump Station and Storage Tank	Inyo Ave and Canal School Road	Combination	1	$10,000,000	$14,000,000
Total				**$40,000,000**	**$56,000,000**

Table 10-2: Capital Improvement Projects – Fire flow

Project ID	Improvement Description	CIP Type	Diameter (inches)	Length (feet)	Total Construction Costs	Total including Soft Costs
FF_01	700-ft of new 8-inch main to the replace the existing 4-inch main along Sydney Avenue between Inyo Avenue and Patchett Drive	Fire flow	8	700	$224,000	$313,600
FF_02	800-ft of new 8-inch water main along alley between Fig Lane and R Street north of Yolo Street	Fire flow	8	800	$256,000	$358,400
Total					**$480,000**	**$672,000**

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DIVIDER NAME

Appendix A Well Production

Well Data 2021						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	236,000	6,783,000	5,514,000	24,684,000		37,217,000
February	207,000	1,145,000	4,923,000	25,334,000		31,609,000
March	317,000	836,000	13,769,000	32,177,000		47,099,000
April	311,000	4,181,000	17,871,000	44,004,000		66,367,000
May	487,000	2,507,000	17,439,000	48,117,000	14,925,000	83,475,000
June	337,000	6,921,000	17,493,000	48,299,000	9,829,891	82,879,891
July	213,000	8,690,000	16,744,000	50,590,000	15,060,000	91,297,000
August	188,000	8,230,000	18,399,000	47,024,000	12,227,960	86,068,960
September	378,000	4,714,000	14,123,000	43,931,000	11,608,000	74,754,000
October	462,000	75,000	15,244,000	32,652,000	12,524,000	60,957,000
November	277,000	18,000	7,550,000	23,658,000	9,921,100	41,424,100
December	330,000	424,000	189,000	27,435,000	10,346,884	38,724,884
Total	3,743,000	44,524,000	149,258,000	447,905,000	96,442,835	741,872,835

Well Data 2020						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	-	499,000	6,838,000	25,737,400		33,074,400
February	56,000	562,000	10,574,000	28,313,000		39,505,000
March	54,000	239,000	13,027,000	32,982,000		46,302,000
April	346,000	251,000	15,210,000	40,221,000		56,028,000
May	771,000	1,520,000	21,944,000	57,996,000		82,231,000
June	377,000	12,648,000	20,019,000	54,066,000		87,110,000
July	378,000	18,080,000	20,257,000	56,681,000		95,396,000
August	360,000	16,832,000	19,098,000	54,537,000		90,827,000
September	316,000	11,768,000	16,900,000	47,774,000		76,758,000
October	268,000	9,446,000	15,970,000	45,095,000		70,779,000
November	272,000	1,503,000	15,225,000	33,445,000		50,445,000
December	196,000	241,000	14,127,000	27,163,000		41,727,000
Total	3,394,000	73,090,000	182,351,000	478,273,000		737,108,000

Well Data 2019						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	1,840,000	8,000	-	29,951,000		31,799,000
February	833,000	-	-	30,020,000		30,853,000
March	747,000	-	-	36,161,000		36,908,000
April	842,000	9,358,000	-	44,086,000		54,286,000
May	903,000	18,304,000	-	47,004,000		66,211,000
June	5,618,000	21,965,000		52,516,000		80,099,000
July	2,305,000	15,068,000	13,051,000	56,425,000		86,849,000
August	284,000	10,559,000	22,896,000	52,519,000		86,258,000
September	241,000	8,106,000	-	45,792,000		54,139,000
October	76,000	1,296,000	21,600,000	42,972,000		65,944,000
November	96,000	1,847,000	17,377,000	32,381,000		51,701,000
December	-	612,000	4,159,000	29,058,000		33,829,000
Total	13,785,000	87,123,000	79,083,000	498,885,000		678,876,000

Well Data 2018						
Month	Well 1R 1125 Fresno St (gallons)	Well 5 876 N St (gallons)	Well 6R 1002 T St (gallons)	Well 8 1051 Barrington Ave (gallons)	Well 10 925 Jensen Road (gallons)	Total (gallons)
January	743,000	1,000	272,000	42,464,000		43,480,000
February	735,000	21,000	-	38,341,000		39,097,000
March	764,000	8,000	-	39,199,000		39,971,000
April	1,404,000	-	3,260,000	43,750,000		48,414,000
May	586,000	-	27,028,000	49,008,000		76,622,000
June	4,311,000	395,000	28,257,000	55,527,000		88,490,000
July	11,420,000	9,661,000	19,706,000	53,824,000		94,611,000
August	6,072,000	36,503,000	111,000	44,830,000		87,516,000
September	2,324,000	33,241,000	-	38,499,000		74,064,000
October	700,000	37,719,000	-	31,049,000		69,468,000
November	654,000	20,199,000	-	32,439,000		53,292,000
December	661,000	122,000	-	33,548,000		34,331,000
Total	30,374,000	137,870,000	78,634,000	502,478,000		749,356,000

Well Data 2017						
Month	Well 1R 1125 Fresno St	Well 5 876 N St	Well 6R 1002 T St	Well 8 1051 Barrington Ave	Well 10 925 Jensen Road	Total (gallons)
January	-	-	701,000	30,532,000		31,233,000
February			1,167,000	27,430,000		28,597,000
March			840,000	36,148,000		36,988,000
April	9,000	-	3,367,000	40,486,000		43,862,000
May	-	-	23,160,000	50,492,000		73,652,000
June	324,000	-	25,718,000	61,115,000		87,157,000
July	1,024,000	-	26,640,000	61,407,000		89,071,000
August	829,000	42,000	24,633,000	62,851,000		88,355,000
September	906,000	2,000	19,585,000	56,785,000		77,278,000
October	739,000	-	15,610,000	53,198,000		69,547,000
November	451,000	18,000	7,728,000	37,000,000		45,197,000
December	743,000	1,000	272,000	42,464,000		43,480,000
Total	5,025,000	63,000	149,421,000	559,908,000		714,417,000

Well Data 2016						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	-	-	838,000	31,326,000		32,164,000
February	-	-	797,000	31,173,000		31,970,000
March	-	-	730,000	34,667,000		35,397,000
April	12,000	-	3,077,000	42,230,000		45,319,000
May	-	-	15,858,000	51,819,000		67,677,000
June	23,000	-	26,022,000	53,369,000		79,414,000
July	4,000	-	27,799,000	56,243,000		84,046,000
August	-	-	26,710,000	52,061,000		78,771,000
September	42,000	-	24,571,000	45,733,000		70,346,000
October	-	-	17,949,000	34,693,000		52,642,000
November	-	-	3,011,000	34,834,000		37,845,000
December	-	-	2,162,000	30,012,000		32,174,000
Total	81,000	0	149,524,000	498,160,000		647,765,000

Well Data 2015						
Month	Well 1R 1125 Fresno St (gallons)	Well 5 876 N St (gallons)	Well 6R 1002 T St (gallons)	Well 8 1051 Barrington Ave (gallons)	Well 10 925 Jensen Road (gallons)	Total (gallons)
January	0	0	856,000	29,318,000		30,174,000
February	0	0	729,000	27,355,000		28,084,000
March	0	0	3,598,000	45,313,000		48,911,000
April	0	0	5,752,000	46,940,000		52,692,000
May	4,000	0	8,194,000	47,629,000		55,827,000
June	69,000	7,463,000	9,760,000	49,437,000		66,729,000
July	0	33,635,000	42,000	27,927,000		61,604,000
August	0	29,798,000	112,000	39,855,000		69,765,000
September	157,000	17,637,000	4,496,000	41,775,000		64,065,000
October	352,000	0	10,237,000	46,031,000		56,620,000
November	0	0	1,981,000	34,981,000		36,962,000
December	0	0	2,582,000	31,696,000		34,278,000
Total	582,000	88,533,000	48,339,000	468,257,000		605,711,000

Well Data 2014						
Month	Well 1R 1125 Fresno St (gallons)	Well 5 876 N St (gallons)	Well 6R 1002 T St (gallons)	Well 8 1051 Barrington Ave (gallons)	Well 10 925 Jensen Road (gallons)	Total (gallons)
January	5,000	0	1,696,000	41,885,000		43,586,000
February	0	0	921,000	32,830,000		33,751,000
March	10,000	0	1,358,000	36,526,000		37,894,000
April	0	0	6,757,000	47,089,000		53,846,000
May	0	12,360,000	4,142,000	58,971,000		75,473,000
June	6,000	18,928,000	17,647,000	50,003,000		86,584,000
July	130,000	31,535,000	12,988,000	46,725,000		91,378,000
August	133,000	30,419,000	13,083,000	47,638,000		91,273,000
September	0	2,186,000	22,660,000	46,091,000		70,937,000
October	0	1,000	24,118,000	44,326,000		68,445,000
November	0	0	2,838,000	31,673,000		34,511,000
December	0	0	2,193,000	31,859,000		34,052,000
Total	284,000	95,429,000	110,401,000	515,616,000		721,730,000

Well Data 2013						
Month	**Well 1R 1125 Fresno St**	**Well 5 876 N St**	**Well 6R 1002 T St**	**Well 8 1051 Barrington Ave**	**Well 10 925 Jensen Road**	**Total (gallons)**
January	6,000	0	22,254,000	10,650,000		32,910,000
February	0	0	701,000	37,214,000		37,915,000
March	0	0	3,732,000	55,166,000		58,898,000
April	24,000	100,000	8,510,000	61,571,000		70,205,000
May	5,000	17,966,000	13,519,000	66,156,000		97,646,000
June	0	20,281,000	15,204,000	57,927,000		93,412,000
July	0	26,277,000	19,686,000	58,222,000		104,185,000
August	0	19,046,000	15,935,000	56,279,000		91,260,000
September	442,000	15,823,000	11,266,000	51,597,000		79,128,000
October	288,000	4,680,000	18,630,000	51,412,000		75,010,000
November	48,000	48,000	22,331,000	35,130,000		57,557,000
December	5,000	0	10,464,000	29,702,000		40,171,000
Total	**818,000**	**104,221,000**	**162,232,000**	**571,026,000**		**838,297,000**

Well Data 2012						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	5,000	0	41,130,000	302,100		41,437,100
February	10,000	0	38,724,000	3,663,000		42,397,000
March	30,000	215,000	12,404,000	41,350,000		53,999,000
April	12,000	2,505,000	645,000	56,015,000		59,177,000
May	414,000	27,699,000	4,726,000	59,948,000		92,787,000
June	176,000	31,391,000	7,287,000	65,687,000		104,541,000
July	8,182,000	31,369,000	21,636,000	40,281,000		101,468,000
August	0	31,114,000	11,131,000	72,387,000		114,632,000
September	7,000	13,881,000	10,721,000	55,138,000		79,747,000
October	12,000	26,811,000	2,131,000	43,061,000		72,015,000
November	1,000	12,042,000	978,000	38,019,000		51,040,000
December	3,000	0	637,000	36,610,000		37,250,000
Total	8,852,000	177,027,000	152,150,000	512,461,100		850,490,100

Well Data 2011						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	8,000	0	590,000	4,987,000		5,585,000
February	12,000	12,000	32,822,000	725,000		33,571,000
March	610,000	0	31,581,000	2,652,000		34,843,000
April	123,000	0	38,962,000	20,270,000		59,355,000
May	51,000	10,121,000	36,404,000	28,183,000		74,759,000
June	303,000	14,066,000	32,314,000	35,108,000		81,791,000
July	84,000	13,980,000	39,148,000	50,816,000		104,028,000
August	48,000	18,980,000	42,851,000	41,282,000		103,161,000
September	4,000	11,598,000	42,787,000	39,778,000		94,167,000
October	22,000	11,596,000	36,245,000	10,948,000		58,811,000
November	32,000	3,860,000	34,485,000	10,651,000		49,028,000
December	2,000	0	44,113,000	2,918,000		47,033,000
Total	1,299,000	84,213,000	412,302,000	248,318,000		746,132,000

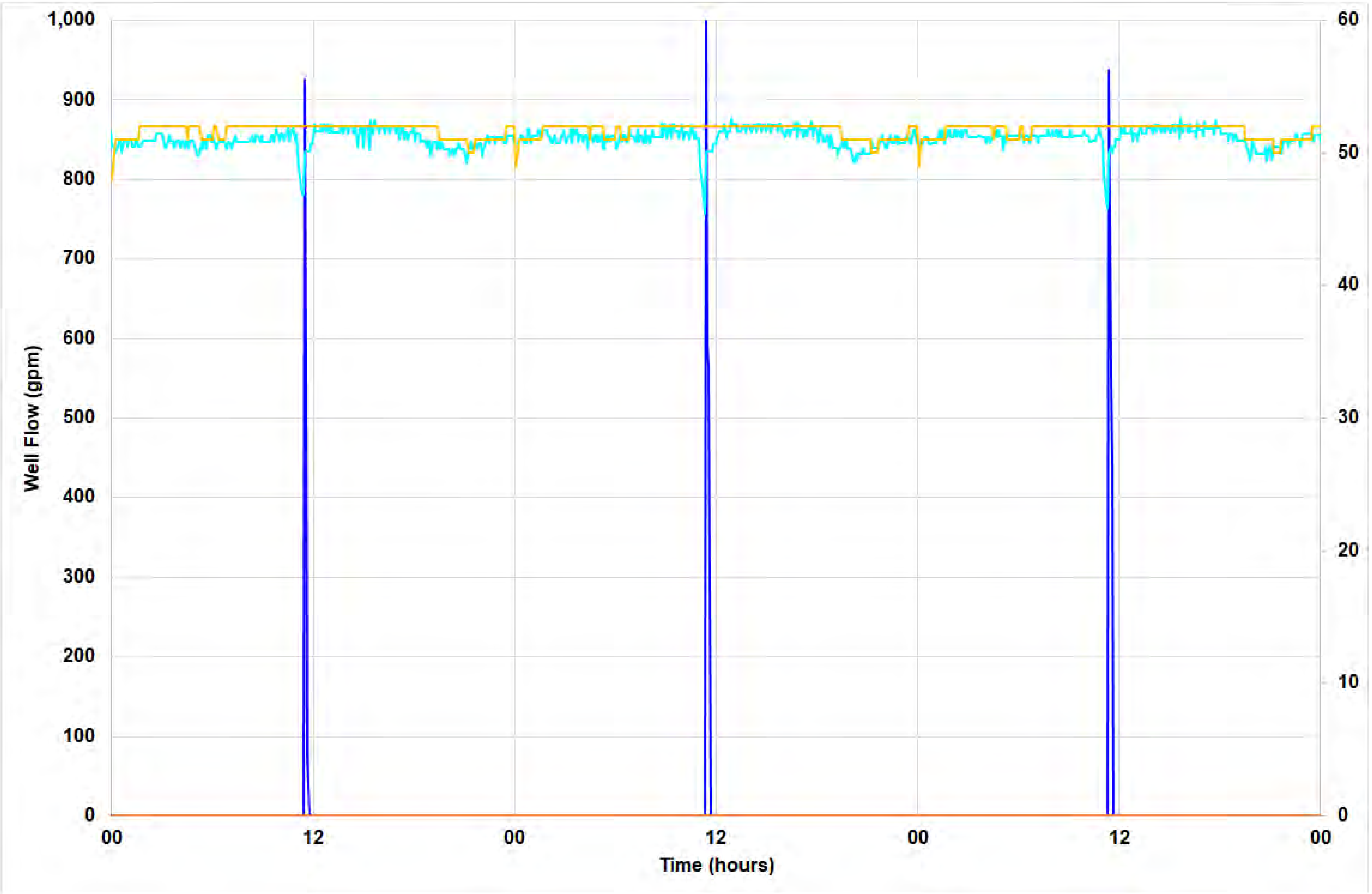
Well Data 2010						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	4,000	7,000	28,758,000	1,318,000		30,087,000
February	5,000	0	28,205,000	878,000		29,088,000
March	1,000	0	33,722,000	6,159,000		39,882,000
April	15,000	449,000	37,708,000	11,006,000		49,178,000
May	86,000	303,000	37,634,000	27,267,000		65,290,000
June	839,000	15,777,000	37,808,000	41,125,000		95,549,000
July	19,000	36,002,000	37,711,000	34,666,000		108,398,000
August	58,000	33,976,000	32,687,000	26,754,000		93,475,000
September	1,626,000	34,073,000	22,998,000	25,191,000		83,888,000
October	188,000	27,639,000	1,651,000	16,078,000		45,556,000
November	35,000	11,000	24,626,000	19,731,000		44,403,000
December	10,000	4,000	33,840,000	4,514,000		38,368,000
Total	2,886,000	148,241,000	357,348,000	214,687,000	0	723,162,000

Well Data 2009						
Month	**Well 1R 1125 Fresno St (gallons)**	**Well 5 876 N St (gallons)**	**Well 6R 1002 T St (gallons)**	**Well 8 1051 Barrington Ave (gallons)**	**Well 10 925 Jensen Road (gallons)**	**Total (gallons)**
January	0	0	32,700,000	736,000		33,436,000
February	4,000	2,000	31,588,000	577,000		32,171,000
March	23,000	102,000	38,725,000	6,759,000		45,609,000
April	60,000	1,869,000	43,834,000	23,347,000		69,110,000
May	9,000	514,000	47,756,000	39,942,000		88,221,000
June	76,000	20,720,000	40,243,000	29,578,000		90,617,000
July	8,000	34,882,000	41,650,000	31,296,000		107,836,000
August	0	16,483,000	38,200,000	34,982,000		89,665,000
September	11,000	0	42,591,000	39,728,000		82,330,000
October	4,000	0	39,163,000	22,320,000		61,487,000
November	0	0	34,626,000	10,456,000		45,082,000
December	2,000	2,256,000	33,749,000	3,939,000		39,946,000
Total	197,000	76,828,000	464,825,000	243,660,000	0	785,510,000

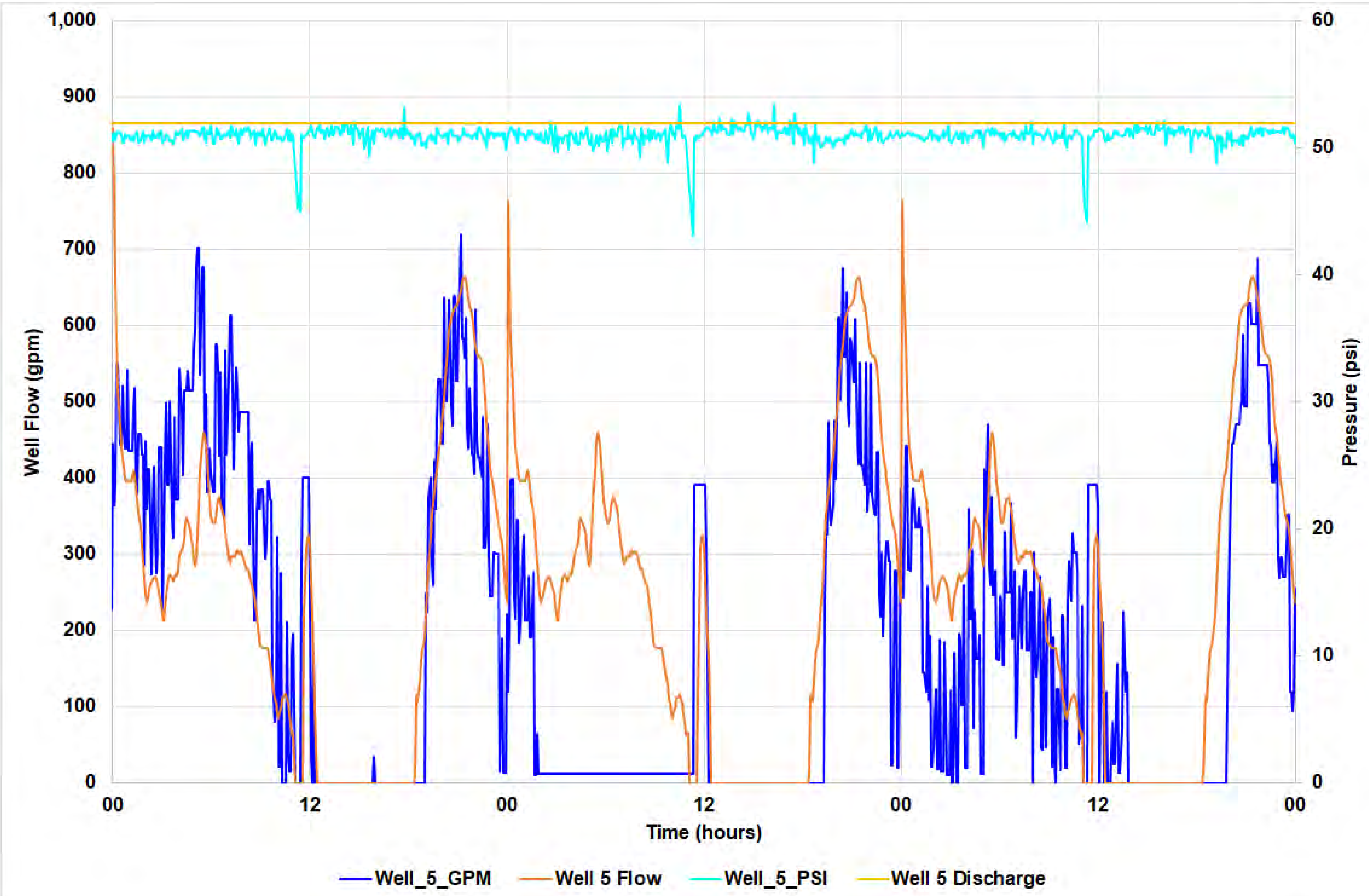
Appendix B Calibration

B.1 July 6th to 9th, 2021

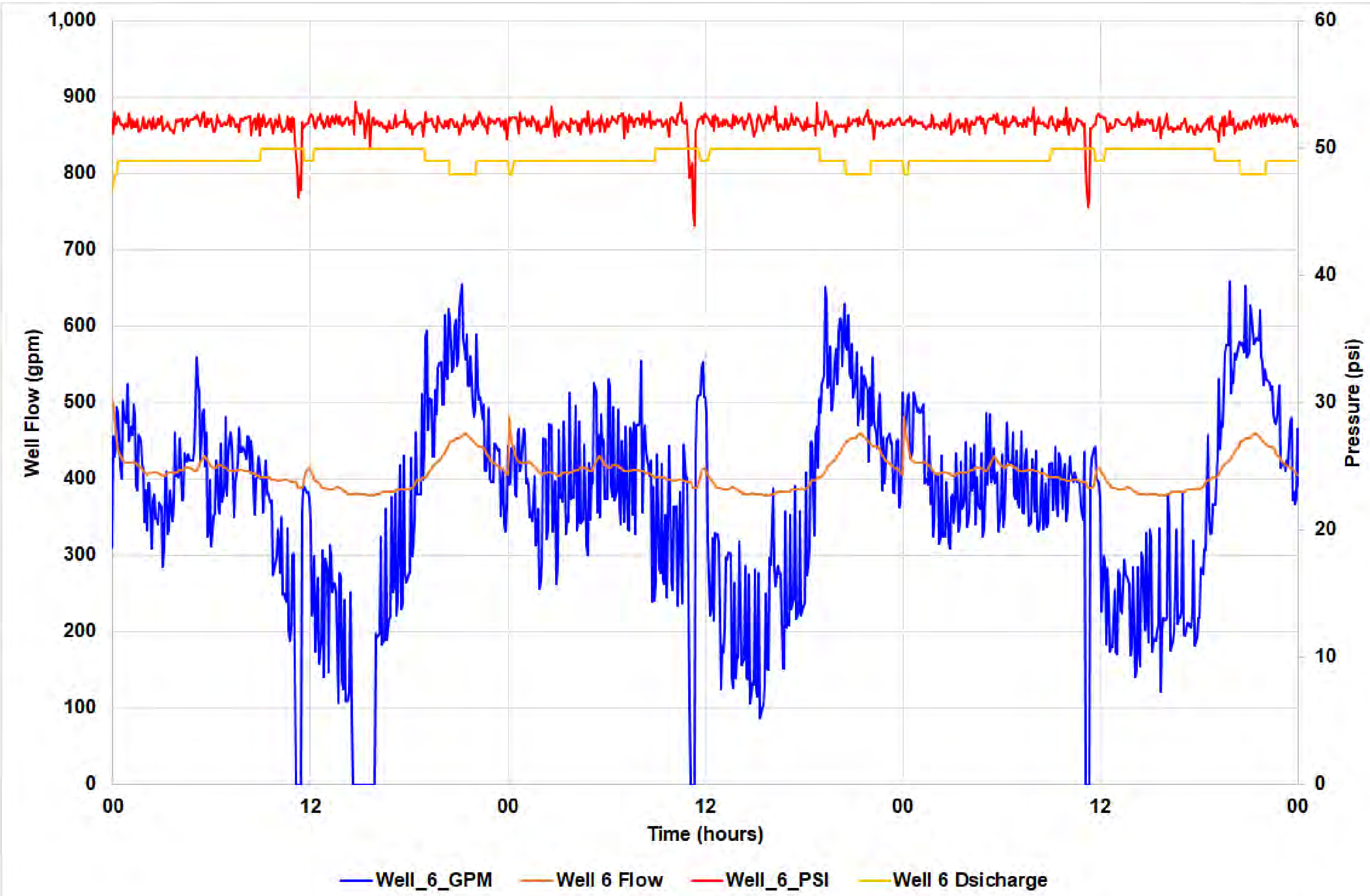
B.1.1 WELL 1R



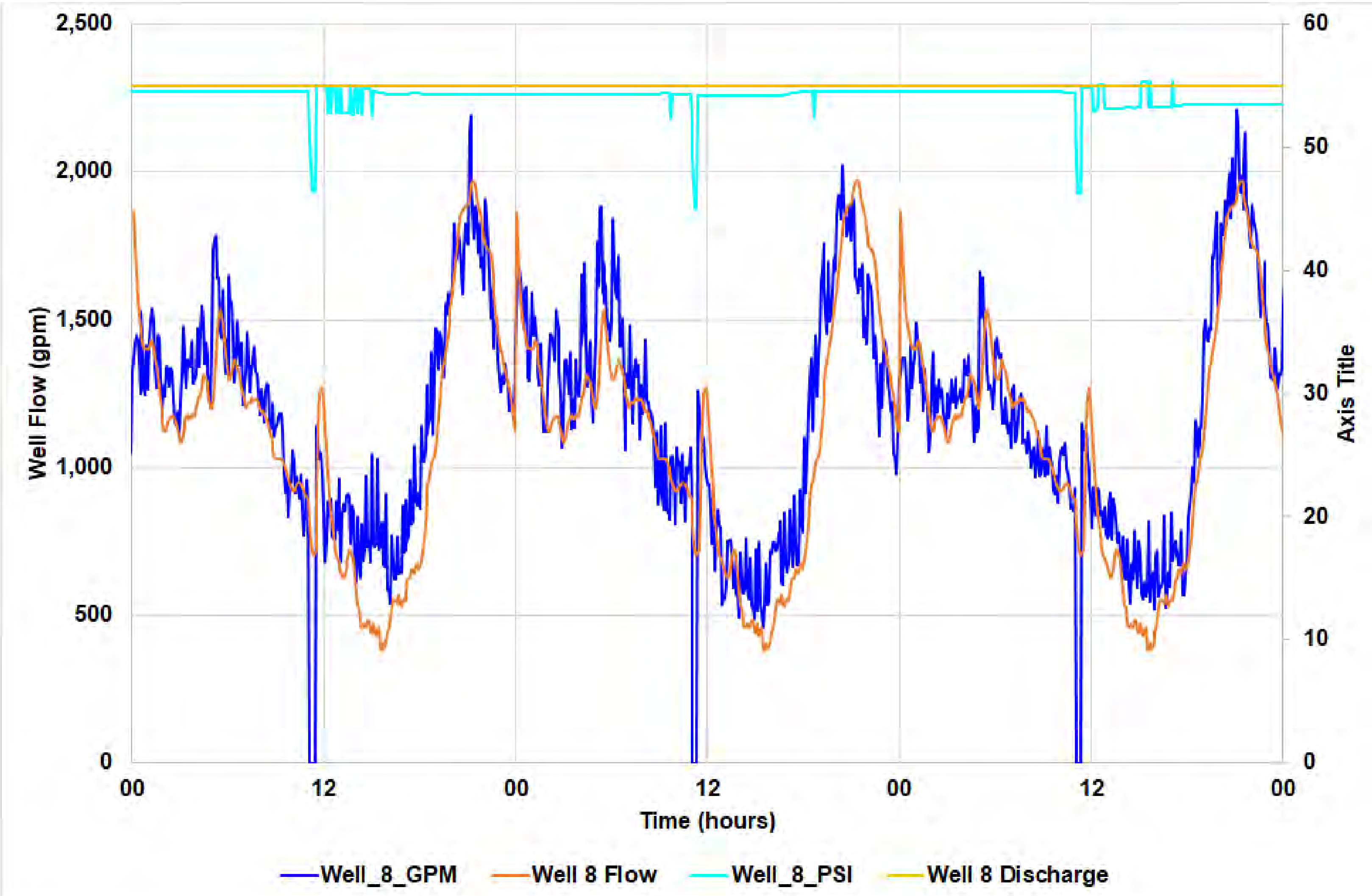
B.1.2 WELL 5


1,000
900
800
700
600
500
400
300
200
100
0
Well Flow (gpm)
60
50
40
30
20
10
0
Pressure (psi)
00
12
00
12
00
12
00
Time (hours)
Well_5_GPM
Well 5 Flow
Well_5_PSI
Well 5 Discharge

B.1.3 WELL 6R

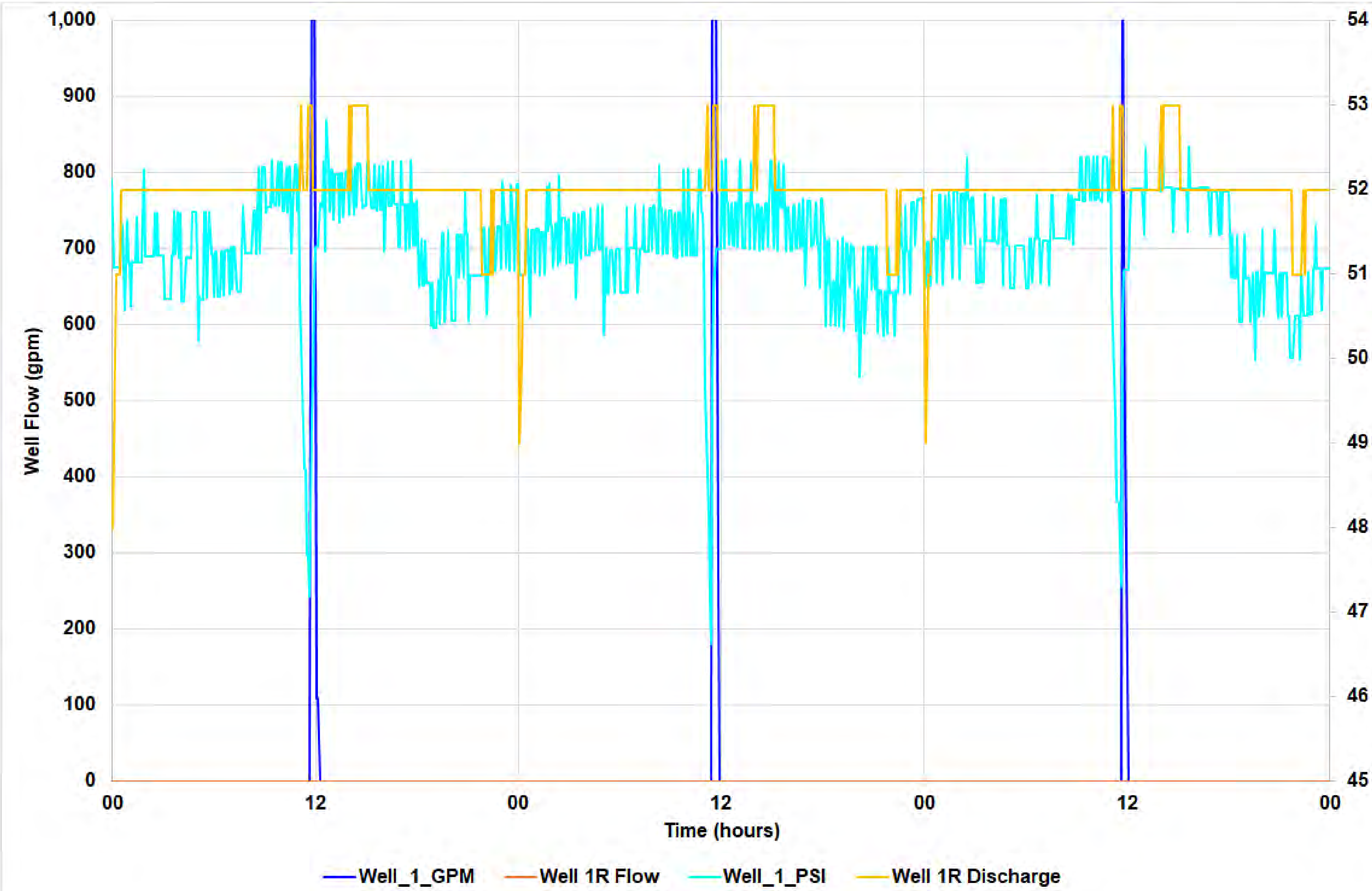

1,000
900
800
700
600
500
400
300
200
100
0
Well Flow (gpm)
60
50
40
30
20
10
0
Pressure (psi)
00
12
00
12
00
12
00
Time (hours)
Well_6_GPM
Well 6 Flow
Well_6_PSI
Well 6 Dsicharge

B.1.4 WELL 8

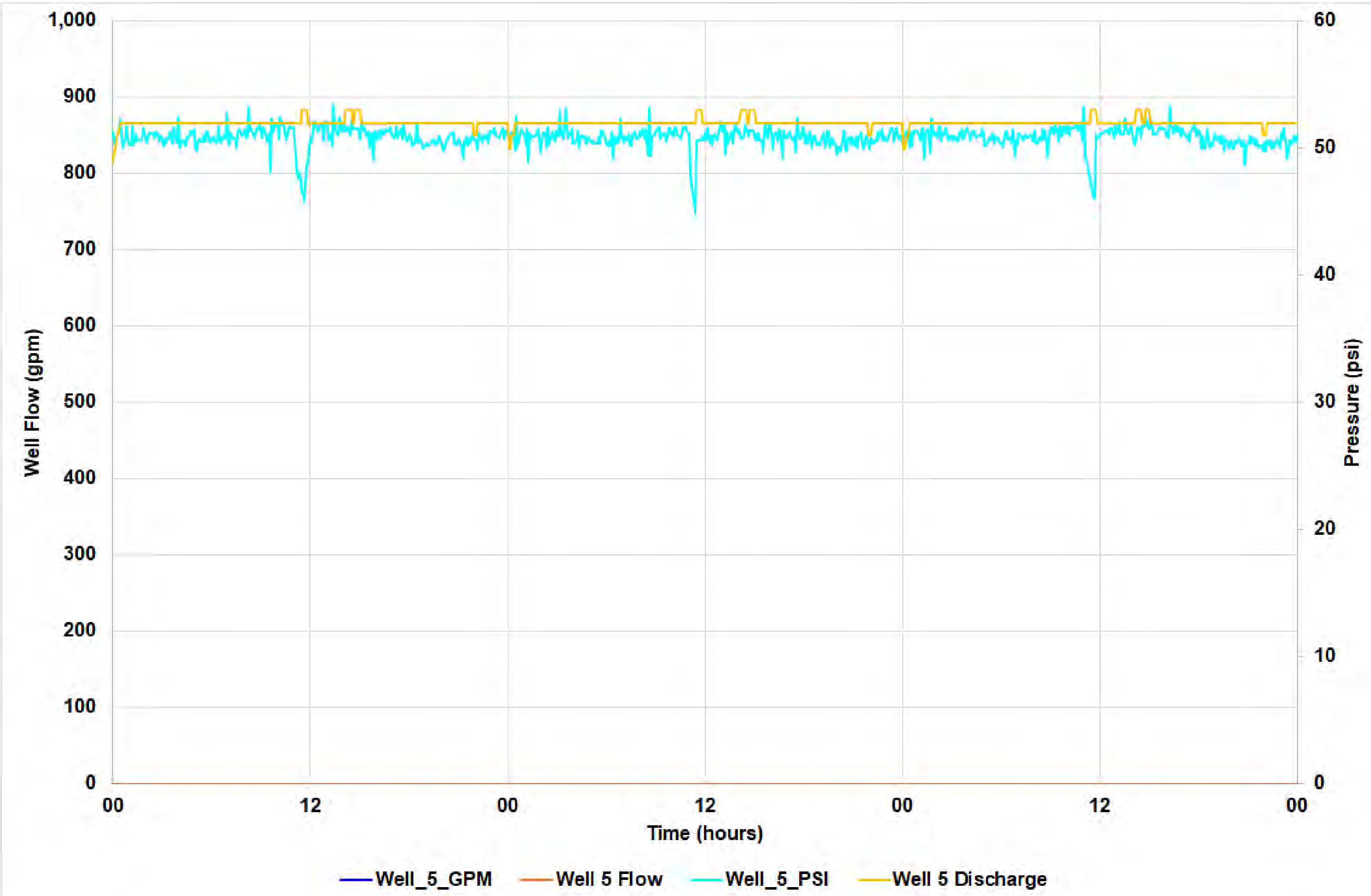

2,500
2,000
1,500
1,000
500
0
Well Flow (gpm)
60
50
40
30
20
10
0
Axis Title
00
12
00
12
00
12
00
Time (hours)
Well_8_GPM
Well 8 Flow
Well_8_PSI
Well 8 Discharge

B.2 October 12th to 15th, 2021

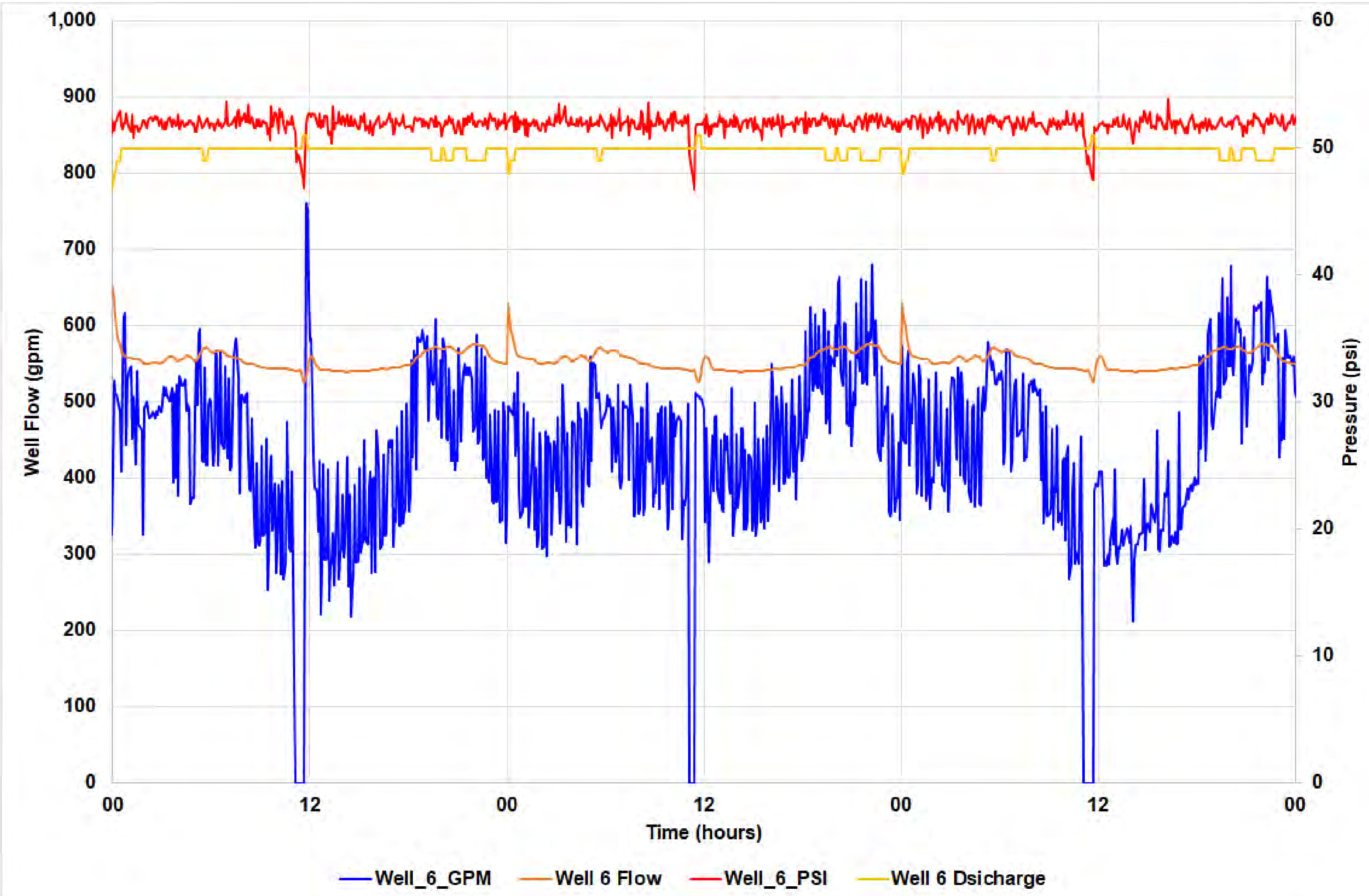
B.2.1 WELL 1R



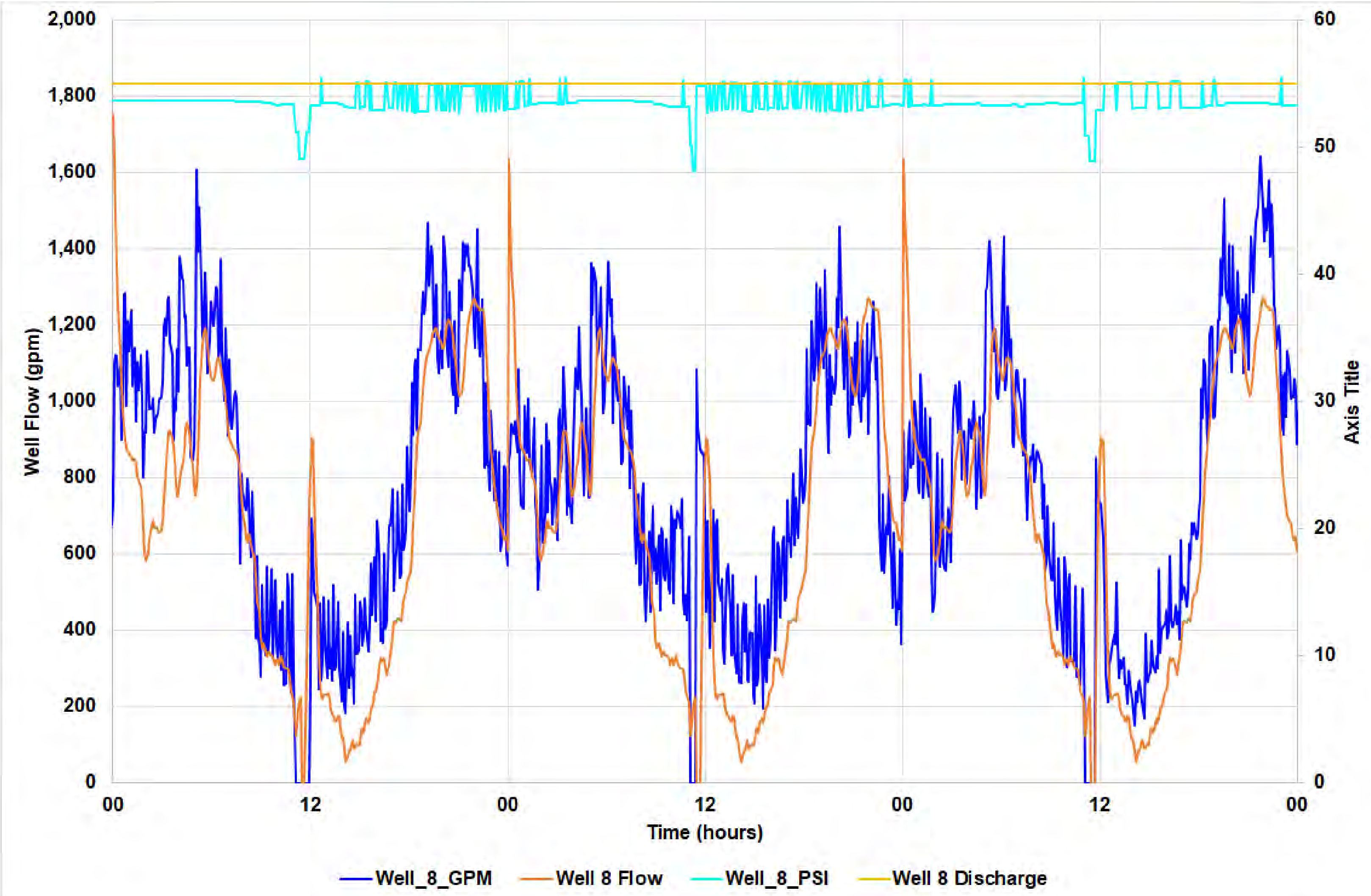
B.2.2 WELL 5


1,000
900
800
700
600
500
400
300
200
100
0
Well Flow (gpm)
60
50
40
30
20
10
0
Pressure (psi)
00
12
00
12
00
12
00
Time (hours)
Well_5_GPM
Well 5 Flow
Well_5_PSI
Well 5 Discharge

B.2.3 WELL 6R


1,000
900
800
700
600
500
400
300
200
100
0
Well Flow (gpm)
60
50
40
30
20
10
0
Pressure (psi)
00
12
00
12
00
12
00
Time (hours)
Well_6_GPM
Well 6 Flow
Well_6_PSI
Well 6 Dsicharge

B.2.4 WELL 8


2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Well Flow (gpm)
60
50
40
30
20
10
0
Axis Title
00
12
00
12
00
12
00
Time (hours)
Well_8_GPM
Well 8 Flow
Well_8_PSI
Well 8 Discharge