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TECHNICAL MEMORANDUM

DATE: March 15, 2023

Project No.: 648-60-22-10
SENT VIA: EMAIL

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SUBJECT: Water Master Plan Supplement

The purpose of this Technical Memorandum (TM) is to summarize the findings and conclusions of West Yost's supplemental analysis of the City of Menlo Park (City) Water System Master Plan (WSMP) completed in 2018. In particular, the City requested that the certain tables and figures be updated, storage recommendations be revisited based on updated demand data, and that recommended pipeline replacement projects be further broken down into smaller project packages for the City's use in its upcoming update to its five-year capital improvement plan. The following sections summarize the evaluations:

1. Background
2. WSMP Updates
3. Storage Evaluation
4. Hydraulic Evaluation
5. Five-Year CIP

1.0 BACKGROUND

In 2018, West Yost completed the WSMP for the City. The WSMP documented existing system conditions and historical water use, projected future water use based on planned development identified in the ConnectMenlo General Plan and M-2 (Bayfront) Area Zoning Update, and hydraulically evaluated system improvements (storage tanks, pump stations, pipelines) needed to support future growth. The WSMP also included a pipeline risk assessment prioritizing pipeline replacements based on several likelihoods of failure and consequence of failure factors.

The WSMP recommended constructing a new storage reservoir to serve the Lower Zone and High-Pressure Zone. Reservoir sizing was based on existing baseline demand conditions, using 2013 water use to represent existing conditions, plus projected demand needs based on anticipated growth in the

Lower Zone and High-Pressure Zone. The WSMP also identified priorities for pipeline replacement projects based on a risk methodology developed collaboratively with the City (refer to Chapter 7).

The City requested a re-evaluation of the baseline and 2040 demands for the Lower and High-Pressure Zone, an updated storage analysis for existing and 2040 conditions, and a hydraulic evaluation to identify improvements that would be required to reliably meet Lower and High-Pressure Zone demand and fire flows in conjunction with the new storage reservoir.

In addition, the City requested an updated prioritized list of high-risk and medium-high risk pipeline replacement projects, in more discrete project packages, to use for the upcoming five-year CIP for pipeline replacements, as well as an update to specific tables in the WSMP to incorporate further clarifications.

The following sections provide additional details on the WSMP update, storage evaluation (including a demand update, peaking factor update, revised storage analysis and hydraulic evaluation) and the recommended pipeline rehabilitation for use in the Five-Year CIP.

2.0 WSMP UPDATES

The City requested an update to the following tables and figures:

- Figure 2-3. Existing System Schematic Hydraulic Profile
- Table 3-7. Summary of Peaking Factors by Pressure Zone
- Table 5-1. Summary of Recommended Water System Planning and Design Criteria
- Table 5-2. Recommended Fire Flow Requirements
- Table 6-8. Summary of Peaking Factors by Pressure Zone and associated text edits

These updates were provided to the City on April 27, 2022, and no further comments were provided. A one-page description was also provided to the City for use in the updated WSMP document and is provided in Attachment A.

3.0 STORAGE EVALUATION

This section describes the updated storage evaluation, which included updating demands and peaking factors, revising the storage analysis and performing a hydraulic evaluation. This storage evaluation is focused on sizing storage in the Lower and High-Pressure Zones, therefore information for the City's Upper Zone is specifically omitted.

3.1 Existing Demand Update

The WSMP baseline demands were based on average water production data from calendar year 2013, as it was determined 2013 demand best represented the City's water usage at the time that the WSMP was being prepared. To estimate maximum day and peak hour usage, hourly and daily turnout data were evaluated for 2016, a drought year, since hourly and daily data were not available prior to 2015. For this analysis, the existing baseline conditions were updated to be reflective of more recent demand trends.

West Yost evaluated water usage for 2018 through 2021 to establish the new baseline demands for the Lower and High-Pressure Zone. Daily flow data from SFPUC turnouts was used to determine average day use and maximum day use for each zone, while hourly turnout deliveries on the maximum delivery day

were used to estimate peak hour use. Table 1 summarizes the average day, max day, and peak hour use for the Lower and High-Pressure Zone for 2018 through 2021.

Table 1. Summary of Water Use from 2018 through 2021

Year	Average Day Use, gpm	Maximum Day Date	Maximum Day Use, gpm	Peak Hour Use, gpm
High-Pressure Zone [a]				
2018	290	7/30/2018	499	664
2019	253	6/10/2019	413	686
2020	228	7/17/2020	418	611
2021	226	7/15/2021	379	611
2018-2021 Average	**249**	**--**	**427**	**642**
Adopted in Master Plan[b]	*188*	--	*290*	*408*
Percent Difference from Master Plan	*32.6*	--	*47.2*	*57.4*
Lower Pressure Zone [c]				
2018	1,016	3/10/2018	1,592	4,750
2019	1,034	6/28/2019	1,551	2,182
2020	1,093	8/14/2020	1,564	2,157
2021	931	7/9/2021	1,396	2,182
2018-2021 Average	**1,018**	**--**	**1,526**	**2,173[d]**
Adopted in Master Plan[e]	*1,442*	--	*2,221*	*3,124*
Percent Difference from Master Plan	*-29.4*	--	*-31.3*	*-30.4*

(a) Use based on flow recorded from SFPUC's EyeOnWater website for the Hill Turnout.
(b) Use from WSMP Chapter 7 Table 7-1 for High-Pressure Zone.
(c) Use based on flow recorded from SFPUC's EyeOnWater website for the Burgess, Madera, and Chilco Turnouts.
(d) Average based on 2019 through 2021 due to peak hour anomaly in 2018.
(e) Use from WSMP Chapter 7 Table 7-1 for Lower Pressure Zone.

With respect to the High-Pressure Zone, average day, max day, and peak hour use were generally consistent from 2018 through 2021. Since water use was consistent for all four years, the average of each demand condition was used to establish the baseline demands.

With respect to the Lower Zone, average day and max day use was generally consistent from 2018 through 2020. In 2021 there was a drop in water use compared to 2018 through 2020 use. Based on input provided by City staff, this drop may be due to a commercial or industrial user going offline. The ratio of maximum day use to average day use remained the same as previous years, so all years were used to calculate existing average day and maximum day use. Peak hour use for the Lower Zone was consistent from 2019 through 2021 but was extremely high in 2018. The value in 2018 was determined to be an anomaly. Therefore, the average of 2019 through 2021 was used as the baseline for peak hour use.

3.2 Peaking Factors Updates

Water system facilities are generally sized to meet peak demands. The peaking conditions of most concern for water facility sizing are maximum day demand plus fire flow and peak hour demand. Peak water use is typically expressed as a ratio, or peaking factor, dividing the peak water use by the average daily or maximum day water use. These peaking factors are then used to calculate maximum day and peak hour water use for future conditions.

Table 2 summarizes the maximum day and peak hour peaking factors by pressure zone, based on water use from 2018 through 2021 as described in the section above.

Table 2. Summary of Maximum Day and Peak Hour Peaking Factors

	Average Day to Maximum Day Peaking Factor	Average Day to Peak Hour Peaking Factor
High-Pressure Zone		
2018-2021 Average	**1.71**	**2.59**
Adopted in Master Plan [(a)]	*1.54*	*2.20*
Percent Difference from Master Plan	*11.3*	*17.8*
Lower Pressure Zone		
2018-2021 Average	**1.50**	**2.14**[(b)]
Adopted in Master Plan	*1.54*	*2.20*
Percent Difference from Master Plan	*-2.6*	*-2.6*

(a) Peaking factors assumed to be identical to Lower Zone in Master Plan, due to similar land use types and data anomalies that indicated unreasonably high peaking factors for the High-Pressure Zone.
(b) Peaking factor based on average demands for 2019 through 2021 due to peak hour anomaly in 2018.

3.3 Summary of Baseline and 2040 Demands

Table 3 summarizes the City's updated existing water demands by pressure zone reflecting recent water use summarized in Table 1. Maximum day and peak hour demands were calculated using average daily demands multiplied by the adopted peaking factors shown in Table 2. As shown in Table 3, updated existing average day, maximum day, and peak hour demands are generally 19 to 22 percent lower than estimates established in the 2018 WSMP.

Table 3. Summary of Existing Water Demands[(a)]

Pressure Zone	Average Day Demand		Maximum Day Demand		Peak Hour Demand	
	gpm	mgd	gpm	mgd	gpm	mgd
Lower Zone	1,018	1.5	1,527	2.2	2,182	3.1
High-Pressure Zone	249	0.4	427	0.6	646	0.9
Total	**1,268**	**1.8**	**1,955**	**2.8**	**2,828**	**4.1**
Master Plan	1,630	2.3	2,511	3.6	3,532	5.1
Change from Master Plan	-22.2%		-22.2%		-19.9%	

(a) Refer to Table 1 and 2. Maximum and peak hour demands calculated based on updated peaking factor information.

Table 4 summarizes the City's future (2040) water demands by pressure zone. Future demands were estimated using the same anticipated growth as identified in the WSMP added to the revised existing demand, which is summarized in Table 3. The increase in average day demand attributed to growth specifically for the Lower and High-Pressure Zones is 0.14 mgd and 0.64 mgd, respectively.

Table 4. Summary of Future (2040) Water Demands[(a)]

Pressure Zone	Average Day Demand[(a)]		Maximum Day Demand		Peak Hour Demand	
	gpm	mgd	gpm	mgd	gpm	mgd
Lower Zone	1,114	1.6	1,671	2.4	2,388	3.4
High-Pressure Zone	693	1.0	1,189	1.7	1,797	2.6
Total	**1,808**	**2.6**	**2,860**	**4.1**	**4,185**	**6.0**
Master Plan	2,170	3.1	3,343	4.8	4,703	6.8
Change from Master Plan	-16.7%		-14.5%		-11.0%	

(a) Based on updated baseline demand summarized in Table 1 plus the same growth estimated in the City's Water System Master Plan. Average day growth for the Lower, High-Pressure and Upper Zones was calculated to be 0.14, 0.64 and 0.03 mgd, respectively.

As summarized in Table 4, there is a net decrease in future demand of 11 to 17 percent when compared to estimates prepared in the 2018 WSMP. The decrease in both the existing and future demand estimates is attributed to the updated existing demand, which now reflects changes in water use within the City following 2014 through 2016 drought years and is now based on water use data from 2018 through 2021.

These updated water demand estimates were subsequently used to re-evaluate the storage needs in the Lower and High-Pressure Zones, as described in the next section.

3.4 Revised Storage Analysis

As described in the 2018 WSMP, the principal advantages that storage provides for the water system are: (1) operational storage to balance differences in demands and supplies; (2) emergency storage in case of supply outage (e.g., loss of SFPUC Supply); and, (3) water to fight fires. The City's water storage capacity requirements are detailed in WSMP Table 5-1, and are as follows:

- Operational storage component equal to 25 percent of maximum day demand.
- Emergency component equal to 50 percent of maximum day demand.
- Fire storage component equal to the highest fire flow multiplied by the recommended duration.

If groundwater wells are available to supply a pressure zone, the emergency storage volume required can be reduced since groundwater wells access the aquifer as a form of storage. The recently completed groundwater well in the Lower Zone (at the City's Corporation Yard), is currently permitted to be used during emergencies, when SFPUC supply is disrupted or unavailable. The City received an amended permit for an "active" well, meaning it can be accessed at any given time. The City is currently investigating if an active well is feasible or if the well should be classified as "standby", which would limit use to five consecutive days and fifteen total days per year. Additionally, the City is also exploring the possibility of a second well in the Lower Zone at Willow Oaks Park, adjacent to where storage is currently planned, as discussed below. This would further contribute to lowering the emergency storage requirements.

To account for the availability of groundwater during an emergency, a reduction of required storage volume, defined as an emergency storage credit, was considered as part of the storage sizing calculations. The emergency groundwater storage credit, detailed in WSMP Table 5-1, is calculated as the minimum of: 1) the emergency storage requirement; or, 2) the volume produced by the wells, assuming an emergency with a 24-hour duration occurring on the maximum day demand.

Table 5 compares the City's available water storage capacity with the required storage capacity for the Lower and High-Pressure Zones under existing conditions. The existing Corporation Yard well in the Lower Zone was assumed to be offline, at the request of the City. One fire volume for both the Lower and High-Pressure Zone was assumed. The existing storage capacity requirement/deficit is 3.1 MG.

Table 6 compares the City's available water storage capacity with the required storage capacity for future conditions with different supply and fire flow scenarios. The following scenarios were explored:

- Future demand conditions, with no groundwater credit and only one fire volume in storage
- Future demand conditions, with emergency storage credit only assigned to the Lower Zone and one fire volume in storage
- Future demand conditions, with emergency storage credit to both the Lower and High-Pressure Zones, and one fire volume in storage
- Future demand conditions, with emergency storage credit to both the Lower and High-Pressure Zones, and two fire volumes in storage

The intent of these scenarios was to provide the City with a menu of options to optimize the amount of storage that should be constructed. As shown on Table 6, whether the emergency storage credit is included or not significantly impacts the storage volume needed. The number of fire volumes also impact total amount of storage needed. The comparison between available and required storage capacities indicates there is a future water storage capacity deficit between 2.0 and 4.1 MG, depending on the scenario, across the Lower and High-Pressure Zones.

It is worth noting, as shown on Table 6, that the current capacity of the existing well is sufficient to maximize the emergency storage credit and a second well would not further reduce storage requirements. However, a second well would further bolster the City's water supply reliability, particularly during an SFPUC outage.

Based on the revised evaluation, it is not recommended that the City size storage without the emergency groundwater credit, as this would yield the largest tank (4.1 MG), which would be costly and would be difficult to maintain water quality during lower demand conditions. A storage tank between 2.0 to 3.0 MG is recommended, depending on whether the City would like to conservatively assume concurrent fires in the Lower and High-Pressure Zones. The likelihood of two simultaneous industrial type of fires in the Lower and High-Pressure Zones is low.

Table 5. Comparison of Available and Existing Required Storage Capacity

[A]	[B]	[C]	[D]	[E]	[F] = [D]+[E]	[G]	[H]	[I]	[J] = [G]+[H]+[I]	[K] = [F]-[J]
		Available Storage Capacity, MG				Required Storage Capacity, MG				
Pressure Zone	Maximum Day Demand, mgd	Facility	Existing Storage Capacity	Emergency Groundwater Storage Credit	Total Existing Storage Capacity	Operational[a]	Emergency[b]	Fire Flow[c]	Total Required Storage Capacity	Storage Capacity Surplus (Deficit), MG
Lower Zone	2.2	--	0.00	0.00	0.00	0.55	1.10	0.96	3.07	(3.07)
High Pressure Zone	0.6	--	0.00	0.00	0.00	0.15	0.31			

(a) Operational storage is 25 percent of the maximum day demand (See WSMP, Chapter 5, Table 5-1)

(b) Emergency storage is 50 percent of the maximum day demand (See WSMP, Chapter 5, Table 5-1)

(c) Fire flow is zones with commercial, Industrial, or Institutional/governmental customers is 4,000 gpm for 4 hours. Assumed to be sprinklered for planning purposes (See Chapter 5, Table 5-2)

Table 6. Comparison of Available and Future Required Storage Capacity

[A]	[B]	[C]	[D]	[E]	[F] = [D]+[E]	[G]	[H]	[I]	[J] = [G]+[H]+[I]	[K] = [F]-[J]
		Available Storage Capacity, MG				Required Storage Capacity, MG				
Pressure Zone	Maximum Day Demand, mgd	Facility	Storage Capacity	Emergency Groundwater Storage Credit	Total Available Storage Capacity	Operational[a]	Emergency[b]	Fire Flow[c]	Total Required Storage Capacity	Storage Capacity Surplus (Deficit), MG
Future Demand Conditions, no groundwater well and one fire volume stored										
Lower Zone	2.41	--	0.00	0.00	0.00	0.60	1.20	0.96	4.05	(4.05)
High Pressure Zone	1.71	--	0.00	0.00	0.00	0.43	0.86			
Future Demand Conditions, with one groundwater well providing emergency supply to Lower Pressure Zone and one fire volume stored[d]										
Lower Zone	2.41	--	0.00	1.20	1.20	0.60	1.20	0.96	4.05	(2.85)
High Pressure Zone	1.71	--	0.00	0.00	0.00	0.43	0.86			
Future Demand Conditions with one groundwater well providing emergency supply to both Lower and High Pressure Zones and one fire volume stored[d]										
Lower Zone	2.41	--	0.00	1.20	1.20	0.60	1.20	0.96	4.05	(1.99)
High Pressure Zone	1.71	--	0.00	0.86	0.86	0.43	0.86			
Future Demand Conditions with one emergency groundwater well providing emergency supply to both Lower and High Pressure Zones and two fire volumes stored[d]										
Lower Zone	2.41	--	0.00	1.20	1.20	0.60	1.20	0.96	5.01	(2.95)
High Pressure Zone	1.71	--	0.00	0.86	0.86	0.43	0.86	0.96		

(a) Operational storage is 25 percent of the maximum day demand (See WSMP, Chapter 5, Table 5-1)

(b) Emergency storage is 50 percent of the maximum day demand (See WSMP, Chapter 5, Table 5-1)

(c) Fire flow volume is based on a single fire associated with commercial, Industrial, or Institutional/governmental land uses, which requires 4,000 gpm for 4 hours and assumed to be sprinklered for planning purposes in the future (See WSMP, Chapter 5, Table 5-2).

(d) Groundwater capacity assumes capacity in emergency well is equal to 1,500 gpm, based on most recent performance testing.

4.0 Hydraulic Evaluation

To hydraulically evaluate recommended storage facilities and the impacts to the City's distribution system, West Yost first updated the City's hydraulic model to include the following:

- Future system scenarios updated with revised 2040 water demands and new diurnal patterns calculated based on updated peaking factor information;
- A new storage reservoir in the Lower Zone, located adjacent to Willow Oaks Park, likely to be constructed beneath the existing school district field. This site is currently being considered by the City. In addition, two booster pump stations, (1) one at the storage site which would supply the Lower Zone, and (2) one at Karl Clark Park to supply the High-Pressure Zone from the Lower Pressure Zone (essentially an in-line booster pump station), and associated pipelines.
- Willow Village and Life Sciences District pipeline improvements, which are planned in the future as established as part of other concurrent analyses.
- Distribution system piping downstream of the Madera Turnout and at the intersection of Ivy Drive and Willow Road was corrected to reflect as-built information provided by the City.
- Model set up to support an extended period simulation. A seven-day extended period simulation, along with the updated diurnal, was used to evaluate tank operations.

As described above, two booster pump stations are needed to support the nominal hydraulic grade lines of the Lower and High-Pressure Zone. Table 7 summarizes the basis for the sizing each of the booster pump stations.

Table 7. Basis of Booster Pump Station Sizing

Facility	Assumed Location	Flow Requirement Basis	Head Requirement Basis
BPS Supplying Lower Zone	At planned storage tank site, Willow Oaks Park	Maximum of either: • Peak Hour demand (2,388 gpm, see Table 4) • Maximum day demand plus fire flow (4,000 gpm plus 1,527 gpm, or 5,527 gpm) **Maximum Day demand plus fire flow drive the sizing and is equivalent to 5,550 gpm or 8 mgd**	• Suction Head Assumption: Low water level in tank of (2 feet) • Discharge Head Assumption: Nominal grade of Lower Zone (213 feet) • Total Nominal Dynamic Head Required: Difference between discharge and suction head (211 feet)
BPS Supplying High-Pressure Zone	At Karl Clark Park	Maximum of either: • Peak Hour demand (1,797 gpm, see Table 4) • Maximum day demand plus fire flow (4,000 gpm plus 1,189 gpm, or 5,189 gpm) **Maximum Day demand plus fire flow drive the sizing and is equivalent to 5,200 gpm or 7.5 mgd**	• Suction Head Assumption: Average grade of Lower Zone (187 feet) • Discharge Head Assumption: Average grade of High-Pressure Zone (319 feet) • Total Nominal Dynamic Head Required: Difference between discharge and suction head (132 feet)

Planning and Modeling Criteria

The planning and modeling criteria used to evaluate the proposed Project are based on the system performance and operational criteria developed in the WSMP. The criteria used to evaluate the water system and proposed pipelines for the Project consist of the following:

- Minimum allowable service pressure is 40 pounds per square inch (psi) under normal system operating conditions.
- Residual pressure at the flowing hydrant (during a maximum day demand plus fire flow condition) and at customer service locations throughout the Lower Pressure Zone must be equal to or greater than 20 psi.
- Maximum velocities of 5 feet per second (ft/s) for distribution system pipelines and 4 ft/s for transmission pipelines under normal conditions.
- Maximum velocities of 12 ft/s for distribution system pipelines and 7 ft/s for transmission pipelines under fire flow conditions.

Hydraulic Evaluation

To evaluate the proposed storage locations the following evaluations were performed under buildout conditions to assess distribution system performance, and to confirm that the City's future distribution system would be able to deliver the required potable water, while meeting the City's adopted water system performance criteria.

- **Future Operating Conditions without New Facilities (Baseline)**. This scenario evaluates customer service pressures in the system without the new facilities and is evaluated over an extended period simulation.
- **Future Operating Conditions with New Facilities.** This scenario evaluates customer service pressures in the system with the new facilities and is evaluated over an extended period simulation.
- **Future Maximum Day Demand plus Fire Flow**. This scenario evaluates whether fire flow can be provided by new facilities.

For this evaluation, storage and pumping facilities were assumed to be located at the following locations:

- Lower Zone Storage and Booster Pump Station at Willow Oaks Park
- High-Pressure Zone Booster Pump Station at Karl Clark Park

With respect to operating assumptions, all turnouts serving the Lower and High-Pressure zones were assumed to be online in all scenarios except the emergency scenario, where fire flows were evaluated with turnouts offline. During peak periods, booster pump stations were assumed to be online and operating together (i.e., in series). Based on the updated diurnal curves from both zones, operation of these facilities was assumed to be between 10 P.M and 9 A.M. to capture peak demand for both pressure zones. The new tank was assumed to refill beginning at 10 A.M. stop when the level reaches 19 feet, to maintain 1 foot of headspace with a 20-foot-tall tank. An altitude valve was assumed to control the rate of flow into the tank by maintaining a minimum upstream pressure of 49 psi (resulting in a fill rate of approximately 2,000 gpm.

Results for the three scenarios are described in the following sections.

Baseline Conditions

Results from the baseline simulation indicate the system can adequately meet the City's minimum pressure criterion of 40 psi at all customer service locations. Figure 1 presents the minimum pressure and maximum pipeline velocity for the Lower Zone and High-Pressure Zone. Under these baseline conditions, the 12-inch pipeline between Burgess Turnout and Santa Monica Ave, located in the Lower Zone, has velocities between 3 and 5 feet per second (ft/s), exceeding the velocity criterion of 4 ft/s for transmission pipelines. This pipeline was also identified in the WSMP as having high velocities however, no recommendations were identified since a minimum pressure of 40 psi was met. Since Figure 1 shows no impact in maintaining pressure, replacement of this pipeline is still not recommended. The high velocities are due to the pressure settings at the Burgess Turnout and the effective hydraulic grade it establishes, which when compared to other turnouts results in this turnout providing the largest amount of supply to the zone. The velocities can be reduced if the pressure settings at the other turnouts are adjusted.

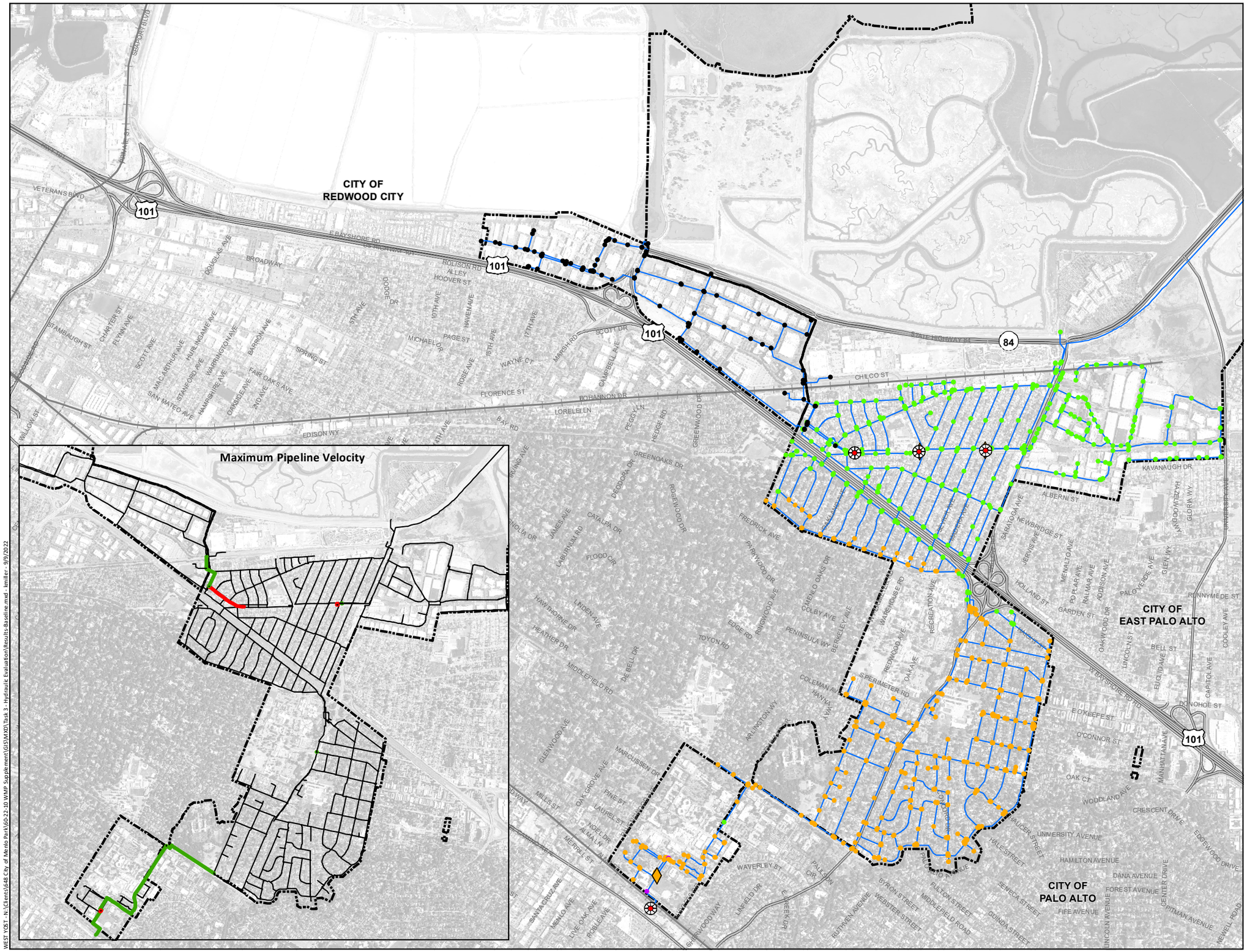
With respect to the High-Pressure Zone, the existing 12-inch pipeline along Market Place and Ivy Drive exceeds 4 ft/s. Since there is no impact to pressure in the vicinity of this pipeline, no recommendations were identified.

With Proposed Tank and Pump Station Facilities

Results with proposed tank and pump station facilities are similar to the baseline conditions and meet the City's minimum pressure criterion of 40 psi at all customer service locations. Figure 2 presents the minimum pressure and maximum pipeline velocity for the Lower and High-Pressure Zone with storage facilities added. Velocities in the 12-inch Willow Road pipeline between Gilbert Avenue and Highway 101 range from 3 to 5 ft/s with the segment of pipe between Okeefe Street and Durham Street exceeding 5 ft/s, which exceed the City's velocity criterion for transmission pipelines. The total headloss through this stretch of pipe is 18 feet, or approximately 4.83 ft of headloss per 1,000 feet. Under normal conditions, the WSMP states maximum headloss for transmission pipelines should be 3 ft of loss per 1,000 feet. While there aren't impacts to pressure from the high velocity, upsizing is recommended to mitigate excessive velocities and headloss through the pipeline. This is further discussed in the Fire Flow discussion below.

Figure 3 presents the decrease in pressure when compared to the baseline conditions. Locations in purple represent a 3 to 5 psi drop in pressure, and locations in blue represent a 1 to 3 psi drop in pressure. The net decrease in pressure of the distribution system can be attributed to the filling of the new tank or the localized reduction in pressures on the suction side of the High-Pressure Zone pump station.

Figure 4 summarizes tank levels and booster pump station flow/operations. The blue line corresponds to the tank level. Periods of decrease indicate the tank is emptying / when the pump station is online and supplying the system, while periods of increase correspond to the tank filling when the pump station is offline. Figure 5 and Figure 6 compare pressures in the vicinity of the Lower Zone and High-Pressure pump stations, respectively. With respect to the Lower Zone, pressures under baseline conditions are maintained at 55 psi. When storage is added, pressures range from 65 psi, when the pump station is operating, to 48 psi, when the pump station is off, and the tank is re-filling. At the High-Pressure Zone pump station, pressures with and without storage are essentially the same.



0 900 1,800

Scale in Feet

Minimum System Pressure

- Less than 40 psi
- ≥ 40 psi to < 60 psi
- ≥ 60 psi to < 80 psi
- ≥ 80 psi to < 100 psi
- ≥ 100 psi to < 120 psi
- 120 psi or greater

Maximum Pipeline Velocity

- Less than 3 ft/s
- 3 to 5 ft/s
- Greater than 5 ft/s
- Existing Pipeline
- Existing Pressure Reducing Valve Station
- Existing SFPUC Turnout
- Water Service Boundary

Notes:

1. Demands reflect the updated baseline demands consistent with Table 2.
2. Future maximum day demand is equal to 1.7 mgd for the High Pressure Zone and 2.4 mgd for the Lower Zone.
3. Results are based on the minimum predicted pressures and maximum velocities observed in a 168 hour extended period simulation. Diurnal patterns in the hydraulic model for the Lower and High Pressure zones were updated based on 2018 through 2021 data. Refer to the diurnal patterns contained in Attachment A.

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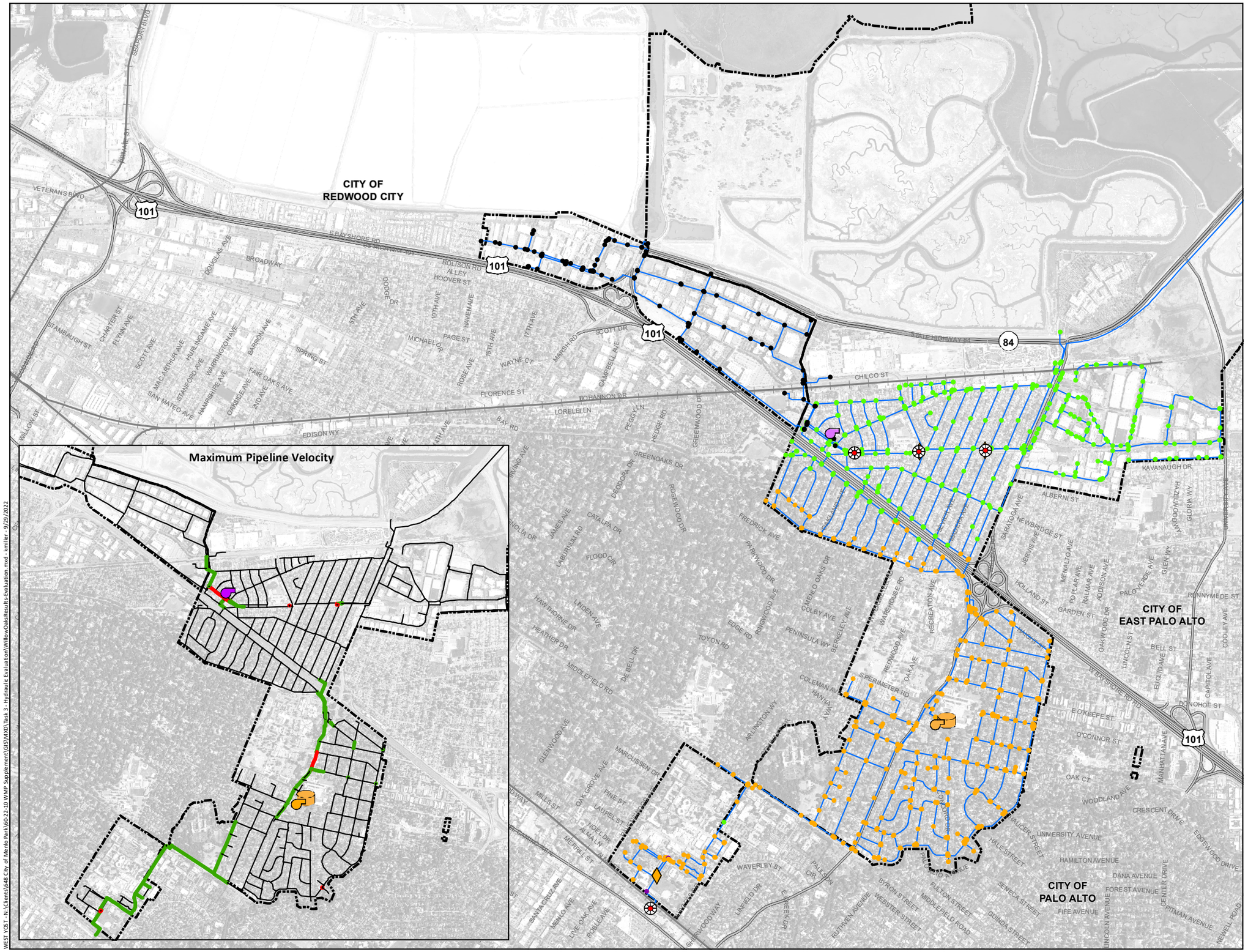
Figure 1

Future System Baseline Maximum Day Results

City of Menlo Park
Water Master Plan Supplement



Notes:

1. Demands reflect the updated baseline demands consistent with Table 2.
2. Future maximum day demand is equal to 1.7 mgd for the High Pressure Zone and 2.4 mgd for the Lower Zone.
3. Results are based on the minimum predicted pressures and maximum velocities observed in a 168 hour extended period simulation. Diurnal patterns in the hydraulic model for the Lower and High Pressure zones were updated based on 2018 through 2021 data. Refer to the diurnal patterns contained in Attachment A.

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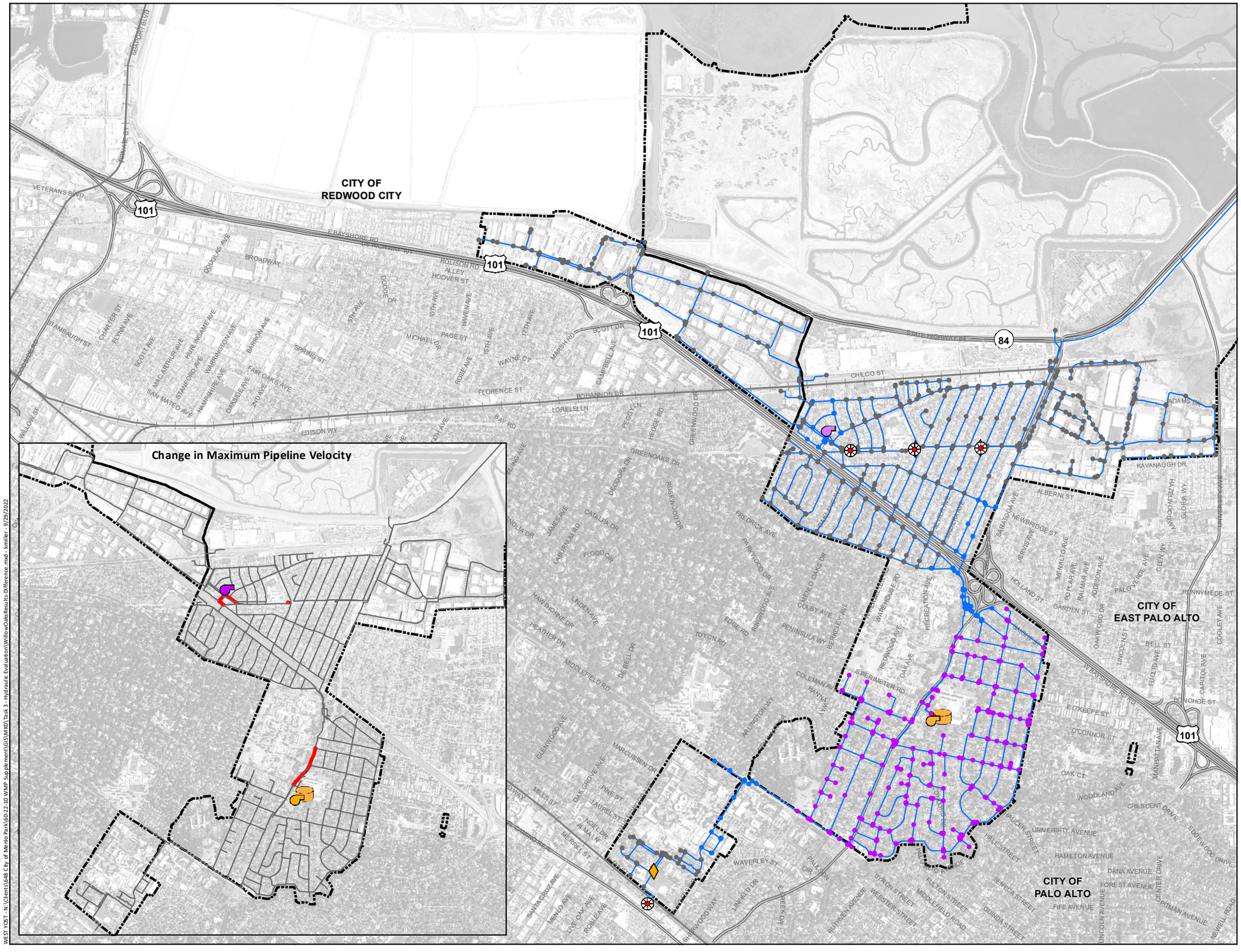
Figure 2

Future System with New Facilities Maximum Day Results

City of Menlo Park
Water Master Plan Supplement



Change in Minimum Pressure

- > 3 to ≤ 5 psi drop
- > 1 to ≤ 3 psi drop
- No Change

Change in Maximum Pipeline Velocity

- Less than 3 ft/s
- Greater than 3 ft/s
- Existing Pipeline
- New 4 MG Tank - Willow Oaks Park
- New 8 MGD Pump Station (Discharging to Lower Zone)
- New 7 MGD Pump Station (Discharging to High Pressure Zone)
- Existing Pressure Reducing Valve Station
- Existing SFPUC Turnout
- Water Service Boundary

Notes:

1. Demands reflect the updated baseline demands consistent with Table 2.
2. Future maximum day demand is equal to 1.7 mgd for the High Pressure Zone and 2.4 mgd for the Lower Zone.
3. Results are based on the minimum predicted pressures and maximum velocities observed in a 168 hour extended period simulation. Diurnal patterns in the hydraulic model for the Lower and High Pressure zones were updated based on 2018 through 2021 data. Refer to the diurnal patterns contained in Attachment A.

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Figure 3

Future System with New Facilities Changes in Differential Pressure and Velocity Results

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Figure 4. Facility Operations

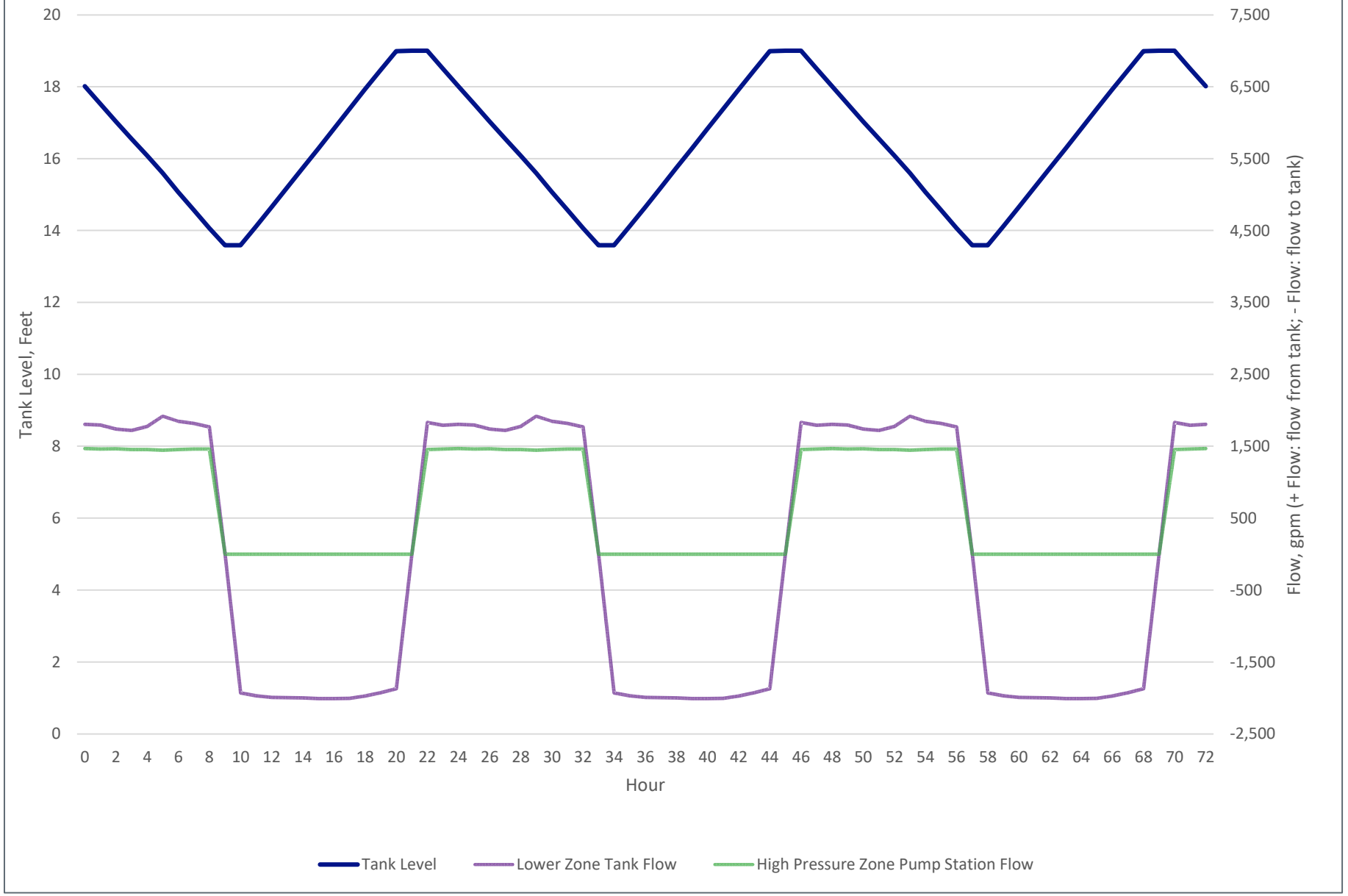


Figure 5. Comparison of Pressure at the Lower Zone Pump Station

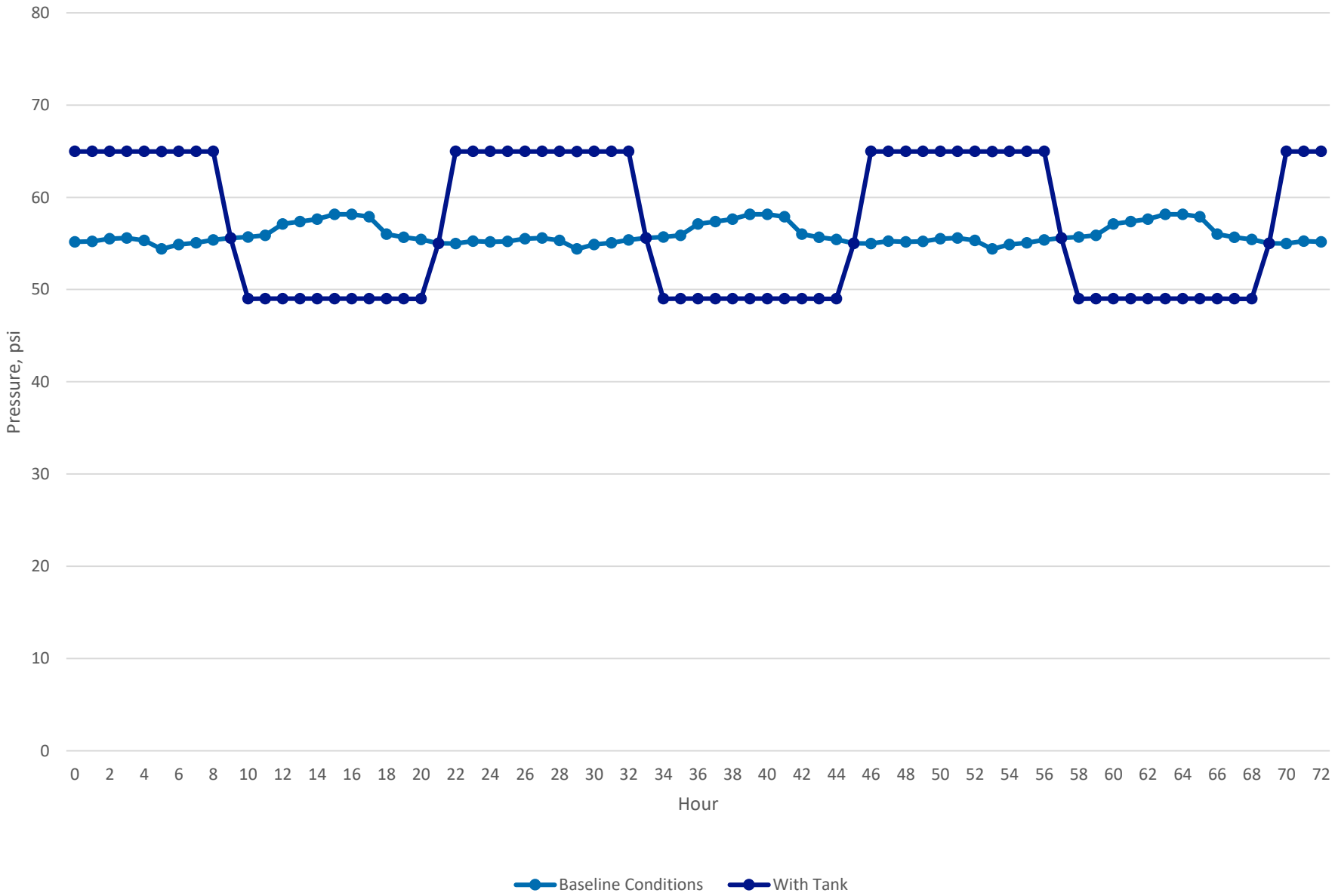
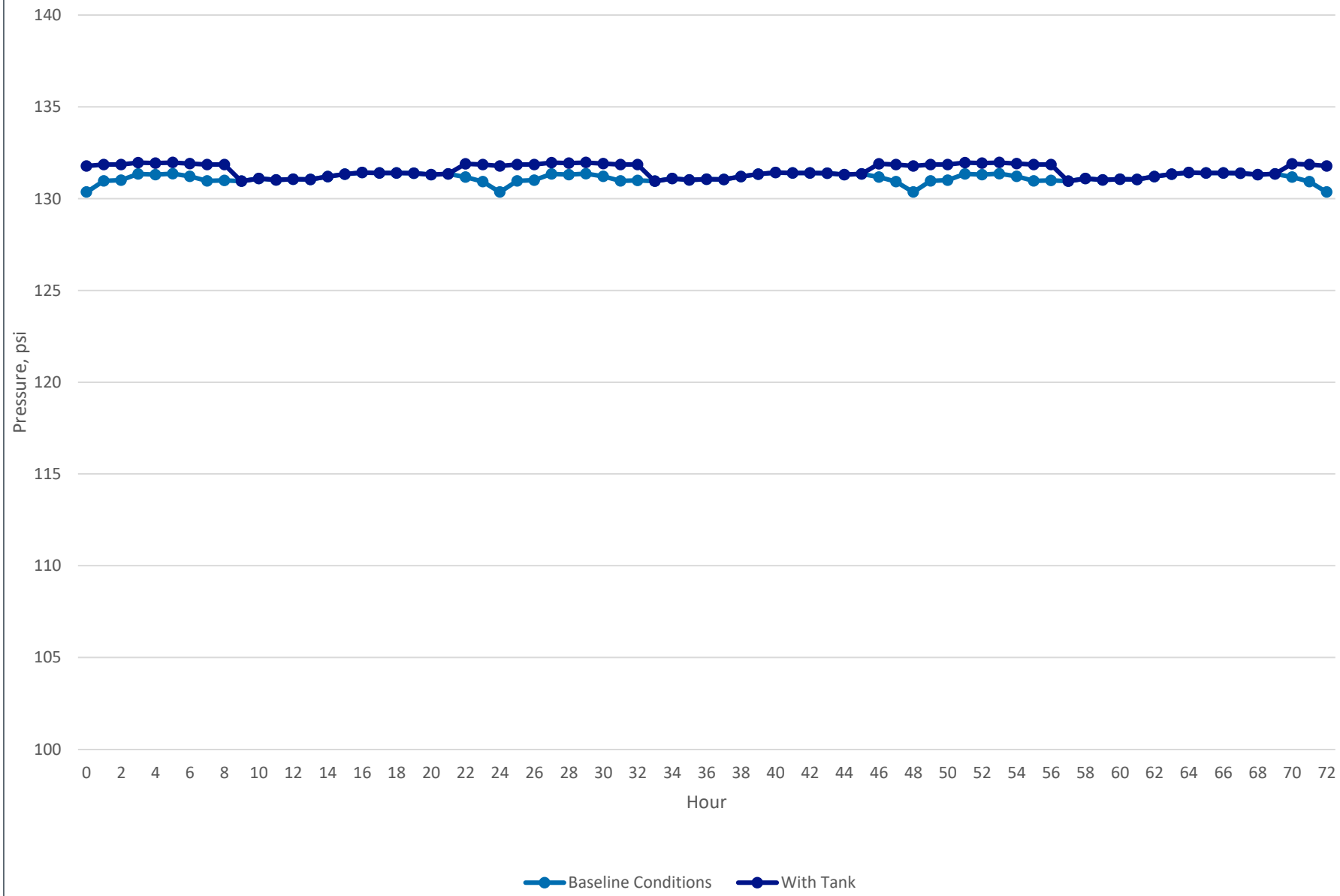


Figure 6. Comparison of Pressure at the High Pressure Zone Pump Station



Fire Flow Conditions

To evaluate the future water system for fire flow conditions, InfoWater's "Available Fire Flow Analysis" tool was used to determine the available flow at a minimum residual pressure of 20 psi under maximum day demand conditions in the Lower and High-Pressure Zones. The analysis assumed the Willow Oaks Tank is 75 percent full and the Lower and High-Pressure Zone booster pump stations are operating. Figure 7 summarizes the available fire flow at each tested hydrant location while meeting the minimum residual pressure criterion of 20 psi and fire flow criteria based on sprinklered services. Fire flow requirements for sprinklered services are 50 percent of not sprinklered service requirements. Locations that meet fire flow requirements are shown in green. Locations that do not meet fire flow requirements are shown in red. The majority of the locations meet fire flow requirements. Deficient locations are confined to areas where there are single feeds to an area or where there are small diameter pipelines supplying the area that constrain flow. These areas were also deficient in the WSMP under sprinklered conditions.

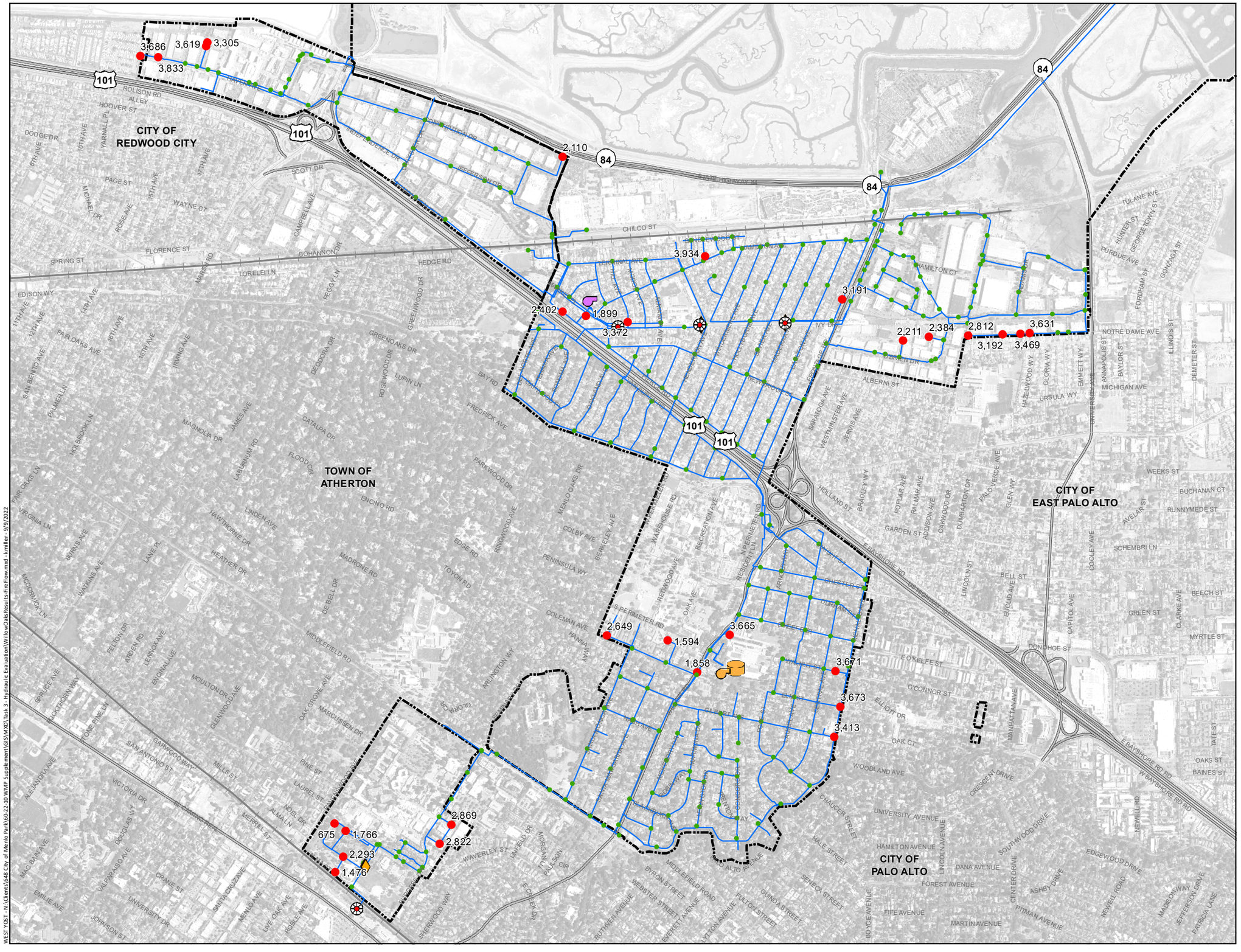
To confirm the tank size and that the tank and booster pump station can provide sufficient capacity to meet fire flow requirements across the system, fire flow under emergency conditions was evaluated. In particular, this analysis was performed to confirm that up to 5,550 gpm is supplied from the proposed tank and booster pump station facilities while also maintaining a residual pressure of 20 psi. If this flow rate of cannot be maintained, it would suggest that the capacity of the tank is oversized. Under normal conditions, up to 5,500 gpm was obtained from the booster pump station, depending on the location of the tested fire flow event.

Fire Flow during Emergency Conditions

Under emergency conditions, the fire flow analysis assumed SFPUC is offline and thus not supplying water to the City through the turnouts. Under these emergency conditions the existing emergency well at the City's Corporation Yard was assumed to be online supplying the Lower Zone. The following five locations were tested and analyzed under these conditions: east of the Willow Oaks Tank site, west of the Willow Oaks Tank site, just before Highway 101, High-Pressure Zone, and near Willow Village Facebook campus in the Bayfront area.

Findings concluded the tank is adequately sized as the flow discharging from the tank and booster pump station exceed 4,000 gpm (ranging between 4,775 and 5,775 gpm). However, for the tested locations within the High-Pressure Zone or in the Bayfront area, hydraulic restrictions along Willow Road, between the Willow Oaks Tank site and Highway 101 crossing, result in pressures in the Bayfront area to drop below 20 psi, thus not satisfying fire flow requirements. It is worth noting that these results are based on maximum day demand during emergency conditions, and likely not resemble realistic demand conditions during an SFPUC supply outage. Under these outage conditions, conservation measures would be in-place and enforced across the City. As a result, average day conditions were also checked and minimum residual pressures across the Lower and High-Pressure Zone remain above 20 psi and all fire flow requirements are met.

To increase and improve the reliability of the system, it is recommended that a new parallel 16-inch diameter pipeline along Willow Road be considered by the City. Currently, there is a 12-inch pipeline along Willow Road which acts as the main conduit for water distribution between the Lower Zone and the Bayfront area and High-Pressure Zone. In the event of a break on the existing pipeline, supply from the Burgess turnout and the emergency well would be limited to the Lower Zone. Additionally, the existing 12-inch diameter pipeline was identified as a high priority pipeline for replacement (PR-LOW-005, PR-LOW-006). To limit traffic disruption along Willow Road, construction of the new parallel 16-inch diameter pipeline should coincide with the replacement of the existing 12-inch diameter pipeline. Costs associated with the new parallel pipeline is provided in the Cost Evaluation section below and included in the City's five-year CIP in Attachment C.



Meets Requirements

- Available Fire Flow is less than the Required Fire Flow
- Available Fire Flow meets or exceeds the Required Fire Flow
- Existing Pipeline
- New 4 MG Tank - Willow Oaks Park
- New 8 MGD Pump Station (Discharging to Lower Zone)
- New 7 MGD Pump Station (Discharging to High Pressure Zone)
- Existing Pressure Reducing Valve Station
- Existing SFPUC Turnout
- Water Service Boundary

Notes:

1. Results based on maintaining a minimum residual pressure of 20 psi at customer service connections.
2. Labeled value adjacent to nodes is the associated Available Fire Flow, reported in gallons per minute (gpm).

WEST YOST

Figure 7

Future System with New Facilities Fire Flow Results under Sprinklered Criteria

City of Menlo Park
Water Master Plan Supplement

Hydraulic Evaluation Findings and Conclusions

The hydraulic evaluation findings indicate that the Lower and High-Pressure Zone pump stations need to operate together to maintain pressure across the zones. When the High-Pressure Zone pump station turns on, the pressures drop locally and require the Lower Zone pump station to supply water and maintain pressure. During tank fill periods, pressures near the tank facility decrease. Therefore, the Lower Zone Booster Pump station is required to support both the Lower Zone and the High-Pressure Zone. If the High-Pressure Zone pump station is not constructed, water in storage could not be used to support the High-Pressure Zone. Therefore, it is recommended that both pump stations and the tank be constructed at the same time.

It is important to note the findings and conclusions presented above are for the Lower Zone tank at Willow Oaks Park site. The City is actively exploring other locations and change in tank site would impact the results discussed in this TM and will need to be further explored. However, a tank site south of Willow Oaks Park would be hydraulically constrained by the existing 12-inch diameter pipeline along Willow Road. Additional pipeline improvements would be required to mitigate the bottleneck, increasing overall construction and capital costs significantly.

The proposed locations for the Willow Oaks Tank and two booster pump stations are in residential areas. The City has expressed concern for potential noise impacts from the operations of these facilities. While there will be noise generated during operations, placing pumps within an enclosure (i.e., in a concrete masonry unit block building) significantly reduces noise. Additional measures (i.e., sound attenuation panels) can be incorporated to further reduce noise.

As discussed above in the Fire Flow during Emergency Conditions section, it is recommended the City consider installing a new 16-inch diameter parallel pipeline along Willow Road to increase reliability of the system, especially during an emergency condition or a main break. While the fire flow analysis determined only 1,500 linear feet (LF), between Willow Oaks Park and Chester Street, is needed to meet all fire flow requirements during a maximum day emergency condition, complete redundancy would be achieved when a parallel pipe is installed between Middlefield Road and the Highway 101 crossing. Construction of the new parallel 16-inch diameter pipeline should coincide with the replacement of the existing 12-inch diameter pipeline.

The hydraulic evaluation performed for the Project is based on the assumptions listed above. If any of these items are changed or modified in any way, other than as described in this TM, additional hydraulic evaluation may be required.

Capital Cost Estimate

Table 8 summarizes the capital cost estimates developed for the major facilities using the same unit costs presented in the WSMP and escalated to San Francisco July 2022 Engineering News Record Construction Cost Index of 15,640. The total capital cost for the new major facilities ranges from $20.8 million (M) with a new 2 MG storage tank to $25.9 M with a new 3 MG Tank.

As discussed in Appendix F of the WSMP, the construction costs of the tank include installation of the storage tank, site piping, minor earthwork and grading, paving, instrumentation, all related sitework and does not include land acquisition. The storage tank construction costs are representative of construction under normal excavation and foundation conditions for a partially or fully buried reinforced concrete tank (up to about 20 feet in depth below grade). If special conditions exist such as high groundwater levels, salinity levels, or fill above storage reservoir, costs may increase drastically.

A capital cost estimate for 1,500 LF of new 16-inch diameter parallel pipeline is included in Table 8. Unit cost, assuming open-cut construction were used. Due to the traffic conditions associated with Willow Road, capital cost estimates include additional contingencies to account for these traffic impacts. The length and cost of this new pipeline is associated with the Willow Oaks Park tank site. If the City selects a different tank location the length and cost of this new parallel pipeline will need to be re-evaluated.

As previously mentioned, the City is considering a second well in the Lower Zone. Currently it is planned that this second well will be located to be located at the Lower Zone tank site. To assist with City in its planning efforts, capital costs for a new groundwater well are included in Table 8. Detailed well costs are shown in Attachment B and include downhole, pump and motor, electrical equipment, chemical feed system, site and building, land acquisition and contingencies. Treatment costs, however, are not included and would further increase capital costs.

Table 8. Capital Cost Estimates for New Storage Tank at Willow Road and Booster Pump Stations[(a)]

Facility	Construction Cost[(b)], $M	Total Capital Cost[(c)], $M
Booster Pump Stations and Tank Costs		
New 2 – 3 MG Tank	7.54 – 11.44	9.80 – 14.87
New 8 mgd pump station for Lower Zone	4.42	5.74
New 7 mgd pump station for High-Pressure Zone	4.03	5.24
Total with 2 MG Tank	**15.99**	**20.78**
Total with 3 MG Tank	**19.89**	**25.85**
Other Costs		
1,500 feet of new 16-inch parallel pipe along Willow Road[(d)] *(minimum LF per hydraulic modeling)*	2.95	3.84
New Groundwater Well	3.89	5.06

(a) Costs shown are based on the July 2022 San Francisco ENR CCI of 15,640.
(b) Costs include mark-ups equal to 30 percent (Base Constructions Costs plus Construction Contingency).
(c) Costs include mark-ups equal to 69 percent (Base Construction Costs plus Construction Contingency: 30 percent and; Professional Services: 30 percent of Base Construction Costs plus Contingency).
(d) New parallel pipeline tied to the new storage tank project due to capacity restrictions along Willow Road. Length and costs are associated with the Willow Oaks Park tank site and will need to be re-evaluated upon selection of a different tank site.

FIVE-YEAR CIP

As part of the WSMP, a pipeline risk assessment was performed to identify priority pipeline replacements based on likelihood of failure and consequence of failure factors. For the current effort, the City required that pipelines identified as high and medium-high risk in the WSMP be grouped into more discrete project packages ranging approximately between 1,500 to 2,500 linear feet (LF) so that the City can subsequently use as part of its update to the upcoming five-year CIP. During the grouping exercise, pipeline segments were grouped based on vicinity to each other. Pipelines within each of the groupings, however, had varying risk assessments (i.e., high, or medium-high). Therefore, a Risk Profile was established to define what the overall project risk profile (based on the grouped pipelines and their associated risk categories) of grouping. Then, to further prioritize pipelines, a system priority rank was developed. This system priority rank was based on the above-described project grouping risk profile and considered other factors

like pipe age and number of leaks. Finally, water mains the City already intends to replace are also included as part of the system priority rank.

Per City request, the new 16-inch diameter parallel pipeline project is included in the updated five-year CIP and will resolve capacity restrictions along Willow Road. It is important to note this pipeline project originated from the hydraulic evaluation and therefore was not included in the WSMP pipeline risk assessment. The length and cost associated with the new pipeline is associated with the Willow Oaks Park tank site and will need to be re-evaluated upon the selection of a different tank site. Project priority is dependent on the timing of the storage tank construction and installation of the parallel pipe should coincide with the replacement of the existing 12-inch diameter pipeline (PR-Low-005 and PR-Low-006) to minimize traffic impacts along Willow Road.

Shapefiles for all project packages will be provided to the City. Attachment C includes the following:

- A table summarizing the thirty-five project packages from highest priority to lowest priority by pressure zone.
- Figures showing the top ten project packages, based on system priority rank, for the High-Pressure and Lower Zone and Upper Zone, respectively.
- Figures showing all project packages for the High-Pressure and Lower Zone and Upper Zone, respectively.

With respect to construction costs, areas where pipelines would need to cross under railroad tracks or canals, project costs were refined to include an approximate Jack-and-bore/trenchless length. Construction costs and capital costs were updated accordingly to reflect proposed construction methods. Due to the current supply chain issues, the unit costs were calculated based on a weighted average, by diameter, of the 2021 Water Main Replacement Project for Haven Avenue Fire Flow Improvements Bid Results received from the City on May 11, 2022, rather than escalated from the WSMP contributing to an 88 percent increase in total capital cost. Unit costs are summarized in Table 9. It is worth noting, that costs presented in Table 9 are base construction costs. Additional markups, consistent with the WSMP, would need to be applied to develop capital cost estimate, which account for construction/estimating contingency as well as implementation or professional services. Refer to Appendix F in the WSMP for more details.

Table 9. Updated Pipeline Construction Unit Cost Summary

Pipe Diameter, inches	Cost, dollar/linear foot
Open-Cut	
8	540
10	670
12	780
14	910
16	1,010
18	1,140
Jack-and-Bore	
8 (with 16-inch casing)	1,600
12 (with 24-inch casing)	2,160
16 (with 30-inch casing)	2,400

Attachment A

WSMP Update

UPDATES TO WATER SYSTEM MASTER PLAN

The City has recently completed a review of the City's 2018 Water System Master Plan (WSMP) document with the State Water Resources Control Board, Division of Drinking Water (DDW). Through this review process, DDW provided minor comments to the 2018 WSMP to enhance the document. At the request of the City, West Yost made minor updates to the City's WSMP which included the following:

- **Updated Table 5-1. Summary of Recommended Water System Planning and Design Criteria**. This table was updated to indicate the source of the fire flow requirements and updated the minimum residential fire flow requirement to 1,000 gallons per minute, whether buildings are sprinklered or non-sprinklered.
- **Updated Table 5-2. Recommended Fire Flow Requirements.** Consistent with changes to Table 5-1, residential fire flow requirements were updated to 1,000 gpm.
- **Updated Table 6-8. Summary of Peak Factors by Pressure Zone.** On this table, footnotes were updated for the High Pressure Zone to clarify that while actual data was used to calculate peaking factors, data for the year considered is questionable. See Supplement Section Below.
- **Table 3-7. Summary of Peaking Factors by Pressure Zone.** The title of this table was updated to Summary of Recommended Peaking Factors by Pressure Zone.
- **Figure 2-3. Existing System Hydraulic Profile**. This figure was updated to indicate the emergency interconnections within each zone. While these interconnections are indicated, hydraulic grade lines were not reported since these are specific to the connecting agencies and data from each of is not available. In addition, a clarifying note was added to the figure to note that the regulating stations serving the Lower Zone reduce pressure from the SFPUC turnouts, and thus their respective settings and elevations set the hydraulic grade of the zone.

WATER MASTER PLAN SUPPLEMENT

Since updated demand and peaking factor data is now available, the City requested that a new demand evaluation be performed to estimate more recent existing demands and confirm peaking factors used to estimate maximum day and peak hour demands. In addition, since storage requirements are based on demands, the City also requested that a storage re-analysis be performed using this updated data so that storage needs could be refined. The City has identified a potential storage site and along with the storage sizing, the City also requested that West Yost hydraulically evaluate the feasibility of this site to serve both the Lower and High Pressure Zones.

In addition, the City also requested that West Yost develop a prioritized list of pipeline replacements projects based on the pipeline risk assessment performed in the 2018 WSMP and a target length of 1,500 to 2,500 linear feet. In addition to further breaking down projects, capital costs were updated to reflect escalation since the completion of the WSMP.

These additional evaluations are documented in a technical memorandum in a new Appendix E, which was appended to this WSMP.

Attachment B

Conceptual Capital Cost Estimate for a New Groundwater Well

Attachment B

A detailed breakdown of the conceptual capital costs for a new groundwater well are summarized in Table 1. These costs were developed based on construction costs for municipal wells in the region.

These costs omit costs significantly impacted by marked volatility and COVID supply chain constraints. Construction costs include allowances for general conditions, contractor overhead and profit, sales tax, and planning-level estimating contingencies. The construction costs are considered budget-level estimates with accuracies of -10 percent to +40 percent in accordance with the recommendations of the Association of Advancement of Cost Engineering (AACE). Other project costs are included to estimate the value of other project elements including engineering, construction management and program implementation (e.g., administrative, CEQA, legal, etc.).

Costs assume water quality in the new groundwater well meet all Title 22 drinking water standards. If water quality in a new well is found not to meet Title 22 drinking water standards, additional treatment facilities would be required to be permitted as active wells, and the type of treatment would be dependent on the specific constituents that exceed maximum contaminant levels. Costs associated with these treatment facilities vary widely and would be in addition to the costs presented in Table 1.

Table 1. Conceptual Capital Cost Estimate for a New Groundwater Well

Cost Element	Basis	Estimated Cost, dollars
Construction Costs		
Downhole	Based on recent bid costs, not significantly impacted by market volatility and or supply chain constraints	816,000
Pump and Motor		150,000
Electrical Equipment		700,000
Chemical Feed System		150,000
Site/Building		700,000
Land Acquisition	$15/sq. ft., with an assumed 6,500 sq. ft. lot	97,500
	Subtotal	**$2,613,500**
Estimating Contingency	20% of Direct Costs	523,000
	Subtotal Direct Construction Cost (with Contingency)	*3,136,500*
General Conditions	10% of Direct Construction Costs (with Contingency)	314,000
Overhead and Profit	10% of Direct Construction Costs (with Contingency)	314,000
Sales Tax	8% of 1/2 of Direct Construction Costs (with Contingency)	126,000
	Total Construction Cost	**$3,890,500**
Other Project Costs[(a)]		
Engineering	10% of Construction Cost	390,000
Construction Management	10% of Construction Cost	390,000
Program Implementation	10% of Construction Cost	390,000
	Total Other Project Costs	**$1,170,000**
	Total Capital Costs	**$5,060,500**

(a) Other project cost multipliers are consistent with City's 2022 Water Master Plan assumptions.

Attachment C

Five-Year CIP

C1: Summary of Updated Project Packages by Zone

C2: Top Ten Project Packages

C3: Pipeline Replacement Projects

C1. Summary of Updated Project Packages by Zone

Table 1. Summary of Updated Project Packages by Zone[a]

Project ID	No. of Pipe Segments	Length, LF	Risk Profile, % by Risk Level	System Priority Rank[b]	Location	Construction Method	Estimated Construction Cost[c]	Capital Cost (includes mark-ups)[d]	Notes (per City list)
High Pressure Zone									
PR-HP-001	9	2,410	100% High	6	Along Independence Drive and Haven Ave	Open-Cut	$ 2,100,000	$ 2,730,000	
PR-HP-009	4	2,641	100% High	4	Along Commonwealth Drive	Open-Cut plus 300 feet of Jack & Bore	$ 3,140,000	$ 4,080,000	
PR-HP-005	12	1,638	100% High	5	Along Jefferson Drive	Open-Cut	$ 1,660,000	$ 2,160,000	Project includes High Pressure Zone item 4 recommended by City staff
PR-HP-008	9	1,578	98% High, 2% Medium-High	12	Along Haven Ave	Open-Cut	$ 1,370,000	$ 1,780,000	
PR-HP-003	5	1,861	80% High, 20% Medium-High	19	Along Chrysler Drive and Commonwelath Drive	Open-Cut	$ 1,790,000	$ 2,320,000	
PR-HP-002	2	2,075	100% Medium-High	18	Along Constitution Drive and Independence Drive	Open-Cut	$ 1,470,000	$ 1,920,000	Project includes High Pressure Zone item1 recommended by City staff
PR-HP-007	13	1,763	100% High	8	Along Del Norte Ave, Market Place and Terminal Ave	Open-Cut plus 310 feet of Jack & Bore	$ 2,380,000	$ 3,100,000	Project includes High Pressure Zone item 2 and 3 recommended by City staff
PR-HP-006	11	2,160	100% High	11	Along Chilco Street and Jefferson Drive	Open-Cut	$ 2,160,000	$ 2,810,000	Project includes High Pressure Zone item 3 and 4 recommended by City staff
PR-HP-004	9	1,698	100% High	10	Along Constitution Drive and Independence Drive	Open-Cut	$ 1,480,000	$ 1,920,000	Project includes High Pressure Zone item 5 recommended by City staff
						High Pressure Zone Subtotal	**$ 17,550,000**	**$ 22,820,000**	
Lower Zone									
PR-Low-010	8	2,244	100% High	7	Along Middlefield Road	Open-Cut	$ 2,100,000	$ 2,730,000	Project includes Low Zone item 1 recommended by City staff
PR-Low-009	12	1,376	98% High, 2% Medium-High	22	Along Laurel Streek and Mielke Drive	Open-Cut plus 460 feet of Jack & Bore	$ 2,210,000	$ 2,870,000	
PR-Low-005	10	1,905	84% High, 16% Medium-High	23	Along Durham Street and Willow Road	Open-Cut	$ 1,860,000	$ 2,420,000	Project includes Low Zone item 2 recommended by City staff
PR-Low-002	23	2,090	100% Medium-High	20	Along Chilco Street and Henderson Ave	Open-Cut	$ 2,150,000	$ 2,790,000	
PR-Low-011	9	1,848	11% High, 89% Medium-High	21	Along O'Brien Drive	Open-Cut	$ 1,880,000	$ 2,440,000	Project includes Low Zone item 3 recommended by City staff
PR-Low-001	10	1,913	84% High, 16% Medium-High	27	Along Almanor Ave, Ivy Drive and Market Place	Open-Cut	$ 1,840,000	$ 2,400,000	
PR-Low-004	8	2,085	80% High, 20% Medium-High	24	Along Bay Road and Van Buren Road	Open-Cut	$ 1,770,000	$ 2,310,000	Project includes Low Zone item 2 recommended by City staff
PR-Low-006	13	1,607	67% High, 33% Medium-High	30	Along Coleman Ave, Gilbert Ave and Willow Road	Open-Cut	$ 1,480,000	$ 1,930,000	Project includes Low Zone item 2 recommended by City staff
PR-Low-007	11	1,801	100% Medium-High	34	Along Bay Road	Open-Cut	$ 1,260,000	$ 1,640,000	
PR-Low-008	16	1,957	100% Medium-High	35	Along Vay Road and Del Norte Ave	Open-Cut	$ 1,470,000	$ 1,910,000	
PR-Low-012	3	670	37% High, 63% Medium-High	33	Along Menlo Oaks Drive	Jack & Bore	$ 1,390,000	$ 1,810,000	
PR-Low-003	8	1,450	24% High, 76% Medium-High	29	Along Bay Road	Open-Cut plus 350 feet of Jack & Bore	$ 2,650,000	$ 3,450,000	Project includes Low Zone item 2 recommended by City staff
PR-Low-013[e]	5	1,500	100% Medium-High	36	Along Willow Road	Open-Cut	$ 2,954,000	$ 3,841,000	
						Lower Zone Subtotal	**$ 25,014,000**	**$ 32,541,000**	
Upper Zone									
PR-Up-014	5	2,060	100% High	3	Along Monte Rosa Drive and Sand Hill Road	Open-Cut	$ 2,710,000	$ 3,520,000	Project includes Upper Zone item 1 recommended by City staff
PR-Up-012	7	1,854	100% High	2	Along Sand Hill Road	Open-Cut	$ 2,430,000	$ 3,160,000	
PR-Up-007	17	2,102	100% High	1	Along Continental Drive	Open-Cut	$ 2,130,000	$ 2,770,000	Project includes Upper Zone item 4 recommended by City staff
PR-Up-004	13	2,038	100% High	9	Along Monte Rosa Drive	Open-Cut	$ 2,070,000	$ 2,690,000	Project includes Upper Zone item 1 recommended by City staff
PR-Up-006	2	2,075	90% High, 10% Medium-High	13	Along Eastridge Ave and Sharon Park Drive	Open-Cut	$ 1,460,000	$ 1,900,000	Project includes Upper Zone item 2 recommended by City staff
PR-Up-009	13	2,139	67% High, 33% Medium-High	16	Along Sharon Park Drive	Open-Cut	$ 1,740,000	$ 2,270,000	Project includes Upper Zone item 2 recommended by City staff
PR-Up-010	14	2,112	60% High, 40% Medium-High	15	Along Sand Hill Circle and Sharon Park Drive	Open-Cut	$ 1,850,000	$ 2,400,000	Project includes Upper Zone item 2 recommended by City staff
PR-Up-001	7	3,275	49% High, 44% Medium-High	14	Along Sharon Oaks Drive, Sharon Park Drive and Sharon Road	Open-Cut	$ 2,800,000	$ 3,650,000	
PR-Up-005	9	1,886	44% High, 56% Medium-High	17	Along Continental Drive and Monte Rosa Drive	Open-Cut	$ 1,910,000	$ 2,490,000	Project includes Upper Zone item 1 recommended by City staff
PR-Up-013	22	1,765	65% High, 35% Medium-High	28	Along Sand Hill Circle and Sand Hill Road	Open-Cut	$ 1,750,000	$ 2,270,000	
PR-Up-002	7	2,547	100% Medium-High	25	Along Branner Drive and Campbell Lane	Open-Cut	$ 1,790,000	$ 2,320,000	Project includes Upper Zone item 2 recommended by City staff
PR-Up-003	6	2,199	100% Medium-High	26	Along Cranner Drive and Sharon Park Drive	Open-Cut	$ 1,540,000	$ 2,010,000	
PR-Up-008	19	2,214	100% Medium-High	31	Along Lassen Drive and Trinity Drive	Open-Cut	$ 1,930,000	$ 2,510,000	
PR-Up-011	8	1,955	100% Medium-High	32	Along Sand Hill Circle	Open-Cut	$ 1,700,000	$ 2,210,000	
						Upper Zone Subtotal	**$ 27,810,000**	**$ 36,170,000**	
Total	**359**	**70,490**				**Total All Zones**	**$ 70,374,000**	**$ 91,531,000**	
Total High & Medium-High	436	78,644				*Total of Projects - 100% High*	$ 18,340,000	$ 23,840,000	
Projects Unprioritized	77	8,153				*Total of Projects - Top 10 by System Priority Rank*	$ 22,090,000	$ 28,720,000	

(a) Costs shown are based on a weighted average, by diameter, of the 2021 Water Main Replacememnt Project for Haven Anenue Fire Flow Improvements Bid Results received from City on 5/11/2022.

(b) Priority rank is based on pipe age and leaks.

(c) Costs include mark-ups equal to 30 percent (Base Construction Costs plus Construction Contingency)

(d) Costs include mark-ups equal to 69 percent (Base Construction Costs plus Construction Contingency: 30 percent and' Professional Services: 30 percent of Base Construction Costs plus Contingency).

(e) New 16-inch diameter parallel pipeline project tied to the Lower Zone storage tank project to resolve capacity restrictions along Willow Road. Project priority will be dependent on timing of tank construction. Length and costs are assoicated with the Willow Oaks Park tank site and will need to be re-evaluated upon selection of a different tank site. Construction costs increased by 50% due to increased traffic control required on Willow Road.

C2. Top Ten Project Packages

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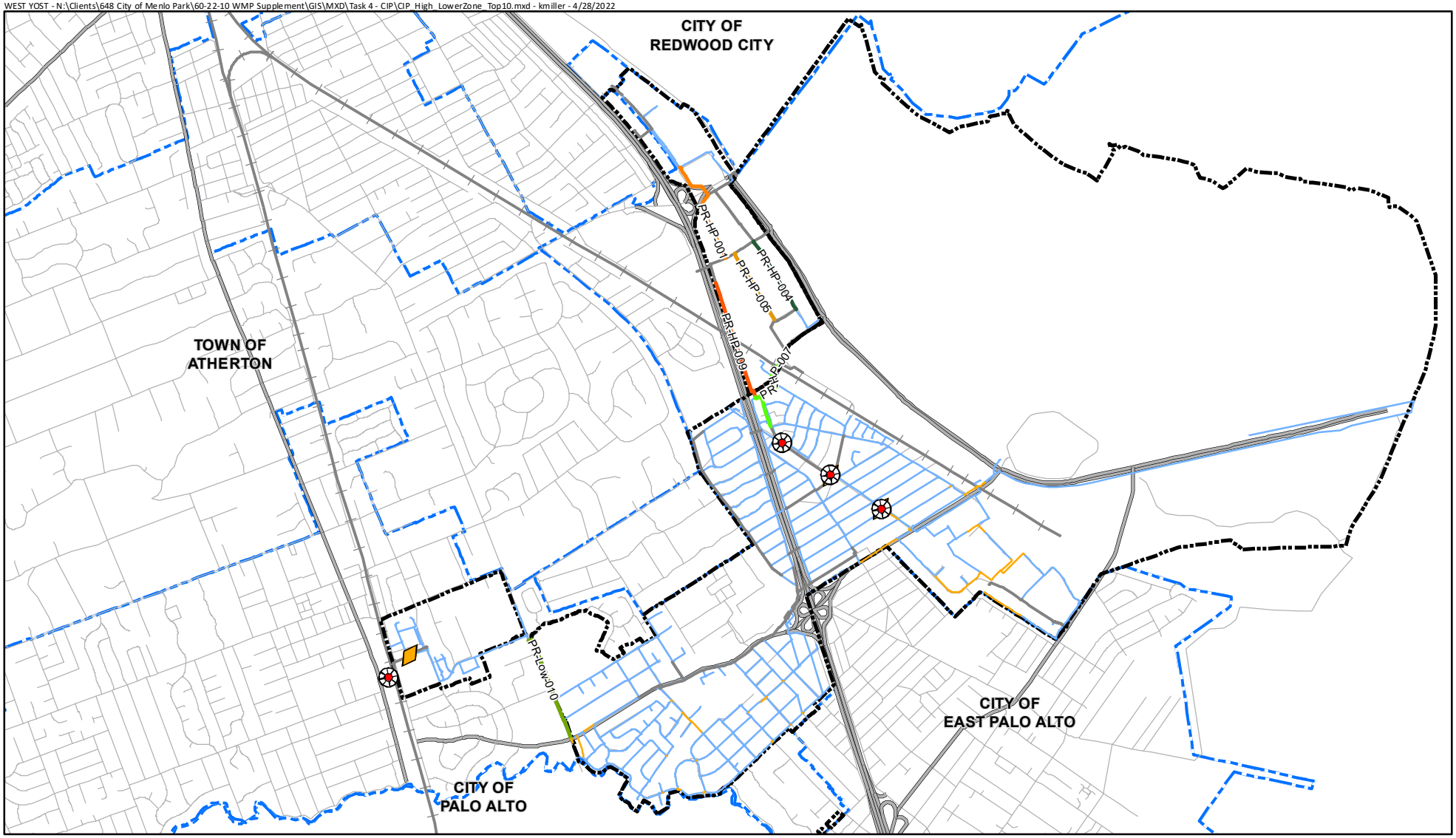

- Sand Hill Reservoirs
- Sharon Heights Pump Station
- Pressure Reducing Valve Station
- SFPUC Turnout

- Priority 1
- Priority 10
- Other CIP Project
- Medium-High/High Risk - Not Prioritized
- Existing Pipeline - Not Medium-High/High Risk

Pipes shown in orage are omitted from the CIP but will be completed as part of main replacements conducted in the future with lower priority rehab and replacement projects.

N

0 1,500 3,000

Scale in Feet

Figure 1

Top 10 Pipeline Replacement Projects High and Lower Zone

City of Menlo Park
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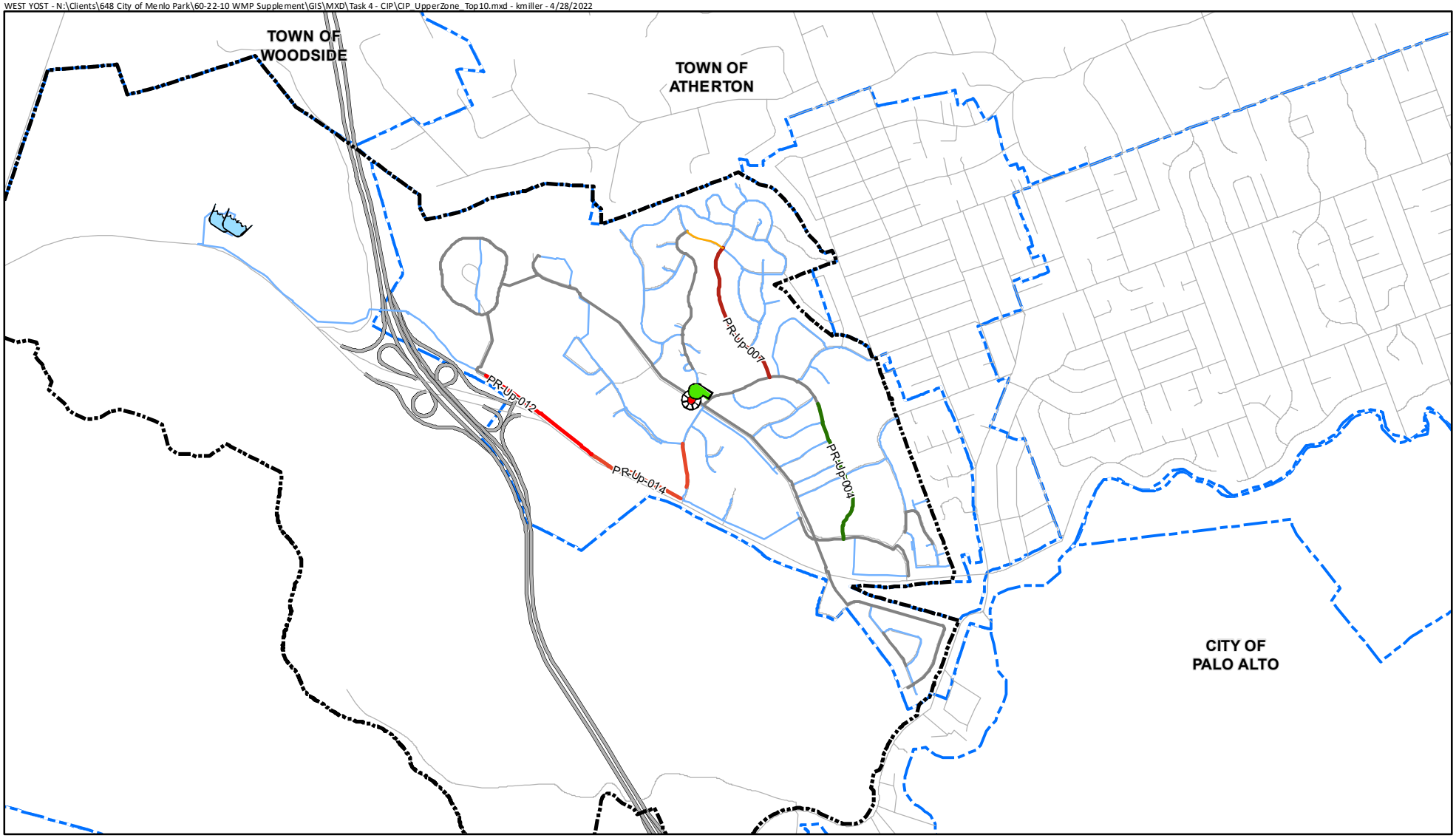


Sand Hill Reservoirs
Sharon Heights Pump Station
Pressure Reducing Valve Station
SFPUC Turnout

Priority 1
Priority 10
Other CIP Project
Medium-High/High Risk - Not Prioritized
Existing Pipeline - Not Medium-High/High Risk

Pipes shown in orage are omitted from the CIP but will be completed as part of main replacements conducted in the future with lower priority rehab and replacement projects.

0 1,000 2,000
Scale in Feet

Figure 2

Top 10 Pipeline Replacement Projects Upper Zone

City of Menlo Park
Water Master Plan Supplement

WEST YOST

C3. Pipeline Replacement Projects

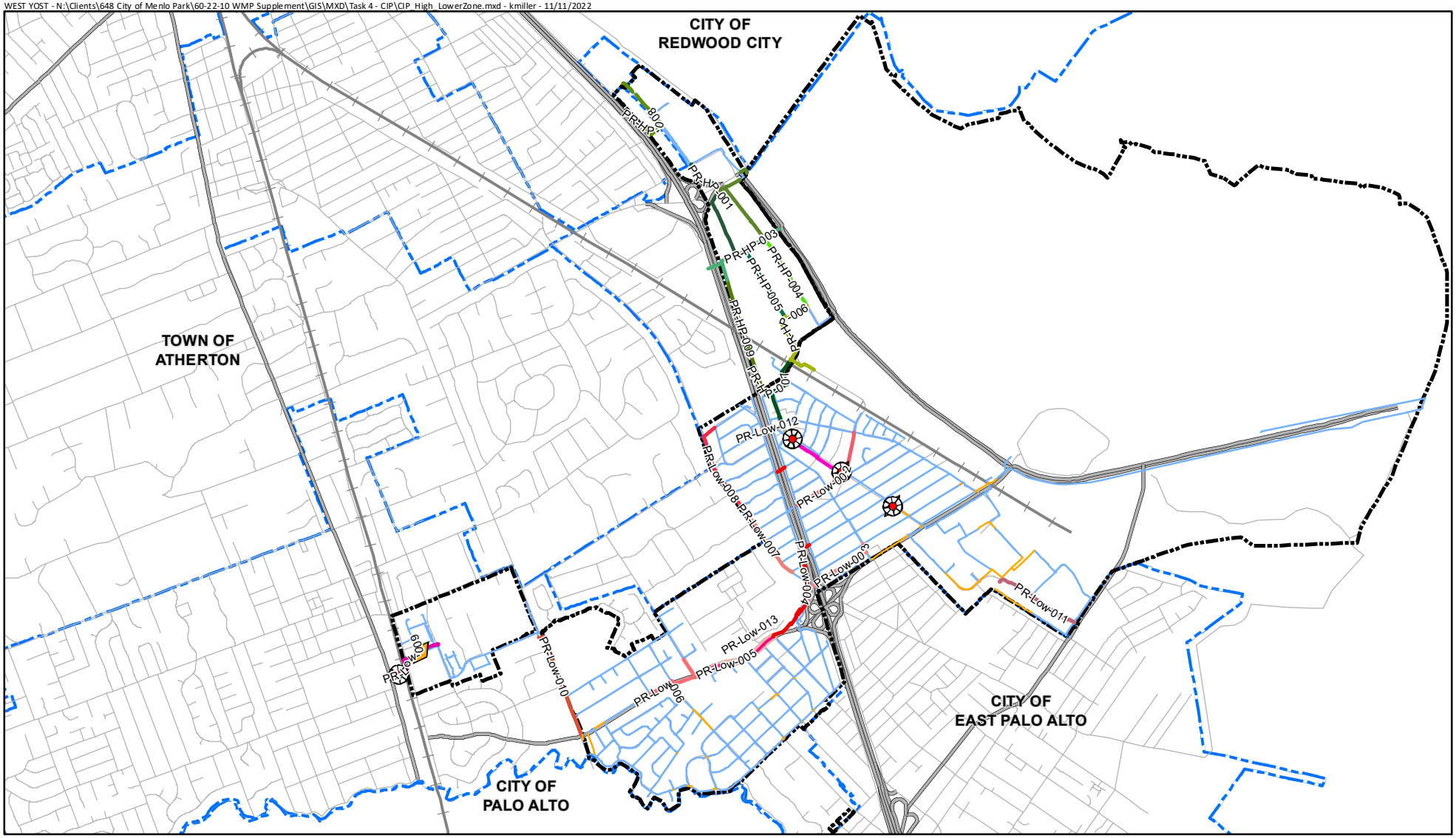
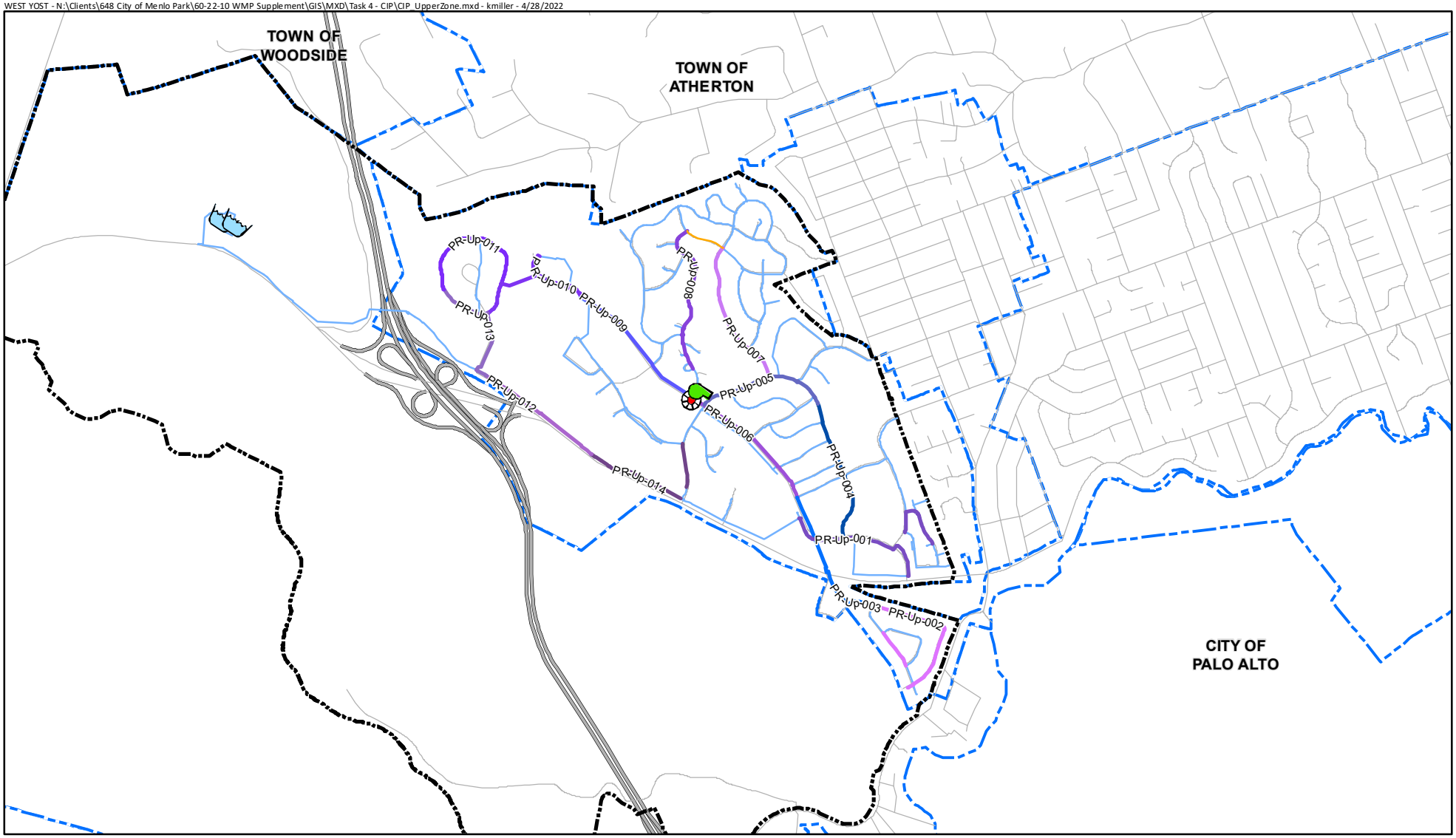


Figure 1

Pipeline Replacement Projects
High and Lower Zone

City of Menlo Park
Water Master Plan Supplement

WEST YOST



Sand Hill Reservoirs
Sharon Heights Pump Station
Pressure Reducing Valve Station
SFPUC Turnout

Upper Zone - CIP Pipeline Projects
Lower Zone - CIP Pipeline Projects
High Pressure Zone - CIP Pipeline Projects
Medium-High/High Risk - Not Prioritized
Existing Pipeline - Not Medium-High/High Risk

Pipes shown in orage are omitted from the CIP but will be completed as part of main replacements conducted in the future with lower priority rehab and replacement projects.

0 1,000 2,000
Scale in Feet

Figure 2

Pipeline Replacement Projects
Upper Zone

City of Menlo Park
Water Master Plan Supplement

WEST YOST