Technical Memorandum

EG to LWW Pipeline Connection Evaluation

Prepared for:

NID
NEVADA IRRIGATION DISTRICT

Prepared by:

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Disclaimer: This document is intended for the District use for planning purposes and not intended for design or construction. The results in this document are based on the information and criteria provided by the District at the time of the evaluation.

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1 Introduction

This technical memorandum (TM) has been developed by Sedaru for the Nevada Irrigation District (District) to evaluate the connection from the Elizabeth George (EG) to the Lake Wildwood (LWW) system. The LWW Water Treatment Plant (WTP) is the sole source of supply to the LWW system and is required to operate close to maximum capacity of 4 mgd to supply system demand and contribute to meeting peak demand conditions. The pipeline connection would provide the District with more flexibility to meet future demands and increase system reliability and redundancy of supply.

The goals of this Project are the following:

- Determine the size of the proposed connecting pipeline to deliver 2 mgd from EG system to LWW system.
- Determine the location and setting of the PRV stations that will be required along the proposed pipe alignment from the EG system to the LWW system.
- Determine the available fire flow along the future waterline extensions, both along the transmission main and laterals.
- Assess the impact of serving the LWW system on the existing EG system in terms of pipe capacity and system improvements.
- Evaluate the transmission lines in LWW system downstream of the entry points of the proposed line connection to verify storage tanks are replenished and cycling within the typical operational range of 70 to 100 % full.

TM includes the following sections:

Section 1 – Introduction
Section 2 – Model Setup and Configuration
Section 3 – System Evaluation
Section 4 – Conclusions and Recommendations

2 Model Setup and Configuration

Sedaru used the District's existing EG/Loma Rica (LR) hydraulic model and added the proposed pipeline connection to existing LWW system, skeletal waterline extensions to serve future areas, and updated LWW demands as described in more detail below.

2.1 Model Updates

The hydraulic model was setup and updated to include the following:

- Merged the LWW system with the EG/LR system as one model for hydraulic evaluation.
- Updated the Penn Valley Zone network in the LWW system using the most recent GIS data provided by the District. The updates included adding new pipes, removing abandoned pipes, updating pipe diameters, and adding a check valve in the 12-inch line leading to the Penn Valley Tanks. All available feature attributes such as pipe diameter, material, year installed, etc. were brought into model.
- Added the proposed pipeline alignment provided by the District to the model connecting EG system at PRV27 (Star Motel) to LWW at the intersection of Golden Trout Way and Minnow Way. The total length is approximately 29,000 ft (5.5 miles). According to topographic information, there is an elevation drop of about 930 feet between the connection point in EG system and the LWW system which required adding four (4) PRV stations along the proposed alignment at key locations to maintain system pressures within the NID criteria.
- Added nodes along the proposed alignment at key locations such as high points and low points to capture the definition of the alignment elevation profile to evaluate pressures against the District's criteria.
- Developed a skeletal waterline extensions system to serve the future areas along the EG-LWW proposed pipeline connection. This skeletal system was laid out along proposed streets, with nodes added at street intersections for better demand allocation and at high and low elevations to determine system pressures. Where possible, looped future waterline extensions were established for improving system hydraulics.

2.2 Node Elevation

Digital Elevation Models (DEMs) were used to calculate the model junction elevations along the proposed pipeline alignment. These DEMs consist of a raster grid of regularly spaced elevation values that have been primarily derived from the USGS topographic maps. For this system, maps with 10-meter resolution were used. Digital Terrain Models (DTMs) which are more accurate than the DEMs were not available for this study area.

2.3 Demand Allocation

Demands for the future area that will be served by the proposed pipeline connection were calculated, and the LWW system demands were updated using 2016 billing data. The future service area was divided into two areas based on the proposed plan: Option 1 to deliver 2 mgd to LWW system and serve the future areas along the proposed alignment and the remaining future areas to be served as Option 2. Option 1 is anticipated in the near-term and includes the area along Rough and Ready Hwy/Rough and Ready Road. Timing of Option 2 is currently unknown and includes the area along Rough and Ready Hwy. **Figure 1** shows the proposed pipeline connection (in red) and the two service areas (outlined in gray).

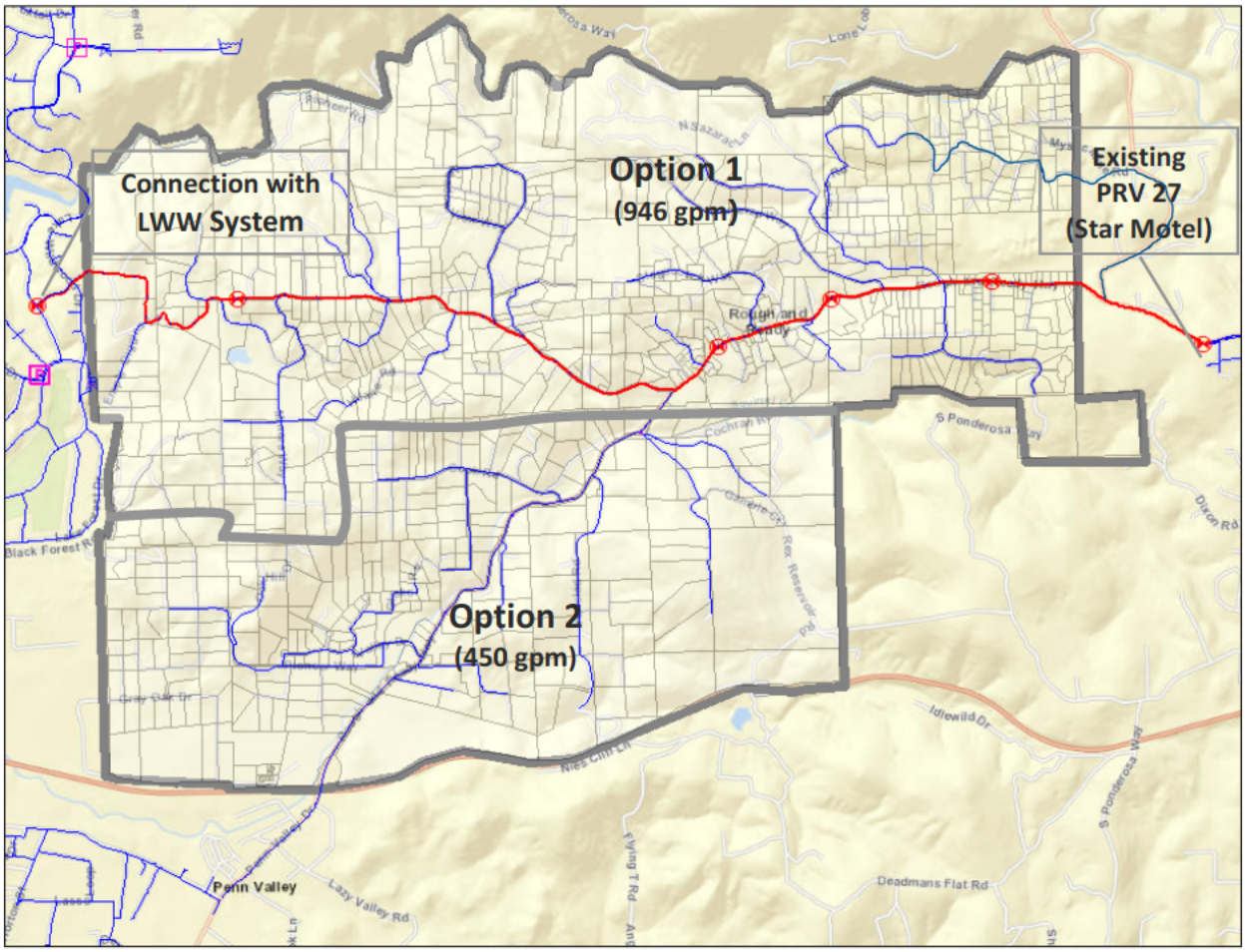

Figure 1. Proposed Pipeline Connection and Service Areas

2.3.1 Demand Allocation along the Proposed Pipeline Connection

The GIS parcel database was used to calculate demands based on parcel size for the outlined service area. For parcel areas less than 10 acres, one (1) dwelling unit was assumed with a maximum day demand

(MDD) of 1.20 gpm. Parcels larger than 10 acres were split by multiple of 10 acres and assigned corresponding demands. **Table 1** below summarizes demands by system.

Table 1. Summary of Demands by System

System	MDD (gpm)	PHD (gpm)	PHD/MDD Ratio
EG/LR	11,500	23,000	2.0
EG-LWW Connection - Option 1	946	1,893	2.0
EG-LWW Connection - Option 2	450	901	2.0
LWW	2,060	5,150	2.5

Parcel demand was allocated to the appropriate junctions (nodes) along the proposed pipeline connection and the skeletal waterline extensions to serve future areas using street alignments within the outlined service area as a guide to group demands.

Based on the "Lake Wildwood Master Plan Update Demand Analysis" by HDR, the average per capita consumption for the past nine years (2006 – 2014) was estimated as 164 gpcd which corresponds to 0.7 gpm for MDD/unit. **Figure 2** shows the LWW historical demands.

To evaluate the consumption data, the LWW historical demands were plotted for analysis. The overall trend of the data shows water consumption is declining over time. This decline could be attributed to water conservation by customers and the use of more efficient home water fixtures. Based on the declining trend shown below, the consumption per capita decreased on average by 20 percent. Applying the same ratio, the 1.5 gpm MDD/unit used in previous evaluations was reduced to 1.2 gpm for this evaluation. Therefore, future demands were calculated using a 1.2 gpm MDD per parcel.

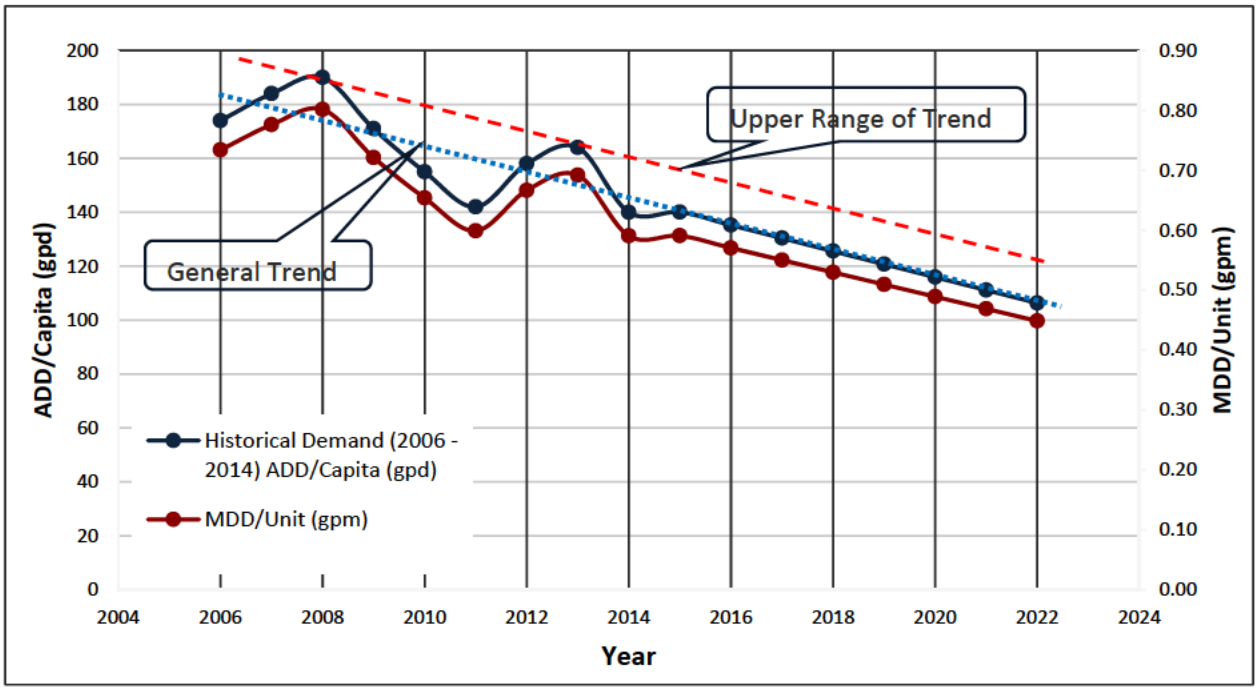

Figure 2. LWW Historic Demand (gpcd)

2.3.2 *Demand Allocation for LWW Existing System*

Demand data was processed for each customer account to determine the individual average day demand (ADD) using 12 consecutive months of usage data provided by the District. The usage data contained the customer account and bi-monthly meter readings. The bi-monthly meter readings were averaged for the 2016 time period to create an ADD for each metered account. The individual demands were allocated to model junctions by first matching the individual customer ADD to the service meter feature class points in GIS. A total of 100 percent of the billing accounts was used in the demand allocation. There are 68 accounts that exist in GIS but not in billing data. Those could be new accounts and were allocated to the nearest node in the model using an average demand of 0.17 gpm per account, a total of 11.56 gpm. **Table 2** summarizes the customer accounts and ADD consumption data for LWW system.

Table 2. LWW Summary of ADD Water Consumption

System	Demand (gpm)	Average Demand per Customer (gpm)	Number of Customers			Demands		
			Billing	GIS	In GIS Not in Billing	In GIS Not in Billing (gpm)	Total Demand (gpm)	Total Demand with Water Loss [1] (gpm)
Lake Wildwood	590	0.17	3,154	3,222	68	11.6	602	634

(1) Unaccounted-for water for LWW system is 5.3%

The customer meter consumption shapefile provided by the District was spatially allocated to model junctions in the LWW system using the closest pipe methodology in InfoWater™'s demand allocator add-on tool. This tool calculates the pipe lengths on either side of where the meter would perpendicularly intersect the nearest pipe. These two lengths are used to proportionally split the demand between the pipe nodes. This process provides high accuracy of demand allocation which generally translates to better system hydraulics.

Consumption customer classes were preserved in the model by keeping each customer class in a separate demand field as shown below.

Model Demand Field	Customer Class
Demand1	Residential
Demand2	Commercial
Demand3	Unknown

Table 3 shows the 2016 ADD by customer class for the LWW system.

Table 3. LWW Average Day Demands

System	Average Day Demands Including Unaccounted-for Water			
	Demand1 (gpm)	Demand2 (gpm)	Demand3 (gpm)	Total Demand[(1)] (gpm)
Lake Wildwood	612	22	0.4	634

(1) Unaccounted-for water for LWW system is 5.3%

2.3.3 LWW Maximum Day Demand

As referenced in the "Last updated September 23, 2016—from Titles 17 and 22 California Code of Regulations California Regulations Related to Drinking Water," the maximum month for the last 10 years should be used to estimate the MDD. Using that approach, 2009 has the highest month with a MDD of 1,512 gpm. However, there is a general trend that system demand is in consistent decline as illustrated in **Figure 3** below. Figure 3 also shows the average of the maximum months (excluding 2015 as drought year with enforced conservation measures) is 1,312 gpm for comparison purposes.

For this evaluation, the MDD threshold was derived from the analysis of the historical maximum month production. Based on the general trends of the data, year 2013 shows a maximum month production of 1,373 gpm and was selected as the basis for calculating MDD. MDD is calculated as 1.5 x maximum month (2,060 gpm). For the system evaluation, the ADD demand of 634 gpm was scaled up to match the MDD that is based on production data.

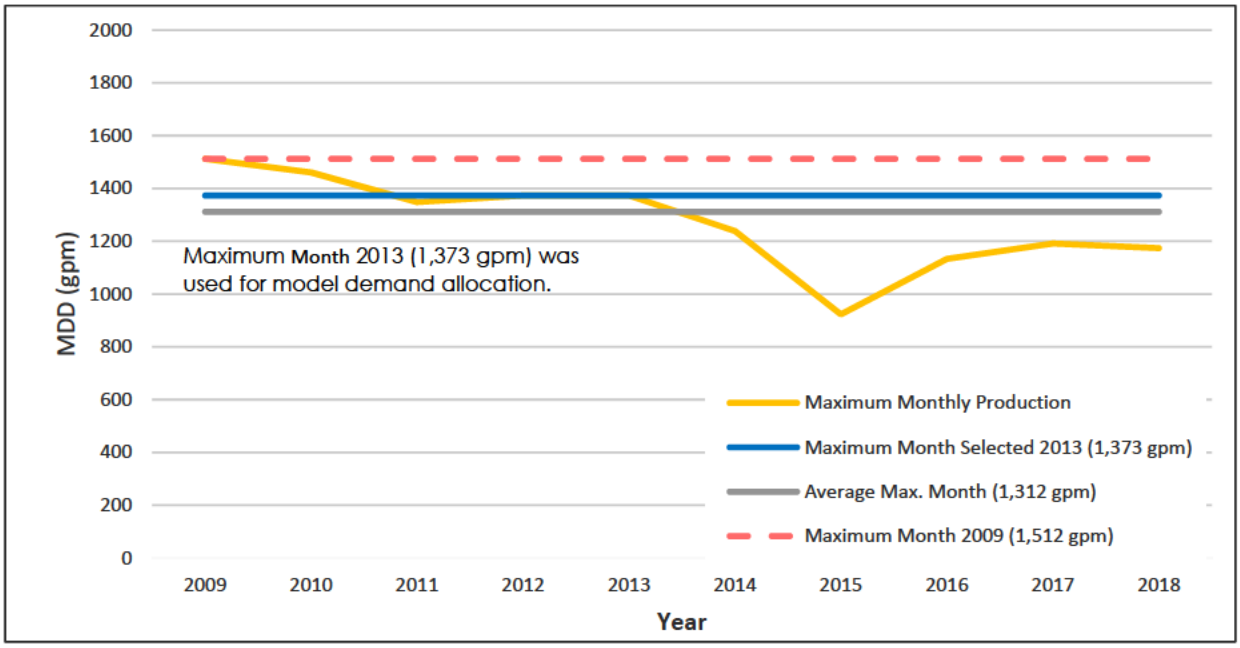

Figure 3. Historical Maximum Month Production

3 System Evaluation

To determine the capacity of the proposed pipeline which will serve the future areas along the proposed alignment and deliver 2.0 mgd supply to LWW system, two demand scenarios were considered for this evaluation. A PHD scenario was used to evaluate the system performance under normal PHD conditions, and MDD + FF scenario was used to evaluate the system performance under high demand conditions.

The system evaluation includes the two options as shown in **Figure 1**. Option 1 extends from existing PRV27 (Star Motel) along Rough and Ready Hwy/Rough and Ready Road to the connection point to LWW system. Option 2 extends from the intersection of Rough and Ready Hwy and Rough and Ready Road along Rough and Ready Hwy to the connection point to Penn Valley Zone at the intersection on Penn Valley Drive and Spenceville Road.

3.1 Evaluation Criteria

Table 4 summarizes the criteria used for this evaluation.

Table 4. Evaluation Criteria

Criteria	Value
MDD peaking factor(1)	2.5 x ADD
PHD peaking factor	2.0 x MDD
Minimum pressure for existing customers	30 psi
Fire flow Requirement	1,000 gpm
Minimum pressure for new developed areas	40 psi
Target maximum allowable pressure	150 psi
Target pipeline velocity during normal operating conditions	1-3 fps
Maximum pipeline velocity during PHD	5 fps

(1) The value listed in the table reflects the District's general criteria. For LWW, the MDD was calculated using the approach outlined in Section 2.3.3.

3.2 Option 1 Evaluation

3.2.1 PHD Analysis

This scenario has the following conditions:

- **Demands**: Total = 30,043 gpm (EG/LR = 23,000 gpm, future service connection Option 1 = 1,893 gpm, and LWW = 5,150 gpm)
- **Network:** Proposed pipeline connection and LWW system
- **Simulation:** Steady-state

The PHD SS simulation was performed with an initial pipe diameter of 16-inch for the proposed pipeline connection. The initial results show the pipeline segments along the proposed alignment between PRV27 (Star Motel) and the intersection of Rough and Ready Hwy and Rough and Ready Road experience high headloss. The PHD simulation was repeated by upsizing the pipelines with high headloss to 18-inch. The pipelines between PRV_L3 and PRV_L4 were downsized to 12-inch lines.

Model results also show junctions along the proposed alignments with both high pressures and low pressures due to the nature of the topography of the area. To mitigate the high pressures, PRV stations were added, as needed, along the proposed alignment to meet District criteria by maintaining a minimum pressure of 40 psi and a maximum pressure of 150 psi. The low pressure was observed at some of the future waterline extensions due to high elevations. Those extensions were added only to capture demands from the future areas and were not analyzed for capacity. However, the low pressure could be improved by increasing the PRV setting as long as the pressure above the target maximum pressure of 150 psi is within acceptable range. **Figure 4** shows the junction pressure and pipeline velocity PHD results

along with the PRV station locations. **Table 3** summarizes the PRV station locations, elevation, and settings.

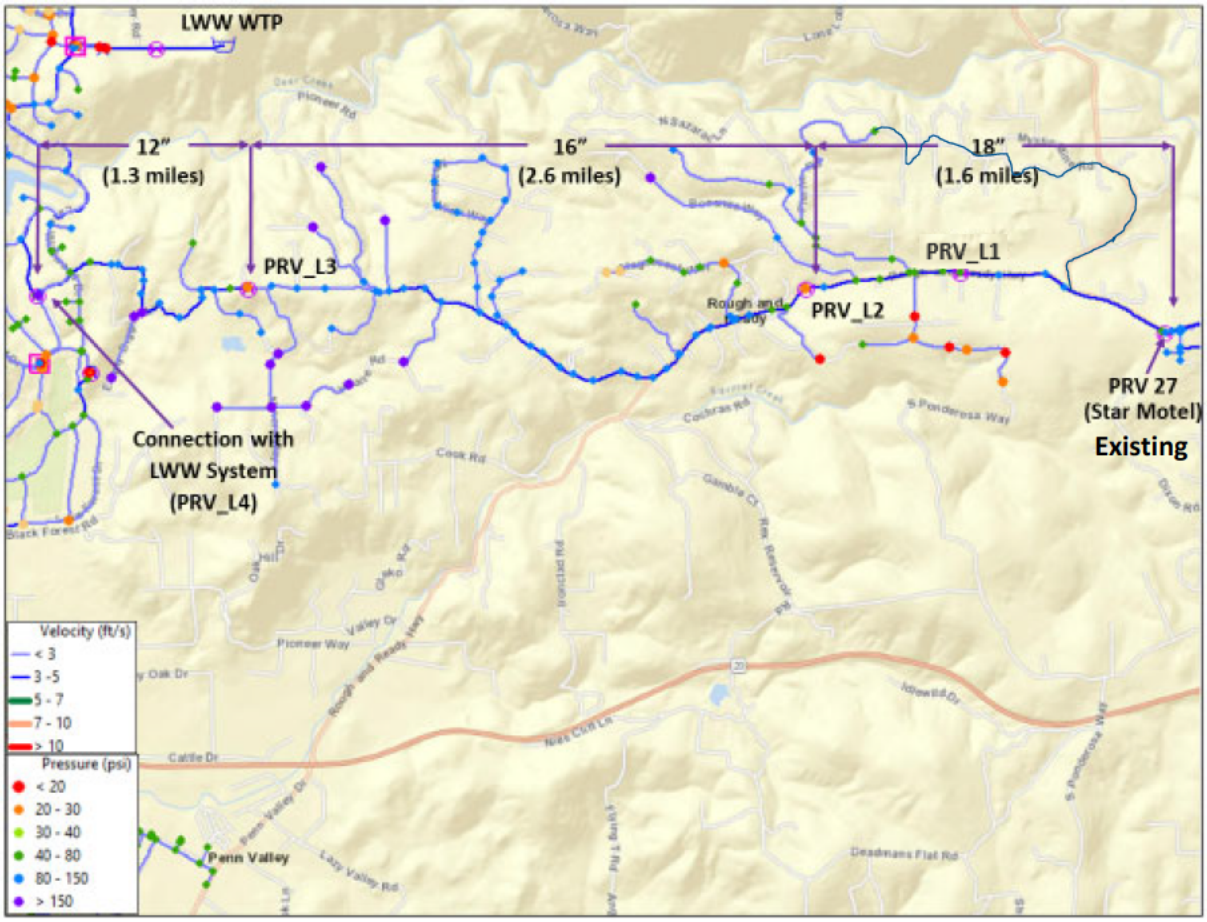

Figure 4. PHD Simulation Results

Table 5. Summary of Proposed PRV Stations

Name	Location	Elevation (ft)	Setting (psi)
PRV_L1	Hard Rock Rd & Rough and Ready Hwy	2,214	44
PRV_L2	Rough and Ready Hwy between Bonanza Rd and Ranch Rd	2,055	30
PRV_L3	Riffle Box Rd & Rough and Ready Rd	1,886	30
PRV_L4	Golden Trout Way & Minnow way	1,355	110

3.2.2 MDD Plus FF Analysis

This scenario has the following conditions:

- **Demands:** Total = 14,506 gpm with FF = 1,000 gpm (EG/LR = 11,500 gpm, future service connection Option 1 = 946 gpm, and LWW = 2,060 gpm)
- **Network:** Proposed pipeline connection and LWW system
- **Simulation:** Steady-state

The MDD plus fire flow analysis was performed to evaluate the ability of the proposed pipeline connection to meet the fire flow requirement of 1,000 gpm and determine the available fire flow while maintaining a minimum 20 psi with limiting the maximum pipe flow velocity to 10 ft/s. Available fire flows were evaluated at all junctions with demands (service nodes) along the alignment of the proposed pipeline connection and the waterline extensions. The FF analysis shows the available FF along the proposed pipeline ranges from 2,081 to 5,991 gpm and along the waterline extensions from 717 to 2,052 gpm. Several nodes along the waterline extensions were excluded from the FF analysis due to high elevations. Those locations require additional hydraulic analysis to determine the best possible way to be served. **Figure 5** shows the fire flow results.

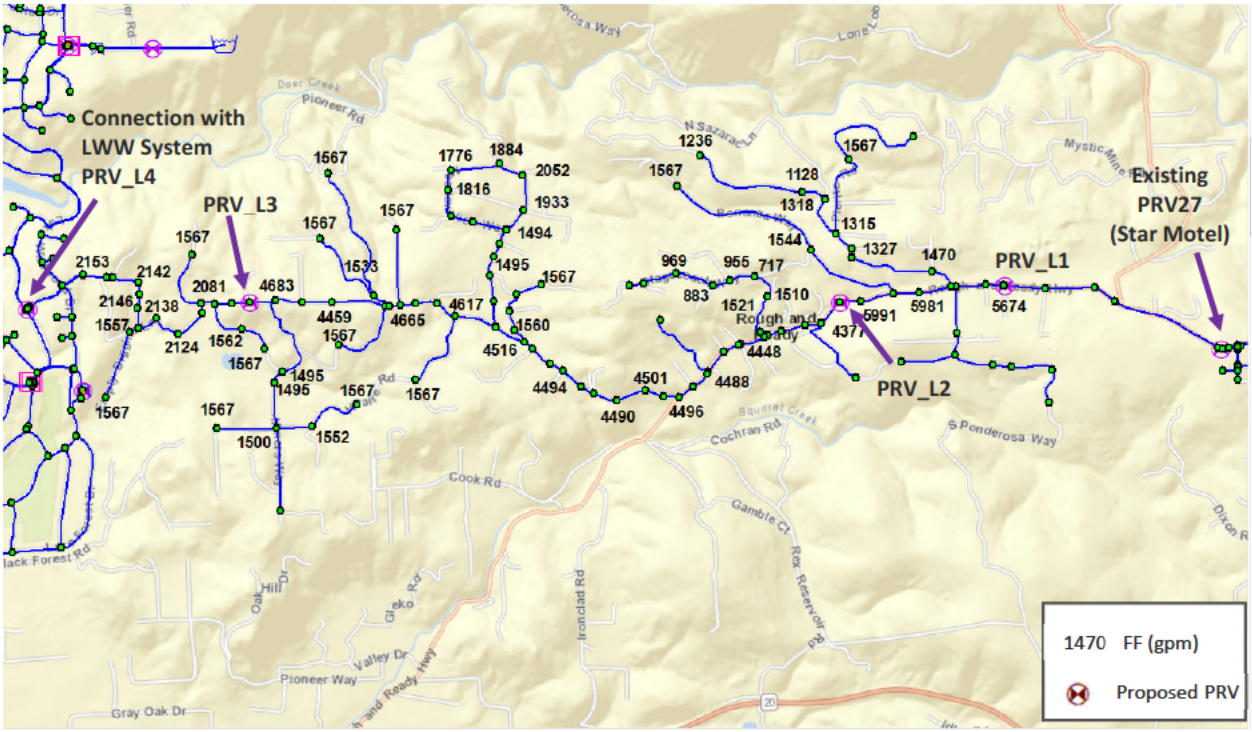

Figure 5. Available Fire Flow (gpm)

3.2.3 PRV Station Evaluation

Based on the topographic information, the overall drop in elevation between the EG system and the LWW system is about 930 feet which required adding multiple PRV stations along the proposed alignment at key locations to maintain system pressures within the NID criteria.

Initially, the location of the proposed PRV stations were identified using static conditions. The PHD and MDD plus FF results were used to determine the preliminary locations with the appropriate settings to mitigate high pressure from EG system at PRV27 (Star Motel) to LWW at the intersection of Golden Trout Way and Minnow Way. As a result of the evaluation, four (4) PRV stations are required to maintain pressure between 40 psi and 150 psi per District criteria. **Figure 6** shows the PRV locations and **Table 6** shows the PRV locations, settings, valve sizes, and maximum flows.

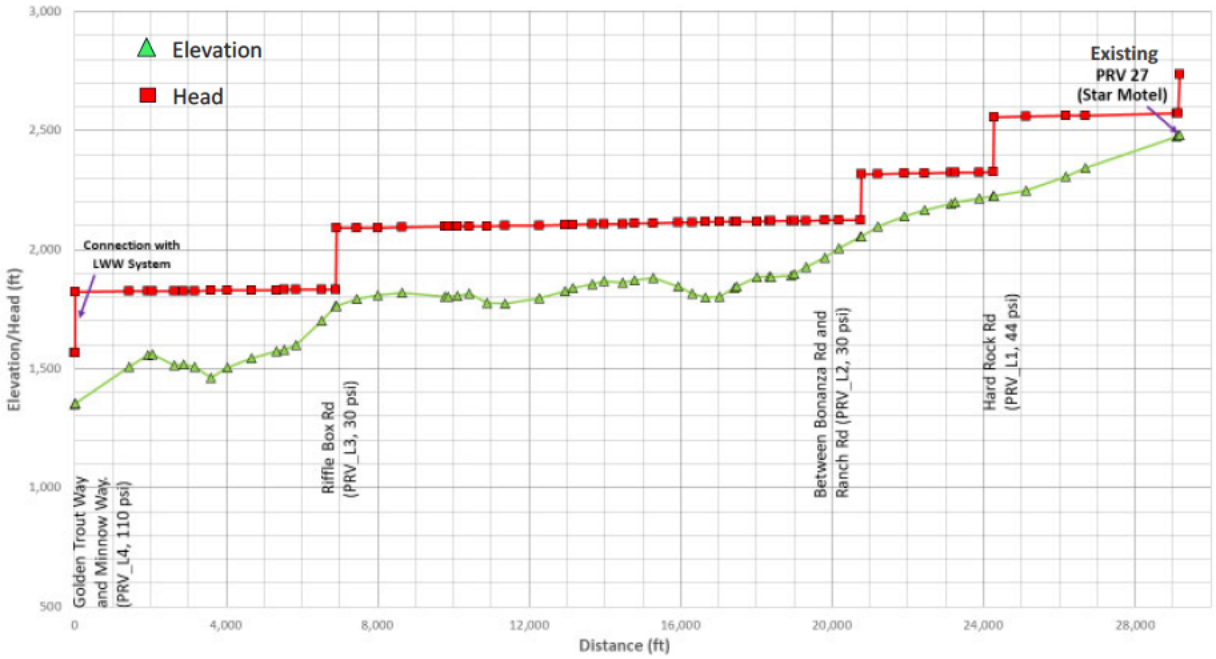

Figure 6. Proposed PRV Station Locations

Table 6. PRV Sizes and Settings

PRV	Location	Setting (psi)	Size (inch)	Peak Flow (gpm)	MDD + FF (gpm)
PRV_L1	Hard Rock Rd & Rough and Ready Hwy	44	10	3,215	3,302
PRV_L2	Rough and Ready Hwy between Bonanza Rd and Ranch Rd	30	8	2,534	2,962
PRV_L3	Riffle Box Rd & Rough and Ready Rd	30	8	1,539	2,465
PRV_L4	Golden Trout Way & Minnow way	110	8	1,390	2,390

3.2.4 Assessing Impact on EG System

To evaluate the impact on the existing pipes in the EG system while serving the future areas along the proposed pipeline connection and deliver 2 mgd to the LWW system, the results from the PHD simulation were used to identify pipes exceeding the velocity criteria and junction pressures below the minimum required. The model results show significant head loss in the pipes that exceeded the velocity criteria of 5 fps which should be further evaluated for improvements. **Figure 7** shows the pipe velocity and junction pressure results.

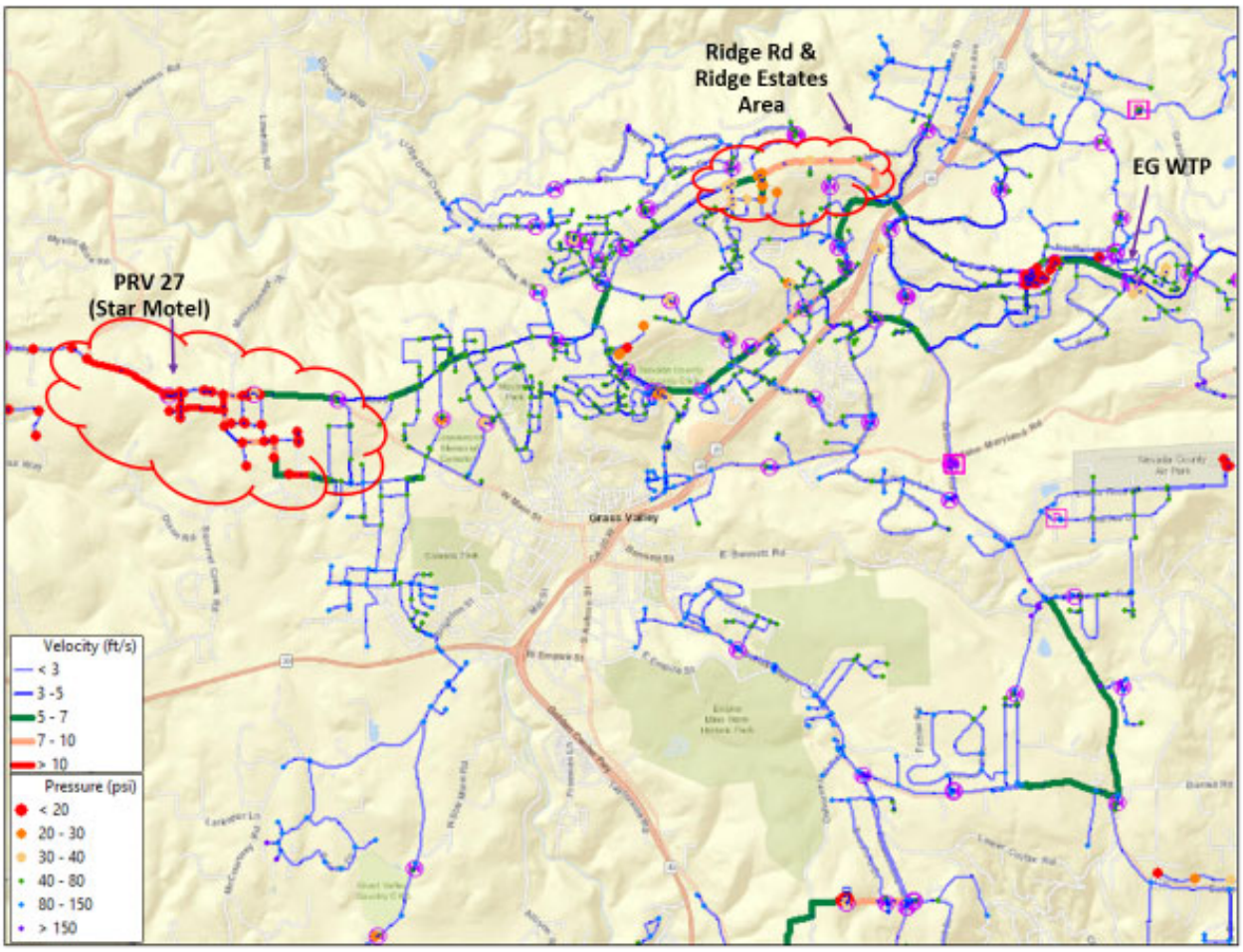

Figure 7. EG System PHD Pipe Velocity and Junction Pressure Results

As expected, the existing 8-inch pipes downstream of the PRV27 (Star Motel) and the existing 10-, and 14-inch pipes upstream along Rough and Ready Hwy and Ridge Road did not have adequate capacity to serve the future areas along the proposed pipeline connection and deliver 2 mgd to LWW system. As a result, pipeline improvements were made to correct those deficiencies and improve system hydraulics. **Figure 8** shows the general location of the pipeline improvements and **Table 7** summarizes in more detail the information of the pipeline improvements.

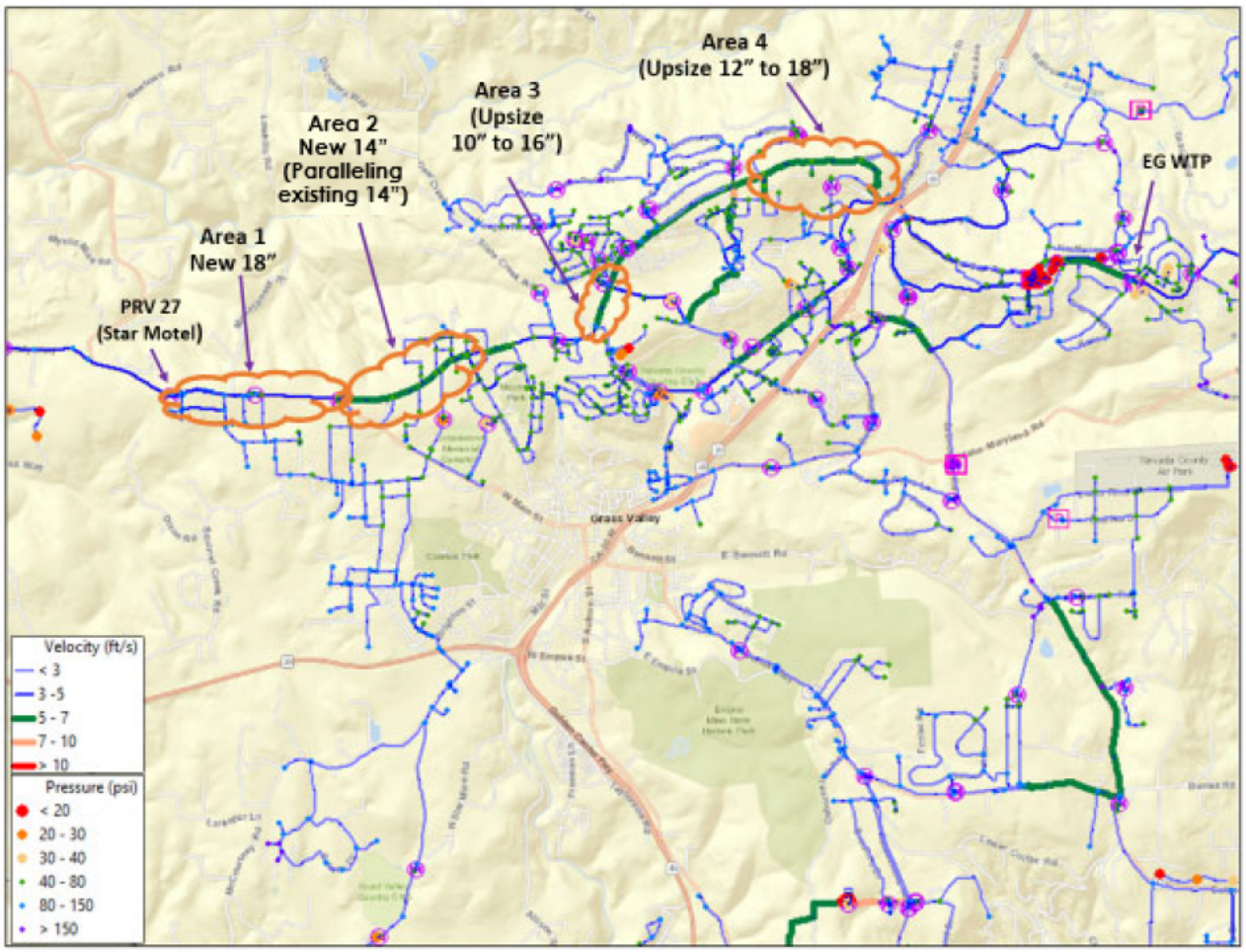

Figure 8. EG System Pipeline Improvements

Table 7. Summary of EG Pipeline Improvements

Area #	Existing Diameter (in)	Proposed Diameter (in)	Length (ft)	Location	Category	Water Delivered to LWW (gpm)	Priority of Improvements
1	10	18	2,290	Along Rough & Ready Hwy from Ridge Rd to Hope St	Parallel	3,300	1
	N/A	18	2,520	Along Rough & Ready Hwy from Hope St to PRV27 (Star Motel)	New Pipe		
2	14	14	3,870	Along Ridge Rd from Alta St to Rough & Ready Hwy	Parallel	1,180	4
3	10	16	1,210	Along Ridge Dr, from Sierra College Dr to Deeken Ct	Replace with 16 or Parallel with 14	3,170	2
4	12	18	4,850	Along Ridge Dr, from Via Vista to Durbrow Rd	Replace with 18 or Parallel with 16	2,520	3
Total			14,740				

To better assess the impact on the EG system hydraulics, a pressure comparison was made before and after serving the future areas along the proposed pipeline connection and delivering 2 mgd to LWW to determine the magnitude of difference in pressure. The simulation results show by serving the future areas and delivering 2 mgd to LWW the pressure in a few areas dropped by as much as 20 psi. However, the minimum pressure at those locations remained above 40 psi minimum required. Other areas show an increase in pressure as much as 13 psi. **Figure 9** shows the results of the pressure comparison.

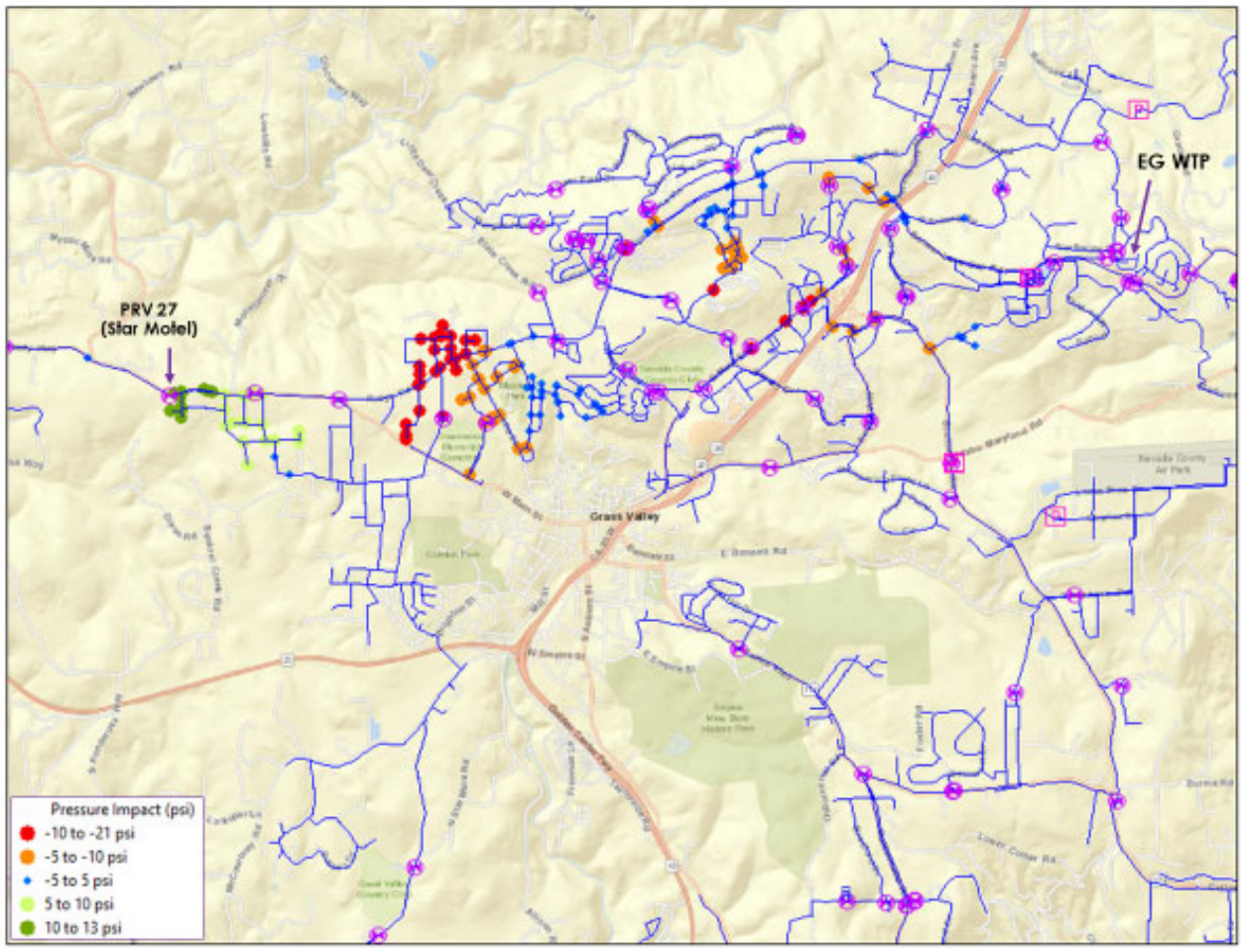

Figure 9. Magnitude of Pressure Difference

3.3 Option 2 Evaluation

Option 2 was evaluated with the assumption that Option 1 facilities are in place. It includes a main transmission line that starts from the intersection of Rough and Ready Road and Rough and Ready Hwy continues along Rough and Ready Hwy and Penn Valley Drive and ends at the intersection on Penn Valley Drive and Spenceville Road with a total length of 15,500 ft (2.9 miles). The elevation drop along this alignment is 381 feet which required adding multiple PRV stations at key locations to maintain system pressures within the District's criteria. This proposed line will serve the future areas along the alignment and supply MDD of 222 gpm to Penn Valley pressure zone.

3.3.1 PHD Analysis

This scenario has the following conditions:

- **Demands**: Total = 30,943 gpm (EG/LR = 23,000 gpm, Option 1 future service area = 1,893 gpm, Option 2 future service area = 900, and LWW = 5,150 gpm)
- **Network:** Proposed pipeline connection Option 1, Option 2, and LWW system
- **Simulation:** Steady-state

The PHD SS analysis was performed with an initial pipe diameter of 12-inch for the proposed pipeline connection. The initial results show the pipeline segments along the proposed alignment has adequate capacity where velocities were below 5 fps. Model results also show junctions along the proposed alignments with both high pressures and low pressures due to the nature of the topography of the area.

To mitigate the high pressures, PRV stations were added, as needed, along the proposed alignment to meet District's criteria by maintaining a minimum pressure of 40 psi and a maximum pressure of 150 psi. The low pressure was observed at some of the future waterline extensions due to high elevations. Those extensions were added only to capture demands from the future areas and were not analyzed for capacity. **Table 8** summarizes the PRV station locations, elevation, and settings. **Figure 10** shows the junction pressure and pipeline velocity PHD results along with the PRV station locations.

Table 8. Summary of Proposed PRV Stations

Name	Location	Elevation (ft)	Setting (psi)
PRV_L5	Rough & Ready Hwy & Gamble Ct	1,526	50
PRV_L6	Rough & Ready Hwy & North of Valley Dr	1,746	40
PRV_L7	Penn Valley Dr & Spenceville Rd	1,417	86

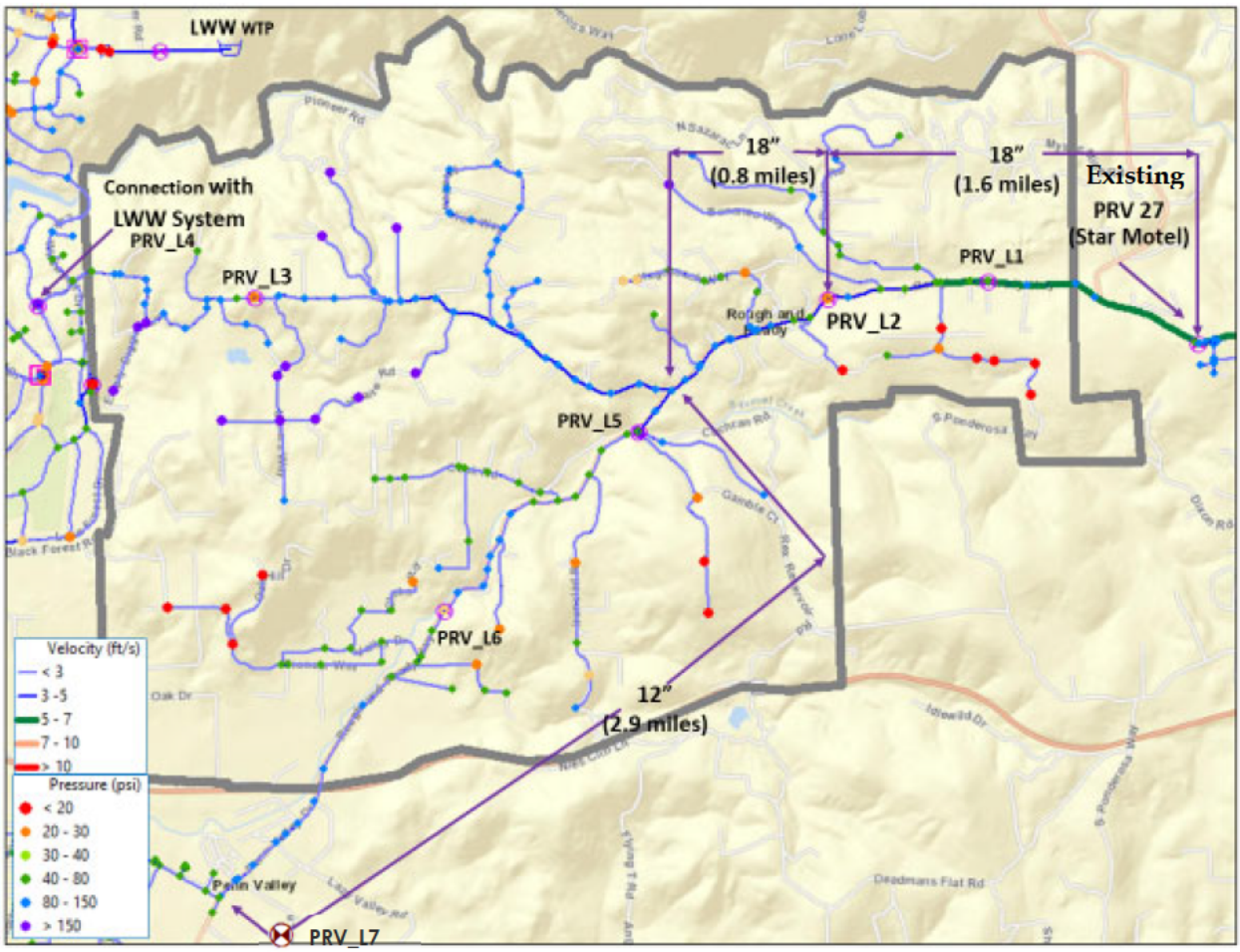

Figure 10. PHD Simulation Results

3.3.2 MDD Plus FF Analysis

This scenario has the following conditions:

- **Demands:** Total = 14,956 gpm Plus FF = 1,000 gpm (EG/LR = 11,500 gpm, Option 1 future service area = 946 gpm, Option 2 future service area = 450 gpm, and LWW = 2,060 gpm)
- **Network:** Option 1 and Option 2 Proposed pipeline connection, and LWW system
- **Simulation:** Steady-state

The MDD plus fire flow analysis was performed to evaluate the ability of the proposed pipeline connection to meet the fire flow requirement of 1,000 gpm and determine the available fire flow while maintaining a minimum 20 psi with limiting the maximum pipe flow velocity to 10 ft/s. Available fire flows were

evaluated at all junctions with demands (service nodes) along the alignment of the proposed pipeline connection and the waterline extensions. The FF analysis shows the available FF along the proposed pipeline ranges from 2,500 to 3,300 gpm and along the waterline extensions from 950 to 1,900 gpm. Several nodes along the waterline extensions were excluded from the FF analysis due to high elevations. Those locations require additional hydraulic analysis to determine the best way to be served which may include adding in-line booster stations. **Figure 11** shows the fire flow results.

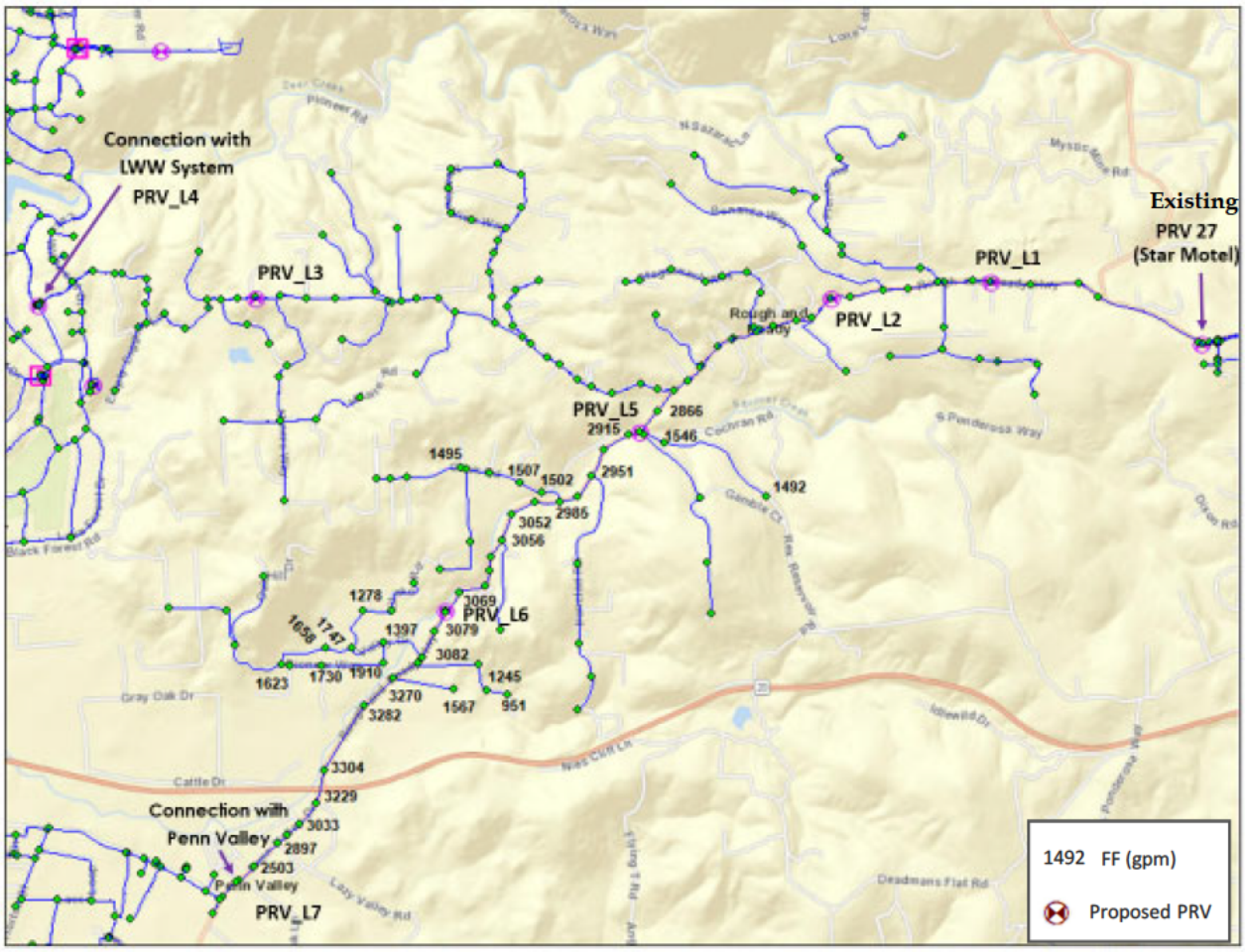

Figure 11. Option 2 Available Fire Flow (gpm)

3.3.3 PRV Station Evaluation

Based on the topographic information, the overall drop in elevation along the proposed alignment is about 381 feet which requires adding multiple PRV stations at key locations to maintain system pressures within the District's criteria.

Initially, the location of the proposed PRV stations were identified using static conditions. The PHD and MDD plus FF results were used to determine the preliminary locations with the appropriate settings to

mitigate high pressure along the Option 2 alignment. As a result of the evaluation, three (3) PRV stations are required to maintain pressure between 40 psi and 150 psi per District criteria. **Figure 12** shows the PRV locations and **Table 9** shows the PRV locations, settings, valve sizes, and maximum flows.

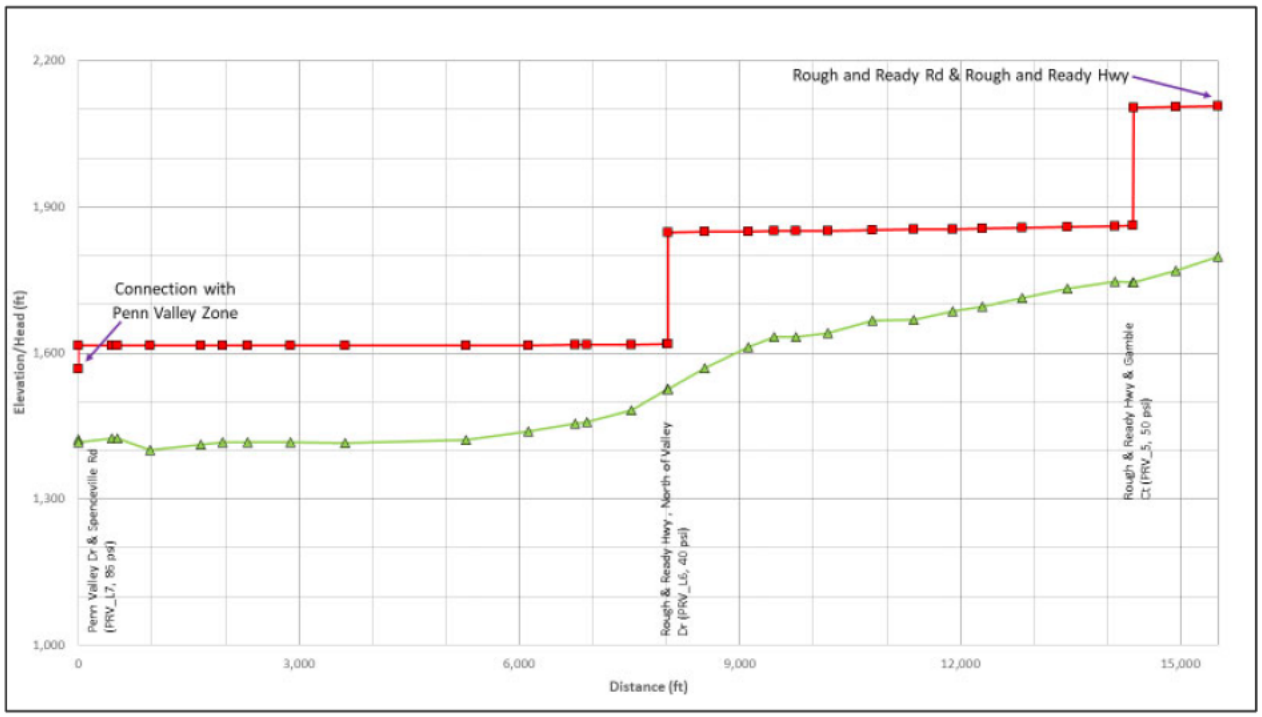

Figure 12. Option 2 Proposed PRV Station Locations

Table 9. Option 2 PRV Sizes and Settings

PRV	Location	Setting (psi)	Size (inch)	Peak Flow (gpm)	MDD + FF (gpm)
PRV_L5	Rough & Ready Hwy & Gamble Ct	50	6	1,017	1,449
PRV_L6	Rough & Ready Hwy, North of Valley Dr	40	4	708	1,243
PRV_L7	Penn Valley Dr & Spenceville Rd	86	4	222	NA

3.3.4 Assessing Impact on EG System

To evaluate the impact on the existing pipes in the EG system with Option 1 and Option 2 demands, the results of the PHD simulation were used to identify pipes exceeding the velocity criteria and junction

pressures below the minimum required. The model results with Option 2 show additional pressure drop in the EG system compared to Option 1 results. For some areas that were affected, the pressure dropped by 7 psi to as much as 17 psi, but still maintained pressure above the 40 psi minimum requirement. **Figure 13** shows the pipe velocity and junction pressure results for the EG system.

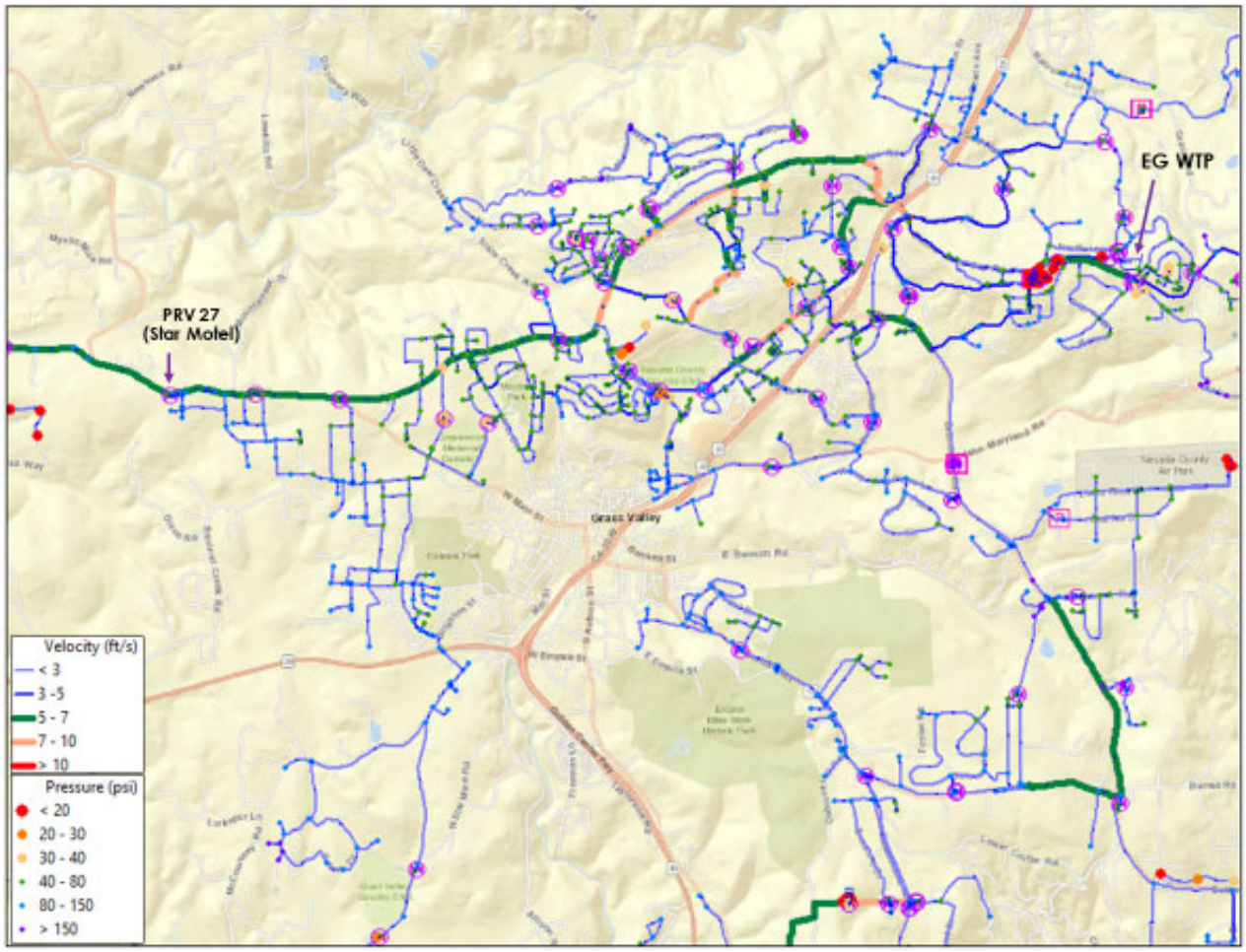

Figure 13. EG System PHD Results with Option 1 and Option 2 Demands

3.4 EPS Evaluation for Option 1

An EPS simulation was used to evaluate the transmission lines in LWW system to provide the additional supply of 2 mgd from EG to the LWW system downstream of the entry points of the proposed line connection and to verify storage tanks are replenished and cycling within the typical operational range. Two alternatives were evaluated—alternative 1 includes a dedicated line from the EG-LWW connection

point to the tanks 1A and 1B near the WTP, and Alternative 2 includes directly connecting to the LWW system into Zone 1 at the intersection of Golden Trout Way and Minnow Way.

3.4.1 Alternative 1: Dedicated Line to Tanks 1A & 1B

This alternative considers installing a dedicated 12-in diameter line from the intersection of Golden Trout Way and Minnow Way to tanks 1A and 1B near the WTP. This alternative maintains the existing system operation where the supply enters directly into tanks 1A and 1B and flows into the LWW system are controlled by a flow control valve. The velocity in this dedicated line is 3.9 fps. **Figure 14** shows the location of the proposed line and **Figure 15** shows the Zone 1 tanks % full. As shown on **Figure 15**, tank levels are dropping below the desirable range of 70 to 100 full due to lack of operational storage in Zone 1 tanks. The LWW system has a diurnal curve with a period of four (4) hours of high peak demands between 7:00 am and 11:00 am causing the tank levels to drop while maintaining constant flow from the WTP (760 gpm) and EG-LWW connection (1390 gpm).

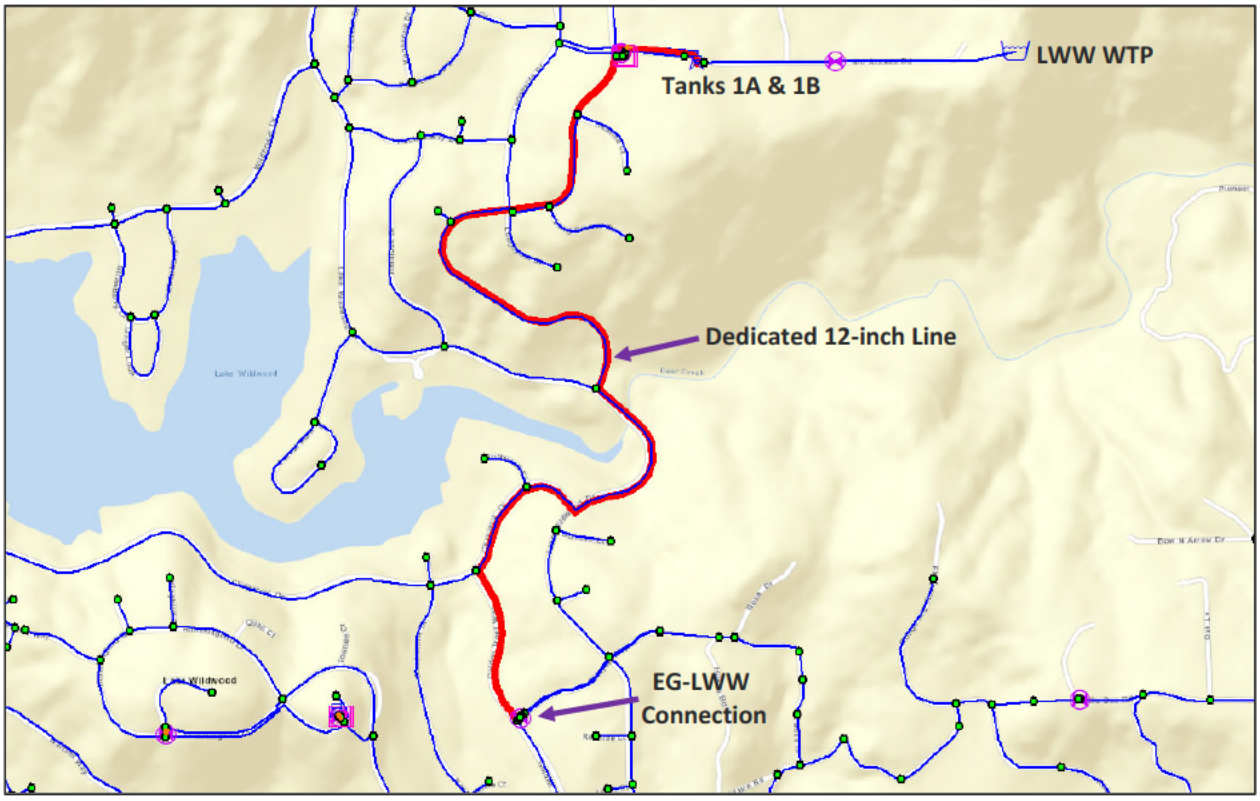

Figure 14. LWW Dedicated Pipeline Location

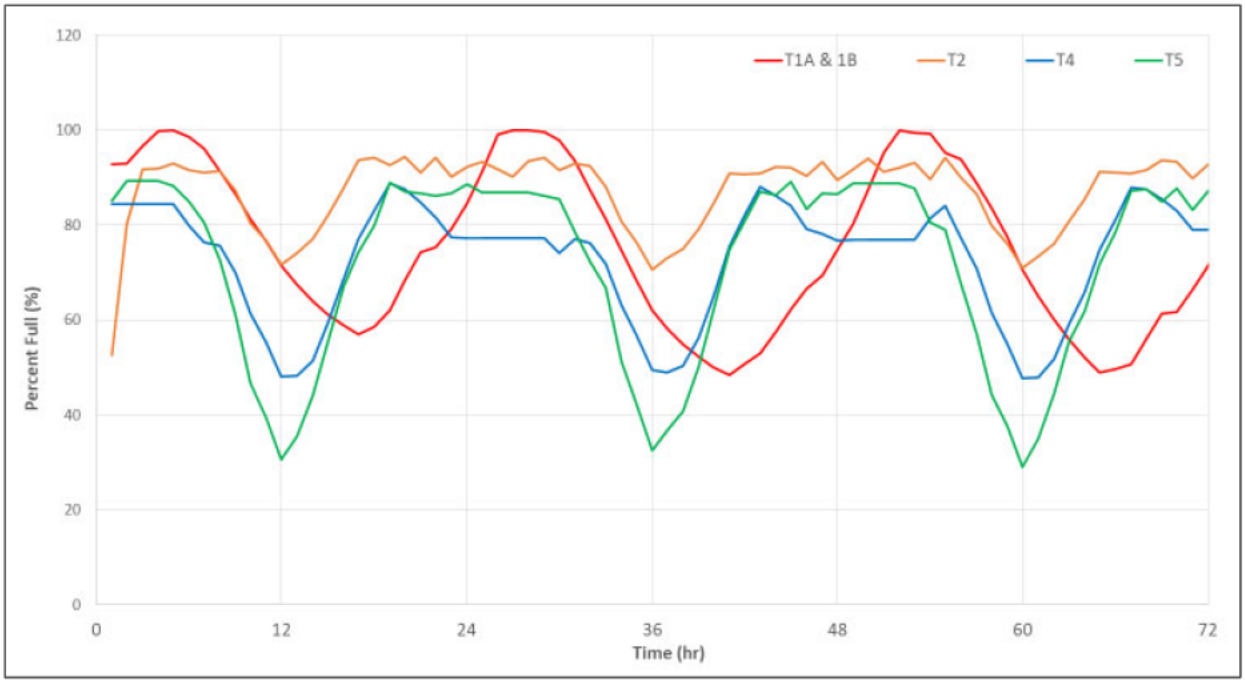

Figure 15. LWW Zone 1 Tanks % Full with a Dedicated Line to Tanks 1A & 1B

3.4.2 Alternative 2 Direct Connection to LWW System

This alternative considers connecting directly to the distribution network of Zone 1 at the intersection of Golden Trout Way and Minnow Way to an existing 12-inch line in Golden Trout Way. An EPS simulation was performed to examine the system hydraulics and tank levels in LWW Zone 1. **Figure 16** shows Zone 1 tanks % full. As shown on **Figure 16**, tank levels are dropping below the desired range of 70 to 100% full due to the combination of lack of adequate operational storage and cumulative head loss in the main lines supplying the tanks. The operational storage deficit is attributed to the large peak demand of four (4) consecutive hours between 7:00 am and 11:00 am while the supply from the WTP and EG-LWW connection are maintained at a constant rate. Tanks T4 and T5 are not cycling during low demand condition where the HGL is too high for the tanks to drain while trying to push water north toward tanks 1A and 1B.

This alternative requires adding a bypass near the system FCV to allow the excess supply to reach tanks 1A & 1B when the LWW system demand is low.

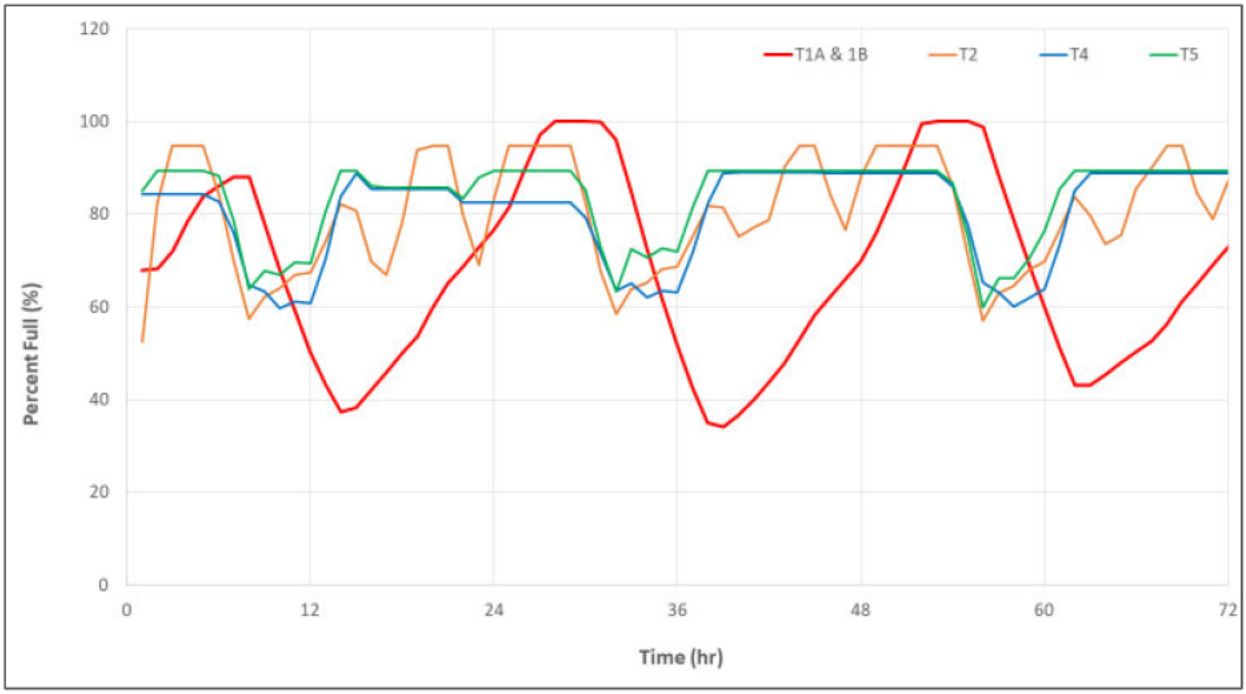

Figure 16. LWW Zone 1 Tanks % Full with Direct Connection

4 Conclusions and Recommendations

This section summarizes conclusions and recommendations for the District based on the evaluation of supplying the LWW System and the area between LWW and EG from the EG System.

Option 1

- **Proposed Pipeline Connection**
  - To keep velocities below 5 fps and pressures between 40 and 150 psi, 8,385 ft of 18-inch, 13,860 ft of 16-inch, and 6,884 ft of 12-inch pipes are needed.
  - Four (4) PRV stations are needed along the proposed pipeline connection to maintain pressures between 40 and 150 psi per District criteria. The PRV settings and sizes are: PRV_L1 (44 psi, 10-inch), PRV_L2 (30 psi, 8-inch), PRV_L3 (30 psi, 6-inch), and PRV_L4 (110 psi, 6-inch).
  - All junctions along the proposed pipeline connection met the minimum 1,000 gpm fire flow requirement. Some nodes along the waterline extensions were not included in the fire flow evaluation due to high elevation as they become an invalid constraint to meet fire flow requirement.

- Under PHD conditions some of the junctions along the waterline extension exhibited low pressure due to high elevation and require further evaluation to determine the appropriate solution (e.g. booster stations).

- **LWW System**
  - For dedicated pipeline connection, a 12-inch pipeline with a length of 9,749 ft (1.85 miles) is needed from the intersection of Golden Trout Way and Minnow Way to tanks 1A and 1B. The velocity is this dedicated pipeline is 3.9 fps. Providing the 2 mgd supply from EG system through a dedicated line to tanks 1A & 1B will maintain the same current system operation without any changes.
  - Zone 1 tank levels are operating below the desired operational range of 70 to 100 % full due to lack of operational storage caused by the four (4) hour period of high peaking factors from 7:00 am to 11:00 am.

- **EG System**
  - Pipeline improvements in EG system are needed to supply 2 mgd to LWW system and meet future demands along the proposed pipeline connection with approximately 4,800 ft of 18-inch, 5,060 ft of 16-inch, and 3,870 ft of 14-inch pipe. Total length of 13,730 ft (2.6 miles).
  - With system improvements and providing additional supply of 2 MGD to LWW system and serving the future areas along the proposed pipeline connection has impacted EG system pressures. During PHD, pressures increase by as high as 13 psi and decreased by as low as 20 psi. However, the EG system pressure remained above the threshold of 40 psi.
  - The existing PRV27 (Star Motel) that has two (2) 1-inch valves needs to be upsized to two (2) 10-inch valves, each with a maximum capacity of 4,900 gpm based on Cla-Val 90-01 series. One valve would be used for normal operation and one as a backup to provide redundancy.

Option 2

- **Proposed Pipeline Connection**
  - To keep velocities below 5 fps and pressure between 40 and 150 psi, 12,480 ft of 18-inch, and 15,500 ft of 12-inch pipes are needed. As a result of the additional demand to serve the future areas along the proposed alignment and to supply Penn Valley Zone system, the 16-inch diameter pipeline that was identified in Option 1 between PRV_L1 and the intersection of Rough and Ready Hwy and Rough and Ready Road was upsized to 18-inch diameter.
  - Three (3) PRV stations are needed along the proposed pipeline connection to maintain pressures between 40 and 150 psi per District criteria. The PRV settings and sizes are: PRV_L5 (50 psi, 6-inch), PRV_L6 (40 psi, 4-inch), and PRV_L7 (86 psi, 4-inch)
  - All junctions along the proposed pipeline connection met the minimum 1,000 gpm fire flow requirement. Some nodes along the waterline extensions were not included in the fire flow

evaluation due to high elevation as they become an invalid constraint to meet fire flow requirement.

- Under PHD conditions some of the junctions along the waterline extension exhibited low pressure due to high elevation and require further evaluation to determine the appropriate solution (e.g. booster stations)

- **LWW System**
  - The proposed pipeline connection along Rough and Ready Hwy connects to Penn Valley Zone in the LWW system at the intersection of Penn Valley Drive and Spenceville Road. This connection has the potential not only to serve the Penn Valley Zone MDD, but also to provide additional capacity to either Zone 1 through a bypass at Pleasant Valley pump station or to serve the proposed future area along the pipeline connection to Smartville.
- **EG System**
  - No additional pipeline improvements are needed in the EG system as a result of the additional demand for Option 2.

Sedaru recommends a focused hydraulic evaluation for the LWW system to optimize facility operation and evaluate operational storage to better understand the hydraulic limitation and the impact on system pressures.