Olympic Valley Public Service District

Basis of Design Report

OVPSD-SVMWC Emergency Intertie

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Description
ACP	asbestos cement pipe
ADD	average daily demand
AF	acre-feet
BPS	booster pump station
CCR	California Code of Regulations
DIP	ductile iron pipe
FAP	Financial Assistance Program
fps	feet per second
gal	gallons
gpm	gallons per minute
HGL	hydraulic grade line
HMI	human machine interface
HOA switch	hand-off-auto switch
Hp	horsepower
MDD	maximum day demand
OVPSD	Olympic Valley Public Service District
PCWA	Placer County Water Agency
PHD	peak hour demand
PRV	pressure relief valve
PZ	pressure zone
ROW	right-of-way
RTU	remote terminal unit
SVMWC	Squaw Valley Mutual Water Company
TDH	total dynamic head
V	volt

EXECUTIVE SUMMARY

INTRODUCTION AND BACKGROUND

The water distribution systems analyzed in this report are located in Olympic Valley, California, which is a mountainous region that resides approximately five miles northwest of Tahoe City, California and approximately 10 miles south of Truckee, California. Residents of Olympic Valley are currently supplied water from two separate water systems; one system is operated by the Olympic Valley Public Services District (OVPSD), and the other is operated by the Squaw Valley Mutual Water Company (SVMWC). Both water systems provide water through the use of vertical wells that take water from the Olympic Valley aquifer and horizontal wells from both the north and south flanks.

Currently, the water systems are not hydraulically connected. The purpose of this report is to discuss the construction of a permanent water system emergency intertie facility to interconnect the two separate water systems, called the OVPSD-SVMWC Emergency Intertie. Interties are interconnections between two separate public water systems that allow the exchange, or delivery, of water between those systems as needed.

The goal of the OVPSD-SVMWC Emergency Intertie is to improve water supply reliability. Connecting the two systems provides redundancy, which will keep both agencies' customers in service while one repairs and/or replaces infrastructure. The construction of an emergency intertie will also enhance water supply reliability during emergency events such as power outages, contamination in one or more wells that affects water quality, mechanical well failures, fires, and other unforeseeable emergencies that may result in interruptions in service. The emergency intertie project cannot address issues like aquifer-wide contamination or low groundwater levels. In such cases, both OVPSD and SVMWC wells may be non-operational and only a redundant emergency supply outside the Olympic Valley groundwater basin would solve the problem.

Plans for an emergency intertie between the OVPSD and SVMWC systems date back to 1989, when the consulting firm Dewante & Stowell performed an evaluation and created drawings that placed the Emergency Intertie BPS inside of the OVPSD Well 5R structure. Since then, the well house has been re-configured and putting the Emergency Intertie BPS inside the well house is no longer feasible. In 2012, another evaluation of potential intertie locations was performed by OVPSD staff. Based on a desktop evaluation of potential sites and cost estimates developed by OVPSD staff, it was decided to move forward with the Christy Lane at Valley View Condominiums location. A preliminary design that laid the concept of a combined BPS/PRV location was completed in 2014 by Shaw Engineering, which was funded by the OVPSD and SVMWC, and a $10,000 grant from the Placer County Water Agency's (PCWA's) Financial Assistance Program (FAP).

Ultimately, the intertie at the Valley View Condominiums was not constructed due to budgetary constraints. However, since this location was considered previously for the intertie and already has a preliminary design, it was analyzed as one of the alternatives in this report.

TECHNICAL BACKGROUND

There are currently three pressure zones within the OVPSD water system, known as Pressure Zone (PZ) 1, 2, and 3. The SVMWC water system has two pressure zones, known as the Upper and Lower pressure zones. The proposed emergency intertie would connect PZ 1 of the OVPSD water system to the Lower PZ of the SVMWC system. SVMWC Lower PZ operates at a higher pressure than OVPSD PZ 1 due to the tank elevations that supply these pressure zones. Water will always flow from higher pressure areas to lower pressure areas, taking the path of least resistance. The Emergency Intertie will need to incorporate infrastructure that keeps each system separated until times of emergency, so that existing pressure zones and system hydraulics do not change.

Since SVMWC Lower PZ is at a higher pressure, a booster pump station (BPS) will need to be installed to pump water from the OVPSD system to the SVMWC system. Conversely, since OVPSD PZ 1 operates at a lower pressure, a pressure reducing valve (PRV) will need to be installed to only allow flow from the SVMWC system to the OVPSD system in times of emergency.

The function of the Emergency Intertie BPS is to increase the OVPSD water pressure so water from OVPSD can flow into the higher pressures of SVMWC's system. The BPS will operate only when the need for water is required. It will operate similar to the wells and will be called on/off based on the Lower Tank level. A BPS can be designed in several different ways:

- Retrofit: the pump system and all necessary additional plumbing are retrofitted to fit within existing well houses and/or plumbing
    - Can be complicated, expensive, and infeasible in certain existing plumbing layouts with constrained space
- Skid mounted: the pump system is designed on a skid in which the full package pumping system is prefabricated by a pump manufacturer and easily plumbed into existing plumbing layouts
    - Can be a simpler design approach with lower construction costs and less impact to existing well buildings and/or plumbing layouts

Additionally, a BPS can be designed as above ground or below ground. A summary of the advantages and disadvantages of above and below ground BPS is listed below:

- Above ground BPS
    - Advantages
        - Easy to access structure for maintenance and repairs
        - Can easily drain, flooding not a significant risk
    - Disadvantages
        - Can be difficult to find a location for an above ground structure in an already-developed area
        - Visibility to residents
- Below ground BPS
    - Advantages
        - Can be built within road rights-of-way (ROWs) since a below ground structure wouldn't pose a risk of getting damaged by vehicles
        - No visible structure to surrounding residents, aside from vault lid
    - Disadvantages
        - Can be difficult to access vault for maintenance and repairs
        - Can flood if there is significant groundwater seepage
        - Since vault is below ground, it cannot drain without installation of a sump pump

A PRV is a self-operating valve that is used to reduce pressure within a water system. The valve contains a spring that is set to a resistance that responds to a specific pressure from the downstream (OVPSD) system. When the downstream (OVPSD) pressure is above that set point, the pressure forces the valve to remain closed. When the downstream (OVPSD) pressure drops below the set point of the valve, the spring pressure overcomes the downstream pressure and forces the valve open to supply water from the upstream (SVMWC) system. A PRV will only open and close based on OVPSD's downstream pressures. SVMWC's upstream pressures will not affect valve function in anyway. Having a PRV ensures that OVPSD will only receive water when pressures in the OVPSD reach critically low levels. The PRV design for the OVPSD-SVMWC intertie will consist of two (2) separate PRVs in a single underground vault. A larger 6-inch PRV will only open for high flow demands and a smaller 2-inch PRV will only open for low flow demands. A bypass to a smaller PRV will prevent the larger PRV from slamming open and closed unnecessarily during low flow events which will protect existing infrastructure from damage due to water hammer.

DESIGN CONSIDERATIONS

The current average day demand (ADD) and maximum day demand (MDD) for SVMWC is 55 gallons per minute (gpm) and 244 gpm, respectively. The current ADD and MDD for OVPSD is 210 gpm and 526 gpm, respectively. The Emergency Intertie will supply each system with 200 gpm, which can provide almost all of MDD for SVMWC and about a third of MDD for OVPSD.

All modeling on the existing systems and proposed alternatives was performed in InfoWater Pro. The original water distribution model for OVPSD was developed in 2012 and was updated in 2021 with updated demands for the entire system. Additionally, fire hydrant flow tests were performed by OVPSD staff in 2021 and the model was calibrated using the flow test results. The model calibration also included updated pump curves for existing wells and booster pump stations, as well as creating extended period simulation scenarios. Lidar of Olympic Valley was produced in 2021 and was incorporated into the model in 2022 to update all node elevations for more accurate hydraulic modeling. Lidar stands for *Light Detection and Ranging* and is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to Earth. These light pulses – combined with other data recorded by an airborne system – generate a precise, three-dimensional map that was used to estimate elevations within the model.

The SVMWC model was sent to Farr West Engineering by Shaw Engineering, which was then combined with the OVPSD model. All modeling was performed with the assumption that all infrastructure, demands, demand locations, pump settings, tank settings, and PRV settings within the SVMWC model were accurate and up to date. Since there was only one demand scenario within the SVMWC model, it was assumed to be MDD. Node elevations for the SVMWC system were updated with the 2021 lidar data that was used to update the OVPSD elevations so that all elevations within the combined model were as updated and accurate, relative to each other, as possible.

Regulatory compliance criteria for system pressure were considered when modeling alternatives. For system pressure requirements, the California Code of Regulations (CCR) Title 22 § 64602 was followed, which requires that pressures must, at the point of service, be always greater than or equal to 20 psi. This 20-psi rule applies to all demands, such as peak hour demand (PHD), average daily demand (ADD), maximum day demand (MDD), and a fire flow event (which is always calculated as fire flow at MDD). Pressures were analyzed at MDD for each alternative.

OPERATIONAL OBJECTIVES

A workshop was held on August 1, 2022 at Farr West Engineering to discuss key design considerations of the OVPSD-SVMWC Emergency Intertie with OVPSD Operations. The following list summarizes key operational aspects that were discussed during this workshop and considered during the alternatives analysis.

- Easy to access location for monthly visits, especially during the winter when snow can be an issue
- Avoiding snow storage areas for BPS/PRV locations (typically 5- to 10-foot width next to road)
- Operations prefers above-ground BPS for safety (electrical and confined space)
- Avoiding installation in paved busy roadways as the location for below-ground vaults
- Electrical and SCADA availability
- Designing for proper draining/pumping for below-ground vaults
- Using a heavy or bolt-down lid on below-ground vaults to avoid intrusion/vandalism
- Operations preferred location for the intertie that will keep the eastern half of the OVPSD system in service during repair/replacement on the Olympic Valley Road transmission

It is important to note that modeling was not performed for every possible operational scenario each water system might see and was only performed to adequately size and find a location for the BPS. Operational considerations will need to be taken into account during the design and incorporated into the Operations and Maintenance Manual for both systems. Based on feedback from Operations staff at OVPSD the following scenarios should be considered during the design phase:

- SVMWC Scenarios
  - Repair or replacement needed on the transmission main between well field and tanks
  - Well(s) out of service for maintenance or replacement
  - Facilitate refilling tanks after a fire flow event
  - Other service interruptions or maintenance activities

- OVPSD Scenarios
  - Keep eastern half of system in service when there is a repair needed on the 12-inch transmission main along Olympic Valley Road
  - Temporary loss well(s) for maintenance or replacement
  - Other service interruptions or maintenance activities

SVMWC BPS ALTERNATIVES ANALYSIS

The BPS analysis looked at five (5) main alternatives, as summarized below. Please note that piping required to connect to the existing OVPSD and SVMWC systems were sized to match the size of the existing mains that each alternative will tie into. Figures showing the location of all alternatives can be found in Appendix A.

- BPS Alternative 1
  - Located near the Squaw Valley North Condos, on the west end of Christy Lane in the road ROW
  - BPS would be in an underground vault since it is in a road ROW
  - Power, and SCADA would need to be extended to this location for the BPS
  - Parking required for trailer mounted emergency generator during power outage
  - Requires approximately 190 feet of 6-inch pipe to connect to both existing systems
- BPS Alternative 2
  - This alternative was originally just going to be at the location of the 2014 Shaw Engineering design. However, due to possible reliability issues at that location, an alternative location was also analyzed.
  - 2A
    - Located in front of Valley View Condos Christy Lane parking lot (original Shaw Engineering design location)
    - BPS would be in an underground vault since it is in a road ROW
    - Power and SCADA would need to be extended to this location for the BPS
    - Parking required for trailer mounted emergency generator during power outage
    - Requires approximately 65 feet of 6-inch pipe to connect to both existing systems
  - 2B
    - Located in Christy Hill Road ROW near dirt lot behind post office at 1600 Olympic Valley Road
    - BPS would be in an underground vault since it is in a road ROW
    - Power and SCADA would need to be extended to this location for the BPS
    - Parking required for trailer mounted emergency generator during power outage
    - Requires approximately 100 feet of pipe installed (80 feet of 6-inch pipe to connect to OVPSD system and approximately 20 feet of 8-inch pipe to connect to SVWMC system)

- BPS Alternative 3
  - Located next to the Well 1 building (in same utility easement)
  - BPS would be in a heated above ground protective structure at this location
  - Adequate power, backup power, chemical feed, and key SCADA instrumentation already exist at this location
  - Requires approximately 115 feet of pipe installed (100 feet of 8-inch pipe to connect to OVPSD system and approximately 15 feet of 6-inch pipe to connect to SVWMC system)
- BPS Alternative 4
  - Located in Olympic Valley Road ROW (between the road and the bike path) at the intersection with Russell Road
  - BPS would be in an underground vault since it is in a road ROW
  - Power and SCADA would need to be extended to this location for the BPS
  - Parking required for trailer mounted emergency generator during power outage
  - Requires approximately 75 feet of pipe installed (45 feet of 8-inch pipe to connect to SVMWC system and approximately 30 feet of 12-inch pipe to connect to OVPSD system)
- BPS Alternative 5
  - Located at convergence of Lanny Lane and Hidden Lake Loop, near 984 Lanny Lane
  - BPS would be in an underground vault since it is in a road ROW
  - Power and SCADA would need to be extended to this location for the BPS
  - Parking required for trailer mounted emergency generator during power outage
  - Requires approximately 115 feet of pipe installed (100 feet of 8-inch pipe to connect to OVPSD system and approximately 15 feet of 6-inch pipe to connect to SVWMC system)

All alternatives were vetted and selected as viable alternatives because they meet the SVMWC operational objectives discussed previously. Modeling the different alternatives determined that there was little to no variation in required pump output, meaning that none of the alternatives were more hydraulically efficient than the other. The reason for this is because each alternative pumps water from the OVPSD Pressure Zone 1 to the SVMWC Pressure Zone 1. Since the hydraulic grade line (HGL) within a pressure zone is the same across the entire pressure zone, these results make sense. Therefore, the hydraulics had the smallest effect on choosing the Preferred Alternative. No significant velocity or pressure changes were present in any of the alternatives, meaning that pressures in both the OVPSD and SVMWC systems exceeded the CCR Title 22, §64602 minimums. A summary of important design aspects for each alternative, as well as the required total dynamic head (TDH) for each alternative is summarized in Table 1, below.

Table 1: Executive Summary Alternative Comparison of Design Considerations

Design Consideration	Alt 1	Alt 2A	Alt 2B	Alt 3	Alt 4	Alt 5
Diameter, Ø (in) and length of pipe (ft) needed to connect to existing systems	190' of 6"Ø	65' of 6"Ø	80' of 6"Ø 20' of 8"Ø	15' of 6"Ø 100' of 8"Ø	45' of 8"Ø 30' of 12"Ø	195' of 8"Ø
Above or below ground vault	Below	Below	Below	Above	Below	Below
Required pump TDH (ft) to achieve 200 gpm of flow	102	101	99	100	100	101

An analysis was performed that compared alternatives to determine which ones had key advantages. The design aspects that were considered advantageous include:

- BPS being in an above-ground vault
- Not located in the ROW of a high-traffic road,
- Have snow removal already performed by OVPSD or SVMWC at the location
- Located in an area that is already consistently plowed
- Can still provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
- Close to existing power and SCADA
- Close to both systems so that the amount of new pipe installation is minimized
- Not be close to residences
- Not be located on private property that requires a utility easement for construction of the Emergency Intertie.

The results of this analysis for each alternative are summarized in Table 2. The advantages and disadvantages of each alternative are discussed in detail in Section 2.0.

Table 2: Executive Summary Alternative Comparison of Key Advantages

Advantages of Alternative	1	2A	2B	3	4	5
Above-ground Vault				X		
Not located in high-traffic road/ROW	X			X		X
OVPSD or SVMWC responsible of snow removal at location				X		
Located in existing high-volume snow removal area		X	X	X	X	
Can provide water during breaks/repairs on 8-inch transmission main from well field	X	X	X		X	X
Close to existing power and SCADA				X		
Close to both existing systems, requiring less pipe for tie-ins		X	X		X	
Not close to residences			X	X	X	
Installation in ROW and no additional utility easements required	X				X	X
Total	**3**	**3**	**4**	**6**	**5**	**3**

Lastly, planning level cost estimates were developed for each alternative. These estimates follow the AACE Level 3 Estimate guidelines and can range in accuracy from -20% to +30%. Cost estimates were developed by taking costs from similar jobs within the Lake Tahoe basin that have been constructed within the last two years and applying inflation factors and other adjustments to account for economic variations since those jobs took place. The numbers listed in the cost estimate are simply an Engineer's Opinion of Probable Costs and can vary widely if taken to bid due to many factors, such as supply chain issues, contractor availability, etc.

All soft costs were calculated as a percentage of the construction total cost. Soft costs include 15% for contingency, 10% for engineering services, 5% for permitting, 10% for inspection and construction management, and 5% for administration. Cost estimates for each alternative are listed in Table 3. Detailed cost estimates can be found in Section 2.0.

Table 3: Executive Summary Alternative Comparison of Cost Estimates for BPS Only

Alternative	Estimated Cost of Constructing BPS
1	$522,800
2A	$453,100
2B	$467,600
3	$387,300
4	$517,000
5	$542,200

OVPSD PREFERRED PRV DESIGN

The PRV portion of the Emergency Intertie will allow water from SVMWC to feed the OVPSD system and will consist of both a 6-inch and a 2-inch PRV, as stated previously. In order to track flow, a flow meter is proposed for the 2-inch PRV. The flow meter will be a Badger 2-inch E-Series meter. Per the manufacturer's website, the flow meter is powered by a 3.6V lithium thionyl chloride battery that has a 20-year battery life. Cut sheets for the flow meter can be found in Appendix B. Power will be necessary to supply heat and light within the below-ground PRV vault; however, SCADA will not need to be extended to the PRV vault since pressure gauges will be manually read and no transducers will be installed as part of this project. A 120V panelboard will provide adequate power for the heating and lighting within the PRV vault and no emergency backup power connection will be required. Conduit should be installed within the PRV vault to allow for future installation of SCADA if necessary and if a transducer is added in the future to connect to SCADA, a meter pedestal with a couple circuits and small transformer will be required that steps the voltage down to 120/240V (single phase).

The location for the PRV vault will be in the dirt shoulder between the road and the bike path at the intersection of Olympic Valley Road and Russell Road. The location of the proposed PRV vault, that houses both the 6-inch and 2-inch PRVs, is shown in Figure 12. The location of the PRV vault is advantageous to the operation of the OVPSD water system when there is an interruption of service on the 12-inch Olympic Valley Road transmission main. Other advantages and disadvantages of this location were considered, which are summarized below:

- Advantages
    - Prime location to meet OVPSD's operational objectives
    - Keeps eastern half of system in service when there is an interruption of service on the 12-inch Olympic Valley Road transmission main
    - Hydraulic modelling suggests location is compatible with both system pressures and maintains sufficient pressure at all water services
    - Even though it is within a road ROW, it is located out of the paved area in the shoulder
    - Located adjacent to Olympic Valley Rd. and the bike trial that are routinely plowed
- Disadvantages
    - County snowplows use 10-foot ROW for snow storage during winter months. OVPSD staff would need to remove snow berms from the top of vault in order to access
    - Potential to impact both vehicular traffic and/or pedestrian traffic during construction and repair activities
    - Risk to above ground electrical and SCADA enclosures

A planning level cost estimate was also developed for the proposed PRV location, which evaluates the construction costs associated with the PRV as a separate project than the BPS. The estimated cost of constructing the PRV within the Olympic Valley Road ROW at the intersection of Russell Road is $259,700. A detailed cost estimate for the PRV project can be found in Section 3.3.

RECOMMENDATIONS AND CONCLUSION

Considering all aspects of each BPS alternative, it is recommended to proceed with BPS Alternative 3 as the Preferred BPS Alternative. Not only does this alternative have the lowest estimated cost of construction, it also has key advantages that are critical when evaluating the impact of the Emergency Intertie. The most significant advantages that Alternative 3 has, which none of the alternatives have, is access to existing infrastructure that is currently in use by the SVMWC Well 1 building. This includes adequate electrical service, existing SCADA system instrumentation, existing chemical feed for system chlorination, and access to a backup power source. This existing infrastructure will reduce costs to the project.

For ease of access in case of maintenance and operation, it is recommended to have it in an-above ground heated cabinet. This would also alleviate any electrical, flooded vault, and confined space entry safety concerns associated with below ground vaults. Other BPS requirements include: a Hand-Off-Auto (HOA) switch, a human-machine interface (HMI), and connection to backup power. As stated in Section 2.6, the pump will need to convey 200 gpm at 100 feet of TDH.

Two BPS configurations were analyzed to aid in the ease of design. Viable alternatives for BPS design include either a pedestal-mounted variable speed single pump, which will require a 460V power supply, or a duplex Tigerflow skid system that includes two pumps in parallel, controls, and requires a 220V power supply. The pedestal-mounted pump is similar to the pump called out in the 2014 Shaw Engineering design. The Tigerflow skid includes a full package pumping system that is prefabricated by a pump manufacturer and may help reduce lead times for certain parts and materials. Cut sheets for the pump can be found in Appendix B.

The construction of the OVPSD-SVMWC Emergency Intertie will encompass both the BPS at SVMWC Well 1 and the PRV at the intersection of Olympic Valley Road and Russell Road. Since the BPS will strictly provide water to SVMWC and the PRV will strictly provide water to OVPSD, cost estimates were kept separate so that each entity can properly anticipate the cost of the infrastructure that they will own and operate. A total project cost estimate is also provided for the overall project. As discussed in Section 1.4, the longest identified lead time to obtain key electrical equipment is one year, which should be taken into account while moving forward with the design and construction schedule.

1.0 PROJECT PURPOSE AND GOALS

The water distribution systems analyzed in this report are located in Olympic Valley, California, which resides approximately five miles northwest of Tahoe City, California and approximately 10 miles south of Truckee, California. Residents of Olympic Valley are currently supplied water from two separate water systems; one system is operated by the Olympic Valley Public Services District (OVPSD), and the other is operated by the Squaw Valley Mutual Water Company (SVMWC). A map of the service area of each water system can be found in Figure 1. Currently, the water systems are not hydraulically connected. The purpose of this report is to discuss the construction of a permanent water system emergency intertie facility to interconnect the two separate water systems, called the OVPSD-SVMWC Emergency Intertie. The intertie will provide a community benefit and improve both systems by leveraging the water supply and storage of the other, not only for emergencies but also for planned maintenance and repair projects as needed.

The goal of the OVPSD-SVMWC Emergency Intertie is to improve water supply reliability. Connecting the two systems provides redundancy, which will keep both agencies' customers in service while one repairs and/or replaces key infrastructure. The construction of an emergency intertie will also enhance water supply reliability during emergency events such as power outages, contamination in one or more wells that affects water quality, mechanical well failures, fires, and other unforeseeable emergencies that may have previously resulted in interruptions in service. The emergency intertie project is not intended to and cannot address issues like aquifer-wide contamination or low groundwater levels. In such cases, both OVPSD and SVMWC wells may require a reduction in pumping capacity or be rendered non-operational and only a redundant emergency supply outside the Olympic Valley groundwater basin would solve the problem.

1.1 PROJECT BACKGROUND AND PREVIOUS WORK COMPLETED

There are currently three pressure zones within the OVPSD water system, known as Pressure Zone 1, 2, and 3. Pressure Zone 1 of the OVPSD water system is supplied by four groundwater wells and one horizontal well, with the 1,150,000-gallon West Tank providing storage for the zone. The West Tank has a base elevation of 6,424.5 feet and a maximum water surface elevation of 6,464.

The SVMWC water system has two pressure zones, known as Pressure Zone 1 and 2. The valley wells and horizontal well overflow supply water to the 160,000-gallon tank, which feeds SVMWC Pressure Zone 1. The Pressure Zone 1 tank has a base elevation of 6,534.2 feet and a maximum water surface elevation of 6,554 feet. The horizontal wells (as well as a BPS from the Pressure Zone 1 tank, when needed) supply water to the 300,000-gallon upper steel tank, which feeds Pressure Zone 2. The Pressure Zone 2 tank has a base elevation of 6,594 feet and a maximum water surface elevation of 6,617 feet.

An intertie would connect Pressure Zone 1 of the OVPSD water system to Pressure Zone 1 of the SVMWC system. The difference in maximum water surface elevations between the tanks in each system is 90 feet, which equates to a 39 psi pressure differential. Since the SVMWC Pressure Zone 1 operates at a higher pressure (or HGL), water from the OVPSD system would need to be pumped by a booster pump station (BPS) to provide water to the SVMWC system. This Intertie BPS would only turn on when pressures in SVMWC Pressure Zone 1 reach a pre-determined low level. Since the OVPSD Pressure Zone 1 operates at a lower pressure (HGL), water from SVMWC would be delivered to the OVPSD system through a PRV. The Emergency Intertie PRV would only open to allow water to flow into the OVPSD system when pressures in the OVPSD Pressure Zone 1 reach a pre-determined low level.

Plans for an emergency intertie between the OVPSD and SVMWC systems date back to 1989, when the consulting firm Dewante & Stowell performed an evaluation and created drawings that placed the Emergency Intertie BPS inside of the OVPSD Well 5R structure. Since then, the well house has been re-configured and putting the Emergency Intertie BPS inside the well house is no longer feasible. In 2012, another evaluation of potential intertie locations was performed by OVPSD staff. The following locations were determined to be feasible sites:

- Next to the Well 5R structure
- Washoe Drive near OVPSD's West Tank
- The intersection of Christy Lane and Olympic Valley Road
- 980 Olympic Valley Road
- Christy Lane at Valley View Condominiums

Based on a desktop evaluation of potential sites and cost estimates developed by OVPSD staff, it was determined that the two sites with the lowest associate cost were the intersection of Christy Lane and Olympic Valley Road and on Christy Lane at Valley View Condominiums. It was recommended to move forward with the Christy Lane at Valley View Condominiums location since a vault installed at that location would drain to daylight, mitigating flooding concerns inside of the vault.

OVPSD was awarded a $10,000 grant from Placer County Water Agency's (PCWA's) Financial Assistance Program (FAP) in 2012. This grant, in addition to funding from OVPSD and SVMWC, was used to support initial planning and preliminary design activities. The 2012 grant was used to fund the preparation of preliminary design documents by Shaw Engineering. The preliminary design, which was completed in 2014, laid the concept of a combined BPS/PRV location. The design was located in the road ROW next to a retaining wall, at 1560 Christy Road, and consisted of a BPS that pumped water from the 6-inch OVPSD main to the 8-inch SVMWC main, as well as two PRV's (6-inch and 2-inch) to allow water from SVMWC to feed the OVPSD system. The booster pump was designed to be a 480V 3 Phase 7.5 Hp vertical, multi-stage pump with a duty point of 200 gpm at 106 feet of TDH.

Ultimately, the intertie at the Valley View Condominiums was not constructed due to budgetary constraints. However, since this location was considered previously for the intertie and already has a preliminary design, it was analyzed as one of the alternatives in this report.

1.2 DESIGN CRITERIA

1.2.1 Existing and Future Water Demands

1.2.1.1 Olympic Valley Public Service District

The OVPSD water system currently owns and operates five wells: Well 1R, Well 2R, Well 3, Well 5R, and a Horizontal Well. The locations of the OVPSD wells are shown in Figure 2. The well capacities of the OVPSD wells are listed in Table 4.

Existing OVPSD system demands were provided to Farr West Engineering by OVPSD staff. An analysis of the system capacity was performed in 2015 by Farr West Engineering that included a determination of the future buildout demands for the system, as well as the additional demands brought on by the future Village at Palisades Tahoe development.

Table 5, below, provides a summary of the existing system demands, future additional demands, and full buildout demands for the OVPSD system. Based on OVPSD's well capacities and water demands, the system will be able to supply 200 gpm to SVMWC through the Emergency Intertie during ADD, MDD, and PHD scenarios.

Table 4: OVPSD Well Capacities

Well	Rated Capacity (gpm)
1R	420
2R	340
3	115
5R	425
Horizontal Well	35
Total OVPSD System Capacity	**1,335**

Table 5: OVPSD Existing System and Buildout Demands

Demand Scenario	ADD (gpm)	MDD (gpm)	PHD (gpm)
Existing System[1]	210	526	1,005
The Village at Palisades Buildout (Future)[2]	145	363	706
Additional Buildout (Future)[2]	189	471	707
Buildout Total	544	1,360	2,418

1 – Per 2021 analysis performed by OVPSD and provided to Farr West Engineering
2 – Per 2015 Water System Capacity Analysis performed by Farr West Engineering

1.2.1.2 Squaw Valley Mutual Water Company

The SVMWC water system currently owns and operates three wells: Well 1, Well 2, and a Horizontal Well. The locations of the SVMWC wells are shown in Figure 3. The well capacities for the SVMWC wells are listed in Table 6.

Existing SVMWC system demands were calculated using well production data provided to Farr West Engineering, with the exception of PHD, which was taken from the SVMWC 2018 Water System Improvements Preliminary Engineering Report (PER) prepared by Shaw Engineering. The 2018 PER indicates that there are only 16 vacant parcels within the SVMWC service area. Additional buildout demands were calculated based on the existing water usage per connection.

Table 7 below summarizes the SVMWC existing demands, additional buildout demands, and the total system buildout demands. Based on SVMWC's well capacities and water demands, the system will be able to supply 200 gpm to OVPSD through the Emergency Intertie during ADD and MDD scenarios, but not during PHD scenarios.

Table 6: SVMWC Well Capacities

Well	Rated Capacity (gpm)
1R	200
2R	200
Horizontal Well	25
Total SVMWC System Capacity	**425**

Table 7: SVMWC Existing System and Buildout Demands

Demand Scenario	ADD (gpm)	MDD (gpm)	PHD (gpm)
Existing System[1]	55	244	606[2]
Additional Buildout (Future)[3]	3	15	37
Buildout Total	58	259	643

1 – Per SVMWC well production data
2 – Per 2019 SVMWC PER
3 – Per existing water usage per connection applied to the 16 vacant parcels identified in the 2019 SVMWC PER

1.2.2 Regulatory Compliance

Regulatory compliance criteria for system pressure were considered when modeling alternatives. For system pressure requirements, the California Code of Regulations (CCR) Title 22 § 64602 was followed, which requires that pressures must, at the point of service, be always greater than or equal to 20 psi. This 20-psi rule applies to all demands, such as peak hour demand (PHD), average daily demand (ADD), maximum day demand (MDD), and a fire flow event (which is always calculated as fire flow at MDD). Pressures were analyzed at MDD for each alternative.

1.2.3 Booster Pump Station and Pressure Reducing Valves

Each Emergency Intertie alternative was analyzed to determine if an above-ground or below-ground BPS would best suit that location. If an above-ground BPS is deemed appropriate, it will consist of accessible housing that will protect the BPS from the elements. However, no structures (i.e., pump houses) will be constructed as part of this project. Rather, the BPS will be contained within an insulated protective structure.

The target flow rate for the BPS under each alternative is 200 gpm, which will provide almost 100% of SVMWC's water demands during MDD and about 33% of OVPSD's water demands during MDD. The ADD, MDD, and PHD for each system is discussed in Section 1.2.1.

The PRVs for the Intertie will consist of a 6-inch PRV sized to handle fire flow demands during MDD and a bypass line to a 2-inch PRV for lower flow events, such as ADD. A bypass to a smaller PRV will prevent the larger PRV from slamming open and closed unnecessarily during low flow events which will protect existing infrastructure from damage due to water hammer. The location of the PRV will be determined by OVPSD to ensure that the location best suits the needs of the system. The location and other details of the PRV are discussed in detail in Section 3.3.

1.2.4 SCADA and Electrical

Each BPS location for the Emergency Intertie will need access to 220V 3 Phase power for the pumps. Ancillary loads (SCADA, instrumentation, RTUs, etc.) did not affect the electrical service requirement. Details on pump specifics are discussed in Section 3.2.

Each PRV location for the Emergency Intertie will need access to power for heating and lights. Since the PRV will be for emergency purposes only, it will utilize manual pressure gauges and only have a flow meter on the 2-inch PRV. No transducers or SCADA will be installed at the PRV location as a part of this project, but empty conduits will be installed that can be used later to add SCADA if required. Details on power needs, type of flow meter, and the associated costs, are discussed in Section 3.2.

1.3 OPERATIONAL CONSTRAINTS/CONCERNS

A workshop was held on August 1, 2022 at Farr West Engineering to discuss key design considerations of the OVPSD-SVMWC Emergency Intertie with OVPSD Operations. The following list summarizes key operational aspects that were discussed during this workshop and considered during the alternatives analysis.

- Easy to access location for monthly visits, especially during the winter when snow can be an issue
- Avoiding snow storage areas for BPS/PRV locations (typically 5- to 10-foot width next to road)
- Operations prefers above-ground BPS for safety (electrical and confined space)
- Avoiding installation in paved busy roadways as the location for below-ground vaults
- Electrical and SCADA availability
- Designing for proper draining/pumping for below-ground vaults
- Using a heavy or bolt-down lid on below-ground vaults to avoid intrusion/vandalism
- Operations preferred location for the intertie that will keep the eastern half of the OVPSD system in service during repair/replacement on the Olympic Valley Road transmission

Operations emphasized their support of an Emergency Intertie location that would provide water supply redundancy to the east end of OVPSD’s Pressure Zone 1. Currently, when repairs are being made on the Olympic Valley Road transmission main, Operations staff has to manually switch the east end of Pressure Zone 1 to Pressure Zone 2 in order to supply water to those services. Having the Emergency Intertie PRVs close to this problem area and able to provide supply redundancy would take a cumbersome operational procedure away from OVPSD’s Operational employees and allow them to focus on quickly executing the repairs that need to be made on the distribution main.

1.4 COST ESTIMATES

The cost estimates developed for each alternative are planning level estimates that follow the AACE Level 3 Estimate guidelines and can range in accuracy from -20% to +30%. Cost estimates were developed by taking costs from similar jobs within the Lake Tahoe basin that have been constructed within the last two years and applying inflation factors and other adjustments to account for economic variations since those jobs took place. The numbers listed in the cost estimate are simply an Engineer’s Opinion of Probable Costs and can vary widely if taken to bid due to many factors, such as supply chain issues, contractor availability, etc. As of the writing of this report (December 2022), the longest identified lead time to obtain key electrical equipment is approximately one year.

All soft costs were calculated as a percentage of the construction total. Soft costs include the contingency, engineering services, permitting, inspection and construction management, and administration. The percentage used for each soft cost was consistent across all alternatives and is listed in Table 8.

Table 8: Percentage of Construction Total Used for Soft Costs

Soft Cost Description	Percentage of Construction Total
Contingency	15%
Engineering	10%
Permitting	5%
Inspection and Construction Management	10%
Administration	5%

2.0 ALTERNATIVES ANALYSIS OF BOOSTER PUMP STATION LOCATION

2.1 DESIGN APPROACH

The configuration of the existing OVPSD and SVMWC water distribution systems controlled the design approach of the OVPSD-SVMWC Emergency Intertie since there are limited alternatives that can be created based on the existing systems and pressure zones. The main considerations for the creation of the OVPSD-SVMWC Emergency Intertie alternatives was placing the BPS and PRVs at locations that would best serve each entity. The BPS analysis looked at five (5) main alternatives, as summarized below:

- BPS Alternative 1
  - Located near the Squaw Valley North Condos, on the west end of Christy Lane
- BPS Alternative 2
  - This alternative was originally just going to be at the location of the 2014 Shaw Engineering design. However, due to possible reliability issues at that location, an alternative location was also analyzed.
  - 2A
    - Located in front of Valley View Condos Christy Lane parking lot (original Shaw Engineering design location)
  - 2B
    - Located in Christy Hill ROW near dirt lot behind post office at 1600 Olympic Valley Road
- BPS Alternative 3
  - Located next to the Well 1 building (in same utility easement)
- BPS Alternative 4
  - Located in Olympic Valley Road ROW (between the road and the bike path) at the intersection with Russell Road
- BPS Alternative 5
  - Located at convergence of Lanny Lane and Hidden Lake Loop, near 984 Lanny Lane

Each BPS alternative is discussed in detail in Section 2.0. No analysis was performed for the location of the PRV. Rather, a location was chosen was OVPSD that would best suit the needs of the system. The location of the PRV is summarized below:

- Proposed PRV Location
  - Located in Olympic Valley Road ROW (between the road and the bike path) at the intersection with Russell Road

Details about the proposed PRV location are discussed in detail in Section 3.3.

2.2 MODEL DESCRIPTION

All modeling on the existing systems and proposed alternatives was performed in InfoWater Pro. The original water distribution model for OVPSD was developed in 2012 and was updated in 2021 with updated demands for Pressure Zone 1. Additionally, fire hydrant flow tests were performed by OVPSD staff in 2021 and the model was calibrated using the flow test results. The model calibration also included updated pump curves for existing wells and booster pump stations, as well as the creation of extended period simulation scenarios. Lidar of Olympic Valley was produced in 2021 and was incorporated into the model in 2022 to update all node elevations for more accurate hydraulic modeling. Lidar stands for *Light Detection and Ranging* and is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to Earth. These light pulses – combined with other data recorded by an airborne system – generate a precise, three-dimensional map that was used to estimate elevations within the model.

The SVMWC model was sent to Farr West Engineering by Shaw Engineering, which was then combined with the OVPSD model. All modeling was performed with the assumption that all infrastructure, demands, demand locations, pump settings, tank settings, and PRV settings within the SVMWC model were accurate and up to date. The SVMWC model contained a single MDD scenario. Node elevations for the SVMWC system were updated with the 2021 Lidar data that was used to update the OVPSD elevations so that all elevations within the combined model were as updated and accurate, relative to each other, as possible.

As the intertie BPS will operate only during emergency situations, it was assumed that the SVMWC wells would not be operational while the intertie booster is in use. With all tanks full and pumps off, the HGL and pressures for the SVMWC system will be at their highest under this condition. Each BPS alternative was modeled with this configuration to ensure that the pump selected will not be undersized. All other aspects of the model reflect how each system normally operates, such as OVPSD's waterline across the meadow being closed.

It is important to note that modeling was not performed for every possible operational scenario each water system might see and was only performed to adequately size and find a location for the BPS. Operational considerations will need to be taken into account during the design and incorporated into the Operations and Maintenance Manual for both systems. Based on feedback from Operations staff at OVPSD the following scenarios should be considered during the design phase:

- SVMWC Scenarios
  - Repair or replacement needed on the transmission main between well field and tanks
  - Well(s) out of service for maintenance or replacement
  - Facilitate refilling tanks after a fire flow event
  - Other service interruptions or maintenance activities

- OVPSD Scenarios
  - Keep eastern half of system in service when there is a repair needed on the 12-inch transmission main along Olympic Valley Road
  - Temporary loss well(s) for maintenance or replacement
  - Other service interruptions or maintenance activities

Each Emergency Intertie alternative was modeled assuming the proposed BPS would pump 200 gpm from OVPSD to SVMWC. The proposed water main sizes that lead to and from the BPS for each alternative were modeled to match the size of the existing main at the point of connection. The required TDH of each pump was determined for each location to evaluate which alternative was the most hydraulically feasible. Since each alternative would have a 6-inch/2-inch PRV setup from SVMWC to OVPSD that would remain closed under normal operations, only the preferred alternative was modeled with the PRVs to determine the operational settings of the PRVs. See Section 3.0 for details on the Preferred Alternative.

The pressures and pipe velocities at MDD for the existing OVPSD and SVMWC systems are shown in Figure 4 and Figure 5, respectively. These are shown as baselines, since modeling results presented for each alternative include changes to pressure and pipe velocities caused by the Emergency Intertie BPS. The operating point for the pump under each scenario will also be discussed, which was sized to pump from OVPSD to SVMWC during the MDD for each alternative. The MDD for each system is discussed in Section 1.2.1.

2.2.1 Modeling Results

Modeling the different alternatives determined that there was little to no variation in required pump TDH, meaning that none of the alternatives were more hydraulically efficient than the other. The reason for this is because each alternative pumps water from the OVPSD Pressure Zone 1 to the SVMWC Pressure Zone 1. Since the HGL within a pressure zone is the same across the entire pressure zone, these results make sense. Therefore, the hydraulics had the smallest effect on choosing the Preferred Alternative. A summary of all modeling results, including the TDH required to achieve 200 gpm of flow for each alternative, the changes in pressure caused by each alternative, and the changes in velocity caused by each alternative, are listed in Table 9, below. Changes in pressure and velocity for each alternative were evaluated where the existing OVPSD and SVMWC systems connect to each alternative, to keep a consistent frame of reference. Pressures in both the OVPSD and SVMWC systems exceeded the CCR Title 22, §64602 minimums under each alternative.

Table 9: Alternative Comparison of Pump Operating Points

Alternative	Total Dynamic Head, TDH (ft)	Pressure Change Upstream (psi)	Pressure Change Downstream (psi)	Velocity Change Upstream (fps)	Velocity Change Downstream (fps)
1	102	+2	-2	+2.5	+2.5
2A	101	+2	-2	+2.5	+2.5
2B	99	-1.5	+1	+2.5	+1.5
3	100	+4	+10	+1.5	+5
4	100	-1.5	+5	+ <1	+ <1
5	101	+3	+4	+1.5	+0.5

2.3 ALTERNATIVE 1: SQUAW VALLEY NORTH CONDOS (WEST END OF CHRISTY LANE)

2.3.1 Alternative Description

Alternative 1 consists of placing the Intertie BPS at the end of Christy Lane, near the Squaw Valley North Condos. The proposed location of the BPS is shown in Figure 6. The BPS under Alternative 1 will be in a below-ground vault since this location is within a ROW and will be plowed for snow in the winter. This location was chosen as an alternative since Christy Lane is a lower traffic road, allowing Operations to easily access the vault.

The BPS for Alternative 1 will tie into 6-inch mains on both the SVMWC and OVPSD side. This Alternative will require approximately 190 feet of 6-inch pipe; 130 feet to connect to OVPSD on the upstream side and 60 feet to connect to SVWMC on the downstream side.

Alternative 1 has specific advantages and disadvantages associated with the location, as summarized below:

- Advantages
  - Located in a less-traveled residential road
  - Snow removal by County
  - Can still provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
  - Is within a public ROW, no additional utility easement required
- Disadvantages
  - Below-ground vault
  - Secondary residential road; potential for delayed County snow removal
  - Rock excavation during construction will add cost and complexity to construction
  - Snow berm removal to access during the winter
  - Power and SCADA would need to be extended to this area
  - Will require approximately 190 feet of pipe to tie-in to existing systems (which is at the higher end for all the alternatives)
  - Close to residences, which could cause noise complaints while the pump is running

- Parking area required for emergency trailer mounted generator
- No chemical feed capabilities
- Risk to above ground electrical and SCADA enclosures

2.3.2 Cost Estimate

The cost estimate for Alternative 1 is summarized in Table 10. The cost estimate only evaluates the construction costs associated with the BPS. Costs associated with constructing the PRV will be determined in a separate analysis in Section 3.3. Assumptions for soft costs are listed in Section 1.4. All cost estimate numbers are roughly based on what market prices should be, but because of supply chain issues and lack of contractor availability at the time of this estimate, contractor bid prices may be drastically different.

The mobilization and demobilization line item was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be lower, at approximately 2.5% of the construction subtotal since Alternative 1 is not located near a major road. Similarly, erosion control was also estimated to be approximately 2.5% of the construction subtotal since Alternative 1 is not located near Washeshu Creek, resulting in a lower effort for erosion control. The cost for the pump and underground vault includes installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the BPS site. Electrical, backup power, and SCADA prices includes the cost of all items necessary to extend services to the BPS location, as well as installation costs. Power at this site was assumed to be 220V 3 Phase.

Table 10: Alternative 1 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$18,000.00	$18,000.00
Traffic Control	1	EA	$9,000.00	$9,000.00
Erosion Control	1	EA	$9,000.00	$9,000.00
4-inch Pump and Underground Vault	1	EA	$125,000.00	$125,000.00
6-inch C900 PVC	190	FT	$300.00	$57,000.00
Interties - Connect to Existing Systems	2	EA	$10,000.00	$20,000.00
3-inch Patch Paving	1,440	SF	$12.00	$17,280.00
Electrical and SCADA	1	LS	$105,000.00	$105,000.00
			Construction Subtotal:	**$360,300.00**
			Contingency:	$54,100.00
			Engineering Design:	$36,100.00
			Permitting:	$18,100.00
			Inspection and Construction Management:	$36,100.00
			Administration:	$18,100.00
			Total Estimated Cost:	**$522,800.00**

2.4 ALTERNATIVE 2A: CHRISTY LANE PARKING LOT FOR VALLEY VIEW CONDOS

As stated previously, Alternative 2 was originally going to only encompass the location recommended by the District in their 2012 site analysis and the 2014 Shaw Engineering design. However, an alternative location was also analyzed that is close-by and does not require reliance on the Valley View Condos water mains for water supply. Although the District owns the 6-inch water mains within the common areas, the Homeowners Association (HOA) owns all water service lines, and in recent years, water supply to Valley

View has been interrupted a number of times due to water service failures. This is expected to be the case for a number of years as the HOA replaces water services as they fail. The location of the Intertie BPS for the 2014 Shaw Engineering design is in front of the Christy Lane parking lot for the Valley View Condos (1560 Olympic Valley Road), which will be discussed and analyzed as Alternative 2A. The alternative BPS site that will be discussed and analyzed as Alternative 2B is located in the County ROW on the east side of the privately owned dirt lot behind the Post Office at 1600 Olympic Valley Road.

2.4.1 Description

Alternative 2A is located on the roadway shoulder between the south edge of Christy Lane and the Valley View Condos parking lot, as shown by Figure 7. The shoulder is approximately 10-feet wide and encompasses the space between the road and the Valley View Condos parking lot. The shoulder is supported by a retaining wall on the parking lot, or southern, side.

The BPS for Alternative 2A will tie into 6-inch mains on both the SVMWC and OVPSD side. This Alternative will require approximately 65 feet of 6-inch pipe; 40 feet to connect to OVPSD on the upstream side and 25 feet to connect to SVWMC on the downstream side.

The 2014 Shaw design for the Emergency Intertie BPS at this location consisted of a below-ground vault that housed both the pump and the PRVs. Since this alternative is within a ROW, it will remain housed in a below-ground vault. This location was originally chosen by OVPSD staff in 2012 since the vault could drain to daylight by connecting the vault drain to an existing drain in the parking lot south of the retaining wall. Additionally, structural considerations would need to be taken during construction to ensure the stability of the retaining wall on the south side of the vault.

Supply to the BPS from the OVPSD water system has to go through the Valley View Condos infrastructure, which is old and in need of frequent repairs. Even though the mains are located in the Valley View Condos common area, they are difficult to access due to obstacles within the developments. Due to these issues, Alternative 2A has a lower reliability for emergency situations that can happen at any time.

Alternative 2A has specific advantages and disadvantages associated with the location, as summarized below:

- Advantages
    - Can still provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
    - Is within a public ROW
    - Snow removal by County
    - Close to tie-in points and only requires 65 feet of new pipe
    - Only location where underground vault could drain to daylight
- Disadvantages
    - Lower reliability due to condition of water infrastructure in Valley View Condos
    - Connection to OVPSD system may require utility easement on private property depending on final design alignment
    - Below-ground vault
    - Secondary residential road; potential for delayed County snow removal
    - Snow berm removal to access during the winter
    - Power and SCADA would need to be extended to this area
    - Close to residences, which could cause noise complaints while pump is running
    - Potential structural impacts to existing retaining wall
    - Parking area required for emergency trailer mounted generator
    - No chemical feed capabilities
    - Risk to above ground electrical and SCADA enclosures

2.4.2 Cost Estimate

The cost estimate for Alternative 2A is summarized in Table 12. The cost estimate only evaluates the construction costs associated with the BPS. Costs associated with constructing the PRV will be determined in a separate analysis in Section 3.3. Assumptions for soft costs are listed in Section 1.4. All cost estimate numbers are roughly based on what market prices should be, but because of supply chain issues and lack of contractor availability at the time of this estimate, contractor bid prices may be very different.

Mobilization/demobilization was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be approximately 5% of the construction subtotal, since Alternative 2A may impact traffic on Christy Lane, which is a main residential road. Erosion control was estimated to be approximately 2.5% of the construction subtotal since Alternative 2A is not located near Washeshu Creek, resulting in a lower effort for erosion control. The cost for the pump and underground vault includes installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the BPS site. Electrical, backup power, and SCADA prices includes the cost of all items necessary to extend services to the BPS location, as well as installation costs. Power at this site was assumed to be 220V 3 Phase.

Table 11: Alternative 2A Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$16,000.00	$16,000.00
Traffic Control	1	EA	$16,000.00	$16,000.00
Erosion Control	1	EA	$8,000.00	$8,000.00
4-inch Pump and Underground Vault	1	EA	$125,000.00	$125,000.00
6-inch C900 PVC	65	FT	$300.00	$19,500.00
Interties - Connect to Existing Systems	2	EA	$10,000.00	$20,000.00
3-inch Patch Paving	220	SF	$12.00	$2,640.00
Electrical and SCADA	1	LS	$105,000.00	$105,000.00
			Construction Subtotal:	**$312,200.00**
			Contingency:	$46,900.00
			Engineering Design:	$31,300.00
			Permitting:	$15,700.00
			Inspection and Construction Management:	$31,300.00
			Administration:	$15,700.00
			Total Estimated Cost:	**$453,100.00**

2.5 ALTERNATIVE 2B: BEHIND POST OFFICE

2.5.1 Description

Alternative 2B is located within the utility ROW of Christy Hill Road on a private dirt lot behind the Post Office located at 1600 Olympic Valley Road, as shown by Figure 8. The BPS will tie into a 6-inch main on the OVPSD side and an 8-inch main on the SVMWC side. This Alternative will require approximately 80 feet of 6-inch pipe to connect to OVPSD on the upstream side, and approximately 20 feet of 8-inch pipe to connect to SVWMC on the downstream side.

The BPS under Alternative 2B would be installed in an underground vault since it will be located within a road ROW. Since Christy Hill Road is a main residential road, snow will be consistently plowed and piled within the 10-foot ROW during the winter months, making the BPS difficult to access.

Alternative 2B has specific advantages and disadvantages associated with the location, as summarized below:

- Advantages
  - Can still provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
  - Close to tie-in locations, requiring only 80 ft of new pipe
  - Would require least amount of work within paved road
  - Snow removal by County
  - Not close to residences
- Disadvantages
  - Below-ground vault
  - Private utility easement or private construction easement may be required
  - Snow berm removal to access during the winter
  - Power and SCADA would need to be extended to this area
  - Snow berm removal to access during the winter
  - No chemical feed capabilities
  - Parking area required for emergency trailer mounted generator

2.5.2 Cost Estimate

The cost estimate for Alternative 2 is summarized in Table 12. The cost estimate only evaluates the construction costs associated with the BPS. Costs associated with constructing the PRV will be determined in a separate analysis in Section 3.3. Assumptions for soft costs are listed in Section 1.4. All cost estimate numbers are roughly based on what market prices should be, but because of supply chain issues and lack of contractor availability at the time of this estimate, contractor bid prices may be very different.

Mobilization/demobilization was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be lower, at approximately 5% of the construction subtotal, since Alternative 2B is within the ROW of a main residential road and may impact traffic during construction. Erosion control was estimated to be approximately 2.5% of the construction subtotal since Alternative 2B is not located near Washeshu Creek, resulting in a lower effort for erosion control. The cost for the pump and underground vault includes installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the BPS site. Electrical, backup power, and SCADA prices includes the cost of all items necessary to extend services to the BPS location, as well as installation costs. Power at this site was assumed to be 220V 3 Phase.

Table 12: Alternative 2B Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$16,000.00	$16,000.00
Traffic Control	1	EA	$16,000.00	$16,000.00
Erosion Control	1	EA	$8,000.00	$8,000.00
4-inch Pump and Underground Vault	1	EA	$125,000.00	$125,000.00
6-inch C900 PVC	80	FT	$300.00	$24,000.00
8-inch C900 PVC	20	FT	$350.00	$7,000.00
Interties - Connect to Existing Systems	2	EA	$10,000.00	$20,000.00
3-inch Patch Paving	100	SF	$12.00	$1,200.00
Electrical and SCADA	1	LS	$105,000.00	$105,000.00
			Construction Subtotal:	**$322,200.00**
			Contingency:	$48,400.00
			Engineering Design:	$32,300.00
			Permitting:	$16,200.00
			Inspection and Construction Management:	$32,300.00
			Administration:	$16,200.00
			Total Estimated Cost:	**$467,600.00**

2.6 ALTERNATIVE 3: SVMWC WELL 1

2.6.1 Alternative Description

Alternative 3 is located at the SVMWC Well 1 pump house. Due to space constraints within the existing well house, the BPS for this alternative would be located just outside of the pump house in an above-ground protective enclosure, as shown in Figure 9. Currently, there is a utility easement for the well house. If the BPS vault cannot fit within the current easement, SVMWC will need to work with the property owner to expand the utility easement prior to design and construction. This alternative has the closest proximity to existing power, SCADA, chemical feed facilities, and backup power at Well 1. It is also the only alternative that will have access to an existing stationary backup power source. With its location in the main ski area parking lot, snow removal is consistently performed in a timely manner by the Palisades Tahoe. The SVMWC staff would only be responsible for snow removal directly adjacent to the well building.

The BPS under Alternative 3 will tie into an 8-inch main on the OVPSD side and a 6-inch main on the SVMWC side. Both the upstream and downstream tie-in locations are on distributions mains that the well fields feed each system from. This alternative will require approximately 100 feet of 8-inch pipe to connect to OVPSD on the upstream side, and approximately 15 feet of 6-inch pipe to connect to SVMWC on the downstream side.

It is acknowledged that the Well 1 building is located within the planned development area for the Palisades at Tahoe Specific Plan. OVPSD has reviewed 90% level backbone infrastructure plans from Palisades engineering consultant Psomas. The improvement plans show the SVMWC Well 1 house remaining in its current location.

Alternative 3 has specific advantages and disadvantages associated with the location, as summarized below:

- Advantages
    - Above ground BPS
    - Located in a parking lot, allowing for easy access with no traffic control
    - Snow removed consistently around Well 1 pump house by Palisades staff with minimal additional snow removal required by SVMWC
    - Power, backup power, chemical feed, and SCADA already on-site
    - Not close to residences
- Disadvantages
    - Cannot provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
    - Will require approximately 115 feet of pipe to tie-in to existing systems, which is on the higher end for all the alternatives
    - Connection to existing systems will require utility easements on private property depending on the final design alignment

2.6.2 Cost Estimate

The cost estimate for Alternative 3 is summarized in Table 13. The cost estimate only evaluates the construction costs associated with the BPS. Costs associated with constructing the PRV will be determined in a separate analysis in Section 3.3. Assumptions for soft costs are listed in Section 1.4. All cost estimate numbers are roughly based on what market prices should be, but because of supply chain issues and lack of contractor availability at the time of this estimate, contractor bid prices may be very different.

Mobilization/demobilization was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be lower, at approximately 2.5% of the construction subtotal, since Alternative 3 is not located near a major road. Similarly, erosion control was also estimated to be approximately 2.5% of the construction subtotal since Alternative 3 is not located near Washeshu Creek, resulting in a lower effort for erosion control. The cost for the pump and enclosure includes installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the BPS site. Electrical, backup power, and SCADA prices includes the cost of all items necessary to extend services to the BPS location, as well as installation costs. Power at this site was assumed to be 220V 3 Phase.

Table 13: Alternative 3 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$14,000.00	$14,000.00
Traffic Control	1	EA	$7,000.00	$7,000.00
Erosion Control	1	EA	$7,000.00	$7,000.00
4-inch Pump with Above Ground Housing	1	EA	$150,000.00	$150,000.00
6-inch C900 PVC	15	FT	$300.00	$4,500.00
8-inch C900 PVC	100	FT	$350.00	$35,000.00
Interties - Connect to Existing Systems	2	EA	$10,000.00	$20,000.00
3" Patch Paving	1,290	SF	$12.00	$15,480.00
Electrical and SCADA	1	EA	$14,000.00	$14,000.00
Construction Subtotal:				**$267,000.00**
Contingency:				$40,100.00
Engineering Design:				$26,700.00
Permitting:				$13,400.00
Inspection and Construction Management:				$26,700.00
Administration:				$13,400.00
Total Estimated Cost:				**$387,300.00**

2.7 ALTERNATIVE 4: INTERSECTION OF OLYMPIC VALLEY ROAD AND RUSSELL ROAD

2.7.1 Alternative Description

The Alternative 4 BPS is located near the intersection of Olympic Valley Road and Russell Road. Under this alternative, the BPS would be housed in an underground vault in the road ROW, between the road and the bike path, as shown by Figure 10.

The BPS under Alternative 4 will tie into a 12-inch main on the OVPSD side and an 8-inch main on the SVMWC side. This Alternative will require approximately 30 feet of 12-inch pipe to connect to OVPSD on the upstream side, and approximately 45 feet of 8-inch pipe to connect to SVWMC on the downstream side. This is the only alternative that will require open trenching on Olympic Valley Road, which will require significant traffic control and an 8-inch-thick pavement patch. In addition, due to the close proximity of this alternative to the meadow and Washeshu Creek, this site would require significantly more erosion control than other alternatives.

Alternative 4 has specific advantages and disadvantages associated with the location, as summarized below:

- Advantages
    - Can still provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
    - Is not located on private property, so would not require a private utility easement
    - Is within a public ROW, off pavement
    - County in charge of snow removal on Olympic Valley Road
    - Close to both existing systems, requiring only 75 feet of pipe for connections
    - Not close to residences

- Disadvantages
    - Proximity to Olympic Valley Rd.
    - Below-ground vault
    - Snow berm removal to access during the winter
    - Power and SCADA would need to be extended to this area
    - Potential impacts to pedestrians and traffic control during construction and O&M
    - No chemical feed capabilities
    - Parking area required for emergency trailer mounted generator
    - Risk to above ground electrical and SCADA enclosures

2.7.2 Cost Estimate

The cost estimate for Alternative 4 is summarized in Table 14. The cost estimate only evaluates the construction costs associated with the BPS. Costs associated with constructing the PRV will be determined in a separate analysis in Section 3.3. Assumptions for soft costs are listed in Section 1.4. All cost estimate numbers are roughly based on what market prices should be, but because of supply chain issues and lack of contractor availability at the time of this estimate, contractor bid prices may be very different.

Mobilization/demobilization was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be high, at approximately 7.5% of the construction subtotal, since Alternative 4 will require traffic control on Olympic Valley Road. Similarly, erosion control was also estimated to be approximately 7.5% of the construction subtotal since Alternative 4 is located near Washeshu Creek, resulting in a higher effort for erosion control to protect the meadow and creek. The cost for the pump and underground vault includes installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the BPS site. It was assumed that Olympic Valley Road will require 8-inches of asphalt for patching and all other roads (including the bike path) would require 3-inches of asphalt for patching. Electrical, backup power, and SCADA prices includes the cost of all items necessary to extend services to the BPS location, as well as installation costs. Power at this site was assumed to be 220V 3 Phase.

Table 14: Alternative 4 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$18,000.00	$18,000.00
Traffic Control	1	EA	$27,000.00	$27,000.00
Erosion Control	1	EA	$27,000.00	$27,000.00
4-inch Pump and Underground Vault	1	EA	$125,000.00	$125,000.00
8-inch C900 PVC	45	FT	$350.00	$15,750.00
12-inch C900 PVC	30	FT	$425.00	$12,750.00
Interties - Connect to Existing Systems	2	EA	$10,000.00	$20,000.00
3-inch Patch Paving	60	SF	$12.00	$720.00
8-inch Patch Paving on Olympic Valley Road	280	SF	$18.00	$5,040.00
Electrical and SCADA	1	LS	$105,000.00	$105,000.00
Construction Subtotal:				**$356,300.00**
Contingency:				$53,500.00
Engineering Design:				$35,700.00
Permitting:				$17,900.00
Inspection and Construction Management:				$35,700.00
Administration:				$17,900.00
Total Estimated Cost:				**$517,000.00**

2.8 ALTERNATIVE 5: HIDDEN LAKE LOOP

2.8.1 Alternative Description

The Alternative 5 BPS is located in the ROW of Lanny Lane, where it transitions to Hidden Lake Loop, as shown by Figure 11. Since this BPS is within a road ROW, it would be housed in an underground vault.

The BPS under Alternative 5 will tie into an 8-inch main on the OVPSD side and an 8-inch main on the SVMWC side. This alternative will require approximately 195 feet of 8-inch pipe; 65 feet to connect to OVPSD on the upstream side and 130 feet of to connect to SVWMC on the downstream side.

Alternative 5 has specific advantages and disadvantages associated with the location, as summarized below:

- Advantages
  - Can still provide water to SVMWC from OVPSD if there is an interruption of service on the 8-inch transmission main under Washeshu Creek from the well field to the tanks
  - Is within a public ROW
  - Snow removed consistently since this is a residential road
- Disadvantages
  - Below-ground vault
  - Secondary residential road; potential for delayed County snow removal
  - County in charge of snow removal at this location
  - Snow berm removal to access during the winter
  - Power and SCADA would need to be extended to this area
  - Will require approximately 260 feet of pipe to tie-in to existing systems, which is the highest amount of new pipe out of all the alternatives

- Close to residences, which could cause noise complaints while the pump is running
- Parking area required for emergency trailer mounted generator
- No chemical feed capabilities
- Risk to above ground electrical and SCADA enclosures

2.8.2 Cost Estimate

The cost estimate for Alternative 5 is summarized in Table 15. The cost estimate only evaluates the construction costs associated with the BPS. Costs associated with constructing the PRV will be determined in a separate analysis in Section 3.3. Assumptions for soft costs are listed in Section 1.4. All cost estimate numbers are roughly based on what market prices should be, but because of supply chain issues and lack of contractor availability at the time of this estimate, contractor bid prices may be very different.

Mobilization/demobilization was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be lower, at approximately 2.5% of the construction subtotal, since Alternative 5 is not located near a major road. Similarly, erosion control was also estimated to be approximately 2.5% of the construction subtotal since Alternative 5 is not located near Washeshu Creek, resulting in a lower effort for erosion control. The cost for the pump and underground vault includes installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the BPS site. Electrical, backup power, and SCADA prices includes the cost of all items necessary to extend services to the BPS location, as well as installation costs. Power at this site was assumed to be 220V 3 Phase.

Table 15: Alternative 5 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$19,000.00	$19,000.00
Traffic Control	1	EA	$9,500.00	$9,500.00
Erosion Control	1	EA	$9,500.00	$9,500.00
Booster Pump Station in Underground Vault	1	EA	$125,000.00	$125,000.00
8-inch C900 PVC	195	FT	$350.00	$68,250.00
Interties - Connect To Existing Systems	2	EA	$10,000.00	$20,000.00
3-inch Patch Paving	1,470	SF	$12.00	$17,640.00
Electrical and SCADA for BPS	1	LS	$105,000.00	$105,000.00
			Construction Subtotal:	**$373,900.00**
			Contingency:	$56,100.00
			Engineering Design:	$37,400.00
			Permitting:	$18,700.00
			Inspection and Construction Management:	$37,400.00
			Administration:	$18,700.00
			Total Estimated Cost:	**$542,200.00**

3.0 RECOMMENDATIONS AND CONCLUSION

3.1 PREFERRED BPS ALTERNATIVE

A Preferred Alternative was chosen after comparing the modeling results, alternative-specific advantages, and cost estimates. As stated in Section 2.2.1, the TDH required by the BPS was the same for each alternative. Similarly, changes in pressure and velocity due to each alternative were minimal. Therefore, no alternative was identified as more hydraulicly efficient than another alternative.

An analysis was performed that compared alternatives to determine which ones had key advantages, as summarized in Table 16. The advantages and disadvantages of each alternative are discussed in detail in Section 2.0. Overall, Alternative 2A had the lowest number of advantages that were identified as important, and Alternatives 3 had the highest number of advantages, making these Alternative 3 the most in-line with identified key aspects of design.

Lastly, the cost estimates for each alternative were compared, as summarized in Table 17. It is important to note that cost estimates developed for each alternative are planning level estimates, which follow the AACE Level 3 Estimate guidelines and can range in accuracy from -20% to +30%. Alternative 3 was identified as the lowest cost alternative, largely due to the connection to existing power, backup power, chlorine chemical feed, and SCADA being close by. This was also the only alternative that did not need to purchase a generator for backup power, since there is an existing backup generator at Well 1 that the Emergency Intertie BPS can connect to.

Considering all aspects of each alternative, it is recommended to proceed with Alternative 3 as the Preferred Alternative. Not only does this alternative have the lowest estimated cost of construction, it has key advantages that are critical when evaluating the impact of the Emergency Intertie. The most significant advantages that Alternative 3 has, which none of the alternatives have, is direct access to power, backup power, chemical feed, and SCADA, as well as a location that is already on a utility easement.

Table 16: Alternative Comparison of Key Advantages

Advantages of Alternative	1	2A	2B	3	4	5
Above-ground Vault				X		
Not located in high-traffic road/ROW	X			X		X
OVPSD or SVMWC already in charge of snow removal at location				X		
Located in existing high-volume snow removal area		X	X	X	X	
Can provide water during breaks/repairs on 8-inch transmission main from well field	X	X	X		X	X
Close to existing power and SCADA				X		
Close to both existing systems, requiring less pipe for tie-ins		X	X		X	
Not close to residences			X	X	X	
Installation in ROW and no additional utility easements required	X				X	X
Total	**3**	**3**	**4**	**6**	**5**	**3**

Table 17: Alternative Comparison of Cost Estimates for BPS Only

Alternative	Estimated Cost of Constructing BPS
1	$522,800
2A	$453,100
2B	$467,600
3	$387,300
4	$517,000
5	$542,200

3.2 SVMWC PREFERRED BPS DESIGN

Under Alternative 3, the BPS will have access to existing infrastructure that is currently in use by the SVMWC Well 1 building. This includes adequate electrical service, existing SCADA system instrumentation, existing chemical feed facilities, and access to a backup power source. This existing infrastructure reduce costs to the project. For ease of access in case of maintenance and operation, it is recommended to have it in an-above ground heated cabinet. This would also alleviate any confined space entry safety concerns by having it below ground. Other BPS requirements include: a Hand-Off-Auto (HOA) switch, a human-machine interface (HMI), and connection to backup power. As stated in Section 2.6, the pump will need to convey 200 gpm at 100 feet of TDH.

Two BPS configurations were analyzed to aid in the ease of design. Viable alternatives for BPS design include either a pedestal-mounted variable speed single pump, which will require a 460V power supply, or a dual Tigerflow skid system that includes two pumps in parallel, controls, and requires a 220V power supply. The pedestal-mounted pump is similar to the pump called out in the 2014 Shaw Engineering design, but cost estimates would need to be updated to reflect the increased power supply necessary for the operation of that pump. The Tigerflow skid includes a full package pumping system that is prefabricated by a pump manufacturer and may help reduce lead times for certain parts and materials. Cut sheets for the pump can be found in Appendix B.

3.3 OVPSD PREFERRED PRV DESIGN

The PRV portion of the Emergency Intertie will allow water from SVMWC to feed the OVPSD system and will consist of both a 6-inch and a 2-inch PRV. The larger 6-inch PRV will only open to feed during larger emergency events, such as a fire flow event, and the smaller 2-inch PRV will only open to feed during smaller emergency events, such as supplying a typical ADD during repairs on the 12-inch Olympic Valley Road transmission main. Having two PRVs will ensure that OVPSD can receive an appropriate amount of water for the situation, while also preventing the 6-inch from creating water hammer by slamming open and closed for smaller amounts of flow. Water hammer is a situation that should always be avoided, since it can have devastating effects on water pipe, pumps, valves, and other PRVs.

In order to track flow, a flow meter is proposed for the 2-inch PRV. The flow meter will be a Badger 2-inch E-Series meter. Per the manufacturer's website, the flow meter is powered by a 3.6V lithium thionyl chloride battery that has a 20-year battery life. Cut sheets for the flow meter can be found in Appendix B. Power will be necessary to supply heat and light within the below-ground PRV vault; however, SCADA will not need to be extended to the PRV vault since pressure gauges will be manually read and no transducers will be installed as part of this project. A 120V panelboard will provide adequate power for the heating and lighting within the PRV vault. Conduit should be installed within the PRV vault to allow for future installation of SCADA if necessary and if a transducer is added in the future to connect to SCADA, a meter pedestal with a couple circuits and small transformer will be required that steps the voltage down to 120/240V (single phase).

The location for the PRV vault will be in the dirt shoulder between the road and the bike path at the intersection of Olympic Valley Road and Russell Road. The location of the proposed PRV vault, that houses both the 6-inch and 2-inch PRVs, is shown in Figure 12. The location of the PRV vault is advantageous to the operation of the OVPSD water system under emergency situations since it adds another water source on the east side of Pressure Zone 1. When repairs are being made on the 12-inch Olympic Valley Road transmission main, the ability for the PRV to supply water to the east side of Pressure Zone 1 will negate OVPSD Operations staff needing to manually open gate valves and PRVs to back feed Pressure Zone 1 from Pressure Zone 2. Other advantages and disadvantages of this location were considered, which are summarized below:

- Advantages
    - Prime location to meet OVPSD's operational objectives
    - Keeps eastern half of system in service when there is an interruption of service on the 12-inch Olympic Valley Road transmission main
    - Hydraulic modelling suggests location is compatible with both system pressures and maintains sufficient pressure at all water services
    - Even though it is within a road ROW, it is located out of the paved area in the shoulder
    - Located adjacent to Olympic Valley Rd. and the bike trial that are routinely plowed
- Disadvantages
    - County snowplows use 10-foot ROW for snow storage during winter months. OVPSD staff would need to remove snow berms from the top of vault in order to access
    - Potential to impact both vehicular traffic and/or pedestrian traffic during construction and repair activities
    - Risk to above ground electrical and SCADA enclosures
-

The cost estimate for the construction of the PRV portion of the Emergency Intertie is summarized in Table 18. The cost estimate only evaluates the construction costs associated with the PRVs. Costs associated with constructing the BPS are listed in Section 2.6.2. Assumptions for soft costs are listed in Section 1.4.

Mobilization/demobilization was assumed to be approximately 5% of the construction subtotal, which is an industry standard. Traffic control was estimated to be high, at approximately 7.5% of the construction subtotal, since installation of the PRVs will require traffic control on Olympic Valley Road. Similarly, erosion control was also estimated to be approximately 7.5% of the construction subtotal since the location of the PRV vault is located near Washeshu Creek, resulting in a higher effort for erosion control to protect the meadow and creek. The cost for the PRV vault includes materials, delivery, and installation costs. Asphalt patch paving assumes 100 ft^2 per connection to the existing OVPSD or SVMWC system, 6 feet wide per linear foot along proposed pipe, and 100 ft^2 at the PRV site. It was assumed that Olympic Valley Road will require 8-inches of asphalt for patching and all other roads (including the bike path) would require 3-inches of asphalt for patching. Electrical prices include the cost of all items necessary to extend services to the PRV location, as well as installation costs.

Table 18: Preferred PRV Location Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$9,000.00	$9,000.00
Traffic Control	1	EA	$13,500.00	$13,500.00
Erosion Control	1	EA	$13,500.00	$13,500.00
8-inch C900 PVC	45	FT	$350.00	$15,750.00
12-inch C900 PVC	30	FT	$425.00	$12,750.00
Interties - Connect to Existing Systems	2	EA	$10,000.00	$20,000.00
PRV Vault	1	EA	$75,000.00	$75,000.00
3-inch Patch Paving on bike path	160	SF	$12.00	$1,920.00
8-inch Patch Paving on Olympic Valley Road	280	SF	$18.00	$5,040.00
Electrical for PRV	1	LS	$12,500.00	$12,500.00
Construction Subtotal:				**$179,000.00**
Contingency:				$26,900.00
Engineering Design:				$17,900.00
Permitting:				$9,000.00
Inspection and Construction Management:				$17,900.00
Administration:				$9,000.00
Total Estimated Cost:				**$259,700.00**

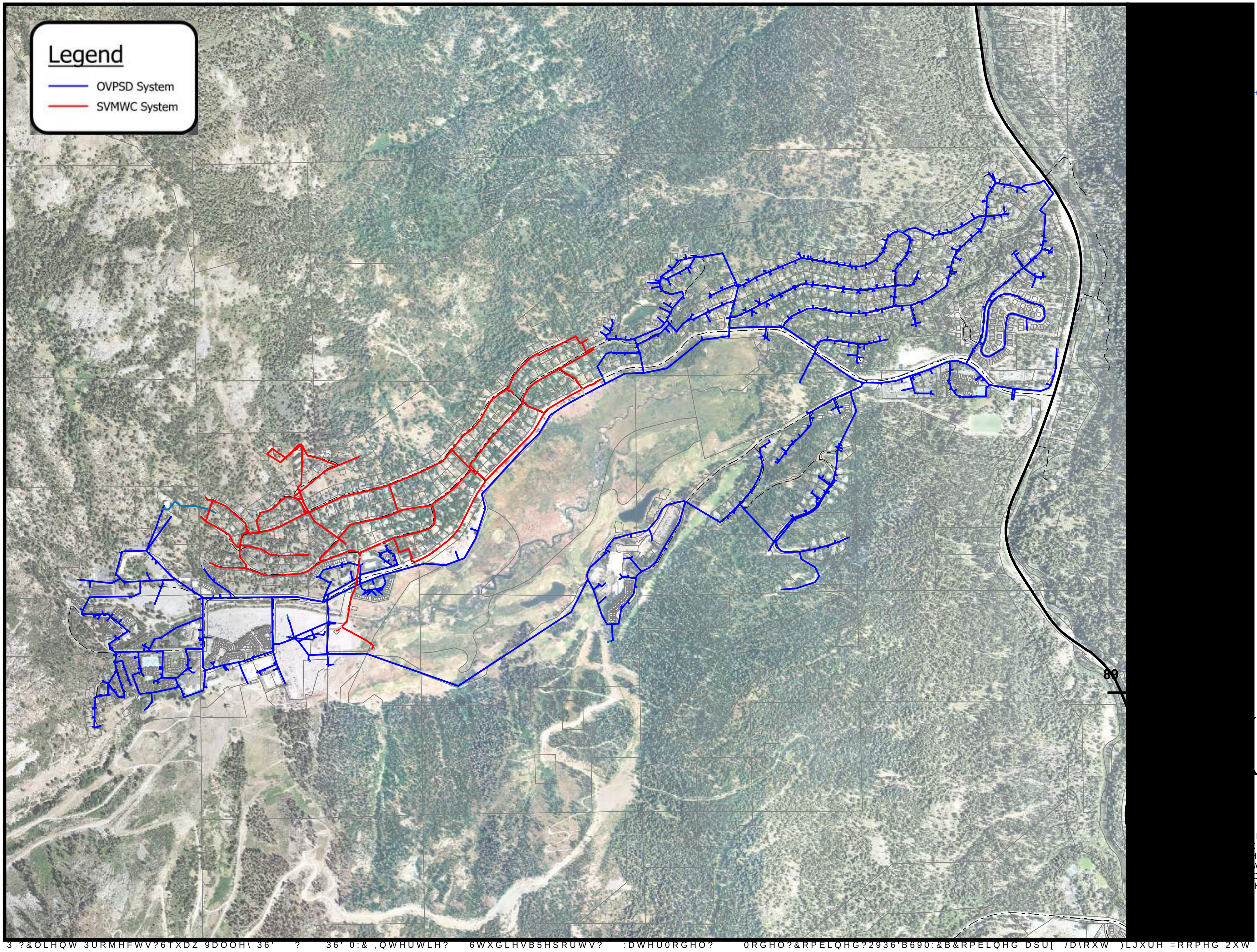
3.4 COMBINED PROJECT RECOMMENDATIONS

The construction of the OVPSD-SVMWC Emergency Intertie will encompass both the BPS at SVMWC Well 1 (BPS Alternative 3) and the PRV at the intersection of Olympic Valley Road and Russell Road. Since the BPS will strictly provide water to SVMWC and the PRV will strictly provide water to OVPSD, cost estimates were kept separate so that each entity can properly anticipate the cost of the infrastructure that they will own and operate. As discussed in Section 1.4, the longest identified lead time to obtain key electrical equipment is one year, which should be taken into account while moving forward with the design and construction schedule. The total project cost estimate for the preferred alternatives, including the BPS and PRV, is summarized in Table 19.

Table 19: Total Project Cost Estimate for Preferred Alternatives

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization	1	EA	$22,500.00	$22,500.00
Traffic Control	1	EA	$20,500.00	$20,500.00
Erosion Control	1	EA	$20,500.00	$20,500.00
Booster Pump Station in Above Ground Housing	1	EA	$150,000.00	$150,000.00
6-inch C900 PVC	15	FT	$300.00	$4,500.00
8-inch C900 PVC	145	FT	$350.00	$50,750.00
12-inch C900 PVC	30	FT	$425.00	$12,750.00
Interties - Connect to Existing Systems	4	EA	$10,000.00	$40,000.00
PRV Vault	1	EA	$75,000.00	$75,000.00
3-inch Patch Paving	1,450	SF	$12.00	$17,400.00
8-inch Patch Paving	280	SF	$18.00	$5,040.00
Electrical and SCADA	1	LS	$26,500.00	$26,500.00
			Construction Subtotal:	**$445,500.00**
			Contingency:	$66,900.00
			Engineering Design:	$45,000.00
			Permitting:	$23,000.00
			Inspection and Construction Management:	$45,000.00
			Administration:	$23,000.00
			Total Estimated Construction Cost:	**$648,400.00**

APPENDIX A: FIGURES



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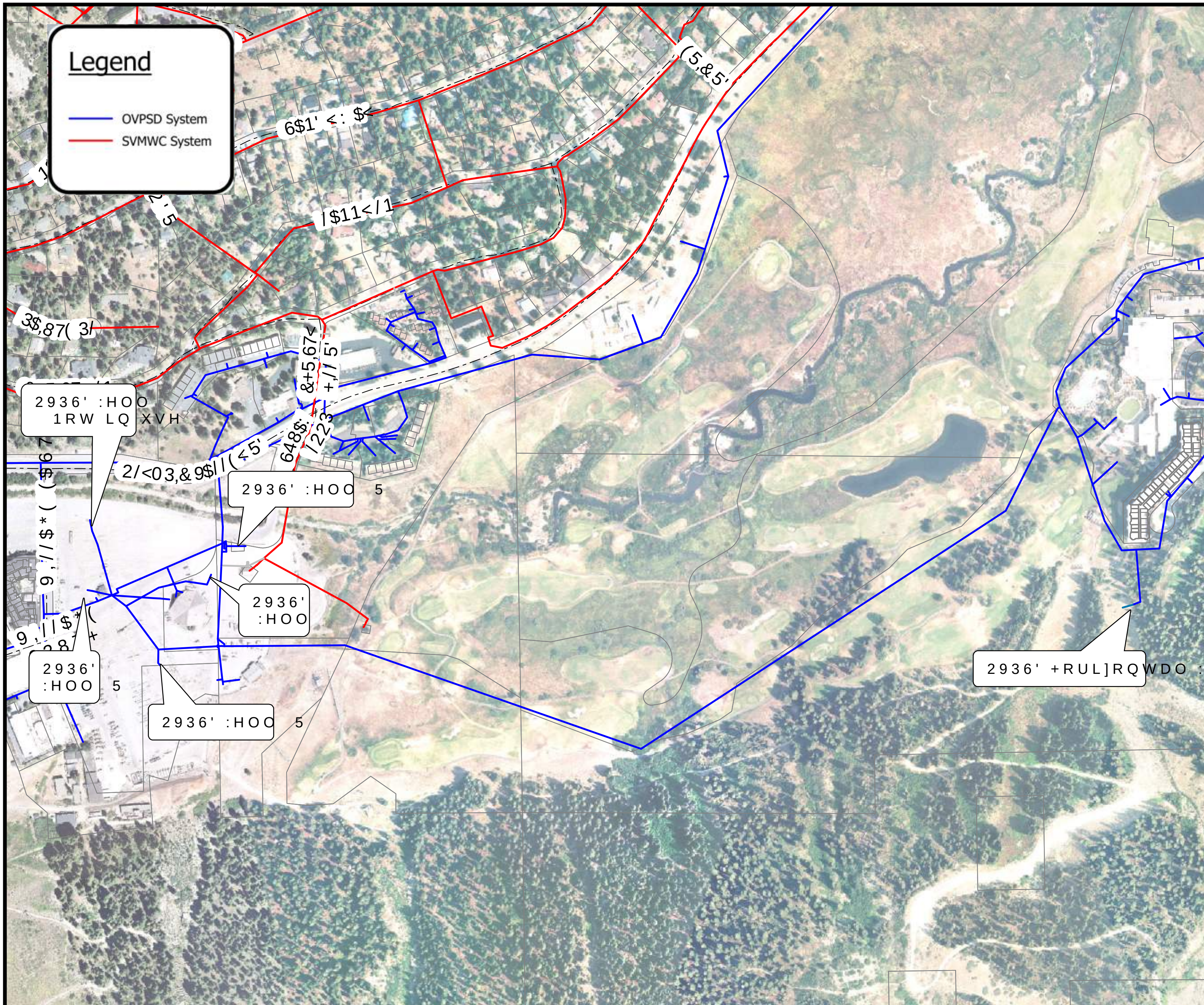

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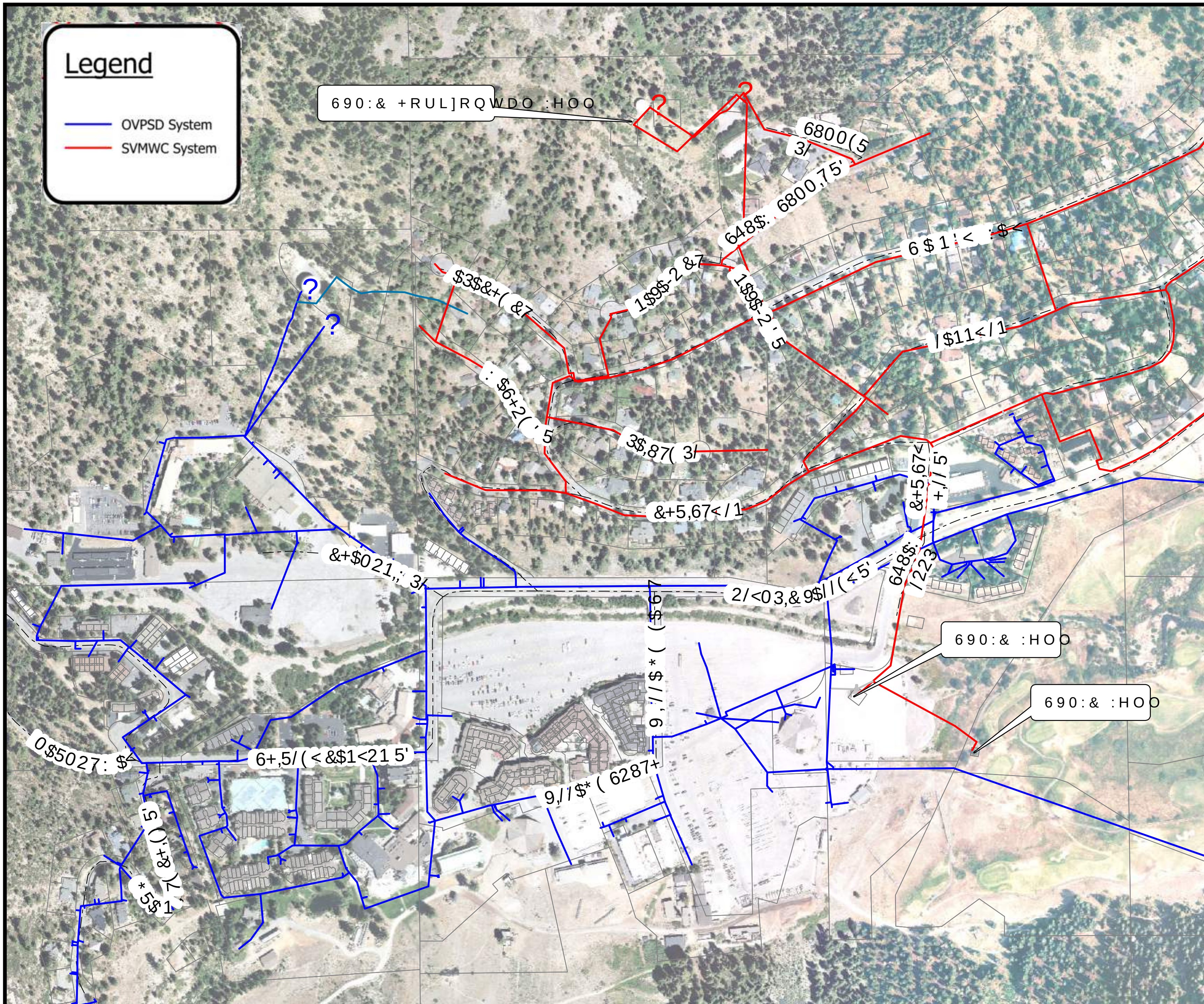

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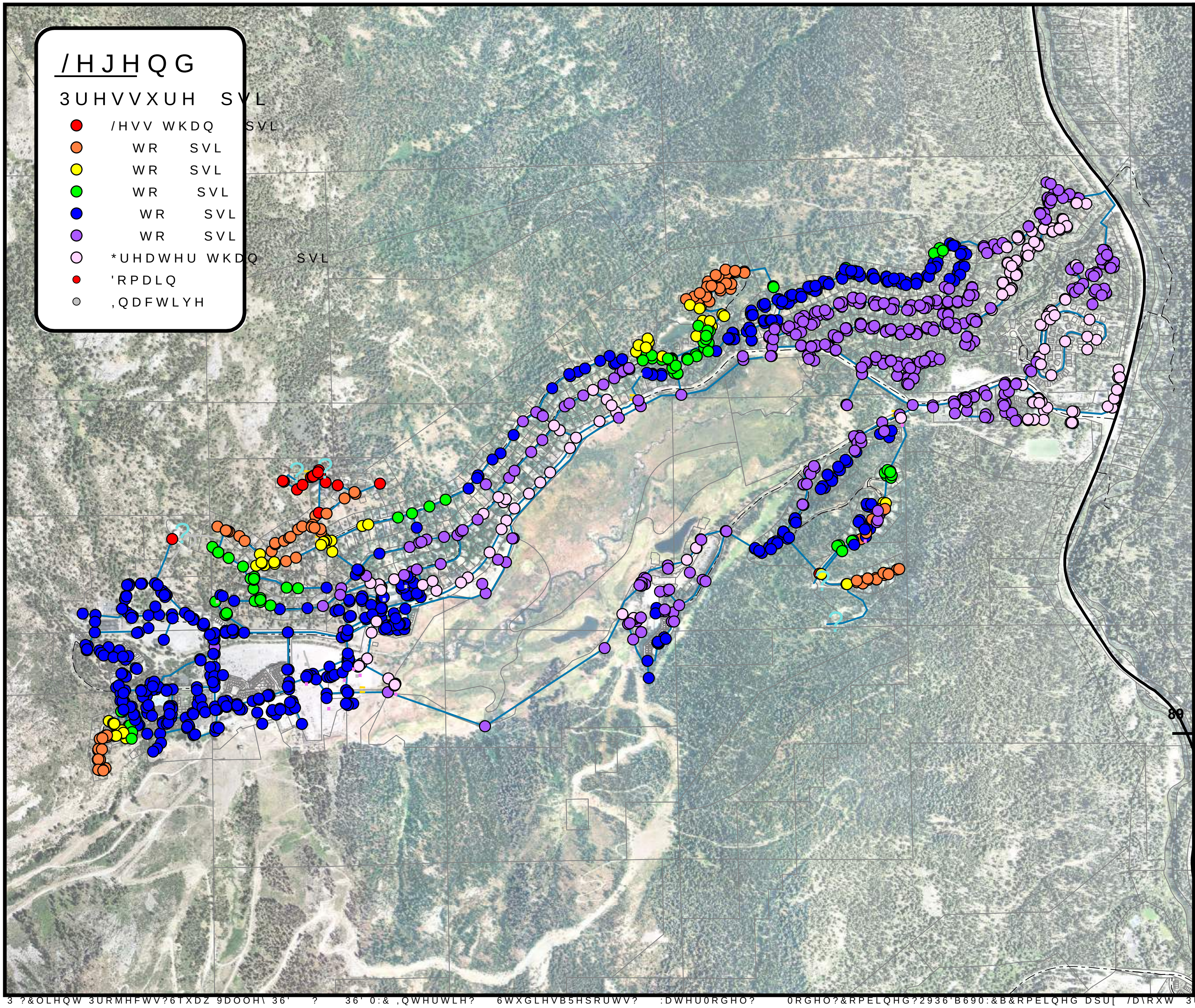

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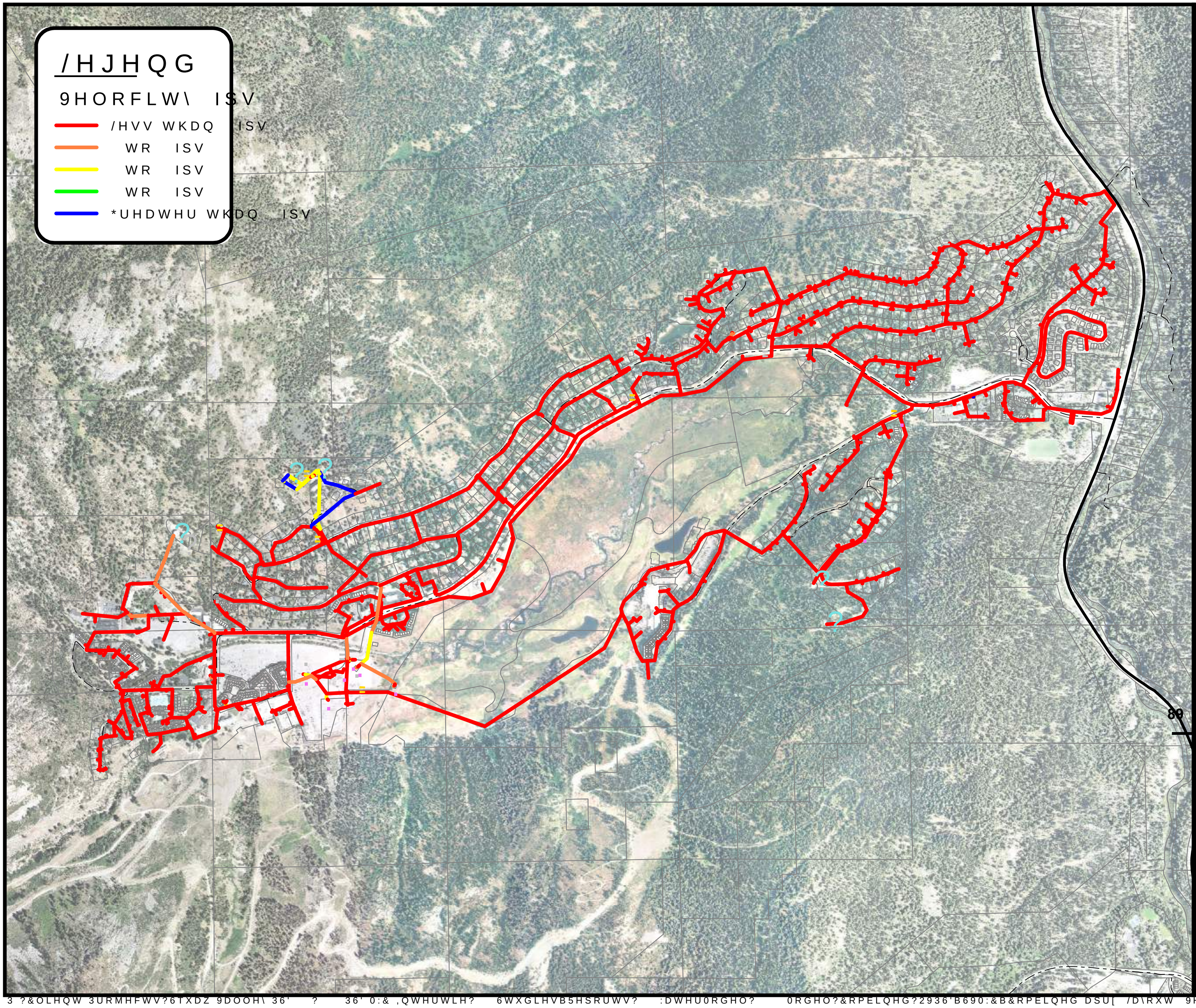
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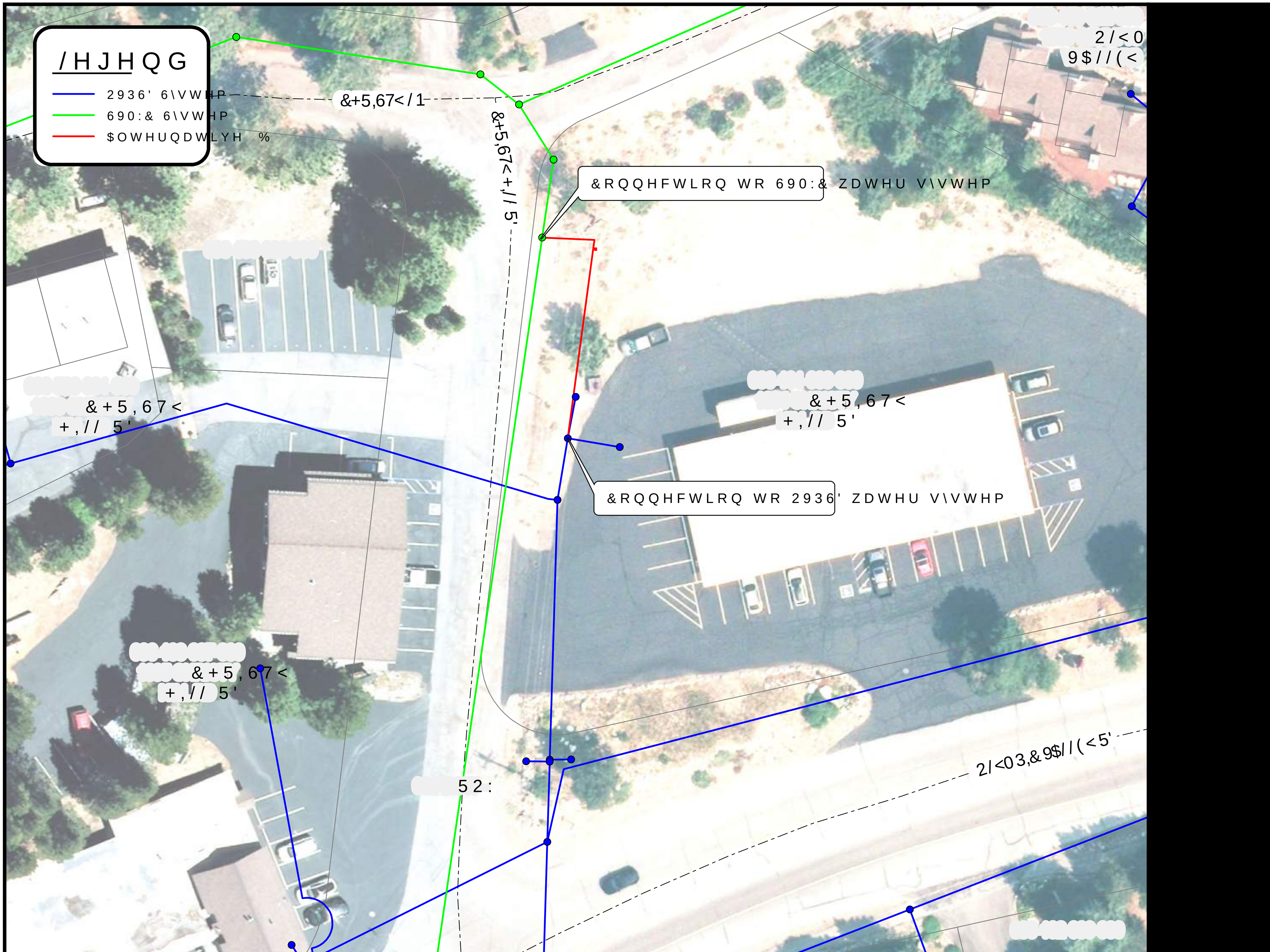

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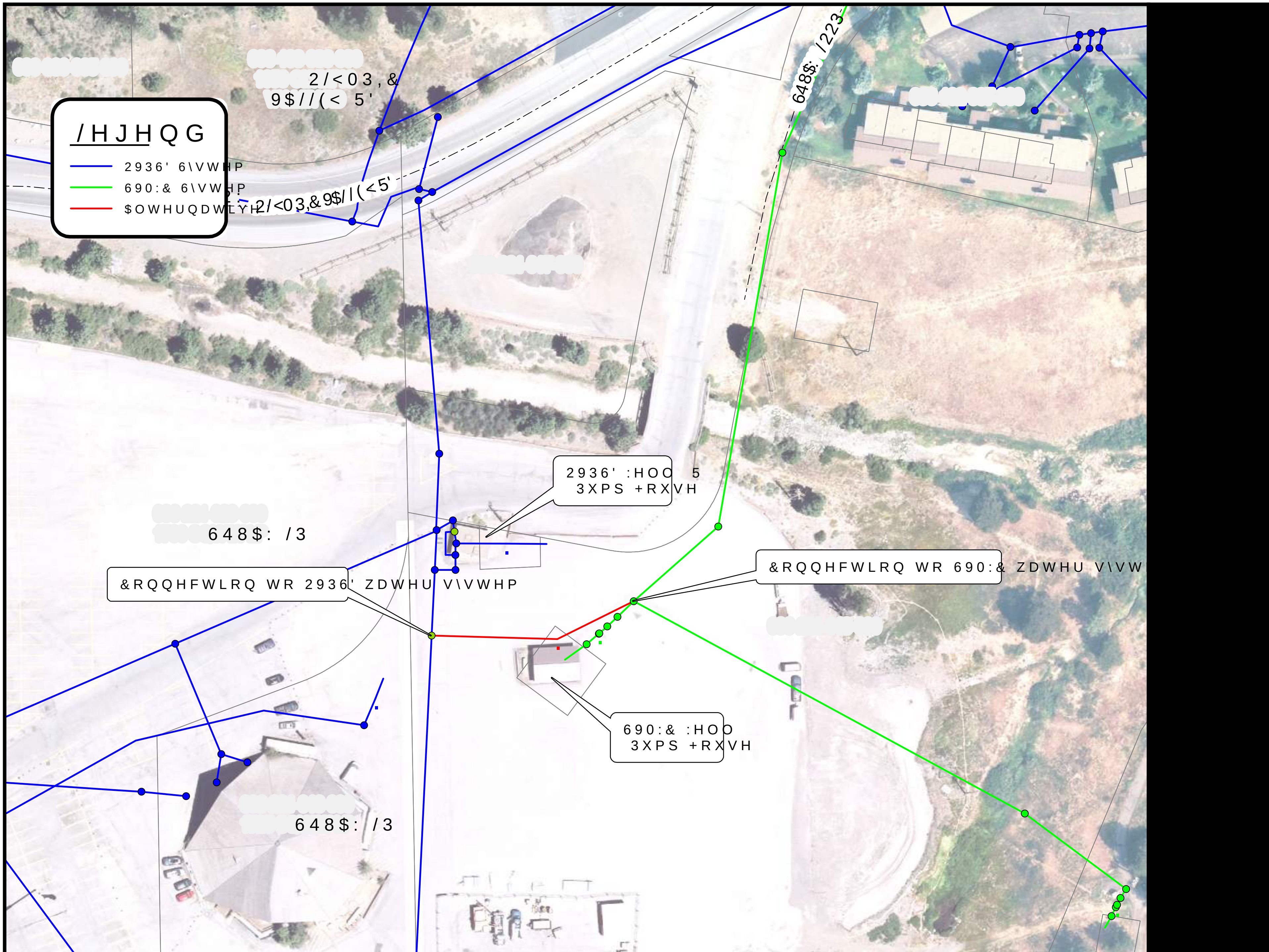

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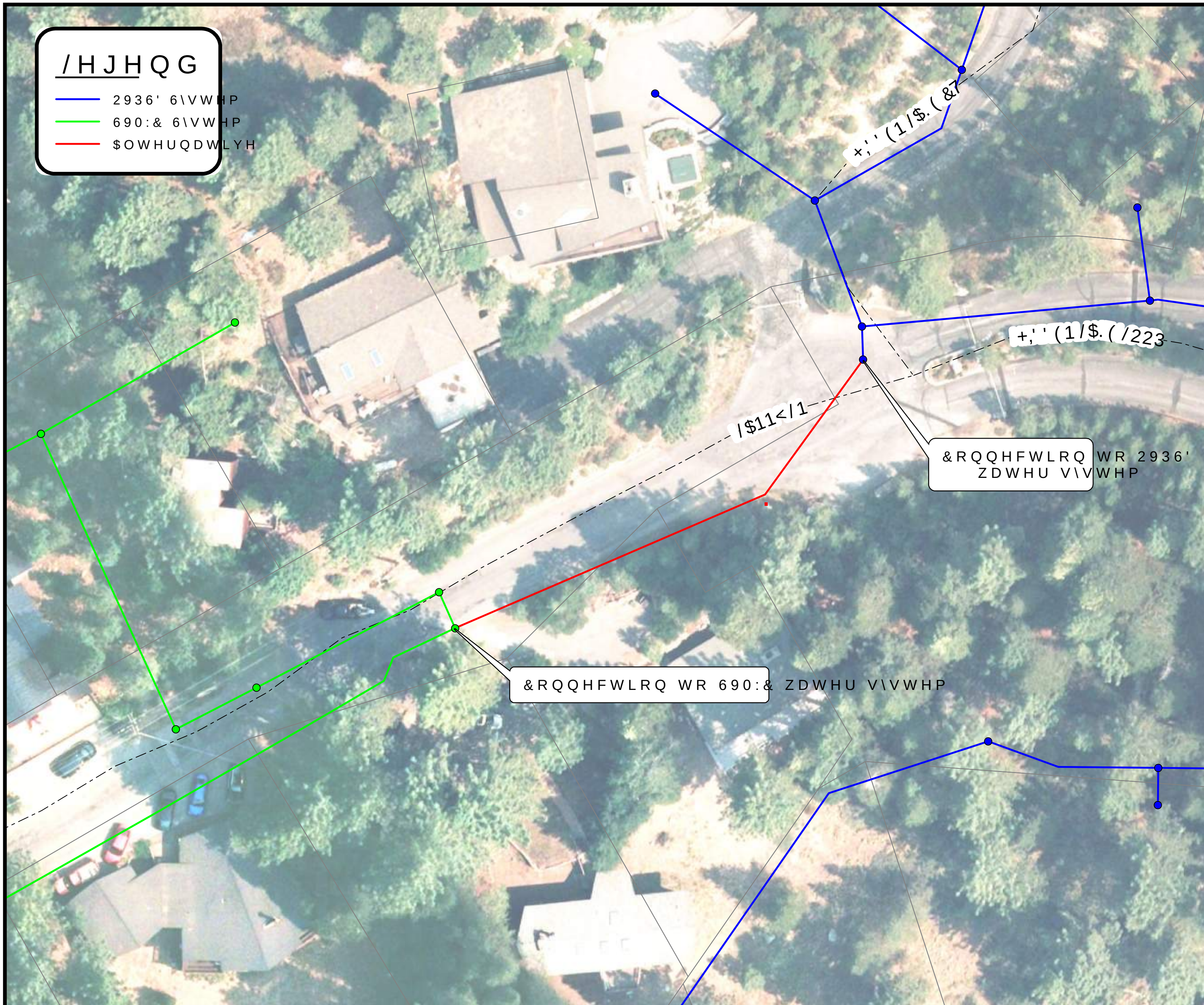
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APPENDIX B: CUTSHEETS

Customer	:		**Customer Technical Offer**
Reference	:		TigerFlow Pump Quotation System 22.4.1

Item number	001	Size / Stages	CD20-2 / 1
Quote number	671965	Pump speed	3500 rpm

Pump

Qty	Description
1	*Tigerflow Booster System Pumping Station*

Configuration

Input Parameters / Controls

Station Input Voltage: 208V/1#/60Hz

Controls HMI: Schneider

BAS Communication Protocol: None

Mechanical

System: Duplex Booster (TF-00-002)
(4) Grooved Style Butterfly Valves, 2"
(2) Wafer Style Check Valves, 2"
-Suction and Discharge Manifolds, 304SS, 3"

Pumps: PUMP, TIGERFLOW, CDF20-2-C0GD2B, 184TC, 5HP, 230/460V/3#/60Hz, TEFC

Flange: FLGxWN, 304SS, CLASS 300, 2" (600-010)

Controls: Controls, Mark V, Duplex
-Schneider HMI, Schneider PLC, Variable Frequency Drives (VFDs)-Y
-Fused branch protection
-208-230V/1#/60Hz, 5HP

Suction Safety: Switch, Float, Eco-Float GSE30NC

Discharge Cap: CAP, 304SS, 3"GRV (A02-07)

Motor Enclosure / Efficiency: TEFC (Totally Enclosed Fan Cooled)

Thermal Purge Assembly: ASSEMBLY, THERMAL PURGE, DUPLEX

Tank: None

Tank Location: None

Coupling: None

Suction Manifold Flange: None

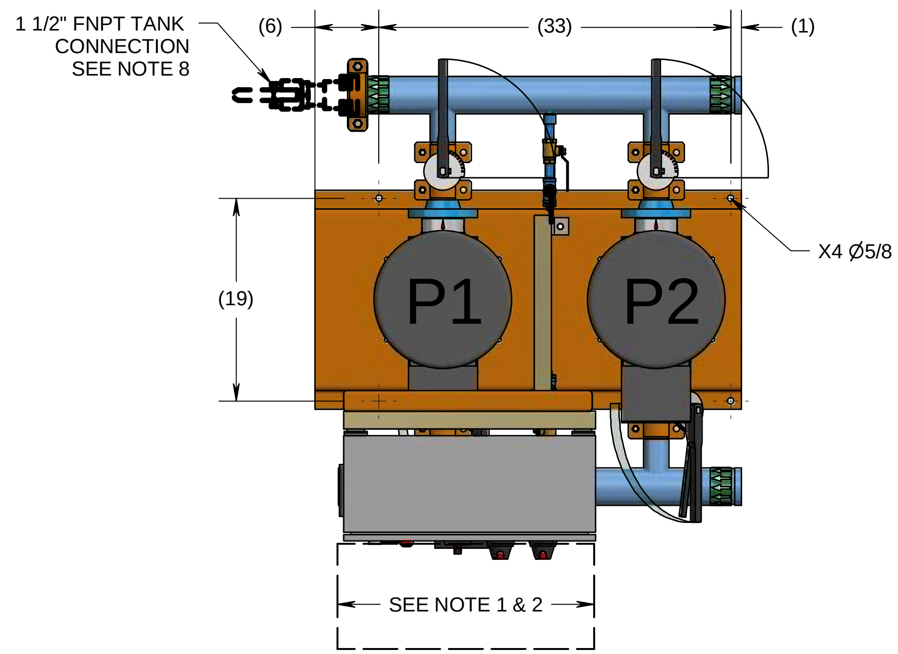
Discharge Manifold Flange: None

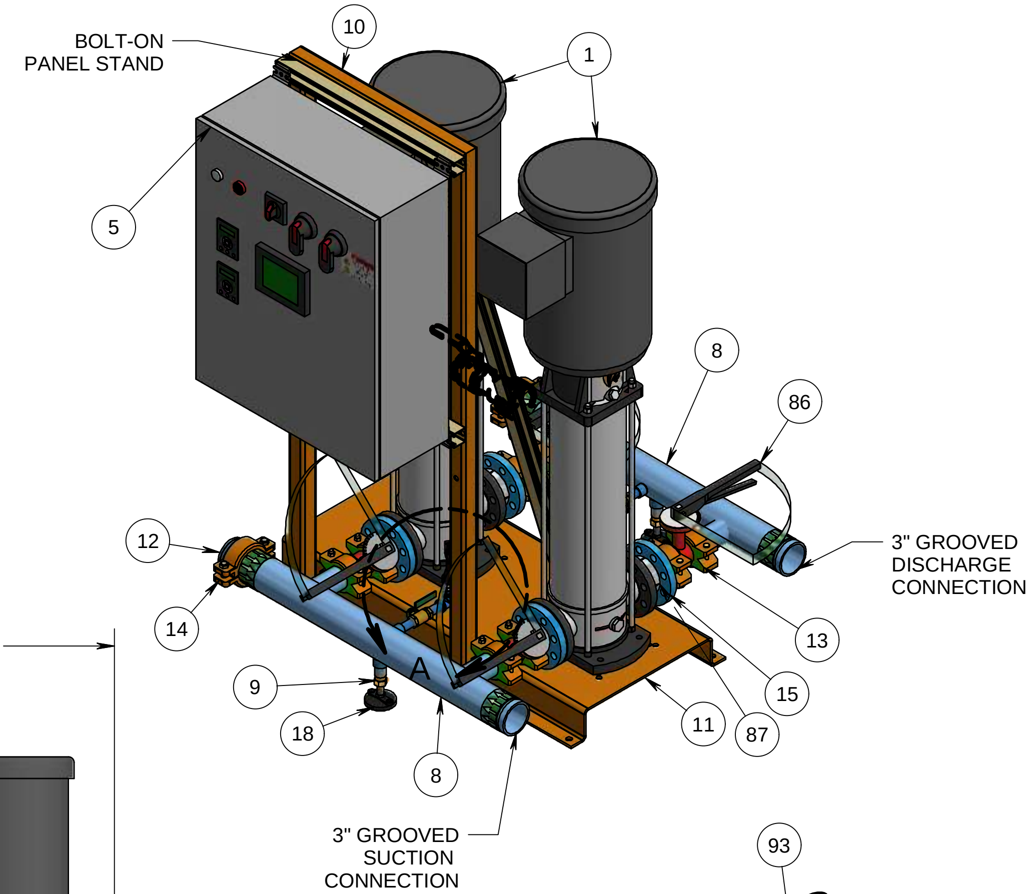
Flow Sensor: None

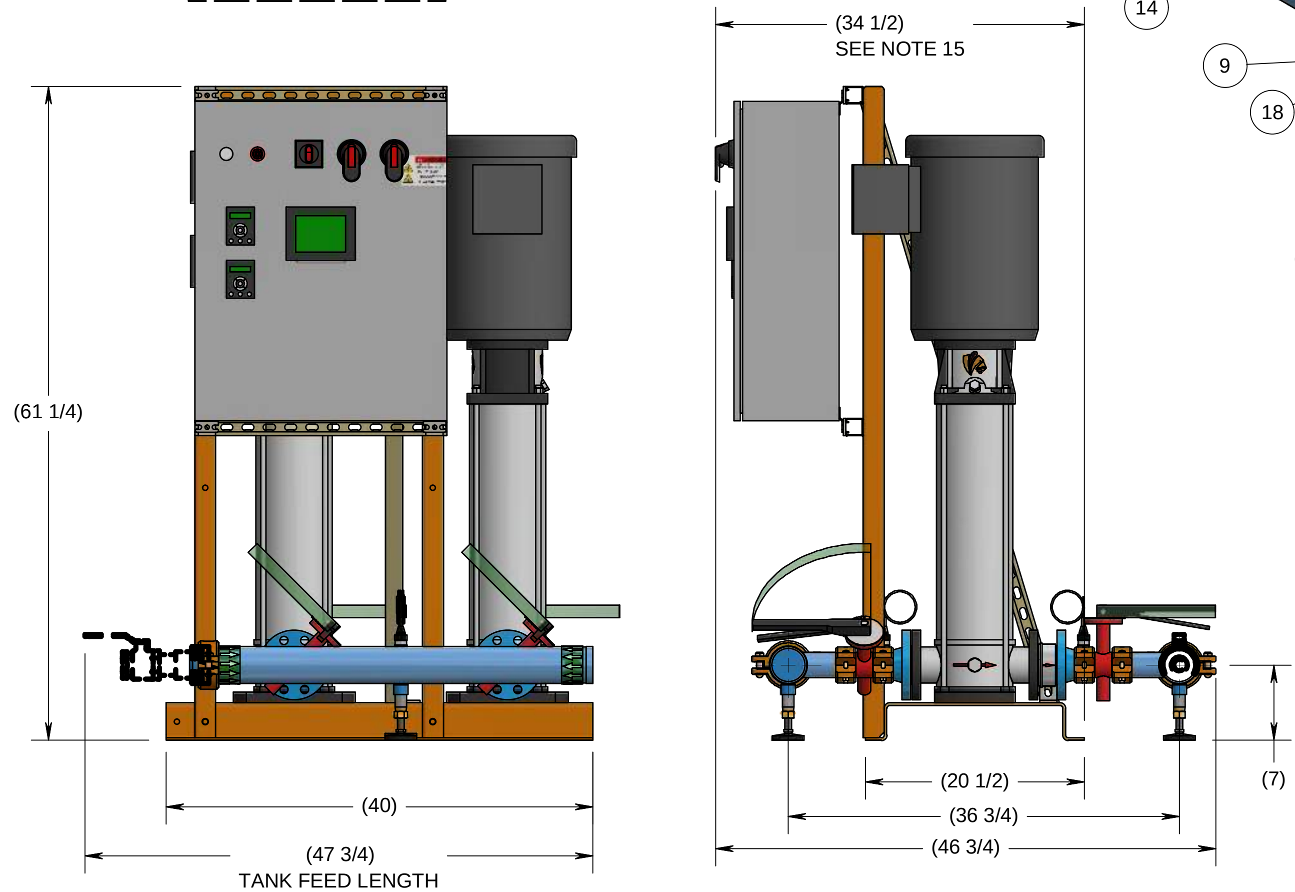
Gauges: None

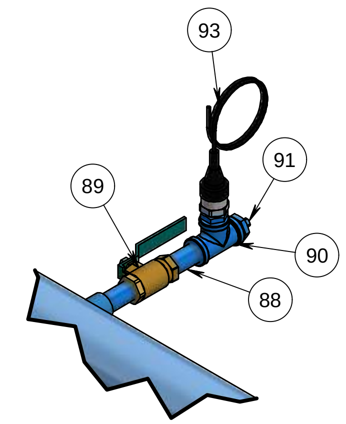
Additional Tests: None

REV	DESCRIPTION	DATE	APPROVED	PAGE(S)
1	UPDATE BILL AND HEADERS.	8/1/2018	B. ANTAL	
03	CHANGED BUTTERFLY AND CHECK VALVES	5/12/2020	A. LUCIANO	









DETAIL A
TRANSDUCER ASSEMBLY
TYP. SUCTION/DISCHARGE

NOTES:

1. 48" CLEARANCE (CLEAR TO GROUND) REQUIRED IN FRONT OF CONTROL PANELS PER 2011 NEC TABLE 110-26(A)(1) CONDITION 3; USER ASSUMES ALL RESPONSIBILITY FOR EVALUATION OF SITE CONDITIONS AND NEC CODE COMPLIANCE IF INSTALLING PER CONDITION 1 OR 2 CLEARANCES.
2. 30" CLEARANCE OR PANEL WIDTH MINIMUM REQUIRED FOR NEC CLEARNACE.
3. UNLESS OTHERWISE INDICATED, ALLOW 12" CLEARANCE AROUND SYSTEM FOR SERVICE.
4. ALL PIPE WELDING TO BE PERFORMED BY ASME SECTION IX CERTIFIED WELDERS.
5. ALL STRUCTURAL WELDING TO BE PERFORMED BY AWS D1.1 CERTIFIED WELDERS.
6. PRESSURE TRANSDUCER WILL BE PROVIDED FOR BOOST APPLICATIONS; LOP SWITCH WILL BE PROVIDED FOR FLOODED APPLICATIONS. REFER TO WORK ORDER FOR OPTION.
7. CONNECTION CENTERLINE DIMENSIONS ARE REFERENCE ONLY. AS-BUILT MEASUREMENTS TO BE PROVIDED PRIOR TO SHIPMENT OF STATION UPON REQUEST.
8. TANK FEED IS SUPPLIED WHEN EXPLICITLY ORDERED. SEE WORK ORDER OR PURCHASE TO CONFIRM.
9. HYDROSTATIC TEST TO 250 PSI FOR 15 MINUTES. SEE WORK ORDER OR PURCHASE TO CONFIRM.
10. SEE WORK ORDER FOR STANDARD PERFORMANCE TEST OR X-Y PERFORMANCE TEST.
11. MAX. SHIPPING WEIGHT: **580** LBS.
12. SEE WORK ORDER FOR PAINT COLOR.
13. SEE WORK ORDER FOR THERMAL PURGE OPTION.
14. MANIFOLD GROOVED BOTH END FOR CONNECTION AT EITHER END.
15. APPROXIMATE WIDTH WITH DISCHARGE MANIFOLD REMOVED.

SYM	QTY	DESCRIPTION	SAP PN
93	2	PRESSURE TRANSDUCER, GEMS 3500 B300PG02E000, 0-300 PSI, 4-20MA OUTPUT, 1/4" NPT, 3M CABLE	3200004776
92	4	HEX BUSHING, ASTM A351 CF8(304), CLASS 150, 1/2"x1/4"	3200010726
91	2	PLUG, MNPT, ASTM A351 CF8(304SS), CLASS 150, 1/4"	3200018802
90	2	TEE, NPT, ASTM A351 CF8 (304), CLASS 150, 1/2"	3200010613
89	2	VALVE, TEST COCK, WATTS LFTC, 1/2"	3200012081
88	4	NIPPLE, 304SS, S40, 1/2x2 1/2"	3100000485
87	2	VALVE, CHECK, TIGERFLOW 871W, 2"	3200022495
86	4	VALVE, BUTTERFLY, TIGERFLOW N-GD-381L, LEVER, 2"	3200021713
85	4	PLATE, UNISTRUT P1064, 1-5/8"X1-5/8X1/4", ĭ 1/2"	3200011416
84	2	1-5/8"x1-5/8",12GA, PRE GAL, 9/16"x1-1/8" SLOT	321161000
22	2	STRUT ACCESORIES, BASE CONNECTOR, HILTI MQP-1/1	3100000734
21	1	1-5/8"x1-5/8",12GA, PRE GAL, 9/16"x1-1/8" SLOT	321161000
18	2	LEVELING MOUNT, 5000LB, GRAINGER 5VN02, 5/8"-11	3200019498
16	2	GASKET, NSF-61	3200018958
15	4	FLGxWN, 304SS, CLASS XXX, 2"	SEE BOM
14	2	COUPLING, RIGID, ANVIL 7401, 3"	3200013077
13	8	COUPLING, ANVIL 7401, EDPM, 2"	3200013073
12	1	CAP,304SS,3GRV,A02-07	3200000264
11	1	BASE, FORMED, DUPLEX, ORANGE, A01-00M	3200000246
10	1	PANEL STAND, INTERNAL DRIVE, VMS, PS001	3200000485
9	2	PIPE SUPPORT	3200000496
8	2	MANIFOLD, 3x2, DUPLEX, 304SS, 20", VMS	3200000693
5	1	CONTROLLER, TIGERFLOW MARK V, INTERNAL DRIVES	SEE E-BOM
1	2	SEE CHART 1	PUMP

PARTS LIST

BIGGEST PUMP SIZE SUPPORTED - CHART 1			
BRAND	MODEL	STAGES	HP
TIGERFLOW	CDF 10	17	15
TIGERFLOW	CDF 15	12	25
TIGERFLOW	CDF 20	10	25
Goulds	10SV	12	10
Goulds	15SV	10	20
Goulds	22SV	10	25
Ebara	EVM 10	12	10
Ebara	EVM 18	8	20
Grundfos	CR 10	12	10
Grundfos	CR 15	10	20
Grundfos	CR 20	8	20

1. DIMENSIONING PER ASME Y14.5-2009.
2. DO NOT SCALE DRAWING.
3. DO NOT USE FOR CONSTRUCTION PURPOSES UNLESS CERTIFIED.
4. DIMENSIONS ARE IN INCHES

(XX) INDICATES REFERENCE, NON-TOLERANCED DIMENSIONS

FRACTIONAL ± 1/4"
DECIMAL .X ± .1
.XX ± .05

TIGERFLOW
4034 MINT WAY
DALLAS, TX 75237
PHONE: 214.337.8780
WWW.TIGERFLOW.COM

ENGR	DATE
M. MARTINEZ	4/27/2017
CHK B. ANTAL	8/1/2018

DESCRIPTION: VMS, 3" X 2", DUPLEX, 10-20/22 SM

PART NUMBER / SAP NUMBER: TF-00-002 / 3200000513 | PAGE 1 /1 | REV 03

\\DC01\Departments\Special Projects\R2014-001 Standard Booster\Standard Booster\VMS-4000\CAD Parts\Assy Standard\TF-00-002 - Booster VMS 10-20_22 SM Duplex\TF-00-002.idw

Pump Performance Datasheet

Customer	:	Quote number	: 671965
Customer reference	:	Size	: CD20-2
Item number	: 001	Stages	: 1
Service	:	Based on curve number	: CD20-2
Quantity	: 1	Date last saved	: 05 Dec 2022 4:31 PM

Operating Conditions

System flowrate	: 200.0 USgpm
Differential head / pressure, rated (requested)	: 107.0 ft
Differential head / pressure, rated (actual)	: 112.2 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed, rated	: 3500 rpm
Impeller diameter, rated	: 4.15 in
Impeller diameter, maximum	: 4.15 in
Impeller diameter, minimum	: 4.15 in
Efficiency	: 71.62 %
NPSH required / margin required	: 9.38 / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow)	: 1,090 / 6,336 US Units
MCSF	: 52.83 USgpm
Head, maximum, rated diameter	: 131.2 ft
Head rise to shutoff	: 17.00 %
Flow, best eff. point	: 108.5 USgpm
Flow ratio, rated / BEP	: 92.19 %
Diameter ratio (rated / max)	: 100.00 %
Head ratio (rated dia / max dia)	: 100.00 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.00 psi.a

Material

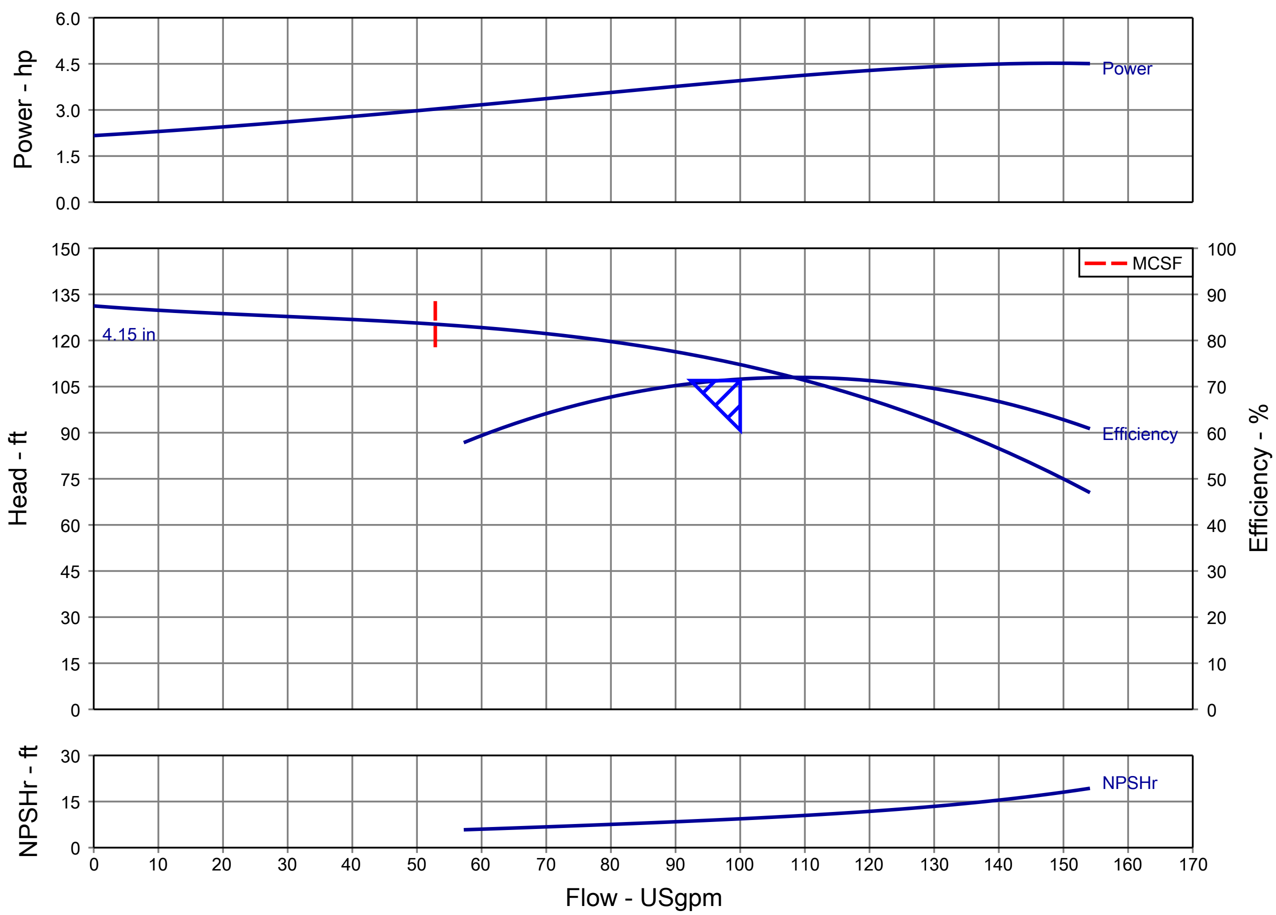
Material selected	: Standard

Pressure Data

Maximum working pressure	: 56.81 psi.g
Maximum allowable working pressure	: N/A
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

Driver & Power Data (@Max density) (Per Pump)

Driver sizing specification	: Standard
Margin over specification	: 0.00 %
Service factor	: 1.15
Power, hydraulic	: 2.83 hp
Power, rated	: 3.95 hp
Power, maximum, rated diameter	: 4.52 hp
Minimum recommended motor rating	: 5.00 hp / 3.73 kW



Jason Bender · 1020 South Rock Blvd · Reno , Nevada 89502
phone: 775-722-6460 · · http://www.wnmech.com/

SKV Series Pump | Submittal Data

Submittal No: 301-S156 | **Model:** SKV3006D | **RPM:** 3500 | **HP:** 10HP | **Effective:** June 17, 2020 | **Supersedes:** January 27, 2020

JOB: Farr West

REPRESENTATIVE: WNMS

ENGINEER: Chelsea Cluff. PE

CONTRACTOR: TBD

PRODUCT DATA

ITEM NO. Squaw Booster

DOE BASIC MODEL NO. SKV3006D-A-2P-PD

MODEL NO. ______

VOLTAGE 460V

PEI$_{VL}$ 0.43

HI ENERGY RATING 57

IMPELLER DIA. 5.70

WEIGHT ______

GPM 200

PUMP/MOTOR ______

HEAD/FT 100

FREQUENCY ______

RPM 3500 **HP** 10

PHASE ______

NSF 61 CERTIFIED* ☑ YES ☐ NO

*Not configurable as a standard option; please contact your account manager to configure.

SUPPORT STAND OPTION ☐ YES ☐ NO

(Ductile Iron ASTM A536-84 Grade 65-45-12)

OPERATING SPECIFICATIONS

FLANGE	PRESSURE	TEMPERATURE
ANSI Class 125	175 PSIG* (1210 KPA)	250°F (120°C)
ANSI Class 250	300 PSIG** (2070 KPA)	250°F (120°C)

* In accordance with ANSI Standard B16.1 Class 125

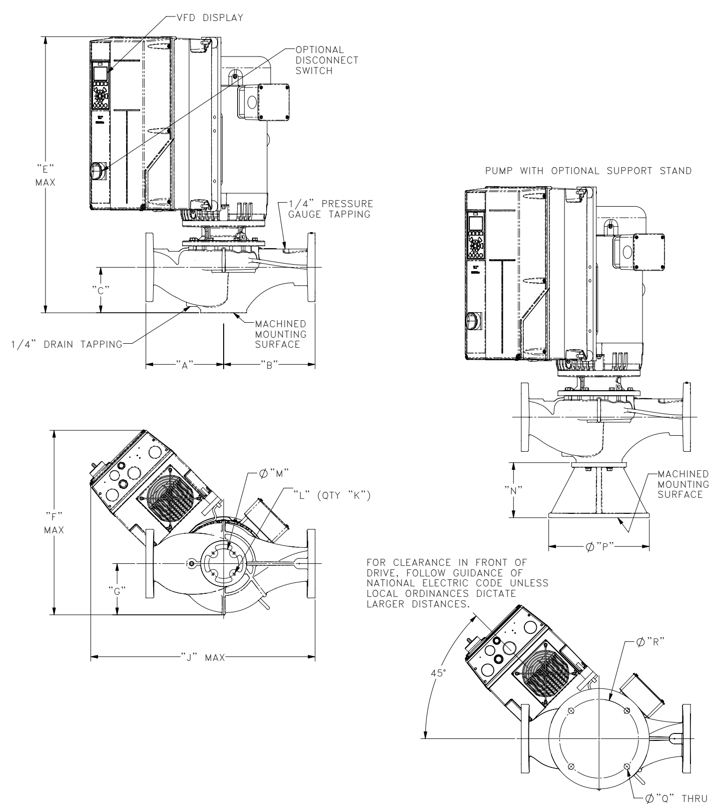
** In accordance with ANSI Standard B16.1 Class 250

DIMENSIONS

Model No. | 3006D

Flange Size (Suction x Discharge) | 3 x 3 (76 x 76)

HORSEPOWER	10
MOTOR FRAME TEFC	215JM
MOTOR FRAME ODP	213JM
WEIGHT WITHOUT OPTIONAL STAND LBS (KG)	374 (170)
WEIGHT WITH OPTIONAL STAND LBS (KG)	402 (182)
FLANGE SIZE ASA	3 (76)
A*	ANSI CLASS 125: 8.5 (216)
	ANSI CLASS 250: 8.87 (225)
B*	ANSI CLASS 125: 10 (254)
	ANSI CLASS 250: 10.37 (263)
C	4.97 (126)
E MAX	37.49 (943)
F MAX	20.44 (519)
G	5.60 (142)
J MAX	24.85 (631)
K	4
L	5/16-18 UNC-2B
M	3.25 (83)
N	6.02 (153)
P	11 (279)
Q	0.63 (16)
R	9.25 (235)



*A & B Dimensions apply for all pump sizes.

English dimensions are in inches. Metric dimensions are in millimeters.

Metric data is presented in ( ). Do not use for construction purposes unless certified.

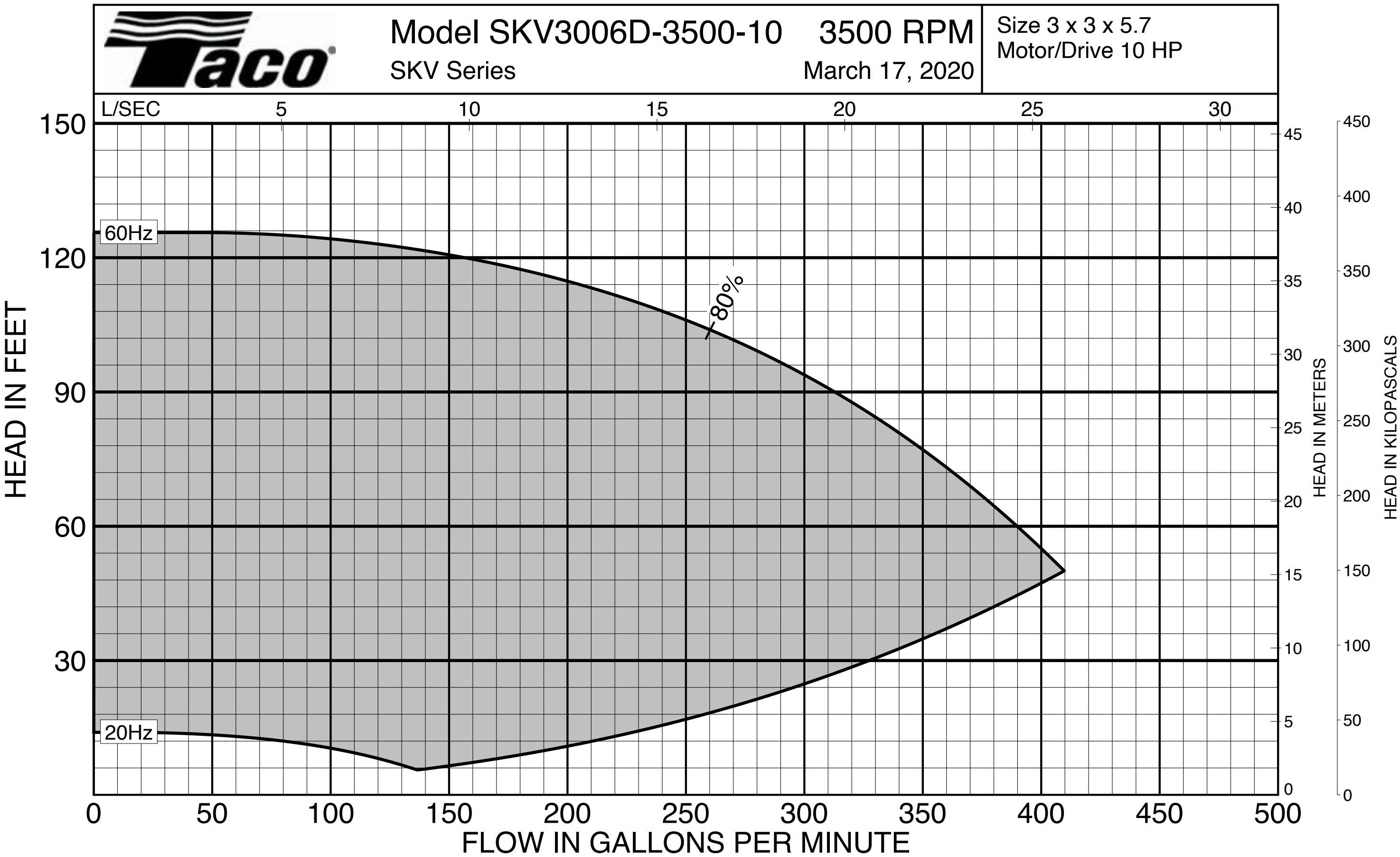
MATERIALS OF CONSTRUCTION			CASING	COVER	IMPELLER	WEAR RING	SHAFT	SHAFT SLEEVE	MECHANICAL SEAL	SEAL FLUSH LINE ASSEMBLY	SUPPORT STAND
STANDARD CONSTRUCTION	BRONZE FITTED	125# FLANGE	Cast Iron ASTM A48/A48M-03 Class 30A	Cast Iron ASTM A48/A48M-03 Class 30A	Bronze ASTM B584 ALLOY C83600 or C84400	N/A	Carbon Steel	Bronze ASTM B584-98A C92200	Ceramic/EPT	Copper & Brass C3600	N/A
		250# FLANGE	Ductile Iron ASTM A536-84 Grade: 65-45-12	Cast Iron ASTM A48/A48M-03 Class 30A	Bronze ASTM B584 ALLOY C83600 or C84400	N/A	Carbon Steel	Bronze ASTM B584-98A C92200	Ceramic/EPT	Copper & Brass C3600	N/A
OPTIONAL		125# OR 250#	N/A	N/A	Stainless Steel ASTM A351/A 351M-08	Bronze ASTM B584-98A C92200	N/A	Stainless Steel TYPE 303 ASTM A276	Tungsten Carbide/EPT or Silicon-Carbide/EPT	N/A	Ductile Iron ASTM A536-84 Grade 65-45-12
STANDARD CONSTRUCTION	NSF 61	125# FLANGE	Cast Iron ASTM A48/A48M-03 Class 30A	Cast Iron ASTM A48/A48M-03 Class 30A	Stainless Steel ASTM A351/A 351M-08	N/A	Carbon Steel	Bronze ASTM B584-98A C92200	Ceramic/EPT	Copper & Brass C3600	N/A
		250# FLANGE	Ductile Iron ASTM A536-84 Grade: 65-45-12	Cast Iron ASTM A48/A48M-03 Class 30A	Stainless Steel ASTM A351/A 351M-08	N/A	Carbon Steel	Bronze ASTM B584-98A C92200	Ceramic/EPT	Copper & Brass C3600	N/A
OPTIONAL		125# OR 250#	N/A	N/A	N/A	Bronze ASTM B584-98A C92200	N/A	N/A	N/A	N/A	Ductile Iron ASTM A536-84 Grade 65-45-12

N/A - Not Available

DRIVE DATA

PROTOCOLS (Standard)	BACnet, Modbus RTU, N2 Metasys, FLN Apogee, FC Protocol
PROTOCOLS (Optional)	☐ LonWorks® ☐DeviceNet ☐ Profibus
ENCLOSURE	☐ NEMA Type 12 / IP55 ☐ NEMA Type 4X / IP66
I/O (Standard)	6 Digital Inputs / 2 Digital Outputs 1 Analog Current Output / 2 Analog Inputs 2 Pulse Inputs 2 Form C Relays
ADDITIONAL CONTROL OPTIONS	☐ None ☐ General Purpose I/O ☐ Relay Card ☐ 24VDC Supply ☐ Analog I/O
DISCONNECT SWITCH	☐Mechanical ☐ Fused
EMC/RFI CONTROL	Intergated filter designed to meet EN61800-3
HARMONIC SUPPRESSION	Dual DC-link chokes (Equivalent: 5% AC line reactor) Supporting IEEE 519-1992 requirements
COOLING	Fan-cooled through back channel
AMBIENT TEMPERATURE	-10°C to 45°C up to 1000 meters above sea level -14°F to 113°F up to 3300 feet above sea level

COMMENTS

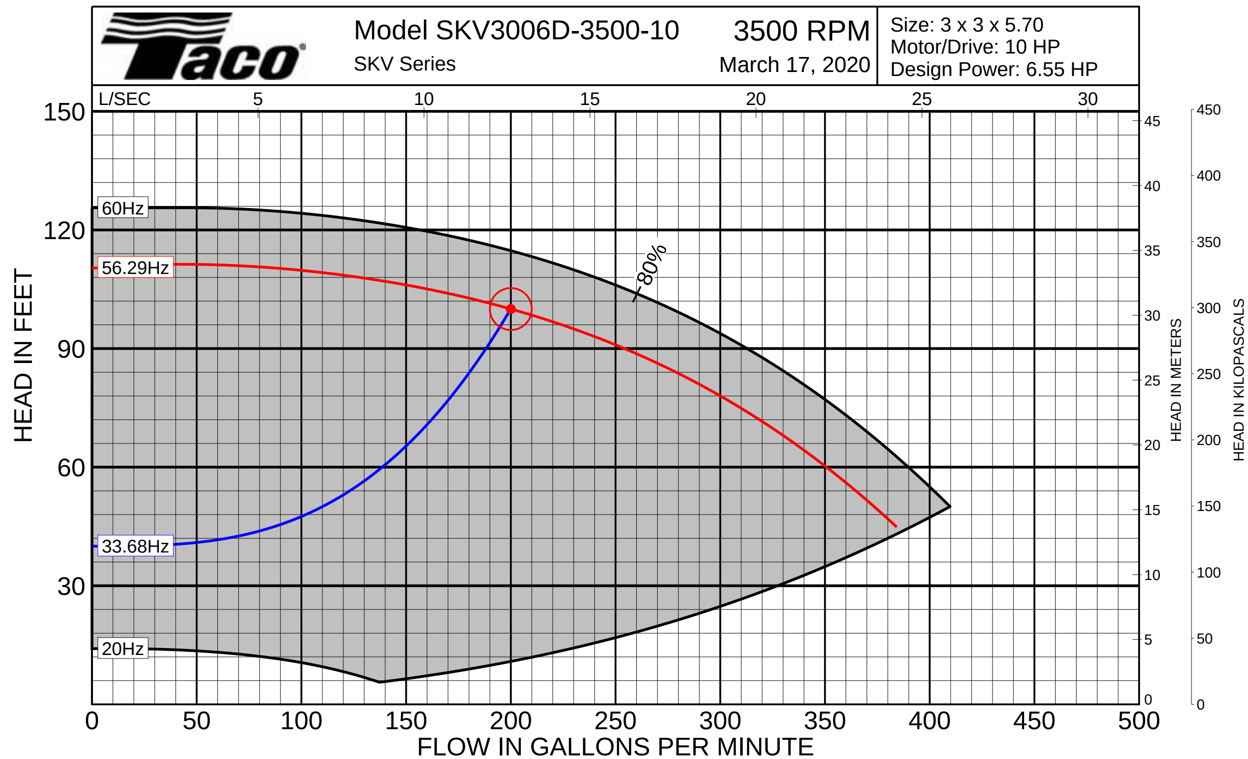


Curves based on Clear Water @ 60F with a Specific Gravity of 1.0

Model: SKV3006D

Tag: Squaw Booster

Flow Rate (GPM): 200
Head (FT): 100
Working Fluid: Water @ 60 F
Efficiency (%): 77%
Construction: Iron
Design Hp: 6.55
Nol Hp: 10.00
Motor Hp: 10
Npsh (Ft): 12
RPM: 3500



Design Point: 200.00 gpm @ 100.00 ft
Curves based on Water @ 60F with Specific Gravity of 1.0000.

E-Series® Ultrasonic Meter

Cold Water Stainless Steel Meter, 1-1/2 and 2 inch

DESCRIPTION

The E-Series® Ultrasonic meter uses solid-state technology in a compact, totally encapsulated, weatherproof, and UV-resistant housing, suitable for residential and commercial applications. Electronic metering provides information—such as rate of flow and reverse flow indication—and data not typically available through traditional, mechanical meters and registers. Electronic metering eliminates measurement errors due to sand, suspended particles and pressure fluctuations.

The Ultrasonic 1-1/2 and 2 inch meters feature:

- Minimum extended low-flow rate lower than typical positive displacement meters.
- Simplified one-piece electronic meter and register that are integral to the meter body and virtually maintenance free.
- Sealed, non-removable, tamper-protected meter and register.
- Easy-to-read, 9-digit LCD display presents consumption, rate of flow, reverse-flow indication, and alarms (empty pipe, temperature, exceeding max flow, sensor error, reverse flow, suspected leak, 30 day no usage, end of life).
- High resolution industry standard ASCII encoder protocol sends alarms and data to ORION® Cellular endpoints and BEACON® SaaS* suite to establish a smart water solution.

The Ultrasonic meter is available with an in-line connector for easy connection and installation to AMR/AMI endpoints. It is also available with a flying lead for field splice connection.

* Software as a Service

APPLICATIONS

Use the Ultrasonic meter for measuring potable cold water in residential, commercial and industrial services. The meter is also ideal for non-potable, reclaimed irrigation water applications or less than optimum water conditions where small particles exist.

E-Series Ultrasonic meters meet and exceed ANSI/AWWA C715 standards. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI/CAN Standards 61 and 372 and carry the NSF-61 mark on the housing.

OPERATION & PERFORMANCE

As water flows into the measuring tube, ultrasonic signals are sent consecutively in forward and reverse directions of flow. Velocity is then determined by measuring the time difference between the measurement in the forward and reverse directions. Total volume is calculated from the measured flow velocity using water temperature and pipe diameter. The LCD display shows total volume and alarm conditions and can toggle to display rate of flow.

In the normal temperature range of 45…122° F (7…50° C), the Ultrasonic "new meter" consumption measurement is accurate to:

- ±1.5% over the normal flow range
- ±3.0% from the extended low flow range to the minimum flow value

CONSTRUCTION

E-Series Ultrasonic meters feature a stainless steel, lead-free meter housing, an engineered polymer and stainless steel metering insert, a meter-control circuit board with associated wiring, LCD, and battery. Wetted elements are limited to the pressure vessel, the polymer/stainless steel metering insert and the transducers. The electronic components are housed and fully potted within a molded, engineered polymer enclosure, which is permanently attached to the meter housing. The transducers extend through the stainless steel housing and are sealed by O-rings.

The metering insert holds the stainless steel ultrasonic reflectors in the center of the flow area, enabling turbulence-free water flow through the tube and around the ultrasonic signal reflectors. The metering insert's patented design virtually eliminates chemical buildup on the reflectors, ensuring long-term metering accuracy.

METER INSTALLATION

The meter is completely submersible and can be installed using horizontal or vertical piping, with flow in the up direction. The meter will not measure flow when an "empty pipe" condition is experienced. An empty pipe is defined as a condition that occurs when the flow sensors are not fully submerged.

SPECIFICATIONS

E-Series Ultrasonic Meter Size	1-1/2 in. (40 mm)	2 in. (50 mm)
Normal Test Flow Limits	1.25…100 gpm (0.28…22.7 m^3/hr)	1.5…160 gpm (0.34…36.3 m^3/hr)
Minimum Test Flow Limits	0.40 gpm (0.09 m^3/hr)	0.50 gpm (0.11 m^3/hr)
Safe Maximum Operating Condition (SMOC)	100 gpm (22.7 m^3/hr)	160 gpm (36.3 m^3/hr)
Typical Pressure Loss	3.8 psi (0.26 bar)	5.2 psi (0.36 bar)
Reverse Flow – Maximum Rate	12 gpm (2.73 m^3/hr)	18 gpm (4.09 m^3/hr)
Operating Performance	In the normal temperature range of 45…122° F (7…50° C), new meter consumption measurement is accurate to: • ±1.5% over the normal flow range • ±3.0% from the extended low flow range to the minimum flow value	
Storage Temperature	– 40…140° F (– 40…60° C)	
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)	
Measured-Fluid Temperature Range	34…140° F (1…60° C)	
Humidity	0…100% condensing; meter is capable of operating in fully submerged environments	
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)	
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high	
Register Display	• Consumption (up to nine digits) • Rate of flow • Alarms (empty pipe, temperature, exceeding max flow, sensor error, reverse flow, suspected leak, 30 day no usage, end of life) • Unit of measure factory programmed for gallons, cubic feet and cubic meters	
Register Capacity	• 100,000,000 gallons • 10,000,000 cubic feet • 1,000,000 cubic meters	
Totalization Display Resolution	• Gallons: 0.X • Cubic feet: 0.XX • Cubic meters: 0.XXX	
Battery	3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life	

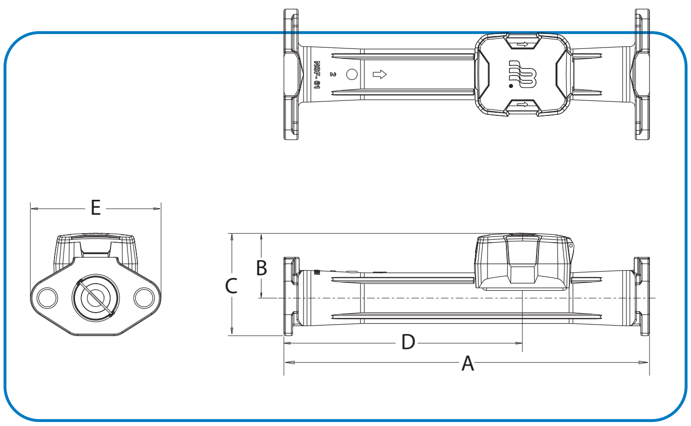
MATERIALS

Meter Housing	316 stainless steel
Measuring Element	Pair of ultrasonic sensors located in the flow tube
Register Housing & Lid	Engineered polymer
Metering Insert	Engineered polymer & stainless steel
Transducers	Piezo-ceramic device with wetted surface of stainless CrNiMo

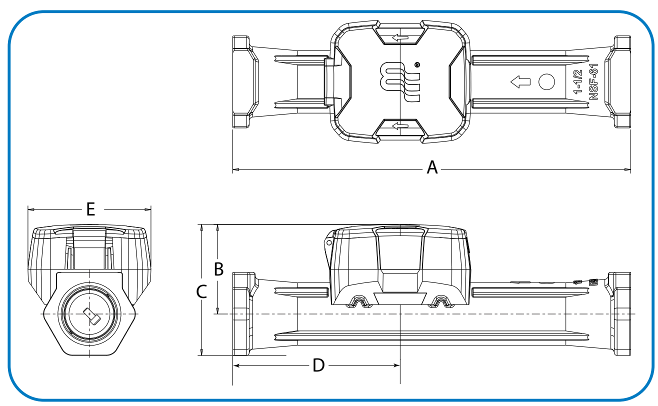
PHYSICAL DIMENSIONS

E-Series Ultrasonic Meter Size	1-1/2 in. (40 mm)	1-1/2 in. (40 mm)	2 in. (50 mm)	2 in. (50 mm)
Housing	**Elliptical**	**HEX**	**Elliptical**	**HEX**
Size Designation X Lay Length	1-1/2 x 13 in. (38 x 330 mm)	1-1/2 x 12.62 in. (38 x 321 mm)	2 x 17 in. (51 x 432 mm)	2 x 15.25 in. (51 x 387 mm)
Weight (without AMR)	8.2 lb (3.7 kg)	6.5 lb (2.9 kg)	11.9 lb (5.4 kg)	8.9 lb (4.0 kg)
See illustration below for Measurement Designations.				
Length (A)	13 in. (330 mm)	12.62 in. (321 mm)	17 in. (432 mm)	15.25 in. (387 mm)
Height (B)	2.80 in. (71 mm)	2.84 in. (72 mm)	3.01 in. (77 mm)	3.06 in. (78 mm)
Height (C)	4.55 in. (116 mm)	4.15 in. (105 mm)	4.76 in. (121 mm)	4.68 in. (119 mm)
Length (D)	7.10 in. (180 mm)	5.31 in. (135 mm)	11.10 in. (282 mm)	5.05 in. (128 mm)
Width (E)	5.50 in. (140 mm)	3.90 in. (99 mm)	6.08 in. (154 mm)	3.90 in. (99 mm)
Bore Size	1-1/2 in. (40 mm)	1-1/2 in. (40 mm)	2 in. (51 mm)	2 in. (51 mm)
Two-Bolt Elliptical Flange (AWWA)	1-1/2 in. (40 mm)	—	2 in. (51 mm)	—
Bolt Hole Diameter	0.69 in. (17.53 mm)	—	0.81 in. (20.57 mm)	—
Companion Flange	1-1/2 in. (40 mm)	—	2 in. (51 mm)	—
Internal Thread Size	—	1-1/2 in. NPT	—	2 in. NPT

Elliptical Measurement Designations

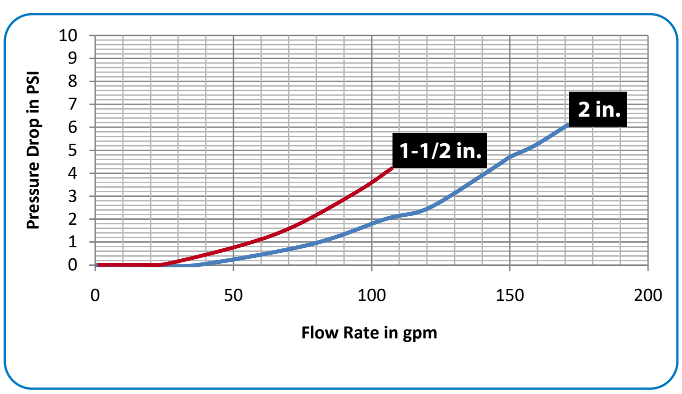


HEX Measurement Designations



PRESSURE LOSS CHART

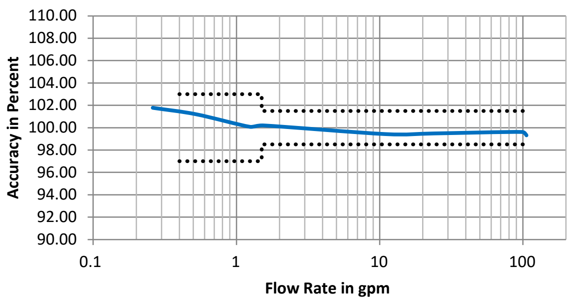
Flow rate in Gallons Per Minute (gpm)



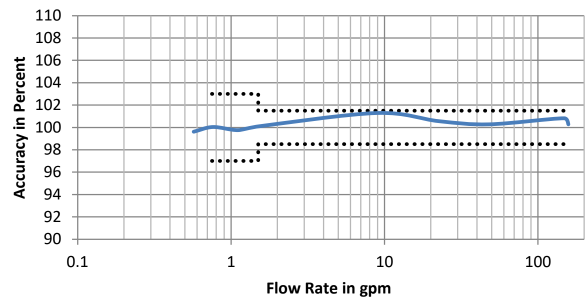
ACCURACY CHARTS

Rate of Flow in gallons per minute (gpm)

1-1/2 in. Meter



2 in. Meter



SMART WATER IS *BADGER METER*