Demonstration Project for

Pine Mountain MWC

Groundwater Well Air Intrusion Analysis

Technical Assistance for Disadvantaged Water and Wastewater Providers

North Coast Resource Partnership

California Department of Water Resources

September 2014

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Technical Assistance for Disadvantaged Water and Wastewater Providers

Demonstration Project for the

Pine Mountain Mutual Water Company

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1. Introduction

1.1 Purpose of Report

The purpose of this report is to demonstrate the use of tools from the Small Community Toolbox and to further the infrastructure improvement goals for the Pine Mountain Mutual Water Company (PMMWC). This report serves as an analysis of a groundwater supply well air intrusion problem identified by the PMMWC System Operators. The analysis includes a description of the problem, identification of potential solutions to the problem, and recommended next steps that can be taken to implement the preferred solution. This report will also serve as a "Preliminary Engineering Report", which is an element required by the State Water Resources Control Board (SWRCB) - Division of Drinking Water for the Agency's application for project funding under the Safe Drinking Water State Revolving Fund (SDWSRF).

1.2 Scope and Limitations

This report has been prepared by Water Works Engineers and reviewed by GHD for the North Coast Resource Partnership. The PMMWC has signed a participation agreement relating to the demonstration project that is the subject of this report. It should be emphasized that this report is to be used as an example of how tools and processes can be used to help further infrastructure improvement projects for a variety of communities throughout the North Coast region.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. This report has been prepared based on information provided by others, which has not been independently verified or checked.

Any cost estimates presented in this report or through related Toolbox elements are for conceptual purposes only. Actual prices, costs and other variables may be different at the time of an actual project and may be subject to change. Actual costs will depend on final project configuration and requirements. There is no warranty or guarantee that the project as currently conceived can or will be undertaken at a cost which is the same or less than costs that may be inferred from this report.

1.3 Assumptions

At the time of the development of this report, original well driller's logs for the 3 existing groundwater wells, and detailed existing well pump data was not available to Water Works Engineers. In addition, the existing groundwater wells do not have level transmitters and the system operators do not actively monitor and document groundwater levels in the wells. The absence of this information will not allow for the source or cause of the air intrusion problem to be positively identified, and therefore the scope of this report is limited to methods of accommodating the air intrusion problem, as opposed to determining if there are any possible means of eliminating the source of the air intrusion.

2. Use of the Small Community Toolbox

This Small Community Toolbox provides resources and references that allow small communities to approach the management of local water and wastewater infrastructure in a systematic fashion. The Toolbox is not a substitute for professional assistance with operations, management, engineering and legal issues. Rather it is intended to help small utilities develop a “first order” understanding of what their options are, how they should begin to budget, and how to get help.

The Small Community Toolbox is organized around the concept of the Utility Management Cycle illustrated in **Figure 2.1**.

Figure 2.1 Utility Management Cycle

Individual tools have been prepared for each of the elements of the Utility Management Cycle which are summarized in **Table 2.1.**

Table 2.1 Small Community Toolbox Elements

Utility Management Cycle Element	Toolbox Element	What it is and How it can be Used
Utility Management Cycle Element 1: *Organize and Plan for Success*	**1.1:** Community Networking Directory:	A contacts database of willing participants interested in collaboration for advice and assistance.
	1.2: Governance Summaries:	An overview of options, benefits, and steps required to form various types of service entities.
	1.3: GIS Layers:	Census, legislative, and other public data to help agencies access information needed for applications.
Utility Management Cycle Element 2: *Match Needs to Economical Technologies*	**2.1:** Technology Overviews:	Overviews of common issues, technologies, and evaluation factors to help select alternatives.
	2.2: General Cost Estimating Charts:	Cost estimating charts to help develop order of magnitude estimates for various types and sizes of infrastructure to begin scoping overall funding strategies.
Utility Management Cycle Element 3: *Create Viable Financing Strategies*	**3.1:** Funding Program Summaries:	A one-stop information shop about funding programs suited to small community infrastructure projects.
	3.2: Capital Recovery Tables:	Lookup tables to translate the portion of total project costs not paid by grant into annual debt service requirements met through a revenue mechanism.
	3.3: Financing District Summaries:	Summary of strategy options for generating revenue to pay the annual debt service.
	3.4: Cash Flow Considerations:	Assists entities in understanding the funds needed to move a project through planning, design, and construction
Utility Management Cycle Element 4: *Prepare Preliminary Design, Studies, and Applications*	**4.1:** Consolidated Preliminary Engineering Report Template:	Consolidated report outline, with model tables that will meet the needs commonly used funding programs.
	4.2: CEQA/NEPA Exemptions and Checklists:	Summary of CEQA/NEPA exemptions and checklists to aid in meeting State and Federal environmental requirements and funding program requirements.
	4.3: Common Permit Triggers:	Summary chart of typical project components that often trigger different types of permits.
Utility Management Cycle Element 5: *Complete Final Design and Construction*	**5.1:** Guidance for Hiring Professionals:	As a project moves from initial planning towards implementation, detailed, community-specific designs are required and communities will need to retain professional support.
	5.2: Public Bidding Process Overview:	Understanding how the public bidding process works, how to set up a successful project bid, and how the low bid contractor is selected
Utility Management Cycle Element 6: *Operate and Manage System*	**6.1:** Technical, Managerial, and Financial (TMF) Resources:	Tools to help agencies be organized and managed to improve overall operations and funding competitiveness.
	6.2: Regulatory Resources:	Sources to provide information to the utility operator on various federal and state regulations.
	6.3: Rate Setting Guidance:	Linking the costs of projects to the need to rate increases and methods to set and change rates
	6.4: Capital Improvement Planning Resources:	Part of the on-going Utility Management Cycle of planning for future system improvements

The tools used for this demonstration project are highlighted within this report. The Small Community Toolbox summaries should be referenced for additional information regarding the tools and their use.

3. PMMWC Background

3.1 Location

The Pine Mountain Mutual Water Company (PMMWC) is located approximately 5 miles southeast of downtown Willits, California in Mendocino County. A vicinity map is shown in **Figure 1 (Appendix A)**. This figure was developed using Toolbox Element 1.3, GIS Layers with General Application Information. The GIS layers and mapping provided the basis for the figure.

3.2 Potable Water Demand

PMMWC currently provides treated potable water to 124 service connections. Typical average water demand data for PMMWC is summarized in **Table 3.1** below.

Table 3.1 Average Potable Water Demand Data

Demand Period	Average Day Demand / Connection (gpd)	Total Average Day Demand (gpd)
Winter / Water Conservation	200	24,800
Typical Summer	500	62,000
Maximum Day Demand	1,000	124,000

3.3 Raw Water Supply

PMMWC has 3 groundwater supply wells, a surface water reservoir, and a surface water treatment plant that supply the system's potable water. PMMWC also has a 500,000 gallon potable water storage tank. PMMWC utilizes both the groundwater and surface water sources consistently throughout the year as needed based on climactic conditions. The surface water supply is considered the primary raw water source, with the groundwater supply supplementing the surface water supply during the summer and times of drought or low surface water supplies. The groundwater supply also allows for the surface water treatment plant to be temporarily shut down during high raw water turbidity events (occurring during rain storms) or algal blooms in the reservoir.

Basic data for PMMWC's 3 groundwater wells is provided in **Table 3.2** below.

Table 3.2 Groundwater Well Data

Well ID	Year Built	Casing Diameter	Casing Depth	Capacity	Pump Head	Pump HP
#1	1970s	8"	~80'	25 gpm	310 ft	3.0 HP
#2	1970s	8"	~80'	10 gpm	310 ft	1.5 HP
#6	2008	8"	~200'	40 gpm	310 ft	5.0 HP

Wells #1 and #2 were built in the 1970's, and are both only 80 feet deep. Well #6 was drilled in between Wells #1 and #2 in 2008. The reason for installing Well #6 was to provide a deeper well in the case of groundwater table recession during drought conditions. **Figure 2 (Appendix A)** shows PMMWC's groundwater well yard. **Figure 3 (Appendix A)** contains several pictures of the well houses and pumps.

3.4 Air Intrusion Problem Description

When Well #6 was installed in 2008, PMMWC System Operators report that upon startup, the well pump discharge was observed to contain noticeable effervescence, and that soon thereafter, Well # 1 developed similar effervescence. Tiny air bubbles are visible in the pump discharge giving the water a "cloudy" appearance. System Operators report that if water is collected from the pump discharge tap and observed, it takes 3-5 minutes for the air bubbles to rise and dissipate. The air observed is consistent with the type of micro-bubbles that would be expected to form when dissolved gasses in groundwater under pressure are released from solution when pressure is reduced (i.e. water is released to atmospheric pressure).

The dissolved air in the groundwater pumped from Wells #1 and #6 has been releasing and accumulating throughout the water distribution system, most notably in residential plumbing such as hot water heaters, faucets, and showerheads. The release of accumulated air in residential plumbing can cause large shocks and water hammer that is potentially damaging. After the startup and use of Well #6, System Operators began receiving numerous complaints, and after some time decided to use Well #1 and #6 sparingly, and most times not at all. Well #2 has not developed the effervescent problem, and has been the primary groundwater production well in the past several years. However, Well #2 has a maximum pumping capacity of 10 gpm which greatly limits PMMWC's groundwater supply capacity.

The inability to use Wells #1 and #6 is a significant water supply capacity issue, because these wells provide supply redundancy if the surface water supply is unavailable due to high turbidity events during storms, severe algal blooms, or times of drought, all of which seem to be occurring with increased frequency. If the surface water supply is temporary lost, and Wells #1 and #6 cannot be used because of the air intrusion problem, PMMWC only has a supply capacity of 10 gpm from Well #2, which is not adequate for the community.

3.4.1 Air Intrusion Causal Analysis

Groundwater well driller's logs were not available at the time of this study from PMMWC for any of the 3 groundwater wells, which may have provided some insight into the potential source of the air intrusion problem. The most likely cause, in the opinion of Water Works Engineers, is that Well #6 accessed a groundwater layer that contains moderate to high levels of a dissolved gas, possibly carbon dioxide. The cause for the development of effervescence in Well #1 coincident with the installation of Well #6 is unknown, and is very difficult to diagnose without access to the original well driller's logs for all 3 wells and/or additional field investigations which are not within the scope of this report.

Another potential cause of air in pumped groundwater is excessive drawdown in the well during pumping, which can result in pump cavitation and/or air entrainment at the pump intake. This second potential cause seems less likely, given that all 3 wells have relay-based liquid level controls that automatically shut down the pump if the groundwater level in the casing reaches a low-level probe, which should have been set by the well pump installer at a level adequate to prevent cavitation or air entrainment at the pump intake.

Additionally, given the depth of Well #6 (~200') and the observed static depth to groundwater of approximately 20' from recent well pump replacements, the Well #6 pump should not have excessive drawdown issues.

System Operators report that Wells #1 and #2 will be occasionally shut down during a run by the liquid level control systems, indicating excessive drawdown does occur. System Operators have tested running Well #1 at a lower flow rate of approximately 14 gpm, and found that running at the lower rate reduces the air problem for between several hours to a day, but that the air intrusion will eventually return if continuously running even at the lower rate. System Operators have not tried running Well #1 below 10 gpm, which is the flow rate at which Well #2 runs without air entrainment problems. Well #1 cannot be easily run below 10 gpm continuously without overheating the existing well pump, which runs optimally at 30 gpm.

4. Alternatives Analysis

The purpose of this section of the report is to present and analyze several alternative solutions to the groundwater well air intrusion problem identified in Section 3 of the report.

4.1 Consolidation

SWRCB encourages small water agencies to consolidate, where feasible, as a potential solution to water supply or treatment issues to allow for greater economies of scale for infrastructure. Consolidation may allow for abandonment of problematic treatment or water supply infrastructure for which the costs to address the identified problems are prohibitive.

As shown in **Figure 4 (Appendix A),** PMMWC's well site is located approximately 1 mile from the City of Willits Water Treatment Plant. However, the direct route shown includes steep undeveloped and wooded terrain, which would result in very difficult planning, engineering, and construction of a potential pipeline if the City of Willits were to supply treated water to PMMWC. Additionally, PMMWC's service area operates at a hydraulic grade line approximately 600' higher in elevation than the maximum water surface elevation in the City of Willits' WTP clearwell storage tank. A theoretical water supply pipeline from the City's WTP to PMMWC would be a 4" pipe carrying up to 90 gpm. A planning level cost per linear foot for the pipeline is $250/lf including planning, permitting, engineering, and construction, resulting in a ~$1.4M cost for the pipeline alone. The booster pump at the Willits WTP that would deliver water to PMMWC would have an approximate design point of 90 gpm @ 650', with a 25 HP motor. With a planning level cost of $200,000 for the booster pump station, the total project planning level cost would be ~$1.6M.

A water supply line could also be extended from the main distribution system infrastructure in the Willits Valley up Eastside Road to PMMWC. This pipeline would be approximately 1.5 miles long, and with a planning level cost of $175/lf would also cost approximately $1.4M and require a booster pump station located at the connection point to the City of Willits distribution system.

4.2 Well Pump Gas Shroud

One possible solution for removal of dissolved gas within the well casing is the installation of a gas shroud on the pump. **Figure 4.1** below shows a schematic of a gas shroud. The concept behind the gas shroud is that the water is forced to flow near to the groundwater table surface within the casing, and then down through the shroud to the pump intake. As the water in the outside of the casing rises towards the surface, the pressure is reduced and the dissolved air comes out of solution. The bubbles float toward the surface and are not carried downward toward the pump intake.

Some success has been reported in reducing or eliminating submersible well pump air problems with the installation of pump gas shrouds, however there are also cases where the shrouds do not significantly reduce entrained air. The success of the shroud depends on the size of the air bubbles being formed in the well casing, and their ability to combine into larger bubbles that will not be drawn back down into the shroud. It would not be possible to predict with certainty whether a gas shroud would work at this site or provide a complete solution without a field trial. Additionally, submersible pump gas shrouds can cause problems with cooling of the submersible motor. A gas shroud separates the pump intake from the motor, thus potentially reducing water flow past the motor, which can lead to overheating depending on the amount of flow moving past the motor from deeper in the well.

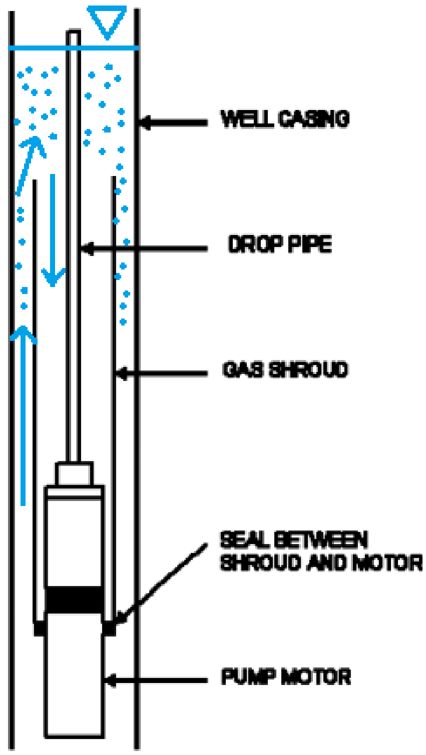


Figure 4.1 Submersible Pump Gas Shroud

The estimated cost to install a pump shroud is $5,000 per pump, which consists mainly of labor costs to pull the pump, install the shroud, and reset the pump.

4.3 Vented Tank

A second possible solution for removal of entrained air is to install a tank open to the atmosphere downstream of the well pump. The inlet of the tank would include a spray nozzle, designed to quickly reduce pressure and allow efficient removal of the entrained air. The tank would provide additional residence time for any remaining entrained air to come out of solution. An additional set of booster pumps is then required to pump water from the bottom of the tank back into the distribution system. A schematic of a proposed vented tank system is shown in **Figure 5 (Appendix A).** It would be recommended to pipe Well Pumps #1 and #6 to discharge into the vented tank, and keep Well Pump #2 piped directly into the distribution system, since Well #2 does not have air entrainment issues.

4.3.1 Well Pump Power

If Well Pumps #1 and #6 discharge directly into the vented tank, the head requirement of the pumps is significantly decreased, since they are discharging to atmosphere rather than into the distribution system at 125 psi. Well Pumps #1 and #6 each operate at approximately 310 feet of head when pumping directly into the distribution system.

Each pump could operate at approximately 75 feet of head if discharging to atmosphere at the new vented tank. Well Pump #1 could be reduced from a 3.0 HP pump to a 3/4 HP pump, and Well Pump #6 could be reduced from a 5.0 HP pump to a 1.5 HP pump.

Instead of replacing the pump, the existing pumps could be left in place, and the globe vales at the discharge of each pump could simply be throttled closed to produce the necessary backpressure to allow the pumps to continue operating at their current flow rates to prevent over-pumping the wells. Doing so would waste energy versus replacing the pumps with lower horsepower models. **Table 4.1** below summarizes the well pump power requirements and the annual “wasted” power costs that would be incurred if the existing pumps were left in place and throttled.

Table 4.1 Well Pump Power Comparison

Well #1			Well #6		
Existing Pump to Vented Tank - Throttled			**Existing Pump to Vented Tank - Throttled**		
Daily Delivery	20,000	gallons	Daily Delivery	20,000	gallons
Annual Delivery	7,300,000	gallons	Annual Delivery	7,300,000	gallons
Pump Rate	25	gpm	Pump Rate	40	gpm
Hours In Service	4,867	hrs/yr	Hours In Service	3,042	hrs/yr
Head	310	feet	Head	310	feet
Pump Efficiency	70	%	Pump Efficiency	70	%
Power Required	2.8	HP	Power Required	4.5	HP
Pump Motor HP	3.0	HP	Pump Motor HP	5.0	HP
Power Required	2.1	kW	Power Required	3.3	kW
Annual Energy Use	10,146	kW-hr	Annual Energy Use	10,146	kW-hr
Energy Unit Cost	$0.14	/ kW-hr	Energy Unit Cost	$0.14	/ kW-hr
Annual Energy Cost	$1,420	/ yr	Annual Energy Cost	$1,420	/ yr
New Pump to Vented Tank – Lower Horsepower			**New Pump to Vented Tank – Lower Horsepower**		
Daily Delivery	20,000	gallons	Daily Delivery	20,000	gallons
Annual Delivery	7,300,000	gallons	Annual Delivery	7,300,000	gallons
Pump Rate	25	gpm	Pump Rate	40	gpm
Hours In Service	4,867	hrs/yr	Hours In Service	3,042	hrs/yr
Head	75	feet	Head	75	feet
Pump Efficiency	70	%	Pump Efficiency	70%	%
Power Required	0.7	HP	Power Required	1.1	HP
Pump Motor HP	0.75	HP	Pump Motor HP	1.5	HP
Power Required	0.5	kW	Power Required	0.8	kW
Annual Energy Use	2,455	kW-hr	Annual Energy Use	2,455	kW-hr
Energy Unit Cost	$0.14	/ kW-hr	Energy Unit Cost	$0.14	/ kW-hr
Annual Energy Cost	$344	/ yr	Annual Energy Cost	$344	/ yr
Energy Wasted	**$1,077**	**/ yr**	**Energy Wasted**	**$1,077**	**/ yr**

The annual “wasted” power costs incurred by throttling the existing well pumps is almost equal to the cost of purchasing a new pump, as these small well pumps are relatively inexpensive with a purchase price of approximately $1,000. Therefore, it is recommended that the well pumps in Wells #1 and #6 be replaced with lower horsepower pumps as detailed in **Table 4.1** above.

4.3.2 Vented Tank Design

The critical design criteria for the vented tank are the diameter and working volume. The tank diameter should be selected such that the vertical velocity of the water moving down towards the outlet is less than the theoretical rise velocity of micro-bubbles that may be formed as dissolved gasses come out of solution. The formation of micro-bubbles from the release of dissolved gasses when water is de-pressurized is similar to the Dissolved Air Flotation (DAF) process, which is a technology used in both water and wastewater treatment. A leading technical reference (Dissolved Air Flotation for Water Clarification – Edzwald 2012) on DAF indicates that most of the bubbles formed from gas release are in the range of 50-100 micrometers in diameter. A calculation for the rise velocity of a 50 micrometer bubble (to be conservative) is included in **Appendix B**, which shows that the rise velocity would be approximately 0.17 feet per minute.

Preliminary sizing calculations for the vented tank are shown in **Table 4.2** below. The design of the tank will accommodate a maximum pumping rate of 40 gpm, which would accommodate either Well #1 or Well #6 running independently.

Table 4.2 Vented Tank Sizing Criteria

Design Criteria	Value	Units
System Flow Rate	40	gpm
Bubble Rise Velocity (50 micrometers)	0.17	ft/min
Tank Diameter	10	ft
Tank Vertical Velocity	0.068	ft/min
Tank Diameter Safety Factor	2.5	
Tank Minimum Depth	4	ft
Tank Minimum Volume	2,350	gal
Tank Minimum Residence Time	59	minutes
Tank Maximum Depth	6.5	ft
Tank Maximum Volume	3,819	gal
Tank Maximum Residence Time	95	minutes
Tank Wall Height	9.83	ft
Minimum Head Space for Spray System	3.33	ft
Tank Nominal Volume	5,500	gal
Recommended Tank Material	HDPE	
Recommended Insulation	2	inches

The vented tank sizing and selection above provides adequate safety factors to account for potential uneven vertical flow velocities in the tank due to currents. The tank outlet would consist of a perforated intake header that extends into the tank to reduce the possibility for significant velocity gradients and short circuiting within the tank. The inlet to the tank would include a full-cone spray nozzle sized for 40 gpm at a pressure drop of 10-15 psi to assist with initial air release and inlet distribution to the tank surface.

4.3.3 Booster Pump Design

Booster pumps are required to pump water from the vented tank back into the distribution system. System pressure at the well site is approximately 125 psi (~289' of water). 2 booster pumps would be recommended for redundancy. The design point for the pumps would be approximately 45 gpm at 300'. The booster pump would be designed to turn on by a high level float switch in the vented tank, and turned off by a low level float switch. When the high level is reached and the booster pump turns on, the booster pumping rate would be greater than the well pumping rate, and therefore the level in the tank would be drawn down until the low level float switch was reached and the booster pump would be turned off. The tank then would begin to fill as the well pump continues to run, until the high level float is reached and the booster pump turns on again. The booster pumps would cycle in this manner, with the cycle time being 132 minutes if Well #1 is running at 25 gpm, and 330 minutes if Well #6 is running at 40 gpm.

For low flow and high head applications, vertical multi-stage centrifugal pumps are recommended, such as the Goulds CR Series. With a design operating point of 45 gpm @ 300', the booster pumps would be 7.5 HP.

4.3.4 Vented Tank System Site Layout

The proposed site layout for the vented tank system is shown in **Figure 6 (Appendix A).** The tank would be founded on a 12" thick octagonal concrete pad. The vertical multi-stage booster pumps have a small footprint, and could be located within the Well #6 well house.

4.3.5 Vented Tank System Cost Estimate

A preliminary project cost estimate is included in **Appendix C.** The cost estimate includes the following overhead and contingency factors:

- 10% Contractor Profit
- 8% Contractor General Conditions, Bonds, and Insurance
- 25% Preliminary Design Contingency
- 25% Design, Engineering, and Construction Management

The total project cost, including design, engineering, and construction management is estimated at $250,000. The Small Community Toolbox Element 2.1 - Project Cost Estimating Tool was used to verify this cost estimate.

4.4 Drill Replacement Groundwater Well

A final option that may be considered is the installation of a new groundwater well elsewhere within PMMWC's service area that would not have an air entrainment issue, to replace Well #1 and Well #6. Installation of a new well at a different location would require the following preparatory activities:

1) Site reconnaissance and research of existing geological data to identify potential new well sites.
2) Installation of a test well to identify water bearing layers, determine well yield, and identify any potential water quality issues.
3) Property / easement acquisition.

Table 4.3 below provides a planning level cost estimate for installation of a replacement well that is assumed to be 200-300' deep, with an 8" casing, yielding 40 gpm.

Table 4.3 Replacement Well Planning Level Cost

Item	Planning Level Cost
Site Recon & Existing Geological Data Review	$15,000
Selection of Test Well Location	$15,000
Test Well Installation	$50,000
Test Well Geological & Water Quality Analysis / Permitting	$30,000
Property / Easement Acquisition	$20,000
Permanent Well Casing, Surface Seal, and Pump Installation	$50,000
Well House, Electrical, Mechanical, Site-Civil	$80,000
Total Planning Level Cost Estimate	$260,000

4.5 Alternative Comparison

Table 4.4 below compares the 4 project alternatives considered to address PMMWC's groundwater well air intrusion problem.

Table 4.4 Project Alternative Comparison Summary

Alternative	Estimated Cost	Comments
Consolidation	$1,600,000	This alternative is likely cost prohibitive and may meet opposition from the City of Willits City Council due to limited water supply issues.
Pump Gas Shroud	$10,000	This alternative would be considered a field trial that may fail.
Vented Tank System	$250,000	This alternative is the most straight forward solution to the problem.
Replacement Well	$260,000	This alternative has uncertainty with respect to the existence of other feasible well fields within the PMMWC service area that would not have air entrainment problems.

4.6 CEQA/NEPA Exemptions

The project alternatives outlined in this report all require California Environmental Quality Act (CEQA) documentation that state how each project is exempt or non-exempt from additional analysis. The different types of documentation required for each project are listed below and are based on the CEQA information provided in Small Community Toolbox Element 4.2 - CEQA-NEPA Exemptions and Checklists.

In addition, a Clean Water State Revolving Fund (CWSRF) Environmental Package document must be completed that covers CEQA and Federal cross-cutting regulatory requirements.

4.6.1 Consolidation Project Alternative

The consolidation project alternative would not qualify for any CEQA/NEPA exemptions because the new water distribution pipeline that would be constructed would be more than 1 mile in length. Consequently, a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report may be required.

4.6.2 Pump Gas Shroud Project Alternative

The pump shroud project alternative would qualify for a categorical exemption under Class 2: Replacement or Reconstruction (CEQA Guidelines 15302). Reason for exemption: Project requires reconstruction of water well that does not affect capacity or use. An individual Notice of Exemption form would be required to declare this.

4.6.3 Vented Tank System Project Alternative

The vented tank system project alternative would qualify for multiple categorical exemptions that would each require Notice of Exemption forms.

- Any grading or land alternation in preparation for the tank would be exempt under Class 4: Minor Alterations of Land (CEQA Guidelines 15304). Reason for exemption: Any trenches, grading or backfilling required to install the water storage tank would be minor and would occur immediately adjacent to existing structures, in land that is already cleared of vegetation, and would not infringe upon any wetland, officially designated scenic area, or land that poses geological hazards.

- The construction of the water tank, as well as any new pumps, pipes, and control equipment would be exempt under Class 3: New Construction or Conversion of Small Structures (CEQA Guidelines 15303). Reason for exemption: The project would require a small structure that consists of a small water storage tank with a capacity that is smaller than 100,000 gallons, as well as the construction of small new equipment for its operation.

- Any additions and modifications to the pumps and associated control equipment in the existing wells would be exempt under Class 1: Existing Facilities (CEQA Guidelines 15301). Reason for exemption: The project would require the addition or modification of existing mechanical, electric, and hydraulic controls for the water supply system and pump station.

4.6.4 Replacement Groundwater Well Project Alternative

The construction of the replacement well alternative as well as any new piping, and control equipment would be exempt under Class 3: New Construction or Conversion of Small Structures (CEQA Guidelines 15303). Reason for exemption: The project would require a small well to be constructed as well as the construction of small new equipment for its operation. This exemption would only stand if the new well facility is not located in any particularly sensitive area (e.g. = wetlands) as described in CEQA Guidelines 15300.

4.7 Regulatory Permits

In addition to the CEQA/NEPA documentation requirements outlined above, other regulatory permits for the project alternatives outlined in this report may be required from Local, State, and Federal regulatory agencies. Information detailing permits from regulatory agencies is based on the information provided in Small Community Toolbox Element 4.3 - Summary of the Common Permit Triggers. The list of applicable regulatory agencies that may require permits are listed below:

- U.S Fish and Wildlife Services (USFWS) / National Marine Fisheries Service (NMFS)
- State Historic Preservation Officer (SHPO)
- State Water Resources Control Board (SWRCB)
- California Department of Fish and Wildlife (CDFW)
- California Department of Transportation (Caltrans)

The pump gas shroud and vented tank alternatives would not be likely to trigger permit requirements from any of the agencies listed above. Consolidation could likely trigger permits from many of the agencies listed above, and a new groundwater well would likely trigger at least some permit requirements.

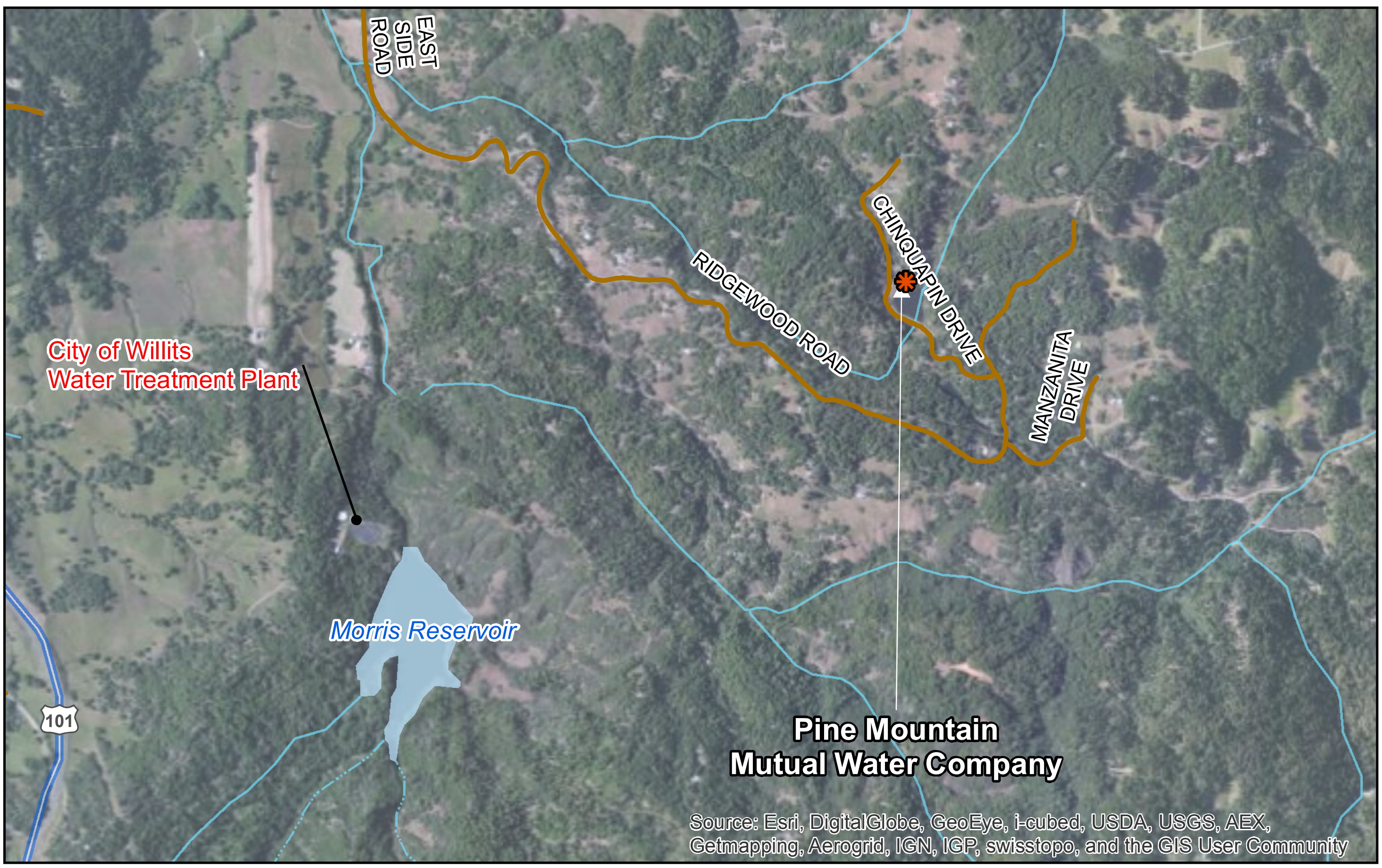
5. Implementation Strategy & Next Steps

Water Works Engineers recommends that PMMWC pursue the vented tank system solution to the groundwater well air entrainment problem. In the opinion of Water Works Engineers, the pump gas shroud concept is not likely to be successful, especially given the high amount of drawdown that may be occurring in the groundwater wells, which would complicate the design and operation of the shrouds. The installation of a replacement groundwater well assumes that a suitable location for another well is available within the PMMWC service area, which is uncertain. The vented tank system design is straight forward.

Water Works Engineers will prepare and submit a pre-application to SWRCB for SDWSRF grant funding for the recommended project, as PMMWC does not have the required project funding in reserve.

Appendices

Appendix A – Supplemental Figures



U.S. Highway

Major Road

Local Roads

Stream

River

Paper Size 8.5" x 11" (ANSI A)
0 500 1,0001,5002,000
Feet
Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

N

GHD

WATERWORKS ENGINEERS

Pine Mountain Mutual Water Company
Technical Assistance

Job Number	8410996
Revision	A
Date	29 Jul 2014

Vicinity Map

Figure 1

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

\\ekasvr3\projects\01081 HumboldtCounty DPW\8410996 NCRP Water-WW Assistance\08-GIS\Maps\Figures\F1_Vicinity_Pine_Mnt_MWC.mxd

Data source: ESRI Street Map; NAIP aerial 1m. Created by:porogers

Paper Size 11" x 17" (ANSI B)

LEGEND

SCALE (FT)

10 20 30 40 60 80

GHD

WATERWORKS ENGINEERS

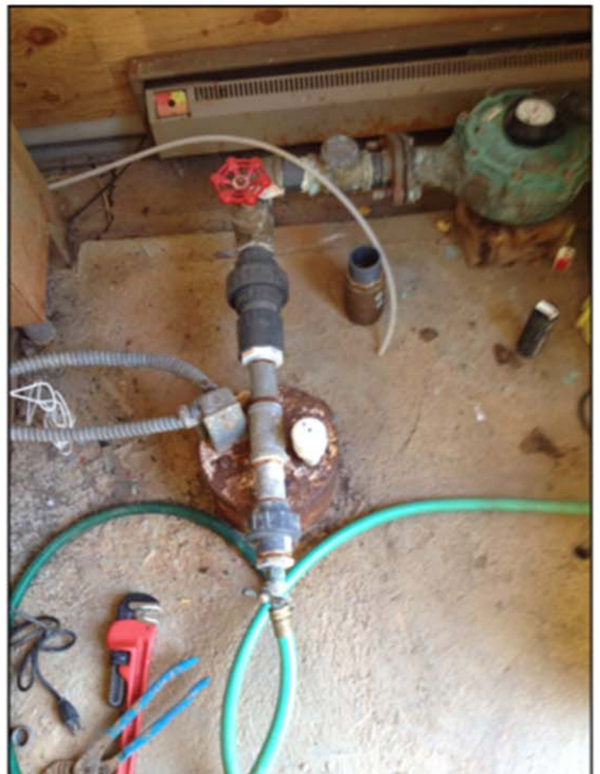
Pine Mountain Mutual Water Co
Groundwater Well Air Intrusion

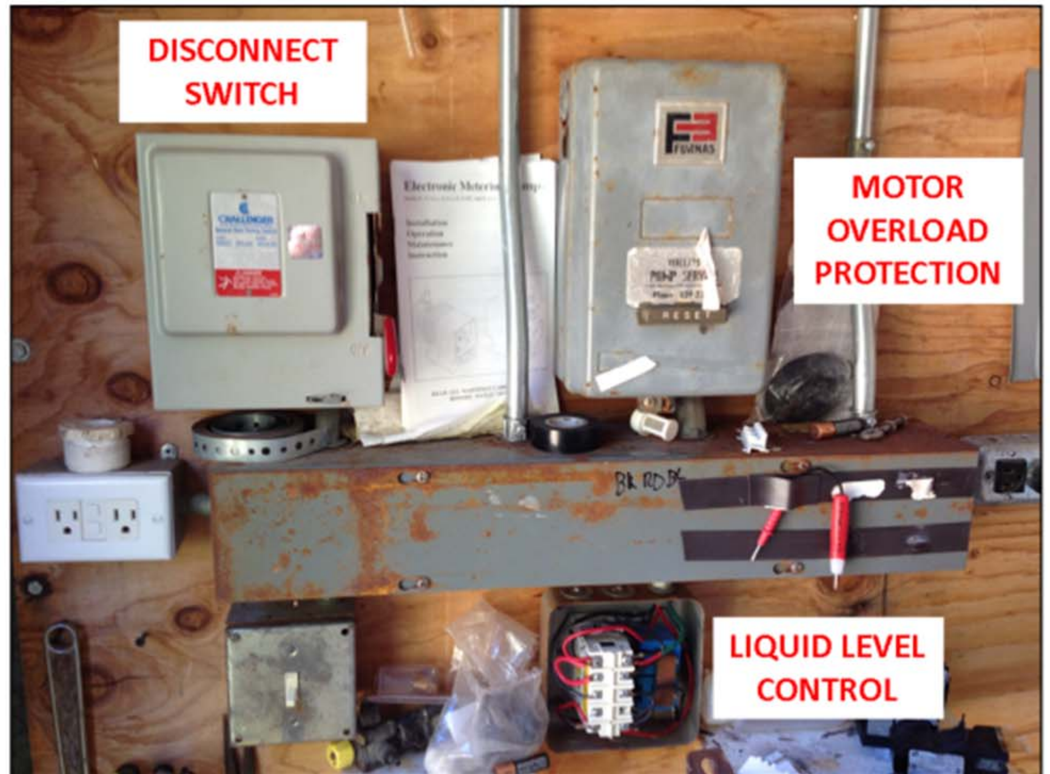
Job Number 8410996
Revision A
Date 21 AUG 2014

Groundwater Well Site

Figure 2

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com


Well #1—Cap and Discharge Piping



Well #1—Electrical Controls (other wells similar)


Well #6—Cap and Discharge Piping


Well #2—Cap and Discharge Piping


Well Houses #6 (foreground) & #1 (background)

Paper Size 11" x 17" (ANSI B)

LEGEND

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Well Site Photographs

Figure 3

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Paper Size 11" x 17" (ANSI B)

LEGEND

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WATERWORKS ENGINEERS

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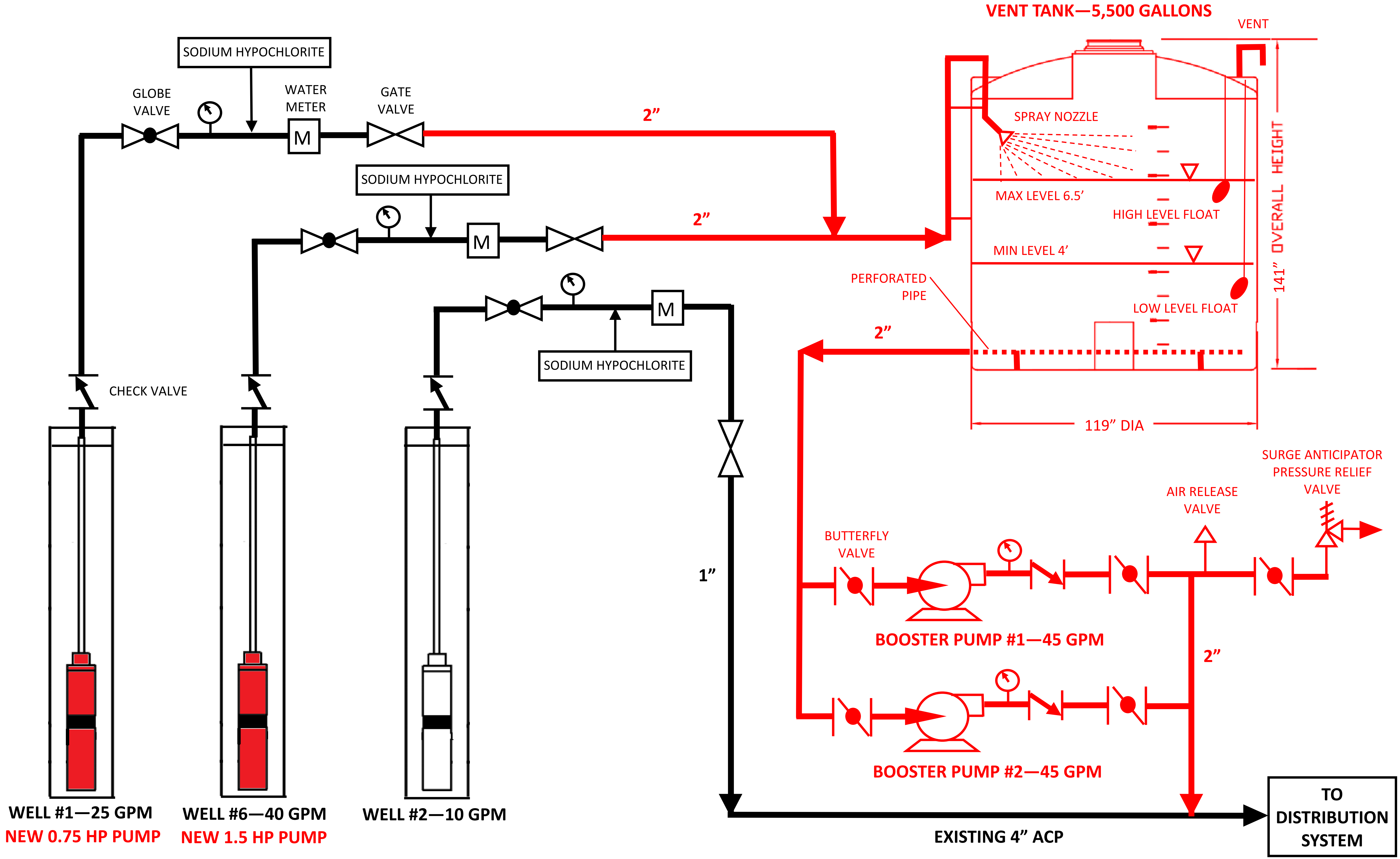
Consolidation

Figure 4

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com



VENT TANK—5,500 GALLONS
VENT
SODIUM HYPOCHLORITE
GLOBE VALVE
WATER METER
GATE VALVE
M
2”
SPRAY NOZZLE
MAX LEVEL 6.5’
HIGH LEVEL FLOAT
141” OVERALL HEIGHT
SODIUM HYPOCHLORITE
M
2”
MIN LEVEL 4’
PERFORATED PIPE
LOW LEVEL FLOAT
M
SODIUM HYPOCHLORITE
2”
CHECK VALVE
119” DIA
SURGE ANTICIPATOR PRESSURE RELIEF VALVE
AIR RELEASE VALVE
BUTTERFLY VALVE
1”
BOOSTER PUMP #1—45 GPM
2”
BOOSTER PUMP #2—45 GPM
TO DISTRIBUTION SYSTEM
WELL #1—25 GPM
NEW 0.75 HP PUMP
WELL #6—40 GPM
NEW 1.5 HP PUMP
WELL #2—10 GPM
EXISTING 4” ACP

Paper Size 11" x 17" (ANSI B)

LEGEND

SCALE (FT)

10 20 30 40 60 80

Pine Mountain Mutual Water Co
Groundwater Well Air Intrusion

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Vented Tank Site Plan

Figure 6

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Appendix B – Calculations

WATERWORKS ENGINEERS

Project No. 14-048
Title PINE WATER COMPANY – BUBBLE RISE VELOCITY CALCULATIONS.
Computed By TIM LEWIS
Date 8/12/14
Checked By
Date
Sheet No. ____ of ____

REFERENCE = pg. 8-2, "DISSOLVED AIR FLOTATION FOR WATER CLARIFICATION" by Edzwald & Haarhoff

FIND = BUBBLE RISE VELOCITY.

ASSUMPTIONS & GIVEN CONSTANTS

- micro air bubble size = 50 μm (conservative)
- bubble sizes the same throughout liquid (water)
- Willits average monthly low temperatures (SOURCE = WWW.WEATHER.COM), Calculated to be T_{low} = 38°F OR 4°C. Bubble rise 60% faster in summer.
- Assume no bubble slip (conservative), K=24

WATER PROP.
- ρ_w = 999.98 kg/m³ at 4°C (water density)
- μ_w = 1.57 ×10⁻³ kg/m·s (viscocity) at 4°C

BUBBLE PROP.
- ρ_B = 1.27 kg/m³ at 4°C (moist air bubble density)
- d_b = 50 μm (bubble diameter)
- g = 9.806 kg·m/s²

- Equation Used = $V_b = \dfrac{g(\rho_w - \rho_b)d_b^2}{18\mu_w}$ (EqN REF = 8-5)

SOLUTION

$$V_b = \frac{9.806\ \text{kg·m/s}^2}{18(1.57\times10^{-3}\ \text{kg/m·s})}(999.98\ \text{kg/m}^3 - 1.27\ \text{kg/m}^3)(50\times10^{-6}\ \text{m})^2 \cdot \frac{3600\,\text{s}}{\text{h}} = 3.12\ \frac{\text{m}}{\text{hr}}$$

(BUBBLE RISE VELOCITY)
$V_b = 3.12\ \frac{m}{hr}$ OR $2.05\ \frac{in}{min}$ $\left(0.17\ \frac{ft}{min}\right)$

Appendix C - Cost Estimates

WATERWORKS ENGINEERS

Project Number:	8410996
Title:	PMMWC Well Air Intrusion
Computed By:	JMZ
Date:	8/22/2014
Checked By:	SB

PER Construction Costs

	Item	Quantity	Unit	Unit Cost	Labor Cost	Total Cost (+10% Profit)
General / Site Work						
1	Submittals	1	ls	$2,500	included	$2,750
2	Mobilization	1	ls	$0	$4,100	$4,510
3	Grading / Site Preparation	1	ls	$0	$4,100	$4,510
4	Site Resoration	1	ls	$0	$2,050	$2,255
4	Security Fencing	100	lf	$30	included	$3,300
						$17,300
Major Equipment						
5	5,500 Gallon HDPE Tank With 2" Insulation and Seismic Restraint	1	ea	$17,500	$3,850	$23,485
6	Vert. Mult. State Booster Pump (45gpm @ 300')	2	ea	$4,530	$1,200	$12,606
7	New Well #1 Pump (25 GPM , 0.75 HP)	1	ea	$1,500	$4,100	$6,160
8	New Well #6 Pump (40 GPH, 1.5 HP)	1	ea	$2,000	$4,100	$6,710
						$49,000
Yard Piping, Valves, and Fittings						
9	2" Interior Piping	30	lf	$40	included	$1,320
10	2" Yard Piping	110	lf	$50	included	$6,050
11	2" Butterfly Valve	4	ea	$200	$75	$1,210
12	2" Check Valve	2	ea	$300	$75	$825
13	2" Air Release Valve	1	ea	$200	$75	$303
14	2" Surge Anticipator Pressure Relief Valve	1	ea	$1,500	$75	$1,733
15	2" Spray Nozzle	1	ea	$250	$75	$358
16	Pipe Supports	1	ls	$2,000	included	$2,200
						$14,000
Major Structural						
17	Vented Tank Concrete Pad	6.0	cy	$750	included	$4,950
18	6" AB Under Pad	3.0	cy	$50	included	$165
						$5,100
Major Electrical						
19	Booster Pump Motor Controls	1	ls	$15,000	$15,000	$33,000
20	Conduit and Wiring	125	lf	$50	included	$6,875
21	Float Switches	2	ea	$150	$100	$550
22	Electrical Service Upgrade	1	ls	$10,000	$10,000	$22,000
						$62,400
Subtotal, General / Site Work						**$17,300**
Subtotal, Major Equipment						**$49,000**
Subtotal, Major Piping & Valves						**$14,000**
Subtotal, Major Structural						**$5,100**
Subtotal, Major Electrical						**$62,400**
General Conditions, Bonds, Insurance				8%		**$12,000**
Project Subtotal 1						**$160,000**
Preliminary Design Contingency				25%		$40,000
Total Opinion of Probable Construction Cost						**$200,000**
Design Engineering and Construction Management				25%		$50,000
TOTAL PROJECT COST OPINION						**$250,000**

Appendix D - Drinking Water State Revolving Fund Program Universal Pre-Application

Template for Drinking Water State Revolving Fund Program Universal Pre-Application

Part One:

A. Project Title: Demonstration Project for Pine Mountain Mutual Water Company Groundwater Well Air Intrusion Analysis

B. Verify the Following Information About the Water System:

- Public Water System (PWS) Identification Number: 2300591
- PWS Name: Pine Mountain Water Company (PMMWC)
- Service Connections: 128
- Population: Approx. 390
- Regulating Entity: State Water Resources Control Board - Division of Drinking Water - Mendocino District
- Classification of Water System: Community Water System (CWS)

C. Provide the Following Project Contact Information:

- Title: President
- Organization: Pine Mountain Mutual Water Company
- Prefix: Mr.
- First Name: Mark
- Last Name: Cameron
- Phone: 707-459-6250
- Phone 2: N/A
- Fax: N/A
- Email Address: mfcameron@wildblue.net / chris@wisgis.com
- Mailing Address: 3800 Chinquapin Dr.
- Mailing Address Line 2: ____________________
- Mailing Address City: Willits
- Mailing Address State: California
- Mailing Address Zip code: 95490
- Physical Address: ______________________________
- Physical Address Line 2: ______________________________
- Physical Address City: ______________________________
- Physical Address State: ______________________________
- Physical Address Zip code: ______________________________

D. Project Description:

- Type of Funding Requested: Design and Construction
- Project Description: PMMWC has two groundwater wells (Well #1 and Well #6) that both experience significant entrained / dissolved air in the pump discharge that accumulates in the water distribution system, particularly within residential plumbing. The release of accumulated air in residential plumbing causes an unacceptable occurrence of large shocks and water hammer that is potentially damaging, and results in numerous customer complaints. The preferred solution to addressing the air entrainment problem is to construct a vented tank downstream of the groundwater wells that is designed to remove the entrained / dissolved air from the groundwater, and then re-pump the water back into the distribution system.
- Total Project Cost: $250,000
- Project Amount Requested from SRF: $250,000
- If applying for construction funding, how soon can the water system submit a construction application? 12/1/2014

E. Consolidation/Permanent Intertie:

- Is the project an intertie: No, determined not to be feasible.
- Will a water system go out of existence after project is complete: No.
- Specify the names of the other participating water system(s): N/A
- If this is a consolidation project, has the other water system(s) been contacted: N/A
- Is there a water service agreement: N/A
- Distance to nearest PWS (miles): 1.5 miles

Part Two:

F. Type of Problem (Select Main Problems This Project Addresses):

Waterborne Disease Outbreaks/Court Order for SDWA (Safe Drinking Water Act) violations

☐ The water system has received a court order to correct a SDWA violation.

☐ The water system has a confirmed waterborne disease outbreak.

Water or Groundwater Under Direct Influence of Surface Water

☐ Untreated or not filtered

☐ Unapproved filtration technology

☐ Not in compliance with Disinfection facilities requirement

Contamination Problem

Bacteria

☐ Water system repeatedly violated the total coliform MCL due to active source(s) contaminated with bacteria (fecal, E. coli, or total coliform)?

☐ The source contamination has resulted in issuance of (a) boil water and/or bacteriological failure notification(s).

☐ The water system has violated the Total Coliform Rule for reasons other than source contamination.

Primary Standard

☐ Nitrate/Nitrite

☐ Perchlorate

☐ Arsenic

☐ Hexavalent Chromium (Chrome 6, proposed)

Others: ______________________________

Secondary Standard (Exceeding Maximum Contaminant Level)

List the Contaminant: ___________________________

Water Outages/Water Quantity Problems

☐ The water system has received a court order to correct water outage problems.

☐ The water system uses non-permitted sources for the purpose of maintaining water pressure.

☐ The water system has received enforcement action (citation, compliance order, ect.), or a permit condition directing/requiring that new sources be developed or improvement is needed in delivery system.

■ The water system uses standby water sources to meet peak demand.

☐ The water system has records (logs) that indicate frequent and prolonged water outages due to lack of sufficient source or water delivery capacity.

■ The water system had an independent engineering firm evaluate and determine that the water system's existing sources cannot meet the current demand without creating significant water problems.

Water Meter Installation Projects

☐ No meters installed.

☐ Install meters on non-metered customer service connections.

☐ Upgrade existing metered connections and new meters on non-metered connections.

California Waterworks Standards/Others

☐ The water system violates portions of the California Waterworks Standards that could result in the entry of wastewater into the water supply or distribution system.

☐ The water supply operates disinfection facilities that lack needed reliability, monitoring, control, or safety features and/or has other disinfection deficiencies that violate the California Water Standards.

☐ The water system fails to meet other California Waterworks Standards not related to disinfection or entry of wastewater.

■ The water system has TMF (Technical, Managerial, and Financial) deficiencies.

☐ The water system lacks adequate security measures for system facilities.

☐ The water system has (an) uncovered distribution reservoir(s).

☐ Other water system deficiencies.

G. Problem Description:

PMMWC has two groundwater wells (Well #1 and Well #6) that both experience significant entrained / dissolved air in the pump discharge that accumulates in the water distribution system, particularly within residential plumbing. The release of accumulated air in residential plumbing causes an unacceptable occurrence of large shocks and water hammer that is potentially damaging, and results in numerous customer complaints.

PMMWC's primary water supply is from a surface reservoir, with a water treatment plant (WTP) that includes pressure contact clarification / pressure filtration / and disinfection. However, the surface reservoir is vulnerable to very high turbidity spikes during winter storm events, which renders the raw water untreatable by the current treatment process. During these events, the Surface WTP must be shut down and the groundwater wells become the only water supply source. Additionally, the surface reservoir volume is relatively small, and this reservoir is vulnerable to algae blooms and depletion during drought conditions.

If the Surface WTP is shut down due to winter storms. algae blooms, or drought, the groundwater wells are the only water supply. The groundwater well air entrainment problem has caused Wells #1 and #6 to be shut down due to air accumulation in the distribution system and customer complaints, and therefore PMMWC's water supply is vulnerable and not adequate to supply the system demand during the events described above. Additionally, PMMWC desires to use the groundwater wells on a regular basis to preserve its supply of surface water during dry years.

Part Three:

H. Additional Information to Determine Readiness to Proceed

General Questions:

- Has the water system received a CDPH Funding Agreement in the past? No.
- Provide water system's ownership type: Mutual Water Company
- If Other: N/A
- If Mutual/Private/Other, is the ownership in good standing with the Secretary of State? Yes.
- Can the water system provide documentation of legal entitlement to water source? Yes.
- Ownership of land: Owned by PMMWC
- Long term lease or Easement: N/A.
- Water supply contract: N/A.
- If water system's source is surface water or an adjudicated groundwater basin, can the water system provide documentation of water rights necessary to operate the project? Yes.
- Does the water system have a consultant helping with the project? Yes.
- If yes, please provide consultant firm name: Water Works Engineers, LLC
- Can the water system provide the past 3 years audited financial statements/tax returns? Yes.
- What is the current estimated Median Household Income (MHI) of customers in the water system's service area that will benefit from this project? $34,504
- How was the MHI determined? 2010 Census – Inflation Adjusted to 2012 per US Census Bureau
- For what year was the MHI determined? 2010

- Has the water system completed a rate study in the last 3 years? No.
- Has the water system anticipated having to do a Prop 218 Assessment for a rate increase to support this project? No. The project will not move forward unless grant funded.
- Does the water system have a capital improvement plan and asset management plan? No.

Construction Project:

- Are plans and specifications documents completed? No. Project design funding is needed.
- If not, when can the water system complete the plans and specifications? Estimated 3 months following identification of design funding.
- Has the project gone through environmental review? No.
- Has CEQA been completed for the project? No, no environmental impacts anticipated based on very small footprint of project.
- If yes, please identify the documents(s) completed: N/A