APPENDIX 4.7

CECorps Design Report for Santa Teresa Village

November 2016

APPENDIX 4.7 SANTA TERESA VILLAGE DESIGN REPORT

This addendum summarizes the results of the design report prepared by Community Engineering Corps (CECorps) team from Cleveland State University dated November 14, 2016 as well as additions to the original report prepared by Peter Waugh, consulting engineer, and the Salinas Valley Water and Wastewater Planning Project Team. Table 1 summarizes the results of the combined work with the intent of providing important cost information for the property owner and residents at Santa Teresa.

Table 1 Summary of Capital Construction and Operation/Maintenance Costs for Santa Teresa

	Alt 1: Consolidation	Alt 2: New Well	Alt 3a: Wellhead Treatment	Alt 3b: Wellhead Treatment [UCLA Project]
Source of Information	CECorps	CECorps	Project Team	UCLA
Capital Cost	$1,740,300	$300,700	$39,900	TBD
Annual O&M Cost	4,800[1]	$24,000	$22,800	TBD
Net Present Value	$1,825,300	$720,700	$438,900	TBD
Estimated average monthly cost/home	$40[2]	$200	$190	TBD

[1] The operation and maintenance cost was estimated to be the same as the cost of water service to the residents. This was calculated by multiplying the estimated annual water cost per home by the number of homes.

[2] Based upon 4 residents using 100 gallons per day and current City of Soledad water rate schedule for Jan. 1, 2018. Assumes 5/8" water meter charge.

Summary of CECorps Design Report

Santa Teresa is an economically disadvantaged community of ten homes located about 3/4 mile north of Soledad, CA. The water system consists of a well, storage tank, pressure tanks and a distribution system. The water system has levels of nitrate higher than the maximum contaminant level (MCL). Four alternative solutions were considered for bringing the water supply into compliance with applicable water quality standards: 1) consolidation, 2) drill a new supply well, 3) wellhead treatment and 4) importing water. The preferred alternative is consolidation with the City of Soledad water system. A summary of costs for two of the alternatives is presented in Table 1 above.

Additions/Revisions to the Original Design Report

a) Standardized Water Demand

A standard method for calculating water demand has been developed for use in the water supply system analysis for each community. This method is summarized in Appendix 4.14 Engineer's Memorandum. Table 2 shows the water demand for each alternative in Santa Teresa.

Table 2 Water Demand for Santa Teresa Alternative Water System Improvements

Alternative	Design Water Demand[1,2]
Alternative 1 – Consolidation	ADD = 10,400 gpd, MDD = 23,400 gpd, PHD = 1,463 gph
Alternative 2 – New supply well	30 gpm
Alternative 3 – Wellhead treatment	30 gpm

Notes:

[1] ADD = average daily demand, MDD = maximum daily demand, PHD = peak hour demand, gpd = gallons per day, gph = gallons per hour, gpm = gallons per minute

[2] Note that consolidation water demand may be modified by the consolidation partner if they have historic water demand data to support using a different value.

b) Wellhead Treatment

The wellhead treatment cost is recalculated using the same criteria as the Middlefield Road and Hudson Landing Road water systems. This refers to Alternative 3 as originally developed by the CECorps team from Cleveland State University. It does not refer to the UCLA treatment system. The wellhead treatment system would be added to the existing water supply well, storage and distribution system. The new treatment system would include an ion exchange treatment facility, a small shed to house the facility, a 3,000 gallon plastic storage tank to accept the waste brine, and a 50 gpm pump to transfer the water to the hauling truck. The operation and maintenance costs include weekly visits by an operator, hauling the waste stream to a treatment facility (approximately monthly) and disposal at the treatment facility. Additional information about this scenario is included in Appendix 4.14 Engineer's Memorandum. A summary of treatment costs in provided in Table 3 below. This includes the capital construction cost as well as the monthly operation and maintenance cost.

Table 3 Summary of Capital Construction Cost and Operation/Maintenance Cost for Santa Teresa Wellhead Treatment Option

Community	No. of Homes	Capital Construction Cost	Monthly O/M Cost	Annual O/M Cost
Santa Teresa	10	$39,947	$1,900	$22,800

c) Net Present Value and Monthly Cost Per Household

The economic evaluation for Santa Teresa was updated to include net present value and projected monthly cost per household using the Johnson Road CECorps team's methodology. Page 20 of Appendix 4.2 Johnson Road CECorps Design Report describes this methodology:

> "The economic evaluation also includes a comparison of the Net Present Value (NPV) of each alternative, which assumes an O&M inflation rate of 1.9% and annual discount rate of 3.1% over a 20 year term. The costs presented in this evaluation are in 2016 dollars, and the backup for these cost estimates can be found in Appendix F... To evaluate each alternative's cost impact on the community members, the estimated annual O&M costs were divided to show the amount that would be paid by each household on a monthly basis."

Community ENGINEERING CORPS®

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Design Report

Project: #184006014

Chapter or Section: EWB-USA CSU-Ohio Student Chapter

State: California

Community: Santa Teresa, Salinas Valley

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Introduction

Objective

The Salinas Valley in California's Monterey County, commonly referred to as the salad bowl of America, relies on the agriculture industry. The use of pesticides, fertilizers and other crop nutrient additives has caused contamination in the region's groundwater basins. Of specific, historical concern is nitrate, a primary ion in fertilizers and manure-based soil additives. Nitrate is a regulated drinking water contaminant with an established Maximum Contaminant Level (MCL) of 45 milligrams per liter (mg/L) set by the California Code of Regulations, Title 22. Nitrate concentrations exceeding this threshold are considered detrimental to human health if consumed. Other federal and state regulatory limits are summarized in the following table.

Table 1 Nitrate (NO_3) Regulatory Concentration Limits[1]

Type	Agency	Concentration Limit (mg/L)
Federal MCL	US EPA[2]	10 (as N)
State MCL	SWRCB-DDW[3]	45 (as NO_3)
	SWRCB-DDW[3]	10 (as N)
Detection Limit for Purposes of Reporting (DLR)	SWRCB-DDW[3]	2 (as NO_3)
	SWRCB-DDW[3]	0.4 (as N)
Public Health Goal (PHG)	OEHHA[4]	10 (as N)

[1] These limits apply for potable water uses; other water quality limits may exist.
[2] United States Environmental Protection Agency
[3] State Water Resources Control Board-Division of Drinking Water
[4] Office of Environmental Health Hazard Assessment

Extracting nitrate from water typically requires expensive, energy-intensive technologies, which are typically inaccessible to Salinas' private well owners. If alternative water sources are not available, residents are faced with the ramifications of relying on and maintaining a contaminated water source.

Santa Teresa is one such community, shown in the following Figure, which lies approximately 0.5 miles north of the city of Soledad and twenty-five (25) miles south of the city of Salinas. Santa Teresa is an unincorporated community of approximately ten (10) homes which has struggled with nitrate contamination since the 1970s. Historically, the community was not aware of other water quality issues, but has expressed concern regarding diminishing groundwater levels in nearby wells and the reliability of their well's future pumping capacity. This report aims to assess Santa Teresa's water quality issues and provide alternatives to address those issues.

Figure 1 Santa Teresa Community in Monterey County

Project Scope

This project was carried out under the Community Engineering Corps Salinas Valley Project Series, and was completed in collaboration with Engineers without Borders and the Environmental Justice Coalition for Water (EJCW). This project assessed Santa Teresa's water quality issues based on historical water quality data provided by Monterey County, additional sampling and resident interviews conducted in a three (3)-day site visit in March 2016, and provided alternatives to address found water quality issues based on this data. Alternatives were developed to the level of detail of information that was provided to the project team from communication between EJCW and the local public agencies, including Monterey County and the city of Soledad, and as collected during the site visit. The project team assessed the condition of the existing water system's infrastructure during the site visit. The project did not evaluate financing or funding sources for the implementation of the alternatives. Additionally, the project did not assess water supply, nor current, future and fire demand volumes. Industry standards were used when assumptions were required. The project proposes one (1) preferred alternative and one (1) intermediate solution based on the engineering experience of the project team.

Description of Community

Santa Teresa, shown in Figure 1, is a small unincorporated community located off of San Vicente Road, approximately 0.5 miles north of the city of Soledad. The 3.58-acre property and approximately ten (10) houses located on the property are owned by one (1) land owner. At the time of the site visit, nine (9) of the houses were occupied and one (1) house was vacant. For the purposes of this report, a household capacity of four (4) persons was estimated per household, for a total population of thirty-six (36). Santa Teresa is surrounded by agricultural fields.

Description of Existing Water System

The following figures displays the approximate layout of Santa Teresa's existing water system and the current process flow diagram (PFD). The system is comprised of one (1) well, one (1) pump, two (2) tanks, and distribution piping to ten (10) connections. Maintenance of the system is managed by Santa Teresa's property owner and is financed by a monthly water fee of $40 (2016) per household.

Figure 2 Santa Teresa's Existing Water System

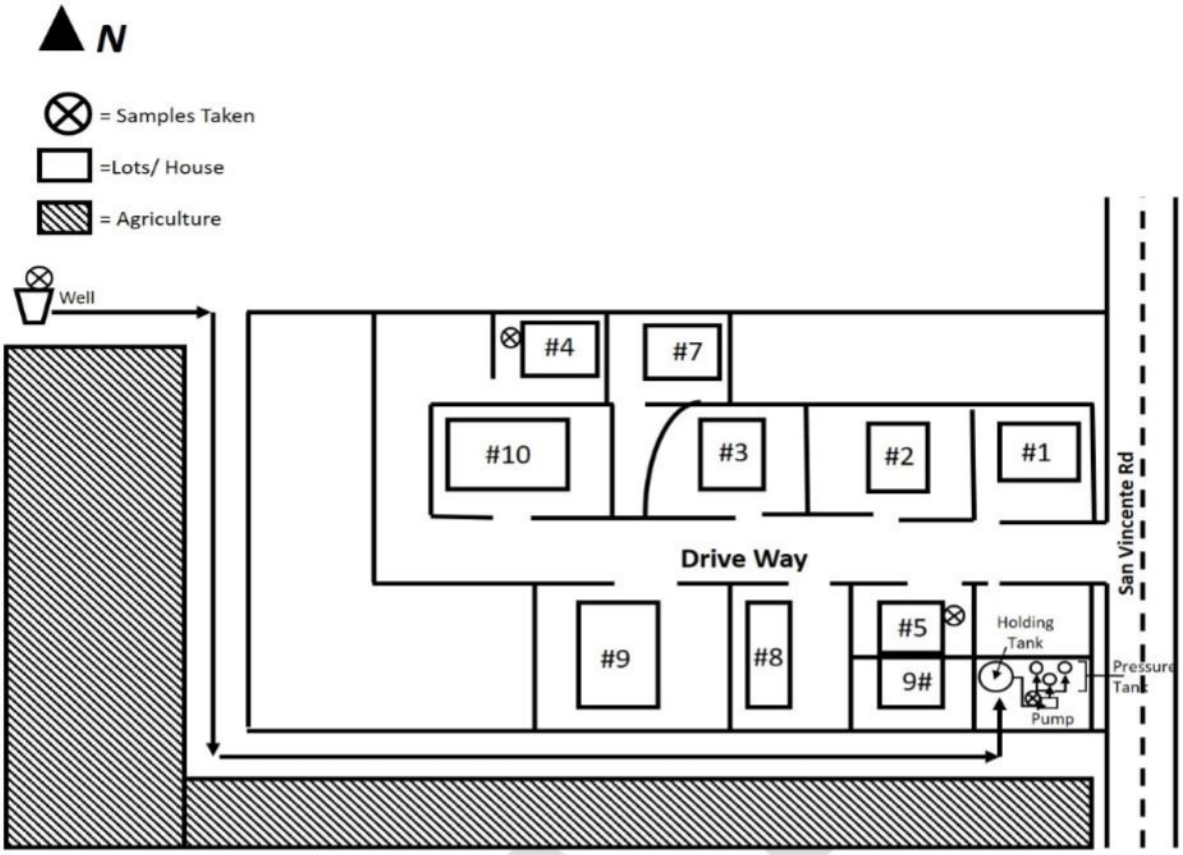
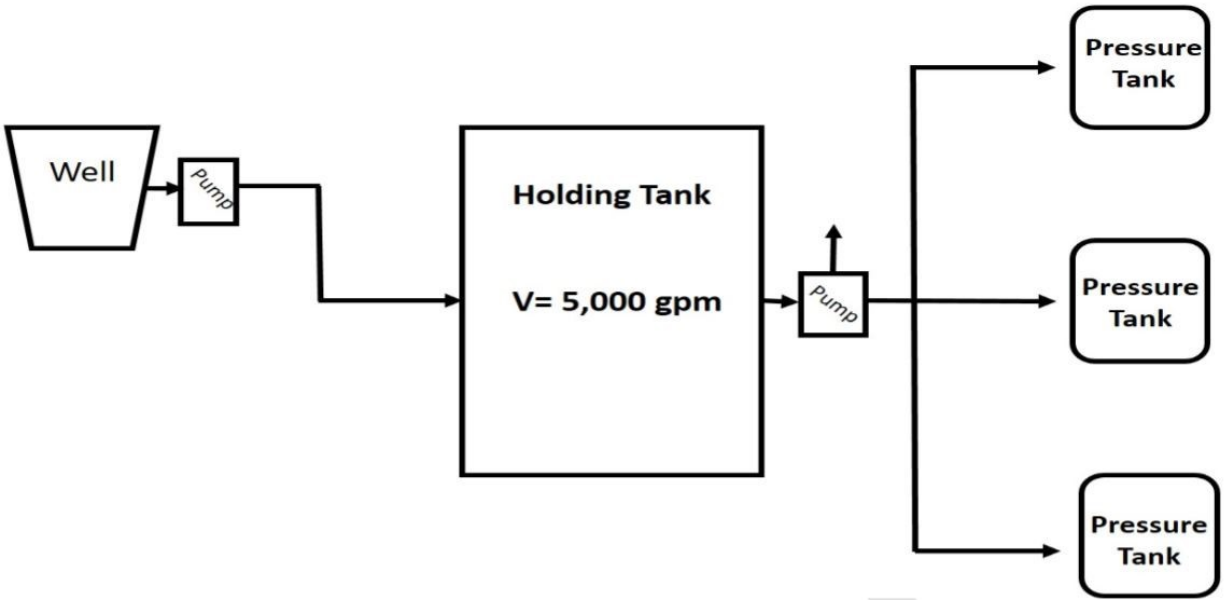


Figure 3 Santa Teresa's Existing PFD



Source

Santa Teresa's sole water source is groundwater extracted from one (1) well, shown on the following Figure, which is located approximately 350 yards west of Santa Teresa in the middle of an agricultural field on a twenty (20) by twenty (20) foot easement. To access this well, the property owner must drive around both agricultural fields. The well was constructed in 1973 and was approved for seven (7) connections and up to 1,000 gallons in storage; in 1990, the County permitted ten (10) connections. Documentation of these permits and well logs were not available at the time of this study.

The rated capacity of the well is ten (10) gallons per minute (gpm); the typical number of hours per day and rate of the pumping operation was not known at the time of this report. The well is pumped using a 0.5-horsepower submersible pump to Santa Teresa via a PVC pipe, the diameter of which is estimated at four (4) inches. The well diameter is twelve (12) inches and is approximately 240-feet deep. The well does not have protected casing. The well encasement, shown in the next Figure, is made primarily of wood panels with no concrete foundation and was deemed in very poor condition at the time of the site visit. There are no known mechanical issues with the current operation of this well and associated equipment. It is unknown if improvements to the well have been made in the last ten (10) years.

Figure 4 Existing Well

Figure 5 Encasement

Treatment

Details of treatment for Santa Teresa's raw water are unknown at this time; it is understood that the water is occasionally chlorinated, but dosing, frequency, triggers, records, chemical storage infrastructure and condition, assumed water quality objectives, nor permits for treatment or chemicals are unknown.

Storage

The current well system relies on a 5,000 gallon plastic holding tank installed in 2016. The holding tank is connected to three (3) plastic pressure tanks with PVC pipe; the

pressure tanks were installed in, approximately, 2006. The area around the storage tank appeared well maintained and easily accessible, but the tank does not undergo any regular maintenance nor disinfection. Since the installation of the new tank, no major issues nor expenses were reported.

Distribution

PVC piping of up to four (4) inches in diameter is used to transmit and distribute water between the well, storage tank and pumps. One (1) pump distributes water to the residences via a four (4) inch pipe (estimated); the material and diameter of individual service lines are unknown. It is assumed that the distribution system was installed in 1973 with service line installations occurring until 1990. The only known maintenance to Santa Teresa's distribution system has been chlorinated when requested by Monterey County, but details of these procedures are unknown. The general condition and design criteria for the distribution system are unknown.

Demand

To monitor water consumption, Santa Teresa's property owner installed water meters between 2005 and 2006 and implemented water usage fees at approximately $15 to $20 per month per household. At the time of this report, no data was available regarding Santa Teresa's water demand.

Water Quality

This section summarizes and assesses Santa Teresa's historical water quality records provided by Monterey County, and results from one (1) sampling event and resident interviews conducted during the March 2016 site visit.

At the time of the March 2016 site visit, each house in Santa Teresa had in display a Monterey County sign stating that the water is not suitable for drinking. These signs were installed in 2010 at the first issuance of an annual County "Do Not Drink Order." Before and after 2010, Monterey County has periodically required that Santa Teresa's property owner either provide water quality information to residents or inform residents that disinfection of the water system is required and to undergo the disinfection. Requirements to notify residents of nitrate concentrations were issued by Monterey County to Santa Teresa in 2008, 2010, 2011 and 2012, and of coliform presence in 2006, 2008, 2010, 2011 and 2012. Santa Teresa has documentation of verbal notification to residents of water quality issues in 2010.

Other Monterey County requirements, permits, monitoring requests or regulatory actions against Santa Teresa, if any, are undocumented and unknown at the time of this report. The Alternatives Analyses described herein is based on the following water quality data.

Historical Data

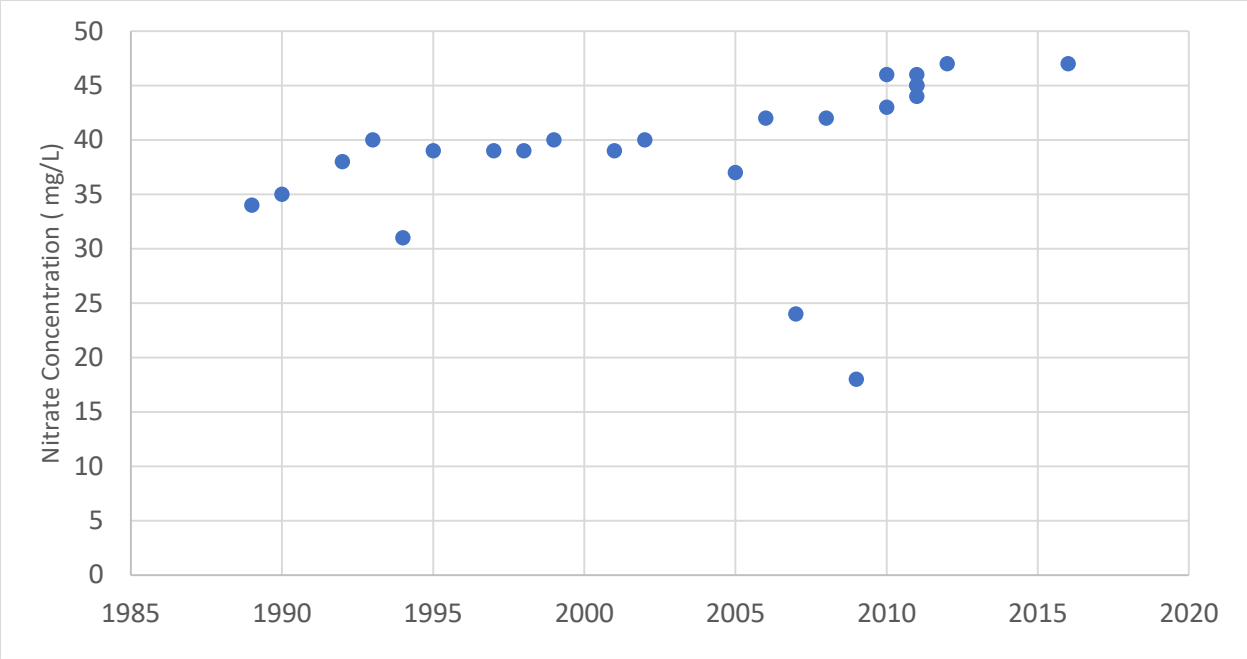
The following Table and Figure represent historical nitrate concentrations and coliform presence, as measured in Santa Teresa's raw water source. Only nitrate and coliform

data is presented herein, since regulatory exceedance of other contaminants were not found in the historical data (see Appendix C and E) nor by Monterey County. As shown, nitrate concentrations have exceeded the state MCL of 45 mg/L since 2010, and coliform is frequently detected, signifying that the Santa Teresa groundwater is of inadequate quality for drinking water purposes as per regulatory standards.

Table 2 Historical Data Collected from the Monterey County Lab on Santa Teresa since 1989

Month	Year	Nitrate (NO3) Concentration (mg/L)	Coliform (E. Coli) Concentration (#/100mL)	Total Coliform Concentration (#/100mL)
January	1989	34	PRESENT	PRESENT
December	1990	35	ABSENT	PRESENT
September	1992	38	ABSENT	ABSENT
June	1993	40	ABSENT	ABSENT
December	1994	31	ABSENT	PRESENT
February	1995	39	ABSENT	ABSENT
January	1997	39	ABSENT	ABSENT
March	1998	39	ABSENT	ABSENT
May	1999	40	ABSENT	ABSENT
August	2001	39	ABSENT	ABSENT
February	2002	40	ABSENT	ABSENT
May	2005	37	ABSENT	ABSENT
January	2006	42	ABSENT	PRESENT
January	2007	24	ABSENT	ABSENT
March	2008	42	ABSENT	PRESENT
April	2008		ABSENT	ABSENT
June	2009	18	ABSENT	ABSENT
March	2010	46	ABSENT	ABSENT
December	2010	43	ABSENT	PRESENT
February	2011	45	ABSENT	PRESENT
June	2011	46	ABSENT	PRESENT
August	2011	44	ABSENT	ABSENT
November	2011	45	ABSENT	ABSENT
May	2012	47	ABSENT	PRESENT
March	2016	47	ABSENT	PRESENT

Figure 6 Nitrate Concentrations, 1989 – 2016



Sampling Plan & Results

Additional sampling during a site visit on March 15, 2016 was conducted to supplement historical data (the last full Title 22 sampling was conducted in 1987), and to identify raw water contamination at the well source and any contamination within the storage and distribution system. Sample locations included the well, the most upstream and downstream residences in the distribution system (Houses No. 4 and 5, respectively, as shown in Figure 2), and the fire access. The fire access was the most accessible sampling site for water quality representative of that in the storage tanks. Sampling at each residence was taken from hose bibs which were flushed for a minimum of five (5) minutes and disinfected. Sampling at the well occurred after a minimum of fifteen (15) minutes of flushing. Sampling frequency was limited to available resources. A full Title 22 panel was taken at the well and coliform samples were taken at the other sample locations. Results are included in Appendix C.

Coliform was detected using EPA Method SM9223B in the fire access sample and at the most upstream residence. The positive result found in the fire access sample may be attributed to the fact that the sample site was extremely dirty, and may not have been completely decontaminated. The positive result at the most upstream residence where no coliform was detected at the well signifies that contamination occurs at the storage tanks. It was recommended to the property owner that the tanks be routinely cleaned and disinfected. Nitrate was detected using EPA Method 300.0 method at the well at a concentration of 47 mg/L.

Resident Interviews

Resident interviews were not conducted during the site visit due to time and resource limitations; the property owner was the only resident interviewed during the site visit. Notes from this interview are included in Appendix D.

Water Quality Analysis

Nitrate and coliform concentrations are the constituents of concern in Santa Teresa's raw water and distribution system. Coliform is present in at least forty (40) percent of historical samples taken between 1989 and 2016, and nitrate concentrations have exceeded the regulatory limit of 45 mg/L since 2010. The highest measured nitrate concentration was observed in 2016 at 47 mg/L.

Summary of Treatment Needs

Based on the aforementioned water quality analysis, Santa Teresa needs to treat the raw water source for nitrates and the distribution system for coliforms. The following section presents proposed alternatives designed to address these treatment needs. Ancillary objectives of the proposed alternatives include infrastructure update needs.

Alternatives Analysis

The following alternatives are proposed to address the treatment needs summarized in the previous section; these alternatives include consolidation, wellhead treatment, new well siting or well relocation, and water importation. Alternatives are compared according to feasibility, likelihood of success, planning-level implementation, and operation and maintenance (O&M) costs. The presented costs are preliminary planning-level estimates for comparison of the alternatives, and should not be used for actual funding analyses. The section concludes with a preferred long-term alternative and intermediate solution recommendations.

Assumptions

The proposed alternatives are based on the following assumptions:

- Water Demand
    - Current Average Daily Demand: 2,600 gallons per day (gpd) (65 gallons per capita per day, gpcd, industry standard, at 4 people per household in 10 houses)
    - Current Peak Hour Demand: 3,900 gpd (1.5 safety factor, industry standard)
    - Future Average Daily Demand: 2,860 gpd (10% population growth in 20 years, the amount of time infrastructure is designed for, industry standard)
    - Future Peak Hour Demand: 4,290 gpd (1.5 safety factor, industry standard)
    - Design Fire Demand, two (2) hour: 1,000 gpm (State industry standard)
- Current Peak Hour Demand Water Quality Objectives

    - Nitrate: less than 45 mg/L
    - Coliform: absent
- Infrastructure shall be upgraded or designed to the City of Soledad Public Works Department Design Specifications.
- Estimated annual O&M costs are based on the following rates:
    - Electricity: $0.13 per kilowatt-hour (kWh), based on 2015 California average residential electricity rates typically used for planning purposes
    - Chemicals:
        - Chlorine: $3.50 per gallon
    - Labor: $15 per man-hour
- New or upgraded equipment costs are based on a twenty (20) year life span and do not include parts replacements after twenty (2) years.
- The ability for Santa Teresa to finance these alternatives and external funding sources were not evaluated.

Description of Alternatives

Alternative 1 – Consolidation

Consolidation with the city of Soledad Public Works water system requires the construction of a 0.8-mile pipeline according to the City's Design Specifications and Standards along San Vicente Road with a tie-in location shown in the following Figure. The City's consolidation requirements may require Santa Teresa to consolidate its wastewater system as well, but these requirements and costs are not evaluated in this report. The new pipeline and associated facilities will be owned, operated and maintained by the city of Soledad, and will be designed to the City of Soledad Public Works Department Design Specifications. Because the Design Specifications and Standards were not available at the time of this report, industry-wide assumptions which meet California's regulations were used to develop this alternative. Complying with these assumptions will require the following improvements to Santa Teresa's existing water system infrastructure:

- Upgrade transmission, distribution and service lines and appurtenances;
- Install meters at each household;
- Install booster and disinfection pumping facilities;
- Upgrade storage tanks;
- Install hydrants; and

- Abandon existing well. Santa Teresa's water rights will require that groundwater from the existing well only be used for non-potable applications, such as irrigation.

Figure 7 Proposed Consolidation Pipeline and Tie-in Location

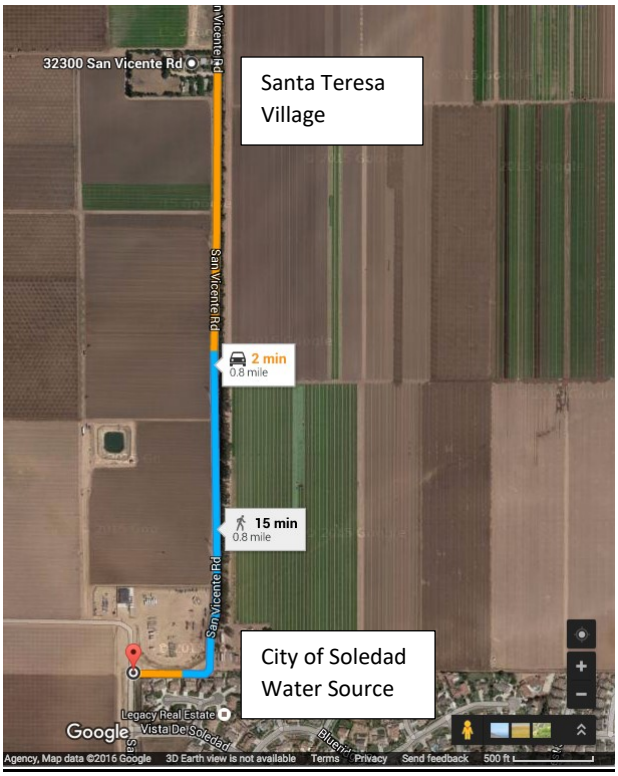


Figure 7 is a general schematic for planning purposes of the proposed consolidation pipeline; City of Soledad as-built drawings would be required to more specifically identify the pipeline layout and tie-in location. The pipeline should be sized to accommodate the fire and future PHD domestic demands less the capacity of available storage at a typical velocity of five (5) feet per second. This is the only alternative for which private fire protection is not optional. For this alternative, it is assumed that the City of Soledad would require that Santa Teresa abandon their existing tanks and that the City has sufficient storage for the relatively small water demand of Santa Teresa. A four (4) inch diameter PVC pipe is assumed sufficient for Santa Teresa's demands.

The need for pumping depends on the pressure in the City of Soledad water system and their existing pump stations, head loss towards Santa Teresa's residences, and friction loss in the pipe. Because this information was not available at the time of this report, it is assumed that booster and chlorination pumping facilities are required and cost estimates are included in the following Table.

Currently, Santa Teresa residents pay a monthly fee to the property owner for water, and an additional cost for bottled water. Residents estimate that they spend approximately $40 per month per household on these two items in 2016. If Santa Teresa consolidates with the city of Soledad's Public Works water system, each household will be required to

pay monthly water consumption fees, associated federal, state and city taxes, and a fixed maintenance fees. These expenses will likely be greater than the current household expenditure on water services, but these costs and the affordability of these costs to the households were not evaluated in the development of this report. It is assumed that Santa Teresa will be required to abandon their current well for domestic purposes upon consolidation. No additional information regarding City contractual and infrastructure requirements, permits and fees for the consolidation of Santa Teresa were available at the time of this report.

Table 3 Alternative 1 Cost Estimate: Consolidation

Item	Estimated Cost
4-inch 4,230-feet PVC Pipeline ($200/LF)	$846,000
Booster & Disinfection Pump Station	$60,000
Required Distribution System Appurtenances	$20,000
Water Meters (10)	$4,990[1]
Upgrades to Santa Teresa Distribution System	$50,000
Upgrades to Santa Teresa Storage System	$10,000
City of Soledad Consolidation Fees	Unknown
Total Probable Construction Cost	*$1,035,901*
Estimated Contingency (20%)	*$207,180*
Estimated Construction Cost	*$1,243,081*
Administrative, Permitting, Legal, Planning, Design, Project and Construction Management (40%)	*$497,232*
Total	**$1,740,314**
Estimated Annual O&M Costs (Power, Chemicals, Labor, Parts)	**$0 (City expense)**

[1] Reference: Edward Waggoner, Water Resources Manager for the City of Soledad

Alternative 2 – New Well Siting or Well Relocation

Santa Teresa's well currently withdraws water from a depth of 240 feet. While the aquifers currently being used are contaminated with nitrates, there are deeper aquifers at depths from 600 to 800 feet that are less likely to have high levels of nitrates according to Edward Waggoner, Water Resources Manager for the City of Soledad. This alternative therefore includes the installation of a new well site that will reach the lower aquifers of potentially improved water quality. It is critical to note that groundwater of adequate quality make not be found in the area, and if found, it may not be a reliable source of adequate quality water in the long-term. According the Edward Wagner, groundwater exploration for a new well site will commence in the area identified in the following Figure, selected based on proximity to the Santa Teresa Community.

Figure 8 Proposed Siting for Initial Groundwater Exploration

Siting of a new well will require pumping, storage and distribution system modifications at Santa Teresa, based on the location of the new well relative to the community. The ability to meet the private fire protection demand will depend on the capacity of the new well site. The following Table presents the estimated costs for the new well alternative, based on the following specifications. These specifications were used to match the construction of the existing well and to obtain competitive drilling estimates; the actual cost of siting a new well for Santa Teresa will vary based on the depth that acceptable water is found and the distance and elevation relative to Santa Teresa. For this alternative, it is assumed that digging the current well to a lower depth will not source a sustainable supply of acceptable water quality, and that land rights for well drilling in and around Santa Teresa property are negotiable.

- Diameter = 6 inches
- Location = approximately 36°27’19.4”N & 121°19’59.6”W
- Flow Rate = 10 gallons per minute
- Tube System Type = Mutual
- Casing = Protected
- Type Pump = 5 horsepower (Submersible)
- Pipe Material = Galvanized Steel
- Depth = 600 to 800 feet

- Possible wooden structure at head for protection

Operating costs for this alternative will include disinfection, pump and pipeline maintenance, electricity for pumping, and potential pump repairs.

Table 4 Alternative 2 Cost Estimate: New Well Siting

Item	Estimated Cost
Well Drilling	$99,000[1]
Booster & Disinfection Pump Equipment[2]	$30,000
Required Distribution System Appurtenances	$20,000
Upgrades to Santa Teresa Distribution System	$30,000
Total Probable Construction Cost	*$179,000*
Estimated Contingency (20%)	*$35,800*
Estimated Construction Cost	*$214,800*
Administrative, Permitting, Legal, Planning, Design, Project and Construction Management (40%)	*$85,920*
Total	**$300,720**
Estimated Annual O&M Costs (Power, Chemicals, Labor, Parts)[3]	**$24,000**

[1] Reference: Guardino Well estimate by phone, date: June 2016; $11,000 for 5 HP 10 gpm pump with wellhead controls, drop pipe, sounding tube and pump cable set at 800 foot depth; $110/LF drill, case, 6" steel well with permit, electrical log and deep seal to 800 foot depth

[2] Booster pump equipment included in well drilling estimate.

[3] $2,000 estimate per month

Alternative 3 – Wellhead Treatment

Nitrate is more difficult to remove from water than organic matter, bacteria or other contaminants which may be removed by traditional treatment processes such as filtration, aeration or flocculation. Three (3) treatment options commonly practiced throughout the United States for nitrate removal are reverse osmosis (RO), ion exchange and blending. RO and ion exchange remove nitrate, while blending dilutes nitrate to an acceptable concentration. These treatment options are described and compared below. Monterey County and the State of California require water systems using these treatment methods to be registered and approved prior to installation, and to be operated by certified technicians. It is assumed that this Alternative will not address private fire protection demand which is not currently accounted for within the existing water system; the reason for this assumption is that the current well does not have sufficient capacity to meet the tertiary treated domestic water demand and the fire protection demand. It is economically infeasible for Santa Teresa to conduct tertiary treatment on and/or store the fire demand volumes within the current system.

Reverse Osmosis

The RO process is based on the use of a semi-permeable membrane to separate containments from the water. The pressure of the system is vital for the efficiency of RO treatment, which is typically in the range of 10 to 85%. Higher efficiencies are observed with higher applied pressure; applying greater pressure requires greater energy consumption and therefore greater costs if traditional electricity sources are used. For the purposes of this report, traditional electricity at the same cost rate listed in the Assumptions section is assumed for RO; it is recommended that alternative power sources such as solar power be assessed if wellhead treatment is implemented. This report did not assess available power nor current power costs, nor brine disposal options, for Santa Teresa.

An RO system is very sensitive to the quality of water it can treat because certain elements may cause fouling, scaling, or degradation of the membranes. The results of the March 2016 sampling of Santa Teresa's groundwater show a greater concentration of silica at 63 mg/L and iron at 0.514 mg/L relative to nitrate levels, which would reduce the lifespan and efficiency of an RO system.

A small-scale Evoqua Vantage 1.8 gpm RO system would suffice for Santa Teresa's water demands; initial capital costs are approximately $12,000 with significant O&M costs.

Ion Exchange

Ion exchange can be used to remove nitrates using a resin that creates a binding site for nitrate ions. Once the resin depletes, it self-regenerates and flushes contaminant particles that have coagulated on the resin bed and can be collected and disposed of. Ion exchange produces less brine than RO, but requires two separate waste disposal mechanisms for brine and contaminant coagulant. Maintenance and monitoring will depend on the quality of the influent and resin used to treat the water. Continuous maintenance of an ion exchange system is critical due to pH sensitivity of the resin.

The water quality analysis at Santa Teresa showed that there are significant concentrations of sulfate and iron compared to nitrate. Sulfate and iron ions compete with nitrate ions for binding sites, and so resins must be selected to minimize this effect. Pre-treatment of sulfate and iron is not recommended for Santa Teresa because treatment options are cost-prohibitive for small water systems.

A small-scale Tonka Water Pure-IX model advanced ion exchange system would suffice for Santa Teresa's water demand; initial capital costs are estimated at $8,500 with significant O&M costs.

Blending

Treating nitrate through the process of dilution via blending Santa Teresa's groundwater with a water source of superior quality requires water importation and mixing. Water importation and costs are detailed in Alternative 4 below; the holding tank will require installation of an active impeller or jet mixing system. Mixing systems effective for installation in Santa Teresa's existing storage are manufactured by Pax; suitable models range in costs from $4,000 to $6,000. O&M requirements involve continuous monitoring of dilution ratios, general tank and distribution system maintenance, and management of imported water source. It is recommended that Santa Teresa implement wellhead treatment equipment in case the imported water source becomes unreliable at any time.

Wellhead Treatment Comparison

The following table compares the estimated initial capital costs of the aforementioned wellhead treatment processes for Santa Teresa.

Table 5 Alternative 3 Cost Estimate: Wellhead Treatment

Item	Estimated Initial Capital Cost	Estimated Annual O&M Costs
Reverse Osmosis	$12,000	Full-time certified operator + significant spare parts and O&M
Ion Exchange	$8,000	Full-time certified operator + significant O&M
Blending	$6,000	Imported water fees + full-time certified operator + general O&M

These costs exclude installation and any upgrades required to the existing system to implement wellhead treatment. At the time of this report, it was determined that Santa Teresa does not have the managerial nor fiscal capacities to directly or indirectly hire a certified operator to oversee wellhead treatment installations as required by the State of California. Therefore, Alternative 3 is eliminated due to infeasibility at Santa Teresa.

Alternative 4 – Water Importation

Water importation to Santa Teresa is currently conducted in the form of bottled water purchasing and is a viable, immediate solution that provides the community with clean drinking water until a long-term solution can be implemented. Alternative to bottled water purchasing, the city of Soledad is willing to deliver water using certified water trucks at a rate that was not established at the time of this report. Therefore, it is unknown if the available delivery rate meets the entirety of Santa Teresa's current, estimated water demand. The remaining water demand may be temporarily met with groundwater from the current well for non-potable applications, or with the purchase of bottled water for portable applications.

This solution, although temporary will provide the residents of Santa Teresa with immediate access to clean drinking water, and requires minimal planning efforts. Upgrades to the existing storage tank may be required for the detention of the imported water; at minimum, the existing tank should be thoroughly cleaned. The current well and distribution system could be reconfigured to address private fire protection demand,

Table 6 Alternative 4 Cost Estimate: Water Importation

Item	Estimated Cost
Upgrades to Santa Teresa Storage System	$3,000
Total Probable Construction Cost	*$3,000*
Estimated Contingency (20%)	*$600*
Estimated Construction Cost	*$3,600*
Administrative, Permitting, Legal, Planning, Design, Project and Construction Management (40%)	*$1,440*
Total	**$5,040**
Estimated Annual O&M Costs (Power, Chemicals, Labor, Parts)[1]	**Unknown**

[1] Monthly water delivery fee unknown

Alternatives Analysis

Alternatives are compared according to feasibility, likelihood of success, planning-level implementation, and operation and maintenance (O&M) costs. The presented costs are preliminary planning-level estimates for comparison of the alternatives, and should not be used for actual funding analyses. The section concludes with a preferred long-term alternative and intermediate solution recommendations.

The estimated construction cost presented in the following table includes twenty (20) percent contingency and forty (40) percent administrative, permitting, legal, planning, design, project and construction management estimates. The estimated annual O&M cost includes estimates for power, chemical, labor and parts.

Table 7 Alternatives Analysis

Item	Estimated Construction Cost	Estimated Annual O&M Costs
Alternative 1: Consolidation	$1,740,314	$0
Alternative 2: New Well Siting or Well Relocation	$300,720	$24,000
Alternative 3: Wellhead Treatment	$12,000	Full-time certified operator + significant spare parts and O&M
Alternative 4: Water Importation	$5,040	Monthly water delivery fee + general O&M

Preferred Alternative

When selecting the alternative that will most likely have a positive impact on the community, the alternatives were evaluated based on likelihood of success, feasibility, and implementation and O&M costs. As such, the recommended, long-term alternative is Alternative 1, consolidation. Water importation is recommended as an intermediate solution.

As previously stated, Alternative 3 is eliminated due to infeasibility of Santa Teresa to directly or indirectly hire a certified operator to oversee wellhead treatment installations as required by the State of California. Alternative 4 is not sustainable for the long-term, and actual costs of water delivery from the City of Soledad were unknown at the time of this report. Alternative 2 may not result in adequate water supply or quality if groundwater exploration is conducted on land available for lease or purchase by Santa Teresa. Therefore, Alternative 1 is the preferred long-term option to provide a safe a reliable supply of domestic water and private fire protection for Santa Teresa. The high construction cost may be funded by Monterey County or by State water access and/or emergency funding.

Recommended Next Steps

The following immediate next steps are recommended for Santa Teresa:

- Conduct thorough cleaning of existing storage tank;
- Hold Community impact meeting with Santa Teresa residents to discuss nitrate and coliform health impacts at current concentrations, potable and non-potable uses of water, and alternative safe options for purchasing and storing water;
- Obtain City of Soledad water system as-built drawings, standard specifications and standard drawings, consolidation fees and requirements, and immediate water delivery rates for potable uses;
- Discuss negotiating terms and conditions, costs and shared cost opportunities, and contractual obligations with City of Soledad for consolidation; and
- Research local, State and County funding sources and application requirements for the construction of the Alternative 1 pipeline and system upgrade. These include but are not limited to the Safe Drinking Water State Revolving Fund which would cover design costs, the City of Soledad's Community Development Block Grant Assistance Loan Program, and the State Water Resources Control Board Consolidation Incentive Program (CIP). CIP provides support to small water systems proactive in their intent to consolidate and provide adequate water supply and quality by providing loans for capital, construction and initial O&M costs, and providing support for other State funding sources and for permit applications.

Appendices

Appendix A – State Water Resources Control Board Technical, Managerial and Financial (TMF) Assessment Form

Appendix B – Monterey County Application for Water System Permit

Appendix C – Monterey Bay Analytical Services Test Results

Appendix D – Summary of Site Visit Interview with Santa Teresa Property Owner

Appendix E – Monterey County Reference Documents

Appendix F – Vendor Quotes

Appendix C

Monterey Bay Analytical Services Test Results

EJCW
Vicente Lara
PO Box 188911 Sacramento CA 95818
vicente@ejcw.org
831-296-0375

MBAS
Monterey Bay Analytical Services
4 Justin Court Suite D, Monterey, CA 93940
831.375.MBAS
www.MBASinc.com
ELAP Certification Number: 2385

Wednesday, March 23, 2016

Lab Number: AB43925

Collection Date/Time: 3/15/2016 11:40 Sample Collector: BROWN L Client Sample #:

Submittal Date/Time: 3/15/2016 15:10 Sample ID Coliform Designation: Special

Sample Description: Well Head

Analyte	Method	Unit	Result	Qual	PQL	MCL	Date Analyzed	Analyst:
Aggressivity Index	Calculation		**11.9**				3/22/2016	MW
Alkalinity, Total (as CaCO3)	SM2320B	mg/L	**109**		10		3/21/2016	LRH
Aluminum, Total	EPA200.8	µg/L	**298**		10	1000	3/16/2016	SM
Antimony, Total	EPA200.8	µg/L	**Not Detected**		1.0	6	3/16/2016	SM
Arsenic, Total	EPA200.8	µg/L	**1**		1	10	3/16/2016	SM
Barium, Total	EPA200.8	µg/L	**180**		10	1000	3/16/2016	SM
Beryllium, Total	EPA200.8	µg/L	**Not Detected**		1	4	3/16/2016	SM
Bicarbonate (as HCO3-)	SM2320B	mg/L	**133**		10		3/21/2016	LRH
Bromide	EPA300.0	mg/L	**0.5**		0.1		3/16/2016	HM
Cadmium, Total	EPA200.8	µg/L	**Not Detected**		0.5	5	3/16/2016	SM
Calcium	EPA200.7	mg/L	**65**		0.5		3/21/2016	MW
Carbonate as CaCO3	SM2320B	mg/L	**Not Detected**		10		3/21/2016	LRH
Chloride	EPA300.0	mg/L	**158**		1	250	3/16/2016	HM
Chromium, Total	EPA200.8	µg/L	**4**		2	50	3/16/2016	SM
Coliform, E. Coli (Quantitray)	SM9223	MPN/100mL	**<1**		1	1	3/15/2016	MW
Coliform, Total (Quantitray)	SM9223	MPN/100mL	**<1**		1	1	3/15/2016	MW
Color, Apparent (Unfiltered)	SM2120B	Color Units	**12**	H	3	15	3/18/2016	MP
Copper, Total	EPA200.8	µg/L	**Not Detected**		4	1300	3/16/2016	SM
Cyanide	QuikChem 10-20	µg/L	**Not Detected**		5	200	3/18/2016	LRH
Fluoride	EPA300.0	mg/L	**0.1**		0.1	2.0	3/16/2016	HM
Hardness (as CaCO3)	SM2340B/Calc	mg/L	**265**		10		3/22/2016	MW
Hydroxide	SM2320B	mg/L	**Not Detected**		10		3/21/2016	LRH
Iron	EPA200.7	µg/L	**514**		10	300	3/21/2016	MW
Langlier Index, 15°C	SM2330B		**0.00**				3/22/2016	HM
Langlier Index, 60°C	SM2330B		**0.59**				3/22/2016	HM
Lead, Total	EPA200.8	µg/L	**Not Detected**		5	15	3/16/2016	SM
Magnesium	EPA200.7	mg/L	**25**		0.5		3/21/2016	MW
Manganese, Total	EPA200.7	µg/L	**Not Detected**		10	50	3/21/2016	MW
MBAS (Surfactants)	SM5540C	mg/L	**Not Detected**		0.05	0.50	3/15/2016	HM
Mercury, Total	EPA200.8	µg/L	**Not Detected**		0.5	2	3/16/2016	SM
Nickel, Total	EPA200.8	µg/L	**Not Detected**		10	100	3/16/2016	SM
Nitrate as NO3	EPA300.0	mg/L	**47**		1	45	3/16/2016	HM
Nitrate as NO3-N	EPA300.0	mg/L	**10.6**		0.1	10	3/16/2016	HM
Nitrate+Nitrite as N	EPA300.0	mg/L	**10.8**		0.1		3/16/2016	HM
Nitrite as NO2-N	EPA300.0	mg/L	**0.2**		0.1	1.0	3/16/2016	HM
Odor Threshold at 60 C	SM2150B	TON	**1**	H	1	3	3/17/2016	MP
o-Phosphate-P, Dissolved	EPA300.0	mg/L	**Not Detected**		0.1		3/16/2016	HM
pH (Laboratory)	SM4500-H+B	pH (H)	**7.7**		0.1		3/15/2016	MP
Potassium	EPA200.7	mg/L	**5.0**		0.5		3/21/2016	MW
QC Anion Sum x 100	Calculation	%	**93%**				3/21/2016	LRH
QC Anion-Cation Balance	Calculation	%	**3**				3/22/2016	MW
QC Cation Sum x 100	Calculation	%	**99%**				3/22/2016	MW
QC Ratio TDS/SEC	Calculation		**0.62**				3/22/2016	HM
Selenium, Total	EPA200.8	µg/L	**3**		2	50	3/16/2016	SM

mg/L: Milligrams per liter ug/L : Micrograms per liter PQL : Practical Quantitation Limit MCL: Maximum Contamination Level

H = Analyzed ouside of hold time E = Analysis performed by External Laboratory; See Report attachments. T = Temperature Exceedance

Lab Number: AB43925

Collection Date/Time: 3/15/2016 11:40 Sample Collector: BROWN L Client Sample #:

Submittal Date/Time: 3/15/2016 15:10 Sample ID Coliform Designation: Special

Sample Description: Well Head

Analyte	Method	Unit	Result	Qual	PQL	MCL	Date Analyzed	Analyst:
Silver, Total	EPA200.8	µg/L	**PENDING**		1	100	1/1/1981	
Sodium	EPA200.7	mg/L	**89**		0.5		3/21/2016	MW
Specific Conductance (E.C)	SM2510B	µmhos/cm	**943**		1	900	3/16/2016	LJ
Sulfate	EPA300.0	mg/L	**67**		1	250	3/16/2016	HM
Synthetic Organic Compounds - Mont		µg/L	**PENDING**		1		1/1/1981	
Thallium, Total	EPA200.8	µg/L	**Not Detected**		1.0	2	3/16/2016	SM
Total Diss. Solids	SM2540C	mg/L	**580**		10	500	3/18/2016	MP
Turbidity	EPA180.1	NTU	**5.3**		0.05	5.0	3/17/2016	ZG
Zinc	EPA200.7	µg/L	**Not Detected**		10		3/21/2016	MW

Sample Comments:

Lab Number: AB43926

Collection Date/Time: 3/15/2016 12:00 Sample Collector: BROWN L Client Sample #:

Submittal Date/Time: 3/15/2016 15:10 Sample ID Coliform Designation: Special

Sample Description: Furthest Home, Lot 4

Analyte	Method	Unit	Result	Qual	PQL	MCL	Date Analyzed	Analyst:
Coliform, E. Coli (Quantitray)	SM9223	MPN/100mL	**<1**		1	1	3/15/2016	MW
Coliform, Total (Quantitray)	SM9223	MPN/100mL	**1**		1	1	3/15/2016	MW

Sample Comments:

Lab Number: AB43927

Collection Date/Time: 3/15/2016 12:30 Sample Collector: BROWN L Client Sample #:

Submittal Date/Time: 3/15/2016 15:10 Sample ID Coliform Designation: Special

Sample Description: After Tank, Hydrant

Analyte	Method	Unit	Result	Qual	PQL	MCL	Date Analyzed	Analyst:
Coliform, E. Coli (Quantitray)	SM9223	MPN/100mL	**<1**		1	1	3/15/2016	MW
Coliform, Total (Quantitray)	SM9223	MPN/100mL	**3**		1	1	3/15/2016	MW

Sample Comments:

Lab Number: AB43928

Collection Date/Time: 3/15/2016 12:15 Sample Collector: BROWN L Client Sample #:

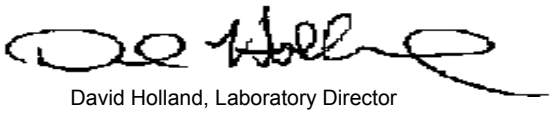
Submittal Date/Time: 3/15/2016 15:10 Sample ID Coliform Designation: Special

Sample Description: Additional Home, Lot 5

Analyte	Method	Unit	Result	Qual	PQL	MCL	Date Analyzed	Analyst:
Coliform, E. Coli (Quantitray)	SM9223	MPN/100mL	**<1**		1	1	3/15/2016	MW
Coliform, Total (Quantitray)	SM9223	MPN/100mL	**4**		1	1	3/15/2016	MW

Sample Comments:

Report Approved by:



David Holland, Laboratory Director

mg/L: Milligrams per liter ug/L : Micrograms per liter PQL : Practical Quantitation Limit MCL: Maximum Contamination Level

H = Analyzed ouside of hold time E = Analysis performed by External Laboratory; See Report attachments. T = Temperature Exceedance

Appendix F

Vendor Quote Sources and Assumptions
Well quote Email log
And Meeting with Water Department

Gmail **Mason Lang <masonlang17@gmail.com>**

Engineers Without Borders Well Quote

5 messages

Mason Lang <masonlang17@gmail.com> Wed, Apr 13, 2016 at 2:48 PM
To: augie@guardinowell.com

Hello,

I called just a few minutes ago about a quote for a well. Here are all of the specifications I can give you:

- Flow Rate = 10 gallons per minute
- Type System = Mutual
- Casing - Protected (Nitrate problem in this area)
- Type Pump = 5 horsepower
- Pipe Material = Galvanized Steel
- Depth = 600 to 800 feet
- Outside City Limits
- Possible outer wooden structure for protection
- Location = 36°27'19.4" N 121°19'59.6" W

I really appreciate your time. Thank you.

Sincerely,
Mason Lang

Augie Guardino <augie@guardinowell.com> Wed, Apr 13, 2016 at 3:38 PM
To: Mason Lang <masonlang17@gmail.com>

Please provide pinpoint on map.

Augie Guardino, General Manager
GUARDINO WELL DRILLING, INC.
4825 Croy Road, Morgan Hill, CA 95037
(408) 779-5904 o, (408) 778-1692 f.
www.guardinowell.com

[Quoted text hidden]

Augie Guardino <augie@guardinowell.com> Wed, Apr 13, 2016 at 5:06 PM
To: Mason Lang <masonlang17@gmail.com>

I was able to find the approximate location. Here is the budget:

Drill, case, develop 6" steel well to 800' with permit, electrical log and deep seal @ $110/ft. to 800' = $88,000.00

5hp, 10 GPM pump with wellhead controls, drop pipe, sounding tube, pump cable set @ 700' = $11,000.00

If you would like to move forward I can send someone down to walk the site.

Augie Guardino, General Manager