

Attachment 5. Work Plan

This Work Plan identifies and describes the activities necessary to complete the proposed project to enhance the groundwater monitoring network, increase understanding of groundwater movement in the study area, improve nature and extent for characterization of perchlorate impacted groundwater, and evaluate fate and transport of perchlorate impacts to groundwater in Sacramento County in the vicinity of the Sacramento Suburban Water District (SSWD) area. The establishment of additional monitoring wells will also benefit the regional groundwater level monitoring system currently implemented under the Groundwater Management Plan (GMP) by the Sacramento Groundwater Authority (SGA). The scope of work includes:

- Completion of California Environmental Quality Act (CEQA) information and notifications, prepare encroachment and drilling permits,
- Install, construct, and develop two triple completion monitoring wells,
- Conduct groundwater sampling of the drilled monitoring wells for perchlorate and general chemistry,
- Conduct predictive contaminant fate and transport modeling,
- Prepare Technical Memorandums (TM)s, and reporting documents including Quarterly Reports and a Final Report.

The following tasks describe in detail the methodologies and anticipated requirements to complete each component of the project. Each task presents a cost and deliverables. Detailed budget and schedule information are included in Attachments 6 and 7 of this application.

Task 1. CEQA Documentation, Permitting, and Access

This task provides CEQA compliance, and acquires the appropriate permits for installation of monitoring wells. CEQA compliance and County permits are essential for project execution, because they are required by law.

Task 1.1 CEQA Exemption Documentation

CEQA requires that the project work tasks be evaluated for their impacts to the environment. The proposed project is anticipated to qualify for an Article 19 Categorical Exemption 15306 - Information Collection. As such, SSWD will submit documentation to support this assertion for public review prior to initiating drilling activities, maintain documentation for the life of the project and file documentation with the California state clearinghouse.

Deliverable:

- One set of CEQA exemption documents

Cost Assumptions

- CEQA exemption documents will require 5 days of staff time to prepare and review
- There are no direct costs expected.

Task 1.2 Well Drilling and Encroachment Permits

A well permit will be completed and submitted to the Sacramento County Department of Environmental Health (County) for each of the drilling locations for approval prior to initiating drilling activities for the proposed monitoring wells. As part of obtaining the well permit, a well construction work plan will be prepared as required by County and the California Department of Water Resource

Standards (DWR, 1981, 1991). The work plan will include the anticipated well designs. The drilling work plan will be prepared to support the well permit applications and document the proposed well installation and development program.

The anticipated drilling locations are located on private property owned and operated by, SSWD. As such, right of ways and easements and access is considered implicit for this project tasks and well locations. Access documentation and encroachment permits will be completed and maintained by the SSWD for the life of the wells.

Deliverables:

- Two sets of County permit applications to install the two triple completion monitoring wells.

Cost Assumptions

- Permits will require 3 days of staff time to prepare and review.
- Sacramento County will charge \$2,352 for necessary permits for both wells.
- Sacramento County will take up to 2 weeks for permit approval.
- Sacramento County permit fees included are based on July 1, 2012 rates.

Task 2. Installation of Groundwater Monitoring Wells

This task involves the installation of two triple completion monitoring wells. The location of these wells will be within the southern portion of SSWD's service area of Sacramento County at the locations shown on Exhibit 1 and labeled #48 and #54. These locations have been selected to be sentry wells to detect the presence of perchlorate, which has been detected in water supply wells upgradient of SSWD wells, which is south of the American River. Monitoring well installation and analysis provides detailed geologic logs and information with identification of formation contacts for assessment of preferential groundwater flow pathways controlling the movement of perchlorate dissolved in groundwater, interactions between aquifer systems, and depth specific water quality data. These wells will be added to the California Statewide Groundwater Elevation Monitoring (CASGEM) system to provide water level data for the region and will also provide critical data for the refinement to regional groundwater models.

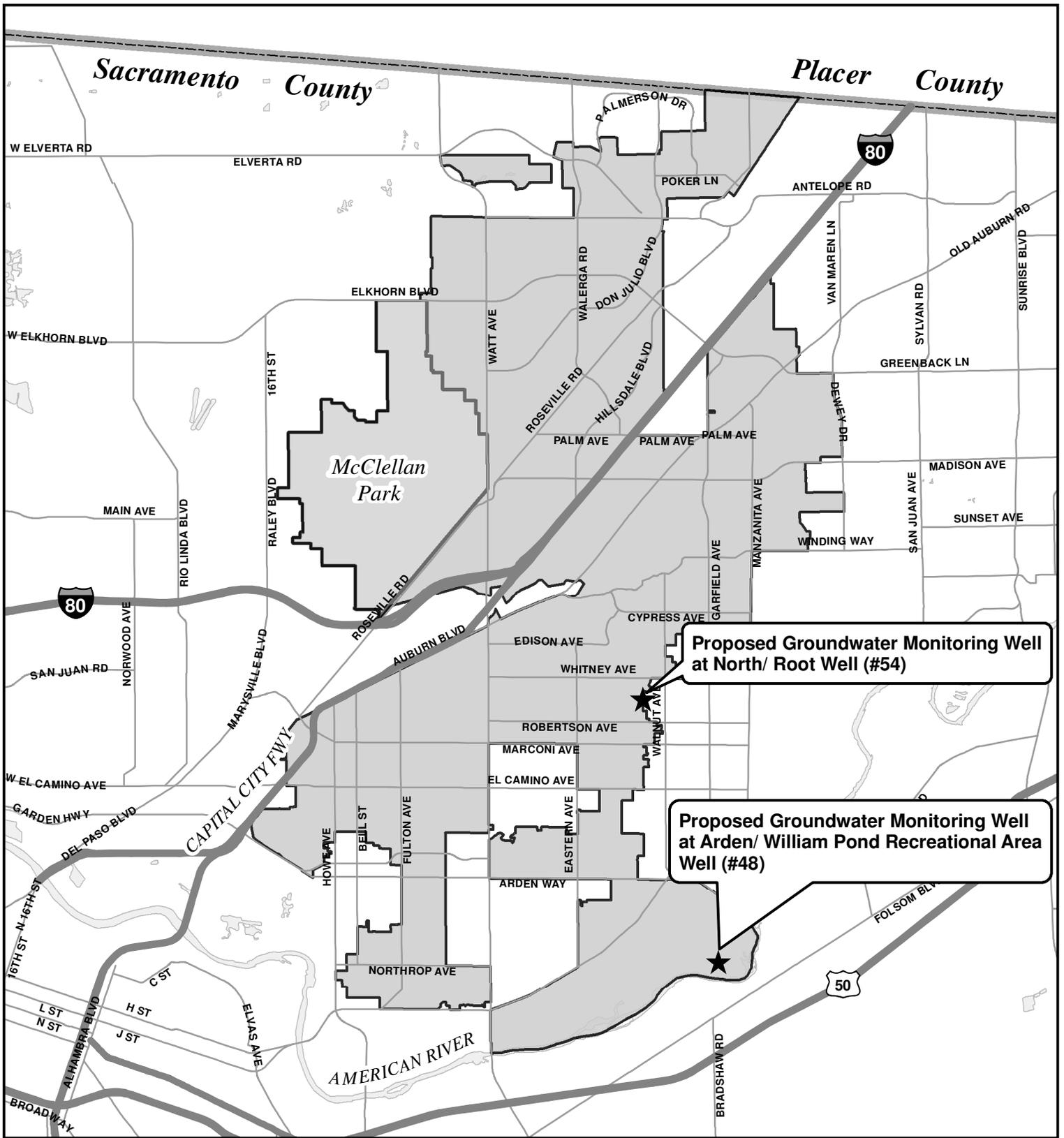
Task 2.1 Drill Monitoring Wells

Prior to drilling, the Underground Service Alert (USA) will be contacted for clearance of underground utilities. The selected locations are within developed areas of the County and, as such, a private utility locator will also be contracted for clearance of underground utilities. Lastly, since the wells will be located on SSWD property that may have been improved by SSWD, their utility department will be notified and consulted before drilling to avoid SSWD's utility lines.

Based on well logs completed in the area, the northern monitoring well (#54) is anticipated to be completed to 330 feet below ground surface (bgs), and the southern monitoring well (#48) is anticipated to be completed to 500 feet bgs. SSWD will contract with a consultant that has extensive experience overseeing the drilling of wells to similar depths in the project area, constructing multi-completion monitoring wells for contaminant fate and transport design, and identifying geologic formation contacts from lithologic samples. The drilling method used will be selected based on the ability to provide depth-discrete lithologic samples and to complete wells to depths up to 500 feet bgs with borehole diameters up to 12-inches. Drill cuttings and groundwater produced during well drilling and development will be stored, transported, and disposed of according to applicable state, federal, and local regulations. Per County permit requirements, drilling and construction of the monitoring wells will be performed by a valid C-57 license contractor.

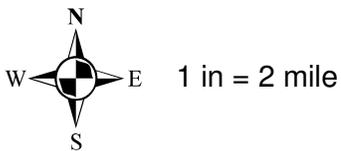
During drilling of the pilot boring, the lithology will be recorded on a geologic boring log from the cuttings collected during drilling. If requested, portions of the bulk samples can be provided to State

and local agencies. Lithologic samples will be logged by a California Professional Geologist proficient in the methods described in ASTM D2488-84 and geologic formation contacts identified in the area. Based on the lithologic descriptions of permeable and saturated materials, ten lithologic samples will be submitted to geotechnical laboratory for mechanical sieve analysis to support identification of water bearing zones for the final well design. After completion of the pilot boring, the hole will be conditioned and prepared for completion of a downhole geophysical log.



Portion of Sacramento Suburban Water District

EXHIBIT 1



DWR Local Groundwater Assistance (LGA) Grant Application



Base Data: Sacramento County Gis Base Map
 Projection: CA State Plane 2, NAD83
 Scale: Relative
 Prepared by: D.A.V., SSWD
 Sacramento, CA - June 2012
 Well #54_Loc.mxd

Methods used for the downhole geophysical logging will include resistivity, spontaneous potential, spectral gamma, and caliper logs. The objective of the downhole geophysical log is to further support the location of the lithologic boundary contacts logged from the soil cuttings and to determine the borehole diameter, location of permeable layers, and determine the water resistivity (i.e, salinity).

Deliverables:

- Data collected and interpreted during this task will be included in the Technical Memorandum (TM) described in Task 2.4.

Cost Assumptions

- Drilling oversight and logging of samples will require 5 days of staff time per well.
- Oversight will be performed for 10 hours per day of drilling.
- Monitoring wells will cost \$82, 260 to drill, install, and develop, based on the driller estimate and breakdown provided in Attachment A (including the downhole geophysical logging).
- Sieve analysis will cost \$80 per sample analyzed, based on the estimate provided in Attachment B. A total of 30 samples are proposed for a total cost of \$1,600.
- Clearance of underground utilities by a subcontractor will cost \$600 for each drilling location, for a total of \$1,200 based on the estimate provided in Attachment C.
- Drilling will be conducted using mud rotary methods

Task 2.2 Construct Monitoring Wells

Using the information collected during Task 2.1 during the drilling of the pilot boring, a California Certified Hydrogeologist will develop the final well design to include screen intervals, slot size, and gravel pack size and gradation. Prior to construction, the finalized well design will be reviewed by SSWD staff.

After the final well design has been approved, the pilot boring will be enlarged to 12 inches. Once the desired depth of the borehole has been obtained, well installation methods will be consistent with Chapter 6.28 of the Sacramento County Code and Section 13801 of the California Water Code. Well casing (blank and screen) is anticipated to consist of 2.5-inch diameter (outside diameter), schedule 80 PVC. Triple completion well screens and casing will be located in the borehole using centralizers. Gravel pack will be placed at each screen interval and the well surged to settle the gravel pack around the well screen and continue until the gravel pack stops settling (preliminary development). Additional gravel pack will then be added to the desired depth. A bentonite seal at least 2-feet thick will be placed immediately above the gravel pack. A volume calculation will be conducted to estimate the volume of a bentonite based grout needed to place between the lower screen and upper screen. Fine mesh sand will then be placed to 1 foot below the next screen interval and the process for placement of gravel pack and bentonite seal repeated as discussed above for the remaining completions. The upper most annular space will then be grouted with a bentonite or cement grout to approximately 2-feet bgs. A wellhead completion will then be placed over the well for security and protection.

Deliverables:

- Data collected and interpreted during this task will be included in the TM described in Task 2.4.

Cost Assumptions

- Well construction will require 1.5 days of continuous 24 hour per day oversight per well.
- Well construction will cost \$34,935 based on the driller estimate and breakdown provided in Attachment A.

- Equipment costs of \$500 are included for health and safety equipment rental and other expendable supplies.

Task 2.3 Develop Monitoring Wells

No earlier than 24-hours after the grout placement, the wells will be developed using one or more of these methods: surging, air lifting, over pumping, and bailing. Generally, each well will be developed until it is free of suspended sediment and turbidity values are less than 10 NTU. After completion, the wells will be surveyed by a California licensed surveyor.

Deliverables:

- Data collected during this task will be included in the TM described in Task 2.4

Cost Assumptions

- Well development will require two days of staff oversight per well. Cost for development of both wells will cost \$3,040 based on the driller estimate and breakdown provided in Attachment A.
- Surveying of well elevations is estimated to cost \$2,500 per multi-completion well.

Task 2.4 Technical Memorandum

After completion of the well installation and development program, a Field Investigation TM will be prepared summarizing the methods used and results of the program. The report will be finalized after review by SSWD staff and will include an inspection and certification by a California Professional Engineer, Geologist, or Hydrogeologist that the project has been completed in accordance with submitted final plans and specifications in accordance with the contract.

Deliverables:

- One Field Investigation TM that describes both monitoring well installation activities. The TM will include boring logs, DWR required well completion logs, well construction as-built diagrams, geophysical logs, and records of well development.

Cost Assumptions

- The Field Investigation TM will require seven days of staff time to prepare and review.
- The Field TM (final only) will be submitted within 15 days after the completion of the wells.

Task 3. Groundwater Sampling

This task includes the development of a Groundwater Sampling Work Plan and involves the sampling of the two newly installed nested monitoring wells (total of six individual monitoring points) installed for this project on a quarterly basis for one year. The approximate location of these wells is shown on Exhibit 1. As discussed above for installation, these locations have been selected as sentinel wells for early detection of perchlorate impacts known to exist upgradient of the SSWD's production well fields. Information obtained from this task will include an assessment of existing perchlorate impacts relative to selective stratigraphic zones, seasonal variations of identified impacts, and an overall view of the fate and transport of any identified current impacts. Other parameters will be measured to assess interactions between aquifer zones, and establish the current groundwater quality conditions so that changes in water quality due to migration of upgradient impacts during future sampling events can be assessed.

Task 3.1 Monitoring Well Sampling

Groundwater samples will be collected for analysis of perchlorate using USEPA Method 314.0 or 331.0 on a quarterly basis for one year. Samples will be collected for general chemistry once for each well screen interval (completion) during the first quarterly sampling activity. Samples collected for general chemistry will include the following analytes: sodium, calcium, potassium, iron, magnesium, manganese, boron; chloride, bicarbonate, sulfate, nitrate, and fluoride; and general minerals including alkalinity, hardness, and total dissolved solids; and oxygen isotope analysis. Prior to sampling, depth to water measurements will be collected and recorded using a depth to water meter. Field parameters measured during sampling of each well will include pH, temperature, specific conductivity, and oxidation-reduction potential.

Groundwater samples will be collected using Hydrasleeves™. Unlike other groundwater samplers, the HydraSleeve instantaneously "cores" a whole water sample from a defined vertical and horizontal interval (usually within the well screen). HydraSleeve samples do not blend fluid from different vertical zones or pull water in from outside the well screen, but instead sample via ambient and/or diffusive flow of groundwater through the well screen. The sample is collected without purging and with very little downwell disturbance, providing excellent control of turbidity. This minimizes the time spent on filtration of turbid samples typically collected after purging with a bailer or submersible pump. Samples can be collected at in-situ pressure with almost no aeration or degassing. This prevents alteration due to loss of volatiles or oxidation of sensitive parameters. Samples can be analyzed for all parameters. HydraSleeve samplers are inexpensive, disposable, and very quick and easy to use, resulting in significant savings on startup and ongoing costs when compared to other sampling equipment such as bailers or pumps.

Deliverables:

- Draft and Final Groundwater Sampling Work Plan outlining procedures that will be used for sampling of wells. The draft Work Plan will be submitted within 10 days after the completion of the wells. The final Work Plan will be finalized within 5 days of receiving comments on the draft Work Plan.
- Results of activities under this task will be included in the TM described in Task 3.2.

Cost Assumptions

- Water quality sampling will require 1 day of staff time to prepare and collect each quarter.
- Analysis for perchlorate will cost \$50 per sample. Perchlorate will be sampled a total of 24 times over the life of the project for a total cost of \$1,200.
- Analysis for general chemistry will cost \$169 per sample. General chemistry will be sampled once for each completion, with three completions per well, for a total of six times, at a cost of \$1,014.
- Analysis costs are based on information provided in Attachment D.
- Field rental equipment (depth to water meter and field parameter meter (pH, temperature, specific conductivity, and oxidation-reduction potential) will cost \$500.

Task 3.2 Monitoring Results Technical Memorandum

After completion of well sampling and water quality analysis, a Groundwater Monitoring Results TM will be prepared summarizing the methods used and results of the sampling and analysis program. The report will be finalized after review by SSWD staff and will be certified by a California Professional Engineer, Geologist or Hydrogeologist that the project has been completed in accordance with the submitted work plan and accordance with the contract.

Deliverables:

- One Groundwater Monitoring Results TM that will document groundwater sampling procedures, field measurements, and analytical results.

Cost Assumptions

- The Groundwater Monitoring Results TM will require seven days of staff time to prepare and review.
- The Groundwater Monitoring Results TM (final version only) will be submitted within 15 days after the completion of the wells.

Task 4. Aquifer Testing

A key component of this project will be the assessment of the interactions, or connections, between permeable zones above and within the zones screened by current production wells. Understanding these connections is critical for assessing the pathways that water and associated chemical contaminants actually flow through the groundwater system and for developing the conceptual model used for construction of the groundwater analytical model. This task will also provide localized estimates of aquifer parameters such as transmissivity (T), storativity (S), specific yield (Sy), effective radius (Ro), and effective capture zone dimensions of the pumping wells that will be used for refinement of the groundwater model described in Task 5.

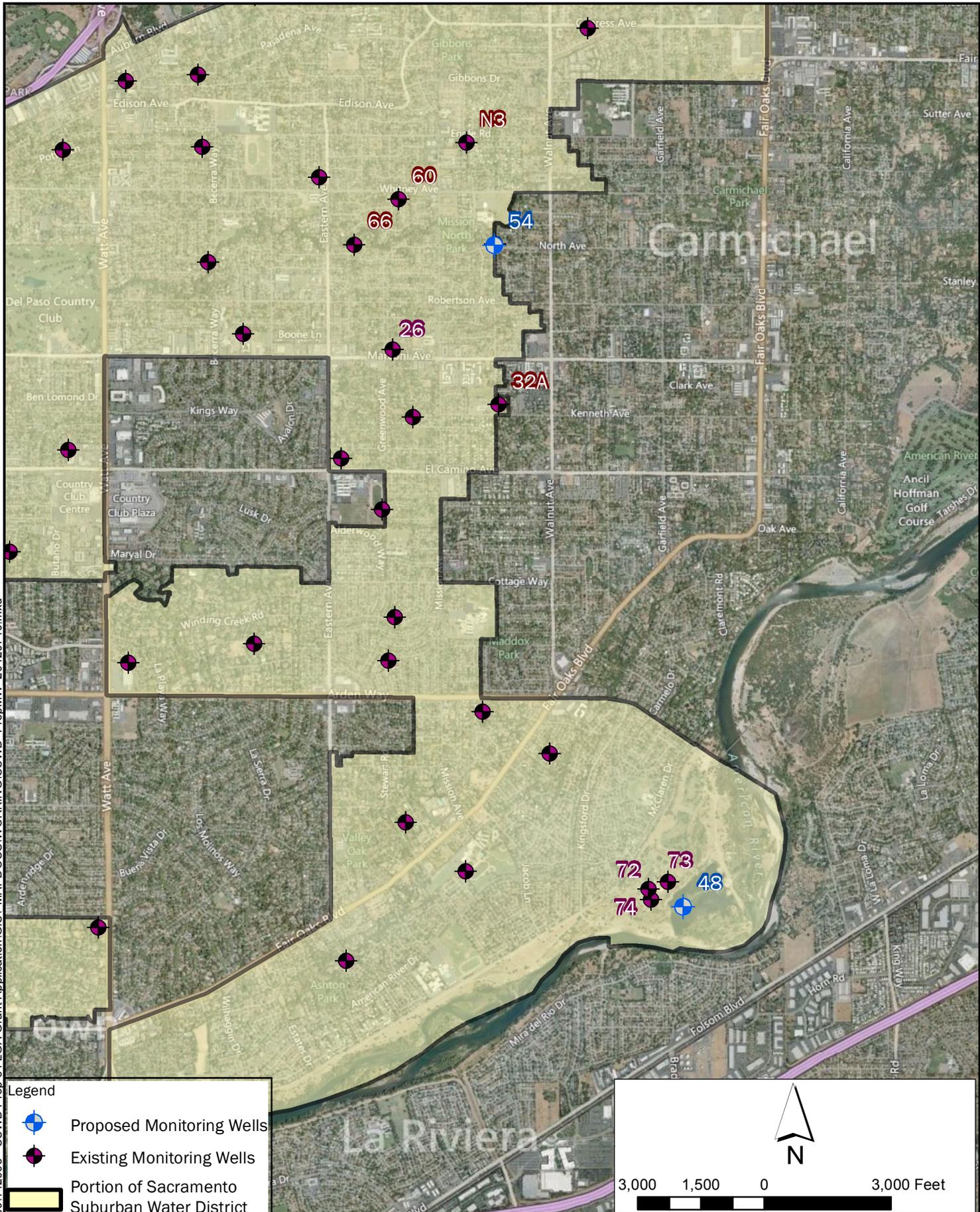
Task 4.1 Field Setup

Pumping wells used for the aquifer tests will be existing SSWD groundwater supply wells anticipated to include wells 72, 73, 74 and 26 as shown on Exhibit 2. Pressure transducers will be purchased for each of the newly installed nested wells (six total wells) and four additional transducers used to install in various pumping wells used for the aquifer tests. The pressure transducers purchased for the project will be the In Situ Level Troll 500 vented transducers, or equivalent. The vented transducers self correct for barometric changes eliminating the need for a barometer during the tests and subsequent water level monitoring. These transducers are capable of measuring water levels to within 0.01 feet and temperature to 0.01 °C. The logging capabilities and data storage allow for a variety of programmable solutions necessary to observe subtleties necessary to accurately record data during aquifer testing at timescales that are appropriate. The pressure transducers will be permanently installed within the new monitoring wells allowing continuous monitoring of water levels in the wells for an

Testing during this aquifer test will occur during normal operation of SSWD's production wells and produced water will be distributed according to normal operating conditions. Setup for the aquifer tests will consist of the following.

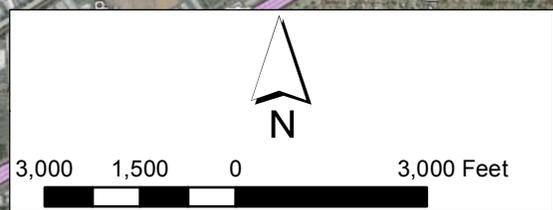
- Placing pressure transducers in pumping wells. Pressure transducers for the new monitoring wells will be installed immediately after completion of the wells. To assess the aquifer system prior to startup of the tests, each pressure transducers will be set to record water levels every hour for a minimum of a two week period. This data will be used to change the depth the transducers are placed based on drawdowns observed during operation of supply wells.
- Identify other nearby irrigation/supply wells that may operate during the aquifer tests. If possible, it is hoped that most of the nearby supply wells will not operate during both the actual pumping test and recovery test. However, wells further away may operate that may affect the results of the tests and recording the operation of these wells will be critical. Information that will be requested for the identified well, if available, will include geologic well logs, well construction details, and pumping rate during operation. The wells will also be

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Legend

-  Proposed Monitoring Wells
-  Existing Monitoring Wells
-  Portion of Sacramento Suburban Water District



	PROJECT 142993	SITE Sacramento Suburban Water District	Exhibit 2
	DATE 7-10-2012	TITLE Grant Application	

- inspected for available flow gauges and/or totalizers that could be used to record flows during the pumping tests.
- Other wells that have been identified that are not owned by SSWD, with approval by owner, will be outfitted with buttons that record when the wells have been turned on and off. These instruments are small (less than 1-inch diameter) and are placed on the discharge pipe of the well to record temperature changes that can be used to tell when the wells are turned on and off. Wells owned by SSWD that are not currently monitored for water level, will be outfitted with pressure transducers for the duration of the tests.

Deliverables:

- Results of the field setup task will be used during the aquifer testing task.

Cost Assumptions

- Field setup will require 4 days of staff time.
- Aquifer test field setup will begin once the wells are completed.
- Ten pressure transducers will be purchased by SSWD at a cost of \$1,500 each for a total cost of \$15,000.

Task 4.2 Aquifer Testing

At the start of aquifer testing, field staff will be on site at least one week before pump testing to begin setup that will include installing programming of the transducers for recording the pump test. During this period, water level measurements will be collected from the pumping well and primary observation wells using a hand held electric well sounder. These water levels will be recorded to the nearest 0.01 foot.

Immediately before pumping is to begin, static water levels will be recorded for the pumping well and the primary observation wells using a hand held electric well sounder. Since the pumping wells used for the test are active supply wells and will be operating under normal practices, the pumping rates available in SSWD records will be used as the test pumping rates. The selected wells do not currently monitor flow rates, a portable flow meter will be used during the test to record actual flow rates during the tests.

Testing will include monitoring and startup of selected wells over a 3 month period. However, it is anticipated that at least one of the tests for each location will operate for a minimum of a four day period. It is anticipated that steady state conditions will be obtained within this period allowing collection of the necessary data to fully assess the aquifer parameters at these locations.

After startup of each test, hand measurements will be recorded for the pumping well and primary observation well daily during the anticipated four day test. These measurements will be used for confirmation of the data recorded using the pressure transducers. The pressure transducer data will be checked at least hourly for the first two hours after pumping, then daily during the four day test to observe overall drawdown curves for each well. Groundwater level measurements in the monitoring and production wells will be recorded by the transducers during aquifer testing at specified times based on the schedule shown in Table 1. Other data that will be recorded during these checks will include flow meter readings from the pumping well. Flow rates and downloading of pressure transducers will occur at a minimum of one month during the remainder of the tests.

Table 1. Maximum Time Interval – Aquifer Test Water Level Measurements	
Frequency, One Measurement Every	Elapsed Time, For the First
1 second	0 – 5 minutes
30 seconds	5 – 15 minutes
1 minute	15 – 30 minutes
5 minutes	30 – 60 minutes (1 hour)
10 minutes	1 hour to 24 hours
30 minutes	24 Hours

After the end of the 4-day period but prior to shut off of the pumping well, the pressure transducers will be reprogrammed for recording recovery. Transducers will be programmed to record water level measurements during recovery at the same frequency as the pumping test (Table 1). Recovery will be measured until the residual drawdown is less than 10 percent of the total drawdown or for an equal period as the pumping test, if possible under SSWD normal operations.

Deliverables:

- Results of the aquifer testing task will be compiled and reported in Task 4.3, Technical Memorandum.

Cost Assumptions

- Aquifer testing will require 16 days of field geologist time, 5 days of lead hydrogeologist time, and three days of senior hydrogeologist time.Task 4.3 Technical Memorandum

After completion of the aquifer tests, a Technical Memoranda will be prepared summarizing the results of the tests. The report will include a summary of the methods used for aquifer analysis, calculations, discussion of assumptions made as part of the analysis, and corrections made to calculations due to other activities such as off-site pumping. A draft and final TM will be prepared.

Deliverables:

- Results of the aquifer testing task will be compiled and reported in Task 4.3, Technical Memorandum.

Cost Assumptions

- The Aquifer Test TM will require seven days of staff time to prepare and review.
- The Aquifer Test TM (final version only) will be submitted within 15 days after recovery portion of the test is complete.

Task 5. Groundwater Contaminant Fate and Transport Modeling

Groundwater modeling will be conducted in order to predict the potential future flow paths of the perchlorate plume. The groundwater model will incorporate data collected from the monitoring wells to improve local hydrogeologic understanding.

The Sacramento Regional Groundwater Groundwater Model (SRM) will be used as a basis for the modeling analyses referred to below. This model is a rigorously calibrated, MODFLOW-based model which produces flow fields that are immediately suitable for use with industry standard particle tracking and solute transport codes, MODPATH and MT3D. The geologic layering and associated hydraulic parameterization for the model layers provide a suitable framework for adjusting the heterogeneity of the hydrostratigraphic units to the extent that it influences the future migration of the perchlorate plume.

The SRM is also fully integrated with industry standard GIS feature classes and geodatabase data models, greatly facilitating the import of additional data sets as they become available and the refinement of model components as additional analyses are completed. The usage of this regional modeling tool also allows the local refinement of the model grid to reflect the influence of local scale heterogeneity and hydraulic parameterization at the scale of the perchlorate plume. The telescopic refinement capability of the SRM modeling tool makes it an excellent framework upon which to develop future, predictive solute transport simulations that can be further advanced and refined in the years to come.

Task 5.1 Data Collection and Incorporation

Relevant information from other modeling tools, publically available hydrogeologic databases, and hydrogeologic reports will be collected and incorporated into the numerical model framework where appropriate.

Deliverables:

- Data collected during this task will be included in the TM described in Task 5.7

Cost Assumptions

- Data collection and incorporation will require three days of staff time to prepare and review.

Task 5.2 Model Refinement and Conceptualization

Model grid (row and column) spacing will be refined to a scale, which is anticipated to be approximately 500 feet spacing, and appropriate to simulate the transport of the perchlorate plume both in the past and future time periods. Likewise, the addition of model layers to accommodate geologic complexities may also be considered and implemented if necessary to improve the three-dimensional resolution of the transport model simulation. Temporal discretization of the calibrated model as well as predictive model scenarios will be reviewed and adjusted to allow for suitable simulation time scales to properly address rate of change in relevant hydrologic conditions, such as: recharge, precipitation, and surface water flows.

The hydrogeologic interpretations included in model layering will be compared to collected data for the study area. Revisions to model layering elevations and hydraulic parameterization will be made where it is deemed that such changes will have an impact upon simulated perchlorate migration in the vicinity of the SSWD service area.

Deliverables:

- Data collected during this task will be included in the TM described in Task 5.7

Cost Assumptions

- Model refinement and conceptualization will require approximately seven days of staff time to prepare and review.

Task 5.3 Model Calibration Verification

Validation of calibration of the flow model will be conducted to verify observed water levels collected the CASGEM monitoring data, and from regional and local flow gradients. Water budget components will be reviewed to verify that they are within reasonable, estimated ranges.

Deliverables:

- Data collected during this task will be included in the TM described in Task 5.7

Cost Assumptions

- Model calibration verification will require eight days of staff time to prepare and review.

Task 5.4 Predictive Model Runs

Predictive model scenarios will be developed for presentation to SSWD and stakeholders for review and approval. Predictive simulation inputs will then be developed and imported into the calibrated modeling tool to produce a series of predictive model simulations describing future transient groundwater flow conditions. Timescales for the predictive scenarios, as well as temporal discretization for the model simulations will be designed to allow for the appropriate estimation of future long term and seasonal groundwater trends and perchlorate migration potential.

Deliverables:

- Data collected during this task will be included in the TM described in Task 5.7

Cost Assumptions

- Predictive model runs will require five days of staff time to prepare and review.

Task 5.5 Particle Tracking

A particle tracking analysis will be performed with the estimated flow fields for the various future scenarios. Forward particle tracking will be performed to estimate future potential migration pathways for the perchlorate plume.

Deliverables:

- Data collected during this task will be included in the TM described in Task 5.7

Cost Assumptions

- Particle tracking will require four days of staff time to prepare and review.

Task 5.6 Fate and Transport Estimation

Fate and transport modeling of the perchlorate plume will be performed using the flow fields from the predictive flow model simulations. Future migration of the perchlorate plume will be estimated assuming solute dispersion, diffusion, and retardation processes. Future potential groundwater receptors for the perchlorate plume will be identified and timing for the arrival of perchlorate mass will be estimated. Results from the fate and transport modeling will be compared to those from the particle tracking analysis to analyze the effects of solute retardation and dispersion relative to conservative transport of the plume, respectively.

Deliverables:

- Data collected during this task will be included in the TM described in Task 5.7

Cost Assumptions

- Fate and transport estimation will require five days of staff time to prepare and review.

Task 5.7 Model Documentation TM

A TM will be developed that documents the model's content. The TM will document: the hydrogeologic conceptual model, the selected groundwater modeling tool, details of modifications to the numerical flow model, descriptions of predictive scenarios, results of model recalibration and predictive model flow, fate and transport simulations, results of particle tracking, results of predictive

perchlorate plume transport simulations, potential groundwater receptor locations, and perchlorate plume arrival estimates. TM contents will be described in text and figurative formats.

Deliverables:

- One Model Documentation TM. The Model Documentation TM will record and describe the developed groundwater model and the results of model runs.

Cost Assumptions

- Model Documentation will require eight days of staff time to prepare and review.
- The draft Model Documentation TM will be submitted within 15 days after completion of the model.
- The final Model Documentation TM will be finalized within 5 days of receiving comments on the draft Model Documentation TM.

Task 5.8 Modeling Meetings

Two meetings will be held to discuss modeling efforts with staff and stakeholders. The first meeting will be held to discuss and demonstrate the updated modeling tool, and will be used to determine predictive scenarios to run with the modeling tool. The second meeting will be held to present the results of the modeling of predictive scenarios.

Deliverables:

- Meeting summaries from the two meetings with SSWD staff and interested stakeholders will be prepared and provided to SSWD.

Cost Assumptions

- Modeling meetings will require approximately three days of staff time for meeting preparation, meeting participation, and preparation of meeting summaries.

Task 6. Project Management

Project management will include activities such as project team coordination, budget and schedule tracking, quarterly reports, and other efforts as needed to complete the project scope of work on schedule and budget.

Task 6.1 Quarterly Reporting

The reporting for this project will include quarterly reporting to provide progress reports and final TMs for Monitoring Well Installation, water quality sampling, and groundwater modeling results. Each quarterly report will summarize the results of each task performed during the quarter. These reports will serve to inform the public, technical advisory committee, and DWR of the progress made during the study and provide accountability for the budget used throughout the life of the project.

The quarterly reports are intended to provide regular updates on the progress of the project and milestones met in accordance to budget utilization. These reports will be submitted to DWR for support for budget allocation. These reports will also serve to inform interested parties and will be posted on the project website for the life of the project and will be made available for public review.

Deliverables:

- Five quarterly reports. Each draft quarterly report will be submitted by the 1st day of the second month after the proceeding quarter.

Cost Assumptions

- Each quarterly report will require four days of staff time to prepare and review.

Task 6.2 Final Report

The Final Report will be prepared at the end of the project. It will include discussions of the all project components, and will include the TM's developed during project implementation.

Deliverables:

- The final report will be submitted within 15 days of completing the last task, Task 5.7 Modeling Documentation TM. It will include a summary (approximately 3 to 4 pages in length) of the project and will include all work products as attachments (in electronic versions).

Cost Assumptions

- The final report will require four days of staff time to prepare and review.

Task 6.3 Quality Control and Quality Assurance

This task provides Quality Assurance and Quality Control (QA/QC) activities. QA/QC activities will consist of reviews of TMs, reviews of well designs by senior hydrogeologists, and reviews of modeling efforts. QA/QC reviews will be documented in the quarterly reports.

Deliverables:

- Results of QA/QC efforts will be included in other project deliverables

Cost Assumptions

- QA/QC activities will require four days of staff time spread out over the life of the project.

Attachment A

Drilling Estimates and Cost Breakdown

Eaton Cost Estimate Break Down and Applied to Two Multi-Completion Monitoring Wells

Drilling Activities	Cost Per Unit	500 Ft Well		330 Ft Well		Total Cost For Both Wells
		# of Each Unit	500 Foot Well Price Estimate	# of Each Unit	330 Foot Well Price Estimate	
Mobilization	\$ 8,500	1	\$ 8,500	1	\$ 8,500	\$ 17,000
Test Hole Drilling	\$ 23	500	\$ 11,500	330	\$ 7,590	\$ 19,090
Geophysical logging	\$ 2,500	1	\$ 2,500	1	\$ 2,500	\$ 5,000
bore hole reaming	\$ 26	150	\$ 3,900	150	\$ 3,900	\$ 7,800
bore hole reaming	\$ 29	370	\$ 10,730	160	\$ 4,640	\$ 15,370
Containment and Disposal	\$ 8,000	1	\$ 8,000	1	\$ 8,000	\$ 16,000
Water Supply	\$ 1,000	1	\$ 1,000	1	\$ 1,000	\$ 2,000
Drilling Total:			\$ 46,130		\$ 36,130	\$ 82,260
2.5" o.d. SCh 80 PVC Blank Casing	\$ 7	990	\$ 6,435	620	\$ 4,030	\$ 10,465
2.5" o.d. SCH 80 PVC Screen	\$ 9	60	\$ 510	60	\$ 510	\$ 1,020
#8 SRI Sand	\$ 10	100	\$ 1,000	100	\$ 1,000	\$ 2,000
Bentonite Chips	\$ 15	320	\$ 4,800	130	\$ 1,950	\$ 6,750
Sanitary Seal	\$ 50	100	\$ 5,000	100	\$ 5,000	\$ 10,000
Grout Pumper	\$ 750	1	\$ 750	1	\$ 750	\$ 1,500
Well Pad	\$ 1,600	1	\$ 1,600	1	\$ 1,600	\$ 3,200
Construction Total:			\$ 20,095		\$ 14,840	\$ 34,935
Development	\$ 190	8	\$ 1,520	8	\$ 1,520	\$ 3,040
Grand Total:			\$ 67,745		\$ 52,490	\$ 120,235



Conventional & Reverse Circulation Water Well Drilling
 Domestic • Agricultural • Industrial • Test Holes • Monitor Wells

Contractor's License #133783-C57A

20 W. KENTUCKY AVE. • WOODLAND, CA 95695 • (530) 662-6795 • FAX (530) 662-3342

**Triple Completion Monitoring Well Construction Proposal
 Brown & Caldwell - North Highlands Project**

9-Jul-12

Item Number	Description	Units	Amount	Unit Price	Total
1a.)	Mobilization	Lump	1	\$ 8,500.00	\$ 8,500.00
1b.)	Site to Site Mobilization	Lump	0	\$ 6,500.00	\$ -
2.)	Test Hole Drilling	Foot	500	\$ 23.00	\$ 11,500.00
3.)	Geophysical Logging - SP, 16N, 64N, PR	Lump	1	\$ 2,500.00	\$ 2,500.00
4a.)	Bore Hole Reaming/Wiper Pass (8")	Foot	150	\$ 26.00	\$ 3,900.00
4b.)	Bore Hole Reaming/Wiper Pass (12")	Foot	370	\$ 29.00	\$ 10,730.00
5.)	Borehole Abandonment	Foot	0	\$ 20.00	\$ -
6.)	2.5" o.d. SCH 80 PVC Blank Casing	Foot	990	\$ 6.50	\$ 6,435.00
7.)	2.5" o.d. SCH 80 PVC Well Screen (0.030 slot)	Foot	60	\$ 8.50	\$ 510.00
8.)	#8 SRI Sand	Foot	100	\$ 10.00	\$ 1,000.00
9.)	Bentonite Chips	Foot	320	\$ 15.00	\$ 4,800.00
10.)	Sanitary Seal	Foot	100	\$ 50.00	\$ 5,000.00
11.)	Grout Pumper	Lump	1	\$ 750.00	\$ 750.00
12.)	Monitoring Well Development	Hour	8	\$ 190.00	\$ 1,520.00
13.)	Well Pad w/Above Ground Vault and 4 Bollards	Each	1	\$ 1,600.00	\$ 1,600.00
14.)	Containment & Disposal - Drill Cuttings & Fluids - 15% markup upon receipt - \$95 hourly rate per EDC Laborer	Lump	1	\$ 8,000.00	\$ 8,000.00
15.)	Construction Water Supply - 15% markup upon receipt - \$95 hourly rate per EDC Laborer	Lump	1	\$ 1,000.00	\$ 1,000.00
16.)	Stand-by Time	Hour	0	\$ 275.00	\$ -
Total to Complete Well as Proposed (Items 1 thru 16)					\$ 67,745.00

Terms & Conditions

- Proposal / Estimate is subject to change after 30 days.
- Payment terms are "Net Due Upon Receipt of Invoice."
- A finance charge of 0.83% per month will be charged on all past due balances in excess of 30 days.
- Cash, check, cashier's check and credit card are acceptable forms of payment.
- Prices are based on normal drilling conditions and do not include drilling rates with rock bit or extensive circulation loss.
- Contractor will obtain well construction permit from the County prior to construction. Well Owner to provide any other Local, State and Federal project specific permits.
- Pricing assumes 24 hour operation without sound control.
- Pricing assumes 5 days on / 2 days off operation schedule
- Pricing assumes adequate site accessibility and pad.
- Pricing does not include bid, payment or performance bonds.

Attachment B

Geotechnical Cost Estimate



INVOICE

BROWN & CALDWELL
10540 WHITE ROCK ROAD #180
RANCHO CORDOVA CA 95670
Attention: **TIMOTHY GODWIN**

Invoice # : 2110712
Project # : S95550601
Invoice Date : 10/21/2011
Client Project # : #138604.400

LOWER TUSCAN AQUIFER

For Professional Services from 9/5/2011 through 10/2/2011
BILLING FOR LAB TESTING.

Expenses

Unit Pricing - Rate	240.00	
		Total Expenses <u>240.00</u>
		Current Invoice <u>240.00</u>
		Amount Due This Invoice *** <u><u>240.00</u></u>

Prior Invoices:	1,440.00
This Invoice:	240.00
Total Invoiced:	1,680.00
Invoices Paid to Date:	1,440.00
Unpaid Invoices Due:	240.00

Company: 1		Vendor No: 43861		PO No: lab	
PO Ln	G/L Code	Project / Phase / task	Org	Amount	
/	51012	138604.310	1017	\$ 240.00	
				\$	
				\$	
				\$	
Date: 11/28/11		Approved by: <i>Tim Godwin</i>		Total: \$ 240.00	





INVOICE

Project : S95550601 -- LOWER TUSCAN AQUIFER

Phase : ** -- GENERAL**

Unit Pricing Expenses

<u>Vendor / Employee Name</u>	<u>Date</u>	<u>Units</u>	<u>Rate</u>	<u>Amount</u>
DIRECT LAB CHARGES				
SIEVE ANALYSIS PIT RUN 200WASH	9/25/2011	3.00	80.00	240.00
Total: DIRECT LAB CHARGES				240.00
Total: Default				

Unit Pricing **240.00**

Total Phase : ** -- GENERAL**

Labor : 0.00
Expense : 240.00

Total Project Labor : 0.00
Total Project Expense : 240.00

Total Project: S95550601 -- LOWER TUSCAN AQUIFER 240.00

Attachment C

Utility Clearance Cost Estimate

Subtronic Corporation

5031 Blum Road #2
Martinez, CA 94553
Phone 925.228.8771
Fax 925.228.8737

Estimate

Estimate # 13157

Date of Estimate 7/9/2012

BILL TO:

Brown and Caldwell
10540 White Rock Road, Ste 180
Rancho Cordova, CA 95670-6025
(916) 444-0123 fax (916) 635-8805
Wendy Linck

ESTIMATE TO:

P.O. #:

SURVEYOR	JOB DATE	DAY	TIME	TERMS
JT				Net 30

DESCRIPTION	QTY	COST	TOTAL
<p>PROJECT LOCATION: 5700 Arden Way, Carmichael and Walnut Ave between Whitney and Robertson Ave, Sacramento, CA</p> <p>AREA OF SURVEY: The area of survey is defined by information received 7/3/2012 regarding the location of underground utilities around 2 ground water monitoring wells in 2 different locations as per above.</p> <p>SCOPE OF SURVEY: We will endeavor to locate underground utilities in the areas indicated, but for technical reasons cannot guarantee to do so, some short lengths of abandoned utilities may not be located.</p> <p>METHODOLOGY: Location of utilities will be by electromagnetic field induction. Ground Penetrating Radar may also be used.</p> <p>INCLUSIONS: Metallic utilities i.e. electric, telephone, gas and water. Non metallic utilities with tracer wire visible. Sewer and drain lines with minimum 4" cleanout or manhole access will be located by inserting a transmitter.</p> <p>EXCLUSIONS: Depths of utilities are not included in this project.</p>			

Signature _____

Date _____

TOTAL

This quotation is subject to our Specification and Standard Conditions of Contract.
CA License # 940232

Subtronic Corporation

5031 Blum Road #2
 Martinez, CA 94553
 Phone 925.228.8771
 Fax 925.228.8737

Estimate

Estimate # **13157**
 Date of Estimate 7/9/2012

BILL TO:

Brown and Caldwell
 10540 White Rock Road, Ste 180
 Rancho Cordova, CA 95670-6025
 (916) 444-0123 fax (916) 635-8805
 Wendy Linck

ESTIMATE TO:

P.O. #:

SURVEYOR	JOB DATE	DAY	TIME	TERMS
JT				Net 30

DESCRIPTION	QTY	COST	TOTAL
<p>ASSUMPTIONS:</p> <p>1. We assume access will be granted to all places requiring admission for the purpose of tracking and identifying the utilities.</p> <p>2. We assume that any existing utility drawings will be made available.</p> <p>3. We assume Underground Service Alert will be notified prior to excavation.</p> <p>4. We assume boring locations or areas of excavation will be marked on site prior to our arrival.</p> <p>PRESENTATION: The utilities will be marked on the ground with spray paint.</p> <p>COMPENSATION: For work performed as described above including equipment, personnel and travel costs for the sum of:</p> <p>Underground utility location, 1st hour on site</p> <p>Underground utility location, subsequent hours:</p> <p>This estimate is good for 60 days.</p>	<p>1</p> <p>0.5</p>	<p>480.00</p> <p>160.00</p>	<p>480.00</p> <p>80.00</p>

Signature _____

Date _____

TOTAL

*This quotation is subject to our Specification and Standard Conditions of Contract.
 CA License # 940232*

Subtronic Corporation

5031 Blum Road #2
Martinez, CA 94553
Phone 925.228.8771
Fax 925.228.8737

Estimate

Estimate # 13157

Date of Estimate 7/9/2012

BILL TO:

Brown and Caldwell
10540 White Rock Road, Ste 180
Rancho Cordova, CA 95670-6025
(916) 444-0123 fax (916) 635-8805
Wendy Linck

ESTIMATE TO:

P.O. #:

SURVEYOR	JOB DATE	DAY	TIME	TERMS
JT				Net 30

DESCRIPTION	QTY	COST	TOTAL
Insurance Coverage: General Liability: \$1,000,000 per occurrence \$ 2,000,000 aggregate Excess/Umbrella Liability: \$5,000,000 Worker's Comp: \$1,000,000 Professional Liability: \$1,000,000 per claim \$2,000,000 annl aggr. Automobile:\$2,000,000			

Signature _____

Date _____

TOTAL

\$560.00

*This quotation is subject to our Specification and Standard Conditions of Contract.
CA License # 940232*

Attachment D

Lab Analysis Cost Estimate

Quote No. 954676 Prepared 07/03/2012 By Dennis Dorning

<u>Client Information</u>		<u>Project Information</u>	
Name:	Wendy Linck	Project ID:	DWR LGAGA
Client:	Brown and Caldwell	Location:	
Address:	10540 White Rock Road, Suite 180 Rancho Cordova, CA 95670-7984	Expected Start Date:	7/3/2012
Phone:	916-444-0123	Quote Valid Until:	12/31/2012
Fax:	916-635-8805	Analytical Fees Include :	
E-mail:	WLinck@brwnncald.com	<input checked="" type="checkbox"/>	Courier Services
		<input checked="" type="checkbox"/>	Sample Disposal
		<input type="checkbox"/>	EDD _____

5 Business Day Turnaround Time (TAT), except as noted.

<u>Matrix</u>	<u>Test</u>	<u>Quantity</u>	<u>TAT</u>	<u>Unit Costs</u>	<u>Subtotal 1</u>	<u>Rush Surcharge</u>	<u>Subtotal 2</u>
Water	1,4-Dioxane by 8270C(M) Isotope Dilution	2	10	\$120.00	\$240.00	\$0.00	\$240.00
Water	EPA 300.0 Anions (Cl,SO4, NO2, NO3)	2	5	\$60.00	\$120.00	\$0.00	\$120.00
Water	EPA 314.0 Perchlorate	2	5	\$50.00	\$100.00	\$0.00	\$100.00
Water	EPA 6010B - Zn, Ca, Fe, Mg, Mn, Na	2	5	\$48.00	\$96.00	\$0.00	\$96.00
Water	EPA 8260B Volatile Organics	2	5	\$85.00	\$170.00	\$0.00	\$170.00
Water	SM 2320B Alkalinity	2	5	\$15.00	\$30.00	\$0.00	\$30.00
Water	SM 2340 C Total Hardness	2	5	\$15.00	\$30.00	\$0.00	\$30.00
Water	SM 2510 B Specific Conductance	2	5	\$8.00	\$16.00	\$0.00	\$16.00
Water	SM 2540 C Total Dissolved Solids	2	5	\$15.00	\$30.00	\$0.00	\$30.00
Water	SM 4500 H+ B pH	2	5	\$8.00	\$16.00	\$0.00	\$16.00

Total for Testcodes : \$848.00

Quote total: \$848.00

Comments:

Deliverables: Level II (Standard) Level III (Surcharge applies) Level IV (Check availability)

Ask us about our AIR testing services!



Quote No. 954676 Prepared 07/03/2012 By Dennis Dorning

Your Project Manager will be : Virendra Patel , vpatel@calscience.com . Please Contact him/her to order sampling supplies (e.g. bottles, coolers) . Unless otherwise stated, all analytical work conducted by Calscience is subject to its standard terms and conditions, a copy of which is available upon request.

Unused sample containers cannot be returned to Calscience for reuse due to possible contamination issues. Calscience can only dispose of unused containers. If a client insists on returning unused containers for disposal, a \$100 minimum disposal fee applies.

Disposal of solid and aqueous samples will occur 60 days following sample receipt unless other arrangements are made. Air samples will be retained only until analysis is completed.

Ask us about our AIR testing services!

Page 2 of 2

