Attachment 8. Quality Assurance

Quality assurance (QA) is an overall management plan used to guarantee the integrity of the data and analysis performed. The plan includes guidelines for:

- Procedural Assurances
- Personnel Qualifications
- Test-hole/Monitoring Well Design, Construction, and Development
- Groundwater Level Measurements
- Groundwater Quality Sampling

Quality control (QC) is a component of QA that includes analytical measurements used to evaluate the quality of data collected. The following sections outline specific QA/QC protocol for the proposed project.

Procedural Assurances

The proposed work will be executed according to clearly delineated lines of authority. Mike Yeraka with Diablo Water District will administer the contract work and ensure that the terms of the contract are met. Technical engineering and hydrogeologic services will be contracted by the District to Luhdorff and Scalmanini, Consulting Engineers (LSCE). LSCE will manage and perform the work proposed in this application as the District's agent with respect to design, inspection, and various data collection activities. LSCE will follow its own internal structure for project management, performance, and internal review. Oversight of project related tasks will be performed by a California Professional Engineer and/or Geologist, as applicable to the work item. Quarterly progress reports will be submitted to the District and DWR in accordance with DWR grant guidelines and requirements.

Personnel Qualifications

Tom Elson will serve as the LSCE project leader. He is a Firm Officer and Principal Engineer with thirty-three years of professional experience including twenty-two years in groundwater consulting with Luhdorff and Scalmanini Consulting Engineers. He currently manages groundwater exploration projects, water supply site assessments, well field planning, water well design, and well construction and testing. He also conducts studies of groundwater impacts for CEQA studies and has served as an expert witness for numerous groundwater seepage matters. Mr. Elson's primary responsibilities for this project will include:

- Coordination of project activities;
- Day-to-day direction of project staff;
- Formal and informal communications and reporting to DWR; and
- Assurance/oversight of overall quality and quantity of the information obtained.

LSCE has twenty-eight experienced professionals and support staff with expertise in all areas of groundwater engineering and hydrogeology. LSCE has extensive experience with projects of similar scope as proposed in this application. LSCE's approach to such projects combines a detailed hydrogeologic assessment with well design and engineering. The primary team members proposed for this project are listed below.

Thomas D. Elson, Principal Engineer Mr. Elson has thirty-three years experience in well siting and design, construction, and rehabilitation projects. He is an expert in well design, sand control, and production logging. He has worked on EPA Class I and II injection well applications, water injection wells of many types including ASR, water disposal, and water flooding (oil and gas enhanced recovery). Mr. Elson holds patents in well completion technology, and served on national committees for standardizing well completion materials in the energy industry. Mr. Elson has excellent verbal and written skills and would provide regular progress reports to staff and management. Mr. Elson has provided similar services for numerous municipal, industrial, and irrigation water well projects. Recent and current clients for which Mr. Elson has performed similar services include the Town of Discovery Bay, Diablo Water District, San Francisco Public Utilities Commission, City of Campbell, City of Morgan Hill, City of Mountain View, and the City of Wheatland. Mr. Elson's role for the City's projects would be to manage "below ground" aspects of groundwater supply projects, including hydrogeologic assessments, well siting, well test hole installation, design, risk from contamination, permitting, and reporting/technical support during the bidding process.

Scott Lewis, P.G., Senior Hydrogeologist Mr. Lewis is a Professional Geologist with an academic degree in geology and over thirteen years of experience in hydrogeology. His experience in water resources and groundwater development includes site evaluations and exploration drilling, hydrogeologic assessments, monitoring well and production well design, well construction and testing oversight, water well rehabilitation, and overall project management. Mr. Lewis specializes in the design and construction of monitoring and municipal water wells. He has experience with over sixty municipal water well projects and over eighty exploration programs. Representative projects included municipal wells for San Jose Water Company, City of Merced, City of Winters, City of Millview, Sacramento County, City of Roseville, and Sacramento Suburban Water District. Mr. Lewis would provide input to the facilities planning, ranking of alternative well sites, management of test hole installations, and design, construction, and testing of test wells.

Kenneth W. Utley, P.G., C.E.G., Senior Geologist Mr. Utley has thirty-three years of experience in engineering geology including definition of geologic and lithologic features in groundwater basins; investigation and definition of areal and vertical extent of aquifers; development of geologic and lithologic descriptions from formation samples and geophysical logs for groundwater development and groundwater contamination studies; investigation of erosional processes, landslides, and stream hydrology; and design and implementation of erosion-control projects on steep mountainous terrain; detailed soil and sedimentary mapping for seismic safety. Mr. Utley would interpret the geologic setting and identification of favorable sites for location of potential well sites.

Carl Wulff, Project Engineer Mr. Wulff has twenty-four years of field engineering and construction management experience in the water well industry including consulting services and major water well services contractor. He is experienced with well construction and rehabilitation requirements, specification, and implementation needs. He has designed rehabilitation programs for cable tool, reverse rotary, direct rotary wells, and injection wells.

Barbara Dalgish, P.G., Project Hydrogeologist Ms. Dalgish has nine years of professional experience including five years in groundwater consulting with Luhdorff and Scalmanini Consulting Engineers and three years as a hydrologist for the U.S. Geological Survey. Experience includes development and construction of site specific and regional groundwater flow models; investigation and assessment of regional geologic and hydrologic conditions for groundwater resource management programs; collection and evaluation of soil, surface water, and groundwater quality; aquifer parameter estimation.

Casey Meirovitz, Staff Hydrogeologist Mr. Meirovitz has three years experience in groundwater and geologic consulting with LSCE and four years of prior experience as a Research Assistant for the University of California at Davis and as a geologist for a consulting firm in Utah. Experience includes the design and development of geostatistical and groundwater flow models; development and construction of groundwater monitoring networks; investigation and assessment of regional geologic and hydrologic conditions; evaluation of groundwater/surface water interactions; preparation of a GWMP; collection and evaluation of lithologic cores and groundwater samples; aquifer parameter estimation.

Other LSCE professionals and support staff will be available to assist with this project as needed. Additional information on the firm is provided in **Appendix 8-1**.

Test-Hole/Monitoring Well Design, Construction, and Development

LSCE's approach for construction administration services includes site visits, inspections, construction meetings, review of submittals, responding to requests for information, and assisting with change order requests. Typical tasks during the construction period are listed below:

Pre-Construction

- Use of detailed specifications for construction related activities. Specifications for test hole drilling and construction of a multi-completion monitoring well installation are provided in **Appendix 8-2**.
- Conduct pre-bid conference to answer questions of prospective bidders in order to eliminate uncertainties regarding pending construction procedures and requirements. Such conferences frequently reduce uncertainties and consequently result in a more competitive bidding process.
- Solicit competitive bids from qualified, licensed contractors; respond to questions during the bid period; evaluate bids and provide recommendation for contract award.
- Review submittals required from contractor, including a construction schedule, site plans, report forms, list of supervisory personnel. The review ensures the contractor's

compliance with the plans and specifications, and any required coordination with other contractors.

- Conduct preconstruction conference with the selected contractor to review work schedules and confirm the contractor's understanding of the intent of the contract documents. Include final site visitation with the contractor as a part of the conference to review site access and to address questions of the contractor prior to equipment arrival.
- Ensure contractor compliance with labor and equipment requirements and site preparation.
- Provide assistance with construction change orders that may be required to address unforeseen conditions, new information and resolve inconsistencies within the project contract documents.

During Construction

- Inspect surface casing installation and grouting operations.
- Inspect drilling operations and drilling fluid control while drilling through the targeted water production aquifers to ensure minimal formation damage.
- Inspect borehole conditioning and casing installation, including casing welds, alignment, casing guide placement, and screen locations.
- Inspect for proper gravel installation and placement of annular seals (including sanitary seals), as required.

Well Development and Site Cleanup

- Inspect initial well development techniques and final development of the well.
- Inspect contractor's compliance with site cleanup and securing of well structure.

Groundwater Level Measurements

Manual Measurements

Static water level measurements will be collected using a *Durham Geo Slope Indicator* electrical sounder (or equal) at the following frequency:

- Following monitoring well construction and development;
- Monthly as part of the District's existing groundwater monitoring program;
- During quarterly transducer downloads; and
- And prior to groundwater quality sampling.

An electric sounder is used to measure the depth to groundwater from a specified reference point (usually the top of the well casing). Wellhead reference points will be marked to provide consistency between measurements. Measurements are recorded to the nearest 0.01 foot. A field sheet will be used to document the date and time, depth to water (feet), and any comments which may be important for consideration (e.g., nearby well pumping).

Automated Water Level/Specific Conductivity Measurements

Automated water level measurements will be collected using Diver© series pressure transducers produced by Schlumberger Water Services. The Micro-Diver © pressure transducer will be installed in each of the monitoring wells for which only water level measurements are required. CTD-Divers© will be installed in the existing Corporate Yard Well and shallow single monitoring well at the High School Site where continuous conductivity measurements are required in addition to water level and temperature. Corrections for barometric pressure (used in conversion of measured pressures in wells to water levels) will be performed using continuous barometric pressures recorded with a Diver-Baro©, deployed at one of the site, on the same frequency and timing as the other transducers. Specifications are provided for each of the transducers mentioned in **Appendix 8-3**.

The transducers will be programmed to collect 1 to 6 measurements per day (4 to 24 hour frequency). The transducer data will be downloaded after one month and then quarterly for the duration of the project following installation (total of 7 downloads). Subsequent downloads would be at least semi-annual. Manual water level measurements made at the time of each download will be used to verify that the transducer data are accurate. After each download, the manual and transducer measurements will be reviewed by a qualified professional before adding the data to the database.

Groundwater Quality Sampling

This section describes guidelines for the retrieval of groundwater level measurements and groundwater quality samples from dedicated groundwater monitoring wells; purging protocol; instrumentation and its calibration and decontamination; sample handling and recordation; and quality assurance procedures. The sampling procedures employed for this project will conform to the standards of the National Field Manual for the Collection of Water-Quality Data (USGS, 2012).

Groundwater Level Measurements
Static water measurements will be collected at each well prior to sampling. The same procedures for measuring groundwater levels described above will be used during water quality sampling. The static water level in conjunction with well construction information is used to calculate the volume of water in the well. This information will be used to determine the minimum volume of water to be purged prior to sample collection.

Purging Protocol
Monitoring wells will be purged and sampled using a portable submersible sampling pump. Alternatively, it may be elected to use an inertial pump, peristaltic pump, or comparable equipment. A discharge hose is attached to the top of the pump assembly through which purge water is discharged. Smaller-diameter tubing for sample collection is also attached to the top of

the pump assembly. Discharge and sample collection tubing are attached to a manifold and are isolated from each other by a check valve.

Monitoring wells are purged of at least three wet casing volumes and until indicator parameters have stabilized prior to sample retrieval. Stabilization is defined as three consecutive readings at 5-minute intervals where parameters do not vary by more than 5 percent. Purged groundwater is disposed of by spreading it on the ground at a reasonable distance from the sampled well to avoid the potential for purge water to enter the well casing again during the purging process.

The following indicator parameters are monitored during the well purging:

- Temperature (°C)
- pH (standard pH-units)
- Electrical conductivity (µS/cm)
- Dissolved oxygen (percent saturation)
- Oxygen reduction potential (mV)
- Turbidity (NTU)

Visual (color, occurrence of solids), olfactory (odor), and other observations (e.g., wellhead conditions, well access, ground conditions, weather) are noted as applicable.

Instrumentation

The following equipment is used during purging and sampling activities:

- Purging: submersible pump with discharge hose;
- Sample retrieval: clean food-grade polyethylene tubing (to bypass the discharge hose);
- Depth-to-water: *Durham Geo Slope Indicator* electrical sounder (or equal);
- pH, temperature, electrical conductivity: *YSI* instrumentation (Model 63) (or equal);
- Turbidity: *Orbeco-Hellige* Model 966 portable turbidity meter (or equal);
- Dissolved oxygen: *YSI* instrumentation (Model 55) (or equal); and
- Oxygen reduction potential: *Oakton ORPTestr* (or equal).

Calibration

Field calibration of instrumentation is conducted following the manufacturer's instructions and standard solutions prior to a sampling event and once on every day of the event. The thermometer is factory calibrated and is not field calibrated.

Decontamination

The pump assembly and discharge hosing will be thoroughly flushed with tap water between well visits. If additional analyses are incorporated into the program in the future (e.g., microbial analyses, volatile organic compounds, low- level metal analyses, pharmaceuticals, or isotopic speciation), decontamination procedures will be appropriately adjusted to include, for example:

- Use of new sampling hose between each well;
- Purging of the pump with a dilute Clorox© solution and subsequent rinsing with clean tap water;
- Washing the portion of the electrical sounder that has entered a well with a dilute Clorox© solution and subsequent rinsing with tap water; and
- Double bagging procedures.

Sample Handling and Recordation

After completion of purging activities, groundwater quality samples are filtered in the field to remove turbidity and collected in laboratory-supplied bottles with or without preservative (depending on analyses to be conducted) without headspace. Bottles are labeled with laboratory-supplied labels, immediately placed on ice, and kept in a dark ice chest (at 4 °C) until delivered to the laboratory. Samples are delivered to a laboratory certified through the State of California (Department of Health Services Environmental Laboratory Accreditation Program) with the proper chain-of- custody documentation within the required holding time. A chain-of-custody (COC) form issued to record sample identification numbers, type of samples (matrix), date and time of collection, and analytical tests requested. In addition, times, dates, and individuals who had possession of the samples are documented to record sample custody.

A field sheet is used to document equipment calibration, water level measurements, well purging activities, and the measurement of indicator parameters; an example is provided in **Appendix 8-4**.

Laboratory Analyses

Laboratory analyses will be conducted for general minerals, general physical, and drinking water metals. Electrical conductance, pH, and temperature will be measured in the field also. **Table 5-2** in **Attachment 5** lists the analytical method, practical quantitation limit, sample containers, preservatives, and holding time for each parameter.

Field Quality Control

“Blind” duplicate field samples are collected to monitor the precision of the field sampling process and to assess laboratory performance. Blind duplicates are collected from at least 5 percent (1 in 20) of the total number of sample locations. The true identity of the duplicate sample is not noted on the COC form, rather a unique identifier is provided. The identities of the blind duplicate samples are recorded in the field sheet, but the sampling locations of the blind field duplicates will not be revealed to the laboratory.

Laboratory Quality Control

Quality assurance and quality control samples (e.g., spiked samples, blank samples, duplicates) are employed by the laboratory to document the laboratory performance. Results of this testing are provided with each laboratory report.

Review of Laboratory Data Reports

Data validation includes a data completeness check of each laboratory analytical report. Specifically, this review includes:

- Review of data package completeness (ensuring that required QC and analytical results are provided);
- Review of the required reporting summary forms to determine if the QC requirements were met and to determine the effect of exceeded QC requirements on the precision, accuracy, and sensitivity of the data;
- Review of the overall data package to determine if contractual requirements were met; and
- Review of additional QA/QC parameters to determine technical usability of the data.

In addition, the data validation includes a comprehensive review of the following QA/QC parameters:

- Holding times (to assess potential for degradation that will affect accuracy);
- Blanks (to assess potential laboratory contamination);
- Matrix spikes/matrix spike duplicates and laboratory control samples (to assess accuracy of the methods and precision of the method relative to the specific sample matrix);
- Internal standards (to assess method accuracy and sensitivity);
- Compound reporting limits and method detection limits; and
- Field duplicate relative percent differences.