# APPENDIX E

## *Monitoring Protocols and Metering Plan*

**E1:** Borrego Sampling and Analysis Plan and Quality Assurance Plan

**E2:** Borrego Metering Plan

# APPENDIX E1

## *Borrego Sampling and Analysis Plan and Quality Assurance Plan*

**The Sampling and Analysis Plan and Quality Assurance Plan has been modified and superseded by Section 4.3 of the Settlement Agreement and Section VI.B. of the Judgment, whereby the interim Watermaster will continue the County-initiated program of water quality monitoring in the Basin that was conducted through March 2019 as part of GSP development on an interim basis until the Court approves the permanent Watermaster and the Watermaster adopts its own Plan.**

# SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN
## Borrego Springs Subbasin

*Prepared for*

**Borrego Valley Groundwater Sustainability Agency**

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## APPENDICES



## TABLES

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| COPC | constituent of potential concern |
| DMS | data management system |
| DQO | data quality objective |
| DWR | California Department of Water Resources |
| EPA | United States Environmental Protection Agency |
| GSP | Groundwater Sustainability Plan |
| HDPE | high-density polyethylene |
| LCS | laboratory control sample |
| LIMS | laboratory information management system |
| mL | milliliter |
| MDL | method detection limit |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| QAPP | Quality Assurance Project Plan |
| QA | quality assurance |
| QC | quality control |
| SAP | Sampling and Analysis Plan |
| SOP | standard operating procedure |
| Subbasin | Borrego Springs Subbasin |

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# 1 INTRODUCTION

The Borrego Springs Subbasin (Subbasin) of the Borrego Valley Groundwater Basin has been identified by the California Department of Water Resources (DWR) as subject to critical conditions of overdraft (DWR 2016a). As such, in accordance with California's Sustainable Groundwater Management Act, a Groundwater Sustainability Agency has been formed to develop and implement a basin-specific Groundwater Sustainability Plan (GSP). The general purpose of the GSP is to facilitate a long-term groundwater withdrawal rate less than or equal to the sustainable yield of the Subbasin within the 20-year implementation period mandated by the Sustainable Groundwater Management Act.

The objective of this Sampling and Analysis Plan (SAP) is to establish consistent field data collection and laboratory analytical procedures, including protocols for measuring groundwater levels and protocols for sampling groundwater quality. The SAP incorporates pertinent protocols presented in DWR's Best Management Practices for the Sustainable Groundwater Management of Groundwater Monitoring Protocols, Standards, and Sites (DWR 2016b).

## 1.1 Project Overview and Applicability of the SAP/QAPP

The GSP is currently being developed for the Subbasin. An interim Monitoring Plan was prepared in support of the GSP that outlines the types of monitoring necessary to address the six DWR-designated sustainability indicators in the Subbasin (Dudek 2017). This SAP serves to supplement the Monitoring Plan by establishing consistent monitoring procedures associated with the two primary sustainability indicators for the Subbasin: (1) chronic lowering of groundwater levels and (2) degraded water quality. The Monitoring Plan identifies these two sustainability indicators as the primary drivers of the anticipated undesirable effects from overdraft in the Subbasin. Although the data collected to address the above-referenced sustainability indicators will also be used to evaluate reduction in groundwater storage, other DWR-designated sustainability indicators (i.e., seawater intrusion, depletion of interconnected surface water, and land subsidence) are not considered significant in the Subbasin at this time (Dudek 2017). Therefore, this SAP does not provide protocols for monitoring seawater intrusion, measuring streamflow, or measuring subsidence.

Included within this SAP is a Quality Assurance Project Plan (QAPP). The QAPP provides a framework for implementing procedures for field sampling, chain-of-custody, sample transportation, laboratory analysis, and reporting that will yield defensible data of known quality. Together, the SAP and QAPP are designed to facilitate data collection such that data are of acceptable quality to meet project requirements.

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# 2 SAMPLING AND ANALYSIS PLAN

The following section describes the sampling methodology, analytical parameters, and sample handling procedures to be followed for routine groundwater monitoring activities in the Subbasin. Specific sampling locations and pertinent well specifications are identified in the Monitoring Plan (Dudek 2017).

## 2.1 Health and Safety

A project-specific Health and Safety Plan will be prepared and implemented to address potential hazards that may be encountered in the field. Safety meetings will be held at the commencement of the project and each day before work begins to discuss safe work practices during field activities.

## 2.2 Sampling Objectives

The objectives of monitoring activities are to collect accurate and defensible groundwater elevation data, and to collect representative groundwater samples to evaluate concentrations of constituents of potential concern (COPCs) in groundwater. The purpose of monitoring activities is to track groundwater conditions in the Subbasin throughout implementation of the GSP to evaluate progress toward achieving measurable objectives and sustainable management of the Subbasin, as defined in the Monitoring Plan (Dudek 2017).

## 2.3 Constituents of Potential Concern

Groundwater samples collected from the site will be analyzed for the site-specific COPCs defined in the Monitoring Plan, including the following:

**Routine Constituents**

- Arsenic
- Fluoride
- Nitrate
- Sulfate
- Radionuclides (gross alpha particle activity)
- Total dissolved solids

**Baseline Constituents**

- Anions (bicarbonate, carbonate, chloride, fluoride, hydroxide, nitrate, sulfate, total alkalinity)

- Cations (calcium, magnesium, potassium, sodium, and total hardness)

Additional detail regarding COPCs is presented in Section 3.5, Analytical Methods, of this SAP.

## 2.4 Groundwater Monitoring Frequency

Groundwater elevation measurements and water quality sampling will be performed on a semi-annual schedule. The initial water quality sampling event will include sampling and analysis for cations and anions to establish baseline chemistry; analysis for cations and anions in subsequent sampling events is not currently planned.

## 2.5 Groundwater Monitoring Methods

Groundwater monitoring procedures described herein were compiled in consideration of the DWR's best management practices (DWR 2016b), the County of San Diego's Site Assessment and Mitigation Manual (County of San Diego 2012), and professional judgment. See Appendix A for an example groundwater elevation monitoring field form.

### 2.5.1 Groundwater Elevation Monitoring

Groundwater elevation monitoring will be conducted using the following procedures:

- Groundwater elevation data should approximate conditions at a discrete period in time; therefore, groundwater levels will be collected within as short a time interval as possible, preferably within a 1- to 2-week period.
- The sampler will have the previous depth to water measurements available in the field.
- The water level indicator will be decontaminated after each well.
- An electronic water level that employs a battery-powered probe assembly attached to a cable marked in 0.01-foot increments will be used. When the probe makes contact with the water surface, an electrical impulse is transmitted in the cable to activate an audible alarm. The equipment will be equipped with a sensitivity adjustment switch that enables the operator to distinguish between actual and false readings caused by the presence of conductive, immiscible components on top of groundwater. The manufacturer's operating manual should be consulted for instructions on use of the sensitivity adjustment.
- The well cap or cap covering the access port will be unlocked and removed.
- The sampler will listen for pressure release while removing the lid. If a release is observed, the measurement will wait to allow the water level to equilibrate. Additionally, multiple measurements will be collected to ensure that the well has reached equilibrium such that no significant changes in water level are observed.

- All parts of the water level indicator that may come into contact with liquids in the well will be thoroughly rinsed or sprayed with deionized water immediately prior to lowering the probe into the well.
- The probe will be lowered through the access port or well casing to the anticipated depth of water.
- When the water level probe signals contact with water, the depth will be read on the tape from a datum point permanently marked on the well casing. Continue until two consecutive readings are within 0.01 foot of each other. The depth will be recorded on the Water Level Measurement Log.
- Measurements will be taken at an established reference point, generally at the top of the casing at the surveyor's mark. The mark should be permanent (e.g., a notch or mark at the top of casing). If the surveyor's point is not marked at the time of the water level, the north side of the casing will be used and marked.
- If water is not encountered in the well, the depth to water will be recorded as "dry" on the Water Level Measurement Log.
- If the water level in the well has dropped below the top of the dedicated pump, the probe will not be lowered past the pump. If feasible, remove the dedicated pump. Once the pump has been removed, allow the water level to equilibrate and measure the water level according to the method described above.
- Rewind the probe, replace the well cap, and relock the well.
- The sampler will calculate the groundwater elevation by subtracting the depth to water from the reference point elevation. The sampler must ensure that all measurements are consistent units of feet, tenths of feet, and hundredths of feet. Measurements at reference point elevations should not be recorded in feet and inches.
- The sampler will record the well identifier, date, time (24-hour format), reference point elevation, height of reference point above the ground surface (stick-up), depth to water, groundwater elevation, and comments regarding any factors that may affect the depth to water readings such as weather, recent well pumping or nearby irrigation cascading water, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it will be noted.
- All relevant data will be entered into the Groundwater Sustainability Agency's data management system (DMS) as soon as possible. Care will be taken to avoid data entry mistakes, and the entries will be checked by a second person for compliance with data quality objectives (DQOs).

**Pressure Transducers**

Groundwater levels and/or calculated groundwater elevations may be recorded using pressure transducers equipped with data loggers installed in monitoring wells. When installing pressure transducers, care must be exercised to ensure that the data recorded by the transducers is confirmed with hand measurements.

The following general protocols will be followed when installing a pressure transducer in a monitoring well:

- The sampler will use an electronic sounder and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in each well to properly program and reference the installation. It is recommended that samplers use transducers to record measured groundwater levels to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.
- The sampler will note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. The installer of the transducer will consider battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers at the time of installation.
- The sampler will note whether the pressure transducer uses a vented or non-vented cable for barometric pressure compensation; appropriate corrections for natural barometric pressure changes will be implemented.
- Manufacturer specifications will be followed for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
- The cable will be secured to the well head with a well dock or another reliable method. The cable will be marked at the elevation of the reference point with tape or an indelible marker to allow for estimate of potential future cable slippage.
- The transducer data will be regularly checked against hand-measured groundwater levels to monitor electronic drift or cable movement. This will happen during routine site visits, at least semi-annually, or as necessary to maintain data integrity.
- Data will be downloaded as necessary to ensure no data is lost and will be entered into the Groundwater Sustainability Agency's DMS following the established quality assurance/quality control (QA/QC) program. Data collected with non-vented data logger cables will be corrected for atmospheric barometric pressure changes, as appropriate. After

the sampler is confident that the data have been safely downloaded and stored, the data will be deleted from the data logger to ensure that adequate data logger memory remains.

### 2.5.2 Groundwater Quality Monitoring

Groundwater quality monitoring and sampling will be conducted using the following procedures. See Appendix B for an example groundwater quality monitoring field form.

- Prior to sampling, the sampler must contact the selected California-certified environmental laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well used for groundwater quality monitoring must have a unique identifier. This identifier must appear on the well housing or the well casing to avoid confusion.
- Groundwater elevation will be measured in the well following appropriate protocols, as described above.
- General well specifications for the wells to be sampled should be available in the field, most notably the screened interval and total well depth.
- Sample containers will be labeled prior to sample collection. The sample label must include sample ID, sample date and time, sample personnel, sample location, preservative used, and analyses and analytical method.
- Samples will be collected under laminar flow conditions. Laminar flow occurs when fluid flows in parallel layers, with limited lateral disruption or mixing of the layers. This may require reducing pumping rates prior to sample collection to minimize turbulent flow of groundwater entering the well screen.
- All field instruments will be calibrated daily and evaluated for drift throughout the day. Calibration will be documented in field logs.
- All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Samples will be appropriately filtered, as recommended for the specific analyte. Samples to be analyzed for metals (i.e., arsenic) will be field-filtered prior to preservation; unfiltered samples will not be collected in a preserved container.
- If pumping during sampling or purging causes a well to go dry, the condition will be documented and the well will be allowed to recovery to within 90% of the original level measured prior to pumping. Professional judgement should be used about to whether the sample will meet the DQOs, and will be adjusted as necessary.

- The following will occur for groundwater wells equipped with a functioning dedicated pump:
    1. Samples will be collected at or near the wellhead. Samples will not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.
    2. After cleaning the sampling port, a new, clean length of flexible clear plastic tubing will be connected to the sample access port. The tubing will be inserted into the sample bottle. The sample access port will be opened slowly. It will be verifies that the liquid stream is not flowing greater than 100 milliliters (mL) per minute.
    3. The sample bottle will be filled so that no air space remains. The bottle will be capped and then wiped clean after capping. The completed label will then be adhered to the sample bottle.
    4. Field measurements for depth to water, pH, specific conductance, temperature, turbidity, dissolved oxygen, oxygen-reduction potential, and color will be collected and documented after the samples are collected.
- The following will occur for groundwater wells requiring sample collection using a temporary pump:
    1. The pump will be lowered slowly down the well, positioning the well intake at the middle of the well screen or at the predetermined selected sampling depth.
    2. Disturbance of the water column in the well will be minimized by initiating pumping at a low rate (see below). Dedicated tubing (left in place between sampling events) is recommended to minimize disturbance to the water column before and during sampling.
    3. Pumping will begin at a steady rate of 100 mL per minute and the depth to water will be measured frequently (e.g., every 1 minute for the first few minutes) to ensure that less than 0.1 feet of drawdown occurs. The pumping rate may be increased if drawdown is less than 0.1 feet, but the pumping rate will not exceed 500 mL per minute.
    4. Field parameters and depth to water will be recorded on field data sheets a minimum of every 5 minutes while purging. Purging will continue until pH, temperature, specific conductance, oxidation reduction potential, dissolved oxygen, and turbidity stabilize (three consecutive readings), which is defined as follows:
        a. ±0.2 units for pH
        b. ±3%–5% for specific conductance
        c. ±20 millivolts (mV) for oxidation reduction potential
        d. ±10% for temperature
        e. ±10% for turbidity

f. ±0.2 milligrams per liter for dissolved oxygen

5. Dissolved oxygen and turbidity tend to stabilize last and are better measures of sufficient purging. Drawdown will be minimized during purging and/or sampling, not exceeding 0.1 feet, if possible.
6. In the case that the above criteria for stabilization are not met before three well volumes have been pumped, then a maximum of five well volumes will be pumped before samples are taken. Also, if stabilization has not occurred after 2 hours of purging regardless of well volume status, samples will be collected at this point. In the spirit of water conservation, this method will be avoided if possible.
7. For protocol regarding variances, consult the Site Assessment and Mitigation Manual (County of San Diego 2012).

- If pumping during sampling or purging causes a well to go dry, the condition will be documented and the well will be allowed to recovery to within 90% of the original level measured prior to pumping. Professional judgement will be used as to whether the sample will meet the DQOs and adjusted as necessary.
- After sample collection, the sealed sample bottle will be placed in a "zip-lock" style bag and placed inside an ice chest filled with ice to maintain a sample temperature of 4°C to prevent degradation of the sample. At the completion of sampling, the completed chain-of-custody will be placed in the ice chest, which will be sealed and labeled. The samples will be transported from the site to the laboratory by courier service or other means. The samples will be delivered to the laboratory within 24 hours after the sample has been collected.

## 2.6 Sample Handling

The following section details methods that are to be used for sample labeling, identification, containerizing, preservation, transportation, and maintaining proper chain-of-custody. Samples will be handled in accordance with San Diego County's Site Assessment and Mitigation Manual (County of San Diego 2012) and the United States Geological Survey's National Field Manual for the Collection Water Quality Data sampling protocols (USGS 2014).

### 2.6.1 Sample Handling and Identification

Each groundwater sample collected for analysis will be designated with a unique identification (ID) number. The sample identification number will include information to identify the sample location, date, and field QC classification, if applicable.

The following identifying factors will be used:

- Local well ID (e.g., ID4-18)
- Date (i.e., year, month, day)
- Field QC classification, if applicable (e.g., "D" for field duplicate)

For example:

- Sample identification number "ID4-18-20170704" would represent a groundwater sample collected from well ID4-18 on July 4, 2017.

### 2.6.2 Sample Containers and Transportation

Groundwater samples will be collected in the following containers:

- Arsenic by United States Environmental Protection Agency (EPA) Method 6010B: 250 mL high-density polyethylene (HDPE) bottle preserved with hydrochloric acid
- Cations and anions: 1 liter unpreserved HDPE
- Fluoride by SM 4500-F C: 250 mL unpreserved HDPE
- Nitrate by EPA 300.0: 250 mL unpreserved HDPE
- Radionuclides (gross alpha particle activity) by EPA 900.0: 1 liter unpreserved HDPE
- Sulfate by EPA 300.0: 250 mL unpreserved HDPE
- Total dissolved solids by SM 2540 C: 1 liter unpreserved HDPE

Analyte-specific laboratory holding times as described in Section 3.5.3 will be reviewed to plan for samples to be received by the laboratory within the appropriate timeframe.

### 2.6.3 Chain-of-Custody Procedures

A chain-of-custody form will be used to record possession of the samples from the time of collection to the time of arrival at the laboratory. The individual who collects the samples will prepare them for shipment, complete the chain-of-custody form, and sign the form when transferring the samples to the laboratory courier. The samples will be released to the laboratory by the courier signature on the chain-of-custody form and signed as received by laboratory receiving personnel. The laboratory receiving personnel will verify that all samples listed on the chain-of-custody form are present, sample integrity, and that proper sample preservation procedures were used.

### 2.6.4 Equipment Decontamination

Prior to sampling, re-usable sampling equipment (e.g., submersible pumps) will be decontaminated using an Alconox wash, a potable water rinse, then a distilled water final rinse (i.e., the three-bucket wash method).

### 2.6.5 Investigative-Derived Waste

Evidence of hazardous concentrations of COPCs has not been identified in Subbasin wells. If purge water is generated from a groundwater well it will be discharged to the ground away from the wellhead. Additionally, investigative-derived wastes (e.g., sampling gloves, disposable sampling devices, tubing) will be disposed of off site as municipal solid waste.

### 2.6.6 Field Documentation

Field logbooks will be maintained during confirmation sampling field activities. The field logbooks will serve to document observations, personnel on site, equipment activity, field procedures, and other vital information. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. The following information for each sampling area will be documented on field forms:

- Field crew names
- Date of sampling
- Wells names
- Names and times of samples collected
- Chain-of-custody number
- General observations

### 2.6.7 Photographs

Photographs will be taken at sample locations and other relevant areas on site. The photographs will serve to verify information entered in the field logbooks.

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# 3 QUALITY ASSURANCE PROJECT PLAN

## 3.1 Roles and Responsibilities

Brief descriptions of key personnel responsibilities are provided below.

The sampling project manager is a member of the project team who will provide oversight and serve as the point of contact for the responsible parties. The sampling project manager will have responsibility for the overall project performance.

The QA manager will be responsible for ensuring the integrity of the SAP/QAPP and will coordinate all QA-specific activities. The QA manager will do the following:

- Ensure that the appropriate analytical methods and sampling equipment are selected.
- Be responsible for data validation and advise the sampling project manager with respect to data management and statistical evaluation of the data.
- Be responsible for performance and/or systems audits of the laboratory, should they be required.

The field manager or designated representative will be located at the site during field activities and will coordinate the technical field activities in accordance with approved plans, including the Monitoring Plan (Dudek 2017), QAPP, and Health and Safety Plan. The field manager will be responsible for verifying that the field work (to include sampling operations and sampling QC) is performed within the approved guidelines. The field manager will be responsible for implementing and maintaining overall operating standards and field QA responsibilities. Such responsibilities will include the following:

- Appropriate calibration and maintenance of field instruments
- Appropriate equipment decontamination
- Compliance with QA/QC sampling requirements (e.g., field duplicate collection)

In addition, the field manager will coordinate safety and technical activities occurring at the site, and conduct daily briefing sessions prior to work on the site. Although various field functions will be performed by individuals, the field manager will bear field responsibilities.

The laboratory project manager will be responsible for the day-to-day management of the laboratory work, to include data processing and data processing QA, verification that laboratory QA/QC procedures are being maintained, and verification that technical review of reports has been performed. Although various laboratory functions will be performed by different

individuals, the laboratory project manager will provide signature approvals to laboratory-generated information and bear laboratory responsibilities.

## 3.2 Quality Objectives and Criteria

The DQO process is used to derive qualitative and quantitative statements in relation to a particular data collection event (or group of events). Performing the DQO process is generally one of the prerequisite steps to data collection. The DQO process is described in EPA Guidance (EPA 2006). The steps of the DQO process are as follows:

- State the problem
- Identify the goals of the study
- Identify information inputs
- Define the boundaries of the study
- Develop the analytic approach
- Specify performance or acceptance criteria
- Develop the plan for obtaining data

The steps of the DQO process for the project are summarized below:

- The problem: Groundwater quality in the Subbasin, as observed through groundwater samples collected from monitoring and production wells, is potentially degrading. Overdraft conditions are potentially exacerbating impacts from naturally occurring COPCs, which may result in undesirable effects such as degraded water quality that is unsuitable for irrigation and/or drinking.
- The goals: Evaluate baseline and long-term trends in COPC concentrations for comparison to measurable objectives to be established in the GSP.
- Information inputs: Obtain analytical data for groundwater samples using the tests outlined in Section 3.5.1 of this SAP.
- The boundaries of the study: Samples will be collected from groundwater wells within the Subbasin, as designated in the Monitoring Plan (Dudek 2017).
- The analytic approach: Concentrations of COPCs will be tracked and studied throughout implementation of the GSP, as described in the Monitoring Plan.
- Performance or acceptance criteria: The usability of the data collected for this phase of work will be based on measurement activities, consistent with accepted guidance

documents such as SW846 Test Methods. Testing results will be evaluated against performance-based acceptance criteria.

- The plan for obtaining data: The overall plan is outlined within the Monitoring Plan (Dudek 2017), and sampling details are presented in Section 2 of this SAP.

## 3.3 Special Training/Certification

No specialized training is required. Standard training specifications will be outlined in the project-specific Health and Safety Plan.

## 3.4 Documentation and Records

Documentation will involve generating, maintaining, and controlling field data, laboratory analytical data, field logs, reports, and any other data relevant to the project. Bound field log books, loose-leaf drilling logs, or automated field data entry records generated with personal data assistants are examples of documents. This project will have dedicated field log books, forms, and a DMS that will not be used for other projects. Entries will be dated and the time of entry will be recorded. Sample collection data and visual observations will be documented on forms or personal data assistants, or, when forms are not available or applicable, in the field log book. Any sample collection equipment, field analytical equipment, and equipment used to make physical measurements will be identified in the field documentation. Calculations, results, equipment usage, maintenance, and repair and calibration data for field sampling, and analytical and physical measurement equipment will also be recorded in field documentation. Once completed, the field forms, field databases, and field log book will become part of the project file.

Office data management will involve establishing and maintaining a project file. The project file will include the following:

- Planning documents, such as the QAPP
- Plans and schedules
- Standard operating procedures (SOPs) (for both the field and laboratory)
- Field sampling logs
- Field screening data
- QA auditing and inspection reports
- Laboratory analytical data
- Calculations
- Drawings and figures

- Reports
- External and internal correspondence
- Notes/minutes of meetings and phone conversations
- Contract/purchase orders
- Change orders
- Bid evaluations

All project-related information will be routed to the sampling project manager who will be responsible for distributing the information to appropriate personnel. Project documentation will be archived for a minimum of 15 years. Pertinent documentation will be uploaded to the project's online DMS.

## 3.5 Analytical Methods

### 3.5.1 Laboratory Methods

The following laboratory methods will be used during groundwater sample analysis activities:

- Arsenic by EPA Method 6010B
- Cations and anions by Methods 300.0, SM 2340C, and SM 2320B
- Fluoride by SM 4500 F C
- Nitrate by EPA 300.0
- Radionuclides by EPA 900.0
- Sulfate by EPA 300.0
- Total dissolved solids by SM 2540 C

### 3.5.2 Required Reporting Limits and Method Detection Limits

Reporting limits represent the lowest normally obtainable measurement level achieved and reported by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. The method detection limit (MDL) is the minimum concentration that can be measured with 99% confidence that the analyte concentration is greater than zero by an analytical procedure in a given matrix containing the analyte. Sample-specific reporting limits may vary as a result of sample matrix and compound concentration. Samples with no positive results (down to the MDL) are typically reported as "ND" (indicating "not detected") by the laboratory. Positive results below the reporting limit but above the MDL are reported as

estimated values by the laboratory. Reporting limits and MDLs are adjusted for dilutions, as necessary, by the laboratory. A summary of the MDLs and reporting limits for the COPCs is presented in Table 1.

**Table 1**
**Summary of Method Detection Limits and Reporting Limits**

| COPC | Method | Reporting Limit (mg/kg) |
|---|---|---|
| Fluoride | SM 4500-F C | 0.10 |
| Arsenic | 6010B | 0.0100 |
| Calcium | 6010B | 0.100 |
| Magnesium | 6010B | 0.100 |
| Potassium | 6010B | 0.500 |
| Sodium | 6010B | 0.500 |
| Total Dissolved Solids | SM 2540 C | 1.0 |
| Chloride | 300.0 | 1.0 |
| Nitrate (as N) | 300.0 | 0.10 |
| Sulfate | 300.0 | 1.0 |
| Hardness (as $CaCO_3$) | SM 2340 C | 2.0 |
| Alkalinity | SM 2320B | 1.0 |
| Bicarbonate | SM 2320B | 1.0 |
| Carbonate | SM 2320B | 1.0 |
| Hydroxide | SM 2320B | 1.0 |
| Radionuclides (Gross Alpha Particle Activity) | 900.0 | Variable |

COPC = constituent of potential concern; mg/kg = milligrams per kilogram

Laboratory analytical methods specified in Section 3.5.1 are generally consistent with those used during previous sampling performed in the Subbasin.

### 3.5.3 Holding Times

Knowledge of required holding times will have a direct impact on scheduling of sample collecting, packing, and shipping activities. To ensure proper sample handling, the sample container, volume, preservation, and holding times applicable to each analytical method are shown in Table 2.

**Table 2**
**Borrego Springs Subbasin – Groundwater Sample Analytical Suite**

| Constituent | Method | Sample Container | Preservative | Holding Time (days) |
|---|---|---|---|---|
| Fluoride | SM 4500-F C | 250 mL HDPE | Ice 4°C | 28 |
| Arsenic | 6010B | 250 mL HDPE | Ice 4°C | 28 |
| Calcium | 6010B | 250 mL HDPE | Ice 4°C | 28 |

**Table 2**
**Borrego Springs Subbasin – Groundwater Sample Analytical Suite**

| Constituent | Method | Sample Container | Preservative | Holding Time (days) |
|---|---|---|---|---|
| Magnesium | 6010B | 250 mL HDPE | Ice 4°C | 28 |
| Potassium | 6010B | 250 mL HDPE | Ice 4°C | 28 |
| Sodium | 6010B | 250 mL HDPE | Ice 4°C | 28 |
| Total Dissolved Solids | SM 2540 C | 1 L HDPE | Ice 4°C | 7 |
| Chloride | 300.0 | 125 mL HDPE | Ice 4°C | 28 |
| Nitrate (as N) | 300.0 | 125 mL HDPE | Ice 4°C | 2 |
| Sulfate | 300.0 | 125 mL HDPE | Ice 4°C | 28 |
| Hardness (as $CaCO_3$) | SM 2340 C | 250 mL HDPE | Ice 4°C | 180 |
| Alkalinity | SM 2320B | 250 mL HDPE | Ice 4°C | 14 |
| Bicarbonate | SM 2320B | 250 mL HDPE | Ice 4°C | 14 |
| Carbonate | SM 2320B | 250 mL HDPE | Ice 4°C | 14 |
| Hydroxide | SM 2320B | 250 mL HDPE | Ice 4°C | 14 |
| Radionuclides | 900.0 | 1 L HDPE | Ice 4°C | 5 |

mL = milliliters; L = liters; HDPE = high-density polyethylene bottle

### 3.5.4 Field Methods

Procedures for using field measurement devices are presented in Section 3.6.4.

## 3.6 Quality Control

### 3.6.1 Introduction

This section addresses QC procedures associated with field sampling and analytical efforts. Included are general QC considerations, as well as specific QC checks that provide ongoing control and assessment of data quality in terms of precision and accuracy.

### 3.6.2 Field Quality Assurance/Quality Control

QA/QC for fieldwork refers to methods of measuring the quality of the field sampling techniques. Drilling, sampling, and field record keeping will be conducted in accordance with current sampling protocols for groundwater sampling, as applicable. Field instrumentation will be calibrated in accordance with the manufacturer's instructions at the beginning of each field day.

In addition to the primary samples, the following QA/QC samples will be collected:

- **Field Duplicate**. One field duplicate sample will be collected for every 20 samples collected. The field duplicates will be analyzed for the same COPCs as the primary samples, and will be used to evaluate field sample collection reproducibility. The location where the field duplicate is collected will be noted on the sampling logs. The duplicate sample name will be different than the original sample name.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD)**. One MS/MSD sample will be selected as applicable, and noted on the chain-of-custody. The MS/MSD samples will be analyzed for the same COPCs as the primary samples, and will be used by the laboratory to check for the ability to accurately and precisely recover compounds of interest from the site-specific matrix.

Field blanks will not be collected for this scope of work because easily transferable constituents such as volatile organic compounds are not anticipated to be encountered. The results of the analyses of these QC sample types are used as independent, external checks on field sample collection techniques.

### 3.6.3 Laboratory Quality Control

To obtain data on precision and accuracy, the analytical laboratory will analyze the QC samples described below. The control limits and corrective actions for each parameter are specified in the pertinent laboratory analytical method SOPs. The analytical methods require analyses of the following QC samples:

- Calibration verification following instrument calibration and continuing calibration verification.
- Laboratory blank verification at instrument calibration and at the method required frequency thereafter for continuing blank verification.
- Method blank analysis at a rate of once per batch of samples or one per 20 samples of a single matrix, whichever is more frequent, to determine contamination levels during sample preparation.
- Laboratory control sample (LCS) analyses at a rate of one per batch. The LCS is used to verify that the analytical system is in control based on the percent recovery of the analyte(s).
- MS/MSD or MS/Laboratory Duplicate analyses will be conducted as applicable. The MS/MSDs and/or MS/Laboratory Duplicate are used to check for the ability to accurately and precisely recover compounds of interest from the matrix.

### 3.6.4 Field Procedures

Field monitoring and analytical equipment will be maintained in accordance with the manufacturers' recommended schedules and procedures. Maintenance activities will be documented by either field or laboratory personnel. Calibration will be performed on a routine basis and as otherwise required. Calibrating equipment or calibration standards will also be routinely recalibrated or replaced and documented. Routine inspection of equipment is intended to identify problems requiring maintenance before they cause a major disruption in field monitoring or analytical activities, or adversely affect the validity and precision of the data being measured.

### 3.6.5 Laboratory Procedures

The laboratory is responsible for maintaining laboratory equipment in accordance with manufacturers' recommended maintenance and procedures in order to minimize downtime of the analytical systems. Each analyst is responsible for conducting a daily inspection of critical systems on instruments under their charge. Inspections will include vacuum lines and pumps for the gas chromatograph/mass spectrometer, automatic injection systems, controlled reagent-feed motors, temperature-controlled ovens in gas chromatographs, capillary columns, detectors and support systems, gas control system for atomic adsorptions, and many others. Wear-dependent items, such as septa on gas chromatograph injection systems, will be replaced as needed. The performance of instruments will be checked against known standards at the beginning of each working day or shift. Failure to achieve proper performance indicates a system problem, which will be addressed by laboratory personnel or by the manufacturer's service representative.

In addition, laboratory personnel or the manufacturer's service representative will service working systems according to a fixed schedule. A record of service and repairs, whether accomplished by laboratory personnel or by the manufacturer's service representative, will be maintained in a log book kept with each instrument.

## 3.7 Inspection/Acceptance of Supplies and Consumables

Critical field supplies and consumables include the following:

Sample bottleware

- Decontamination fluids
- Personal protective equipment
- General sampling consumables (e.g., ice, plastic bags, paper towels, aluminum foil)

For bottleware, the acceptance criteria will entail an inspection upon receipt of analytical testing to confirm the absence of cross-contamination and the presence of appropriate preservatives. For decontamination fluids, field staff will ensure that the fluids meet the necessary requirements for concentration and quality grade (e.g., reagent-grade methanol). Personal protective equipment will be inspected to confirm integrity and ensure that the appropriate sizes are available as required by sampling team members.

### 3.7.1 Laboratory Supplies

The inspection and acceptance criteria for analytical reagents will be performed in accordance with the selected California-certified laboratory's SOPs.

## 3.8 Assessments and Response Actions

The project team may conduct performance and systems audits of field and laboratory activities, as necessary. Following is a discussion of audits, corrective action, and reporting procedures.

### 3.8.1 Systems Audit

A systems audit consists of the evaluation of key components of the measurement systems to determine their proper selection and use. When required by the EPA or alternative regulatory authority, systems audits are performed prior to or shortly after systems are operational. This audit includes a careful evaluation of field and laboratory QC procedures, which are explained below.

**Field Systems Audits**

Field systems audits are on-site audits that focus on data collection systems, using the appropriate SAP/QAPP as a reference. Specific activities vary with the scope of the audit, but can include a review of sample collection activities, decontamination practices, equipment calibration techniques and records, decontamination and equipment cleaning, background and training of personnel, sample containers and preservation techniques, and chain-of-custody procedures.

**Laboratory Systems Audit**

The laboratory systems audit is a review of laboratory operations to verify that the laboratory has the necessary facilities, equipment, staff, and procedures to generate acceptable data.

Specific activities vary with the scope of the audit, but can include a review of equipment suitability and maintenance/repair; SOPs; background and training of personnel; laboratory control charts and support systems; and QA samples, including performance evaluation samples, chain-of-custody procedures, data logs, data transfer, data reduction, and validation.

### 3.8.2 Performance Audits

After systems are operational and generating data, a performance audit may be requested to determine the accuracy of the total measurement system(s) or component parts thereof. Similar to the systems audit, there are two types of performance audits, as explained below.

**Field Performance Audit**

Performance audits of sampling activities will be conducted using review of laboratory sample receipt forms.

An inspection for suitability of the samples for proper laboratory analysis will serve as the performance audit of the sample collection procedures. Insufficient sample volume for analysis, or improper preservation of samples, will be noted by the analytical laboratory. A preponderance of such reports of unsuitable samples will indicate that the sampling procedures are poor or unacceptable. Analytical results will be reviewed by the sampling project manager and the QA manager to assess the performance and adequacy of sample collection procedures.

Proper execution of sampling procedures will be audited by the sampling project manager and the QA manager. The sampling project manager and QA manager will audit these project operations on a regular basis over the life of the project through review of the field log book and audit forms, and through discussion with the field manager.

**Laboratory Performance Audits**

The project laboratories participate in a variety of federal and state programs that subject laboratories to stringent performance audits on a regular basis. QA policies and procedures currently in place at the laboratories, and actions that will be included in sampling activities to ensure QA, include the following:

- Inter-laboratory check samples
- Periodic audits
- Laboratory control samples analyzed at applicable analytical method frequencies
- Performance evaluation samples to be submitted to laboratories by the project team to each laboratory during major sampling events that use the particular laboratory

Laboratory performance in these areas will be monitored by the project team QA manager. If necessary, the project team QA manager will conduct an on-site audit of field operations or the analytical laboratory.

### 3.8.3 Corrective Action for Measurement Systems

When a problem situation arises regarding any significant impediment to the progress of the SAP during site characterization, corrective action will be implemented to identify the problem and its source. Appropriate documentation of this action will be recorded in the project file.

Personnel responsible for the initiation and approval of corrective action will be the laboratory QA manager (for corrective action at the laboratory) and the project team project manager (for corrective actions identified during field activities and/or during the data validation effort).

### 3.8.4 Quality Assurance Reporting Procedures

Below are the QA reporting procedures that will be implemented for this project.

**Reporting Responsibility and Recordkeeping**

Comprehensive records will be maintained by the project team to provide evidence of QA activities. These records will include the following:

- Results of performance and systems audits
- Data validation summary
- QA problems and proposed corrective action
- Changes to the project documents

The proper maintenance of QA records is essential to provide support in any evidentiary proceedings. The original QA records will be kept in the QC manager's records.

Access to working files will be restricted to project personnel.

**Audit Reports**

Should audits be requested, the corresponding audit reports will be distributed to the following project personnel, as appropriate:

- Project Manager/Project Director
- Field Manager
- Laboratory QA/QC Manager

## 3.9 Data Reduction, Review, Verification, and Validation

This section addresses the stages of data quality assessment after data have been received. It addresses data review, verification, and validation. It also sets procedures for evaluating the usability of data with respect to the DQOs set forth in Section 3.2.

### 3.9.1 Data Reduction

Raw analytical data generated in the laboratory are collected on printouts from the instruments and associated data system, generated electronically and stored in a laboratory information management system (LIMS), or manually recorded into bound notebooks. Analysts review data as they are generated to determine that the instruments are performing within specifications. This review includes calibration checks, surrogate recoveries, blank checks, retention time reproducibility, and other QC checks as specified in the laboratory's SOPs. If problems are noted during the analytical run, corrective action will be taken and documented.

Each analytical run is reviewed for completeness prior to interpretation and data reduction.

### 3.9.2 Data Review

Data review is an initial and relatively non-technical step of data assessment that primarily addresses issues of completeness and data handling integrity. In data review, the reviewer will ensure that all necessary reporting components have been included in laboratory reports, such as necessary fields (e.g., collection/analysis dates, units) and the presence of (but not implications of) QA/QC data components (e.g., LCS records, surrogate results).

### 3.9.3 Data Verification and Validation

Data verification is a more technical process than data review in that the core technical aspects of data quality (e.g., precision, accuracy) are evaluated through a review of the results of QA/QC measures, such as LCSs and surrogates.

Following interpretation and data reduction by an analyst, data are transferred to the LIMS either by direct data upload from the analytical data system or manually. The data are reviewed by the group leader or another analyst and recorded in the LIMS as being verified. The person performing the verification reviews all data, including QC information, prior to verifying the data. The laboratory will complete the appropriate forms summarizing the QC information and transfer copies of all raw data (e.g., instrument printouts, spectra, chromatograms) to the project management group for the final laboratory deliverable. This laboratory project manager will combine the information from the various analytical groups and the analytical reports from the LIMS into one package. This package will be reviewed by the laboratory project manager for

conformance with SOPs and to ensure that all project QC goals have been met. Any analytical problems are discussed in the case narrative, which is also included with the data package deliverables. A Level 2 data deliverable will be required for this project.

Following data verification by the laboratory, data validation will be conducted on 100% of the laboratory data by an entity independent of the laboratory. The following level of validation will be performed:

- Stage 1: 100% of samples collected

If systematic errors with the laboratory data are identified, further validation may be necessary. Data validation may be performed on hard-copy data or electronically, as applicable. General compliance to the August 2014 National Functional Guidelines for Inorganic Data Review and the National Functional Guidelines for Superfund Method Organic Data Review (EPA 2014), and EPA Region 9 validation guidance will be used as the basis for the validation. The guidance documents provide structured approaches for the assignment of data qualifiers based on observations made in the data verification process, and will be used in conjunction with the specific EPA method criteria and the QA criteria set forth in the project-specific SAP.

### 3.9.4 Data Validation and Usability Determination

Data verification is a technical process to evaluate data, but it does not answer the final question of the usability of the data and the implications of any departures from data expectations. The data validation process is designed to assign data qualifiers based on the data verification results, and provide a case-by-case review of data quality issues with respect to QAPP objectives to render a final assessment of data usability.

## 3.10 Data Evaluation Roles and Responsibilities

The following components of data evaluation will be performed:

- Data reduction will be performed by the analytical laboratory
- Data review will be performed by both the laboratory and by the project team
- Data verification will be performed by the laboratory
- Data validation and usability determination will be performed by the project team

## 3.11 Data Reporting

Laboratory reports will contain the following:

- **Case Narrative:** Description of sample types, tests performed, any problems encountered, corrective actions taken, and general comments.
- **Analytical Data:** Data are reported by sample or by test. Pertinent information, such as dates sampled, received, prepared, and extracted, will be included on each results page. The reporting limit and method detection limit for each analyte will also be recorded. In addition to a report saved as a pdf, the laboratory will provide an electronic data deliverable in a text format corresponding to each analytical report.
- **Laboratory Performance QC Information:** The results for all of the associated laboratory QC samples and practices will be reported (e.g., LCS, method blanks, surrogate recoveries).
- **Matrix-Specific QC Information:** Results of any sample duplicates, MSs, MSDs, or other project-specific QC measures that are requested will be reported.
- **Methodology:** The reference for the applied analytical methodology will be cited.

# 4 REFERENCES

County of San Diego, Department of Environmental Health. 2012. *Site Assessment and Mitigation Manual*. Updated June 21, 2012.

Dudek. 2017. *Borrego Springs Subbasin, Monitoring Plan*. 21 August.

DWR (California Department of Water Resources). 2016a. *Bulletin 118. Interim Update.* California Department of Water Resources. December 22, 2016.

DWR. 2016b. *Best Management Practices for the Sustainable Groundwater Management of Groundwater – Monitoring Protocols, Standards, and Sites.* California Department of Water Resources, Sustainable Groundwater Management Program. December 2016.

EPA (United States Environmental Protection Agency). 2006. *Guidance on Systematic Planning Using the Data Quality Objectives* Process (EPA QA/G-4). February 2006.

EPA. 2014. C*ontract Laboratory Program, National Functional Guidelines for Superfund Organic Data Review*, EPA 540-R-014-002, August 2014.

USGS (United States Geological Survey). 2014. *National Field Manual for the Collection Water Quality Data, Techniques and Methods, Handbooks for Water-Resources Investigations*, Version 3.1. United States Geological Survey. Updated April 2014.

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# APPENDIX A

*Example Groundwater Elevation Monitoring Field Form*

Geosyntec consultants

**SAN DIEGO COUNTY WELL MONITORING DATA SHEET**
**BORREGO SPRINGS SUBBASIN**
**GROUNDWATER GAUGING SHEET**

Date: _____
Sampler: _____

| State Well # | No Measurement | Questionable Measurement | Depth to Water | Groundwater Elevation | Previous DTW | Gauge Time | Well Box Type | Well Cap Type | Survey Point (Reference Point) | Comments |
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**Notes:**

*NO MEASUREMENT:* 0. Measurement discontinued 1. Pumping 2. Pump house Locked 3. Tape hung up 4. Can't get tape in casing 5. Unable to locate well 6. Well has been destroyed 7. Special 8. Casing leaky or wet 9. Temporarily inaccessible

*QUESTIONABLE MEASUREMENT:* 0. Caved or deepened 1. Pumping 2. Nearby pump operating 3. Casing leaky or wet 4. Pumped recently 5. Air or pressure gauge measurement 6. Other 7. Recharge operation at or nearby well 8. Oil in casing

*Notate depth in feet, tenths of feet, and/or hundredths of feet. Do not notate in inches.*

# APPENDIX B

*Example Groundwater Quality Monitoring Field Form*

**SAN DIEGO COUNTY LOW FLOW WELL MONITORING DATA SHEET**

DATE:_____

| | |
|---|---|
| Project Name: Borrego Springs Subbasin | Project Address: |
| Sampled by: | Project Number: |
| Sampling Company: | Well GPS Latitude: _____ |
| Well ID: | Longitude: |
| Borehole Diameter: inches | Well Diameter: inches |
| Static Water Level (ft. btc): Time_____ | Referenced to: Top of PVC Casing |
| Reference Point Elevation (ft. MSL): | |
| Total Well Depth (ft. btc) (WD): | |
| Meter type/ID: Ultrameter YSI 556 YSI 550 | ID:_____ |
| Water Level Indicator Type: GeoSlope Indicator | ID:_____ |
| Decontamination Method: Steam/High Pressure Wash 3 Stage Rinse | Other |
| Sampling Equipment: | __Other: _____ |

Purge Method: Low Flow _____

Pump Depth (ft btc): _____ Date Pump Installed: _____

Purge Rate:_____ Start Purge:_____

| Time | Temp (°C) | pH | Cond. (mS or µS) | Turbidity (NTUs) | D.O. (mg/L) | ORP (mV) | Depth to Water (ft btc) | Water Removed (ml) | Observations |
|---|---|---|---|---|---|---|---|---|---|
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| Stabilization Parameters* | +/-3% | +/0.2 units | +/-3-5% | +/-10% | +/0.2 units | +/-20 mV | | | |

| | | |
|---|---|---|
| Sampling Date: | Sampling Time: | Depth to Water: |
| Sample I.D.: | Laboratory: | |

| Analyzed for: | Volume | Container | Filtered | Pres. | Parameters |
|---|---|---|---|---|---|
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| EB I.D. (if applicable): Time | Duplicate I.D. (if applicable): |
| Field Sheet Checked By: | License #: |
| COMMENTS: | |

* 3 Consecutive Readings



Geosyntec consultants