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## SECTION 1 GENERAL INFORMATION AND REQUIREMENTS

### 1.01 Summary of Work to be Performed

- A. The work to be performed under this Contract consists of furnishing all labor, materials and equipment for the construction, development and testing of **one (1) municipal water supply well, Well 5F, with an estimated design capacity of 800 gpm**, including but not limited to site preparation, conductor casing and sanitary seal installation, pilot borehole drilling, geophysical logging, borehole reaming, casing installation, gravel envelope placement, well development and testing, disinfection, and/or other work as necessary to complete the project as described in the Plans and Specifications.
- B. Contractor shall provide all work, materials, and services necessary for the complete and proper construction of the work in good faith, **including items not expressly shown or called for in the Contract documents**.

### 1.02 Fulfillment of Project Purpose

- A. The purpose of this project is to provide municipal water supply to the City of Corcoran (City).
- B. The completed project shall be suitable for the intended purpose(s).
- C. The completed project shall meet the performance requirements of the Contract.
- D. If at any time the Contractor believes that the project as designed will not fulfill the intended purpose, or will not meet the performance requirements, the Contractor shall notify the Owner in writing. Contractor shall include all relevant information and shall provide a detailed explanation of the Contractor's concerns and recommended alternatives to achieve project objectives and performance requirements.

### 1.03 Project Location

- A. The project is located in the City of Corcoran, Kings County, California.
- B. Sheet W-1 of the Plans shows the location of the project site. Sheet W-2 of the Plans shows the approximate location of Well 5F.
- C. The project site is located just south of Nevada Avenue and 300 feet west of the intersection of Nevada Avenue and 5<sup>th</sup> Avenue, Corcoran, CA 93212.
- D. Kings County Assessor Parcel Number is 034-012-002-000.
- E. Public Land Survey: Township 21S, Range 22E, Section 2.

### 1.04 Owner and Owner's Hydrogeologist

- A. The Owner is the City of Corcoran; 832 Whitley Avenue, Corcoran, California, 93212. Contact: The owners contact for this project is Joseph Faulkner - Office: (559) 992-2151; Email: [Joe.Faulkner@cityofcorcoran.com](mailto:Joe.Faulkner@cityofcorcoran.com).
- B. The Operator is the same as the Owner.

- C. The Owner's Hydrogeologist for the project is Wood Rodgers, Inc.; 3301 C Street, Building 100-B; Sacramento, CA 95816; Contact: Sean Spaeth; Phone: (916) 326-5368; Email: [sspaeth@woodrogers.com](mailto:sspaeth@woodrogers.com). The Owner's Hydrogeologist is the Owner's agent with respect to the design and construction observations of the project.

1.05 Conformance with Codes and Standards

- A. All work and materials shall comply with the California Department of Water Resources' California Water Well Standards Bulletin 74-84, its supplement Bulletin 74-90, and the Kings County Code Chapter 14A – Water Wells and Well Ordinance No. 587.
- B. All work and materials shall comply with applicable federal, state, and local codes, laws, and regulations.

## **SECTION 2      SITE REQUIREMENTS**

### **2.01    Site Access**

- A. The Owner has obtained the necessary legal right-of-way for the project.
- B. The Owner will provide the Contractor with access to the project site for the purpose of performing work under this Contract.
- C. Contractor's use of the project site shall be limited to activities associated with performing work under this Contract.

### **2.02    Area for Construction**

- A. The Contractor shall confine all construction activities to the subject parcel, adjacent easements, and public right-of-way.
- B. The Contractor shall not encroach onto private property without the prior written permission of the property owner.

### **2.03    Health and Safety**

- A. The Contractor shall be solely and completely responsible for conditions of the job site, including the health and safety of all persons (including employees, subcontractors, service personnel, and site visitors) and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- B. Health and safety provisions shall conform to U.S. Safety Orders, Title 8, U.S. Environmental Protection Agency Standard Operations Safety Guides, and all other applicable federal, state, county, and local laws, ordinances, codes, and the contract requirements. Where any of these are in conflict, the more stringent requirement shall be followed.
- C. Failure of the Contractor to become familiar with the aforementioned safety provisions shall not relieve the Contractor from compliance with the obligations and penalties set forth herein.

### **2.04    Staking**

- A. The Owner will stake or mark property corners and the well location.
- B. The Contractor shall carefully preserve all stakes and marks, and shall pay for any re-staking or re-marking required because of the Contractor's careless or unnecessary destruction or removal of stakes or marks.

### **2.05    Existing Utilities and Facilities**

- A. The approximate location of existing utilities and other facilities are shown on the Contract Plans; their exact location is unknown. Additional utilities may exist that are unknown to the Owner and the Contractor. The Owner warrants neither the accuracy nor the extent of existing utilities as shown on the Contract Plans.

- B. The Contractor shall confirm the location of, and protect, all existing utilities and other facilities.
- C. The Contractor shall contact Underground Service Alert (USA) at (800) 642-2444 (or 811) at least two (2) working days, but no more than 28 working days, before any underground excavation at the site. For the purpose of this requirement, excavation shall be defined as any operations that take place 18 inches or more below the existing ground surface. Before contacting USA, the Contractor shall clearly mark the location of planned excavation. The Contractor shall not begin any underground excavation until the locations of underground utilities have been identified. If necessary, the Contractor shall hand dig to expose any underground utilities that may conflict with planned excavation.
- D. In the event that the Contractor discovers utilities not identified in the Contract Plans and/or Specifications, the Contractor shall immediately notify the Owner and the utility owner by the most expeditious method reasonably available and later confirm in writing.
- E. If the Contractor damages, disconnects, or relocates any existing facilities or utilities, the Contractor shall, at Contractor's own expense, restore them to the original condition as specified by the owner of the facility or utility.

#### 2.06 Security

- A. The Contractor shall properly safeguard all equipment, materials, and work against loss, damage, malicious mischief or tampering by unauthorized persons until acceptance of the work by the Owner.
- B. The Contractor shall provide, at Contractor's expense, secured storage or continuous surveillance by a watchman as necessary to accomplish this objective.

#### 2.07 Storage

- A. Contractor's storage of materials and equipment at the project site is subject to approval by the Hydrogeologist.
- B. All materials shall be stored in accordance with the manufacturer's Safety Data Sheet.
- C. Materials and equipment stored at the site shall not interfere with work at the site and shall not create a hazard.

#### 2.08 Temporary Facilities

- A. The Contractor shall incorporate all costs associated with temporary facilities into the bid price for "Bid Item No. 1 – Mobilization". No additional compensation will be paid for temporary facilities.
- B. The Contractor shall provide and pay for all electric power required to perform all work under this Contract.
- C. The Contractor shall provide and pay for lighting to allow for safe work at the site, and in compliance with Cal/OSHA standards.



D. Construction Water

- (1) Construction water is available approximately two miles south of the site from a City of Corcoran owned fire hydrant at either City facility located at 510 Orange Avenue or 23947 5½ Avenue, Corcoran.
- (2) The Contractor shall provide a plan to provide adequate onsite storage with appropriate volume of water during drilling operations. The plan shall include the water source, equipment to transport water, and backflow prevention device.
- (3) The Contractor shall provide and pay for all equipment and personnel necessary to provide construction water to the project site.
- (4) The Contractor shall not be required to obtain a water supply permit; however, the Contractor must provide and use a backflow preventer that meets the City's requirements.

E. Toilet Facilities

- (1) The Contractor shall provide, pay for, and maintain in sanitary condition for the duration of the work, toilet facilities at the work site.
- (2) In the event of a spill or leakage, Contractor shall provide and pay for disinfection.

2.09 Temporary Discharge Pipe

- A. The Contractor shall provide and pay for all equipment and personnel associated with conveying and discharging final development water.
- B. The Contractor shall provide approximately 300 feet of discharge pipe to move water from the well site to the specified discharge location. The Owner will obtain all permits required for the discharge to the reservoir located north of the site across Nevada Avenue.
- C. The discharge pipe shall cross Nevada Avenue and be protected from local traffic.
- D. The Contractor shall provide appropriate erosion control at the discharge point, including as necessary: plastic sheeting, energy dissipating devices, rip-rap, and other control materials. Erosion control shall be adequate to prevent damage to the discharge point.

2.10 Traffic Control Plan

- A. Contractor shall provide a traffic control plan for the discharge pipe crossing Nevada Avenue during well development and testing, as shown on Plan Sheet W-2.
- B. The traffic control plan shall include the closure of Nevada Avenue between 5<sup>th</sup> Avenue and 5½ Avenue during discharge operations.
- C. The Contractor is responsible for submitting temporary traffic control plan to the City of Corcoran for approval.

- D. The contractor shall incorporate all costs associated with the traffic control plan into the bid price for “Bid Item No. 17 – Temporary Discharge piping.”

2.11 Drainage

- A. Contractor shall ensure that Contractor’s activities do not result in fluids other than rainwater entering any storm drain or other drainage facility.
- B. Contractor shall ensure that Contractor’s activities do not degrade the quality of rainwater runoff into any storm drain or other drainage facility.
- C. These provisions apply to both on- and off-site facilities, unless Contractor obtains written permission from the owner or operator of the facility.

2.12 Noise Control

- A. The Contractor shall comply with all local sound control and noise level rules, regulations, and ordinances that apply to any work performed pursuant to the Contract.
- B. Each internal combustion engine shall be equipped with a muffler of a type recommended by the manufacturer to provide acceptable noise control.
- C. No separate payment will be made for noise control.

2.13 Cooperation

- A. The Contractor shall cooperate fully with all utilities, regulatory agencies, adjacent landowners, the Owner, the Operator, and their officers, officials, employees, agents, and volunteers.
- B. At all times during the performance of work on this project, the Contractor shall practice good neighborhood relations.
- C. The Contractor shall make every effort to be considerate of the impact of Contractor’s activities on neighbors, and to minimize those impacts.

2.14 Air Emissions

- A. The Contractor shall acquire all relevant registrations or permits from the San Joaquin Valley Air Pollution Control District (SJVAPCD) and/or the California Air Resources Board (CARB) as necessary for the operation of portable generators or engines, if the portable engines do not already include a SJVAPCD registration or permit, or are not registered for the CARB Portable Equipment Registration Program. The SJVAPCD Central Region can be reached at 1990 E. Gettysburg Ave., Fresno, CA 93726; Phone: (559) 230-6000; <http://valleyair.org/busind/pto/ptoforms/1ptoforidx.htm>

2.15 Cultural Resources

- A. During any earthwork activities at the project site, the Contractor will be notified of, and will be required to monitor for, signs of potential undiscovered paleontological, archaeological, ethnic, or religious resources. In the event

undiscovered paleontological, archaeological, ethnic, or religious resources are encountered during construction, ground-disturbing work will be halted at the site until a qualified archaeologist evaluates the situation and recommends an appropriate course of action. Prehistoric material might include obsidian and chert flaked-stone tools (projectile points, knives, scraping implements) or tool-making debris; culturally darkened soil (“midden”) containing heat-altered rock, shellfish remains, and cultural materials; and stone milling equipment (mortars, pestles, handstones, and milling stones). Historical material might include stone footings or walls; building materials or other remains with square nails; and backfilled wells, privies, or other deposits of historic-period metal, glass, and/or ceramic refuse.

- B. The possibility of encountering archeological resources and human remains cannot be discounted. Section 7050.5 of the California Health and Safety Code states that it is a misdemeanor to knowingly disturb a human burial. If human burials are encountered, the Contractor shall halt work in the vicinity of the remains and, as required by law, notify the County Coroner immediately. At the same time, the Contractor shall notify the Owner and /or Hydrogeologist so that an archaeologist can be contacted to evaluate the situation.

## SECTION 3 SITE CONDITIONS

### 3.01 Local Geology

A. The Tulare Formation extends from ground surface to a depth of approximately 2,000 feet beneath the well site, and consists of gravel, sand, silt and clay. The Tulare Formation is divided into three distinct units: an upper unconfined aquifer and a lower confined aquifer, separated by an aquitard known as the E-Clay, or Corcoran Clay. The upper unconfined aquifer extends from ground surface to a depth of approximately 500 feet to the top of the Corcoran Clay beneath the well site. The upper unconfined aquifer is further subdivided by four discontinuous clay beds designated the A-, B-, C-, and D-Clay layers. Static water level is anticipated to be approximately 155 feet below ground surface.

### 3.02 Difficult Drilling Conditions

A. Known difficult drilling conditions in the project vicinity include:

(1) Swelling and sloughing clays.

B. The Contractor shall be responsible for reviewing local records and identifying difficult drilling conditions that could be encountered in this area.

### 3.03 Unusual Site Conditions

A. The Contractor shall notify the Owner immediately if the Contractor suspects or detects that the site contains:

(1) Hazardous waste.

(2) Material the Contractor believes may be hazardous.

(3) Subsurface or latent physical conditions at the site differing materially from those indicated in the Contract documents.

(4) Unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

## SECTION 4 DISPOSAL OF MATERIALS

### 4.01 General Requirements

- A. All refuse generated by and/or removed from the work shall become the property of the Contractor. The Contractor shall dispose of all refuse and materials in accordance with all applicable federal, state and local regulations.

### 4.02 Nuisance Water

- A. Contractor shall dispose of nuisance water at the project site, including construction water, rainfall, groundwater, surface water runoff, and any other nuisance water as necessary to protect the work from damage.
- B. Contractor's method of disposing of nuisance water shall not damage the project site or any other property.

### 4.03 Drill Cuttings

- A. The Contractor shall stockpile drill cuttings at the project site. At the end of the project, Contractor shall spread drill cuttings across the project site to facilitate drying.

### 4.04 Drilling Fluids and Initial Development Water

- A. Drilling fluids shall consist of all fluids circulated in the borehole that have a Marsh Funnel viscosity greater than 26 seconds per quart, *or* a density greater than 8.4 pounds per gallon, *or* an average turbidity greater than 500 NTU.
- B. Initial development water shall consist of all water produced during well development that has an average turbidity greater than 100 NTU.
- C. The Contractor shall dispose of drilling fluids and initial development water as follows:
  - (1) The Contractor shall dispose of drilling fluids at the project site, within the area designated in the Plans. The Contractor will be required to create berms to contain the fluids as necessary to prevent them from leaving the site.
  - (2) The Contractor shall discharge initial development water to the specified location, as indicated in Drawing W-2.

### 4.05 Final Development and Testing Water

- A. Final development water shall consist of all water produced during well development after the average turbidity of the water becomes less than 100 NTU.
- B. Testing water shall consist of all water produced during well and aquifer testing.
- C. The Contractor shall discharge all final development and testing water to the reservoir north of the project site, as indicated in Drawing W-2.

## SECTION 5 PERMITS AND LICENSES

### 5.01 Contractor Responsibility

- A. The Contractor shall identify and obtain all licenses and permits in accordance with the laws and regulations governing the work. Any information about specific licenses or permits provided in these Specifications is for informational purposes and does not relieve the Contractor of this obligation.
- B. Contractor shall pay for all permits and licenses required for the work and shall pay all taxes properly assessed against the Contractor's equipment or property used in connection with the work.

### 5.02 Contractor's License

- A. The Contractor shall hold an active contractor's license in the C-57 (Water Well Drilling) classification. The license shall be in good standing.

### 5.03 Well Construction Permit

- A. The Contractor shall obtain a Well Permit Application Form from the Kings County Community Development Agency – Building Division, 1400 W. Lacey Blvd., Building 6, Hanford, CA 93230; Contact: Phone (559) 852-2670; Fax: (559) 584-8989. The County must inspect sanitary seal and annular seal placement, and requires 48 hours advance notification.

### 5.04 Water Supply Permit

- A. The Contractor will not be required to obtain a water supply permit for this project. The Contractor will be required to install a meter and document all water used for drilling and construction, and shall make all efforts to conserve water.
- B. The Contractor will be required to provide and use a backflow preventer that meets the City's requirements.

### 5.05 Discharge Permit(s)

- A. The Owner will obtain and pay for all required discharge permits for this project.

### 5.06 Encroachment Permit

- A. The Contractor shall obtain an Encroachment Permit for any activities that impact the public rights-of-way adjacent to, or as a result of the project.
- B. The Contractor shall obtain an Encroachment Permit for activities that impact private landowners, as a result of the project.

## SECTION 6 SUBMITTALS

### 6.01 Submittal Review Process

- A. Contractor shall provide pre-mobilization submittals to the Owner five (5) working days in advance of planned mobilization date. Contractor shall provide pre-borehole drilling submittals to the Owner five (5) working days in advance of planned borehole drilling start date.
- B. Contractor shall not begin work on a project phase until all the required submittals have been submitted to the Owner.

### 6.02 Required Submittals

- A. The Contractor shall submit all required submittals, as shown on the Required Submittals List on page 14 and as listed below in a timely manner.
- B. Contractor shall submit the following items to the Owner prior to mobilization:
  - (1) Well Construction Permit.
  - (2) Project Schedule.
  - (3) Emergency Plan.
  - (4) Site Plan.
  - (5) Traffic control plan.
  - (6) Daily Report Form.
  - (7) Contractor Contact Information.
  - (8) Certified welder information and certifications reflecting appropriate welding techniques and materials for the specified steel types.
  - (9) Manufacturer sieve samples of gravel envelope material, minimum of 500 grams.
  - (10) Safety Data Sheets (SDS) for materials to be used in conjunction with the project.
  - (11) Construction water supply plan, including details on tapping fire hydrant.
  - (12) Backflow Prevention (BFP) device certification (performed in-situ).
  - (13) Temporary discharge pipeline route, including details on pipeline specifications and temporary connection to the discharge point.
- C. The Contractor shall submit the following items to the Owner prior to installing conductor casing:
  - (1) Mill certification for conductor casing.
  - (2) Formation Samples
- D. Contractor shall submit the following items to the Owner prior to borehole drilling:

- (1) Mill certifications for well casing, well screen, and accessory pipes.
  - (2) Drilling Fluid Control Program.
  - (3) Gravel Envelope Installation Diagram.
  - (4) Initial Gravel Envelope Consolidation Tool Drawing.
  - (5) Well Development Tool Diagram.
  - (6) Proposed cement mix for sanitary and deep annular cement seals.
- E. The Contractor shall submit the following items to the Owner during drilling:
- (1) Daily field logs and records.
- F. Contractor shall submit the following items to the Owner prior to well construction:
- (1) Field copies of the geophysical surveys.
  - (2) Casing schedule from manufacturer includes blank well casing, well screen, and accessory pipes.
  - (3) Formation Samples
  - (4) Field copies of the borehole caliper survey logs.
  - (5) Manufacturer and gradation of gravel envelope material.
  - (6) An estimate of the volume of gravel required to construct the well as specified, based on the actual borehole diameter as measured during the caliper survey.
  - (7) Manufacturer and order volume of annular cement seal materials.
  - (8) Batch tickets for the annular cement seal materials.
- G. Contractor shall submit the following items to the Owner prior to final development:
- (1) Pump curve, proposed depth of pump intake, and maximum capacity of test pump and motor.
  - (2) Calibration report for totalizer flowmeter (calibrated within 12 months of anticipated date of use).
- H. Contractor shall submit the following items to the Owner prior to the alignment testing and well disinfection:
- (1) Shop drawing of dummy tool and dimensions.
  - (2) Disinfection plan which includes manufacturer, type, volume, and application method of chemicals.
- I. The Contractor shall submit complete records and as-built construction information for the project:
- (1) California Department of Water Resources Well Completion Report.
  - (2) Plumbness and alignment survey and testing logs.



- (3) Downhole video survey log summary report and DVD.
- (4) All daily reports associated with drilling, construction, development, testing, and mobilization/demobilization.
- (5) All records of drilling fluid measurements.
- (6) Cement tickets, and any other documentation of materials installed.
- (7) Contractor's tallies of all materials installed.
- (8) Well development and testing records.

<b>Required Submittal List</b>		
<b>Time of Submittal</b>	<b>Specification Section</b>	<b>Submittal</b>
Pre-Mobilization	5.03	Kings County Well Construction Permit
	9.01	Project Schedule
	11.03	Emergency Plan
	11.03	Site Plan
	2.10	Traffic Control Plan
	11.03	Daily Report Form
	11.03	Contractor Contact Information
	17.03	Certified welder information and certifications reflecting appropriate welding techniques and materials for the specified steel types.
	18.02	Manufacturer sieve samples of gravel envelope material, minimum of 500 grams
	11.03	SDS for all drilling fluid materials used
	2.08	Construction water supply plan, including details on tapping fire hydrant and onsite storage.
	2.08	Backflow Prevention (BFP) device certification (performed in-situ).
21.02	Temporary discharge pipeline route, including details on pipeline specifications and temporary connection to the discharge point.	
Pre-Conductor Installation	12.02	Mill certification for conductor casing
	12.03	Formation samples
Pre-Borehole Drilling	17.02	Mill certification for well casing, well screen, and accessory pipes
	13.03	Drilling Fluid Control Program
	18.03	Gravel envelope installation diagram
	18.02	Initial gravel envelope consolidation tool drawing
	19.02	Well development tool diagram
	20.02	Proposed cement mix for sanitary and deep annular cement seals
During Borehole Drilling	13.03	Daily field logs and records
Pre-Construction	14.03	Field Copies of the geophysical surveys
	17.02	Casing schedule from manufacturer includes blank well casing, well screen, and accessory pipes

<b>Required Submittal List</b>		
<b>Time of Submittal</b>	<b>Specification Section</b>	<b>Submittal</b>
Pre-Construction	13.03	Formation Samples
	16.03	Field copies of caliper survey logs
	18.02	Manufacturer and gradation of gravel envelope material
	18.02	Estimate of the volume of gravel required to construct the well as specified, based on the actual borehole diameter as measured during the caliper survey
	19.02	Manufacturer and order volume of annular cement seal materials
	19.02	Batch tickets for the annular cement seal materials
Pre-Final Development	20.02	Pump curve, proposed depth of pump intake, and maximum capacity of test pump and motor
	21.03	Calibration report for totalizer flowmeter (calibrated within 12 months of anticipated date of use)
Pre-Alignment and Disinfection	23.02	Shop drawing of dummy tool and dimensions
	26.03	Disinfection plan which includes manufacturer, type, volume, and application method of chemicals.
Post-Construction	25.03	California Department of Water Resources Well Completion Report; all daily reports; all records of drilling fluid measurements; all mill certifications, cement tickets, and any other documentation of materials installed; Contractor's tallies of materials installed; all well development and testing records.
	23.03	Plumbness and alignment survey and testing logs
	24.03	Well Video Survey (DVD)

## SECTION 7      INSPECTIONS AND MEETINGS

### 7.01    Pre-Construction Meeting

- A. A pre-construction meeting shall be held at the project site at a time agreed upon by the Contractor and the Owner.
- B. The pre-construction meeting shall be completed prior to, or in conjunction with, mobilization.
- C. Attendance of the pre-construction meeting by the Contractor's project superintendent is **mandatory**.

### 7.02    Observations Purpose and General Requirements

- A. The primary purpose of the Owner or Owner's Hydrogeologist site visits is to observe that the work is being performed in accordance with the Contract requirements.
- B. The secondary purpose of the Owner or Owner's Hydrogeologist site visits are to observe conditions throughout construction, so the Owner's Hydrogeologist can provide the Owner with updates to specific work items and conditions.
- C. The Owner and Owner's Hydrogeologist observations and comments during site visits are intended to document Contractor progress during completion of work. The Contractor is solely responsible for determining the appropriate course of action, for directing the work, and for fulfilling the Contract requirements. The Owner or Owner's Hydrogeologist's observations and comments shall not be considered to be direction of the work.
- D. The Contractor shall make a good faith effort to make the work available for observation by the Owner and Owner's Hydrogeologist, to collect and provide samples to the Owner and Owner's Hydrogeologist, and to honestly represent the work to the Owner.
- E. The Owner or Owner's Hydrogeologist shall make a good faith effort to accommodate the Contractor's construction schedule, to be available throughout construction to make site visits on short notice at the Contractor's request.

### 7.03    Mobilization

- A. Contractor shall notify the Owner a minimum of 24 hours in advance of the anticipated time of mobilization and shall update the Owner with any changes in the schedule for mobilization.
- B. Contractor shall make drilling equipment and accessories, and sanitary facilities, available for observation by the Owner or Owner's Hydrogeologist.
- C. Contractor shall delineate with chalk marking paint the proposed location of mud pits (if used) and any other excavations, for inspection by the Owner or Owner's Hydrogeologist.

### 7.04    Site Preparation

- A. Contractor shall provide Owner with access for observation and approval of any site preparation to be performed as part of this Contract.

7.05 Construction Materials

- A. Contractor shall make drilling fluid additives, well casing, well screen, accessory pipes, gravel envelope material, transition seal, annular seal, and all other construction materials available for review by the Owner or Owner's Hydrogeologist.

7.06 Conductor Casing

- A. Contractor shall notify Owner a minimum of 24 hours in advance of the anticipated time of the seal placement, and shall update the Owner with any changes in schedule, so the Owner or Owner's Hydrogeologist may be on site to observe the seal placement.
- B. Contractor shall provide a level and shall demonstrate to the Owner or Owner's Hydrogeologist that the conductor casing is installed plumb prior to installation of the sanitary seal.
- C. Contractor shall provide Owner or Owner's Hydrogeologist with a quart-sized sample of excavated material from the bottom of the conductor casing borehole.
- D. Contractor shall also notify the Kings County Community Development Agency – Building Division, as required, for sanitary seal placement.

7.07 Borehole Drilling and Reaming

- A. Contractor shall notify Owner or Owner's Hydrogeologist a minimum of 24 hours in advance of beginning borehole drilling and reaming, and shall update the Owner with any changes in schedule, so the Owner's Hydrogeologist may be on site to observe the beginning of borehole drilling and reaming.
- B. Contractor shall notify Owner or Owner's Hydrogeologist a minimum of 24 hours in advance of the anticipated time of geophysical logging, and shall update the Owner or Owner's Hydrogeologist with any changes in schedule, so the Owner's Hydrogeologist may be on site to observe the geophysical logging.
- C. Contractor shall make the following items available for observation by the Owner or Owner's Hydrogeologist: planned formation sample storage location, the Contractor's borehole drilling records, and Contractor's Driller's Log.
- D. Contractor shall provide samples of drilling fluid to the Owner or Owner's Hydrogeologist as requested for analysis.

7.08 Formation Sample Collection

- A. Contractor shall make the following items available for review by the Owner or Owner's Hydrogeologist: formation sample collection protocol, equipment used for formation sample collection, methods for preparing or washing formation samples, and the resulting formation samples.

#### 7.09 Well Construction

- A. Contractor shall notify Owner or Owner's Hydrogeologist a minimum of 24 hours in advance of the anticipated time of both well construction and seal placement, and shall update the Owner or Owner's Hydrogeologist with any changes in schedule, so the Owner's Hydrogeologist may be on site to observe well construction and the seal placement.
- B. Contractor shall make the following items available for observation by the Owner or Owner's Hydrogeologist: well casing and screen joints; centralizer placement and attachment; gravel envelope material, equipment, and installation methods; and sanitary seal grout and installation methods.
- C. Contractor shall assist Owner or Owner's Hydrogeologist with inspection by making other measurements requested by the Owner's Hydrogeologist.

#### 7.10 Well Development

- A. Contractor shall notify Owner or Owner's Hydrogeologist a minimum of 24 hours in advance of the anticipated time of initial well development. Contractor shall update the Owner or Owner's Hydrogeologist with any changes in schedule, so the Owner's Hydrogeologist may be on site to observe initial well development.
- B. Contractor shall make well development tools and discharge assembly available for observation by the Owner or Owner's Hydrogeologist.

#### 7.11 Surface Completion

- A. Contractor shall notify Owner a minimum of 24 hours in advance of the anticipated time of surface completion, and shall update the Owner with any changes in schedule, so the Owner may be on site to witness the surface completion.
- B. Contractor shall make surface completion materials and methods available for observation by the Owner.

#### 7.12 Site Clean-up and Records

- A. Contractor shall notify Owner a minimum of 24 hours in advance of the anticipated time of the video inspection, and shall update the Owner with any changes in schedule, so the Owner's Hydrogeologist may be on site to witness the video inspection.
- B. Contractor shall make wellhead security, backfilling and compaction, and site cleanup available for observation by the Owner.

#### 7.13 Well Disinfection

- A. Contractor shall notify Owner a minimum of 24 hours in advance of the anticipated time of well disinfection, and shall update the Owner with any changes in schedule, so the Owner or Owner's Hydrogeologist may be on site to observe well disinfection.

- B. Contractor shall make well disinfection available for observation by the Owner or Owner's Hydrogeologist.

## SECTION 8 PERFORMANCE REQUIREMENTS

### 8.01 General

- A. These performance requirements are intended to objectively measure the suitability of the project for the intended purpose(s).
- B. The Contractor shall be solely responsible for meeting the performance requirements.
- C. The Owner's Hydrogeologist shall witness, at the Owner's Hydrogeologist's sole discretion, all tests to evaluate compliance with performance requirements. Tests made by the Contractor without the Owner's Hydrogeologist present, or without the Owner's Hydrogeologist's approval, shall not be valid for the purpose of determining compliance with performance requirements.
- D. If the completed project does not meet the performance requirements, the Contractor shall do any and all work necessary to cause the project to meet the performance requirements. If, after such efforts, the completed project does not meet the performance requirements, the project may be rejected.

### 8.02 Sand Content Requirement

- A. Sand content of pumped water shall be measured at the design capacity of the well.
- B. Sand content of pumped water shall be measured with a centrifugal ("Rossum") sand sampler in accordance with ANSI/AWWA A100-97.
- C. The average sand content of water pumped over any five (5)-minute period shall not exceed five (5) parts per million over the first 30 minutes of pumping.

### 8.03 Turbidity Requirement

- A. Turbidity of pumped water shall be measured at the design capacity of the well. The well shall not be required to meet the turbidity requirement when operating at flow rates greater than the design capacity.
- B. The turbidity requirement shall not apply for the first 15 minutes after surging or start-up.
- C. The turbidity of pumped water shall not exceed five (5) NTU.

### 8.04 Well Efficiency Requirement

- A. As measured during well development, the specific capacity of the well (gallons per minute per foot of drawdown) shall have stabilized.

### 8.05 Drift Requirement

- (1) The drift of the pilot borehole shall be measured as described in "Section 13 – Pilot Borehole Drilling."



- (2) The drift from vertical shall be not more than 0.5 of one (1) degree. Any deviation shall be corrected at the Contractor's expense before continuing to drill deeper. If it is suspected that the pilot borehole has excessive deviation, the Contractor shall be required to run a more accurate geophysical log type such as a directional deviation survey using a magnetic survey meter or equivalent to document the alignment direction and dogleg severity condition of the pilot borehole to any further work on site.

8.06 Plumbness Requirement

- A. The plumbness of the well shall be measured as described in "Section 23 – Plumbness and Alignment Testing".
- B. The horizontal deviation of the well from vertical shall not exceed two-thirds (2/3) of the smallest inside diameter per one-hundred (100) feet of depth, for the entire depth of the well.

8.07 Alignment Requirement

- A. The alignment of the well shall be measured with a pipe or dummy, and by installing the test pump, as described in "Section 23 – Plumbness and Alignment Testing".
- B. The pipe or dummy must pass freely from the ground surface to the top of the first screened interval.
- C. The test pump, with a minimum column pipe diameter of 10-inches, must be installed freely to a depth of 360 feet without any obstruction.

8.08 Video Survey Requirement

- A. The video survey shall be conducted as described in "Section 24 – Video Camera Survey".
- B. The total well depth, as measured by the video survey, shall be as specified.
- C. As measured by the video survey, no more than 20-percent of the length of the well sump shall contain fill material.
- D. The depth of well screens and the sounding port, as measured by the video survey, shall be as specified in Final Well Design.
- E. As observed during the video survey, no voids shall be present in welded joints.
- F. All materials, as observed during the video survey, shall be undamaged and in suitable condition to allow the full use of the well for the intended purpose.
- G. All well screens, as observed during the video survey, shall be free of mud or other incrustation.

## **SECTION 9      SCHEDULE**

### 9.01 Project Schedule

- A. Contractor shall notify the Owner at least five (5) working days before the anticipated date of mobilization.
- B. Contractor shall maintain a current project schedule and shall update the schedule weekly.
- C. Contractor shall immediately provide verbal updates of project schedule to the Owner upon request. Contractor shall provide a written update of the project schedule within two (2) working days of Owner's request.

## **SECTION 10 REJECTION OF WORK**

### **10.01 Rejection of Work**

- A. Any work that is not performed as specified, does not meet the performance requirements, or is not suitable for the intended use, may be rejected by the Owner.
- B. Contractor may salvage materials from any rejected work. Salvaged materials shall not be used in corrections or replacement of work unless approved by the Owner in writing.
- C. The Contractor shall be required to properly destroy any rejected borehole or well in accordance with all applicable regulations.

### **10.02 Correction of Work**

- A. The Contractor will be given two (2) opportunities to correct rejected work, unless otherwise approved by the Owner in writing.
- B. The Contractor must submit to the Owner a plan for correcting the work. The Owner must approve this plan before the Contractor proceeds with any corrections.
- C. If, in two (2) attempts, the Contractor does not correct the work so that it is as specified, meets the performance requirements, and is suitable for the intended use, the work will be rejected and the Contractor will be required to provide a replacement.

### **10.03 Replacement of Work**

- A. All replacement work shall be performed in accordance with this Contract and as specified.

## **SECTION 11 MOBILIZATION**

### **11.01 Scope of Work**

- A. This section includes the following:
  - (1) Obtaining all permits.
  - (2) Complying with all applicable regulations.
  - (3) Preparing all submittals.
  - (4) Preparing an Emergency Plan.
  - (5) Providing, installing, and maintaining all temporary facilities.
  - (6) Attending all meetings.
  - (7) Providing access for all inspections.
  - (8) Transporting personnel, equipment, and materials to the project site.
  - (9) Setting up equipment at the project site.
  - (10) Demobilizing from the project site.

### **11.02 Materials and Equipment**

- A. Reverse Circulation Drill Rig
  - (1) Reverse circulation drill rig shall include all associated equipment for reverse circulation drilling.
  - (2) Drill pipe shall be a minimum of six (6) inches in diameter.
- B. Air Compressor
  - (1) Air compressor shall be capable of airlifting a minimum of 350 gallons per minute.

### **11.03 Methods**

- A. The Contractor shall prepare a site plan that shows the planned configuration of equipment at the well site.
- B. The Contractor shall provide email and cellular phone contact information for their office project manager, field superintendent, and project drillers prior to mobilization.
- C. The Contractor shall provide an example of the Daily Report Form to be used to document all onsite activities.
- D. The Contractor shall provide all Safety Data Sheets (SDS) to be used in conjunction with the project.
- E. Emergency Plan
  - (1) The intent of the Emergency Plan is to ensure that, in the event of an emergency at the project site, all workers know the procedure to follow and

have all contact and location information necessary to quickly respond to an emergency at the project site.

- (2) Contractor shall prepare an Emergency Plan that includes the following minimum components:
    - a. The name, address, and phone number of the nearest medical facility that accepts emergency patients.
    - b. A map and turn-by-turn directions from the project site to the emergency facility.
    - c. Emergency phone numbers for the local police department, fire departments, and poison control center.
    - d. A location map showing the project site, and a written description of the project site location that can be used to direct emergency vehicles to the project site.
    - e. The procedure to be followed in the event of an emergency.
  - (3) The Contractor shall review the Emergency Plan with all regular workers at the site. All regular workers at the site should know where the nearest emergency medical facility is, the route from the project site to that facility, and the procedure to be followed in the event of an emergency.
- F. Contractor shall provide, mobilize to the project site, set up, operate, maintain in good working condition, and demobilize from the project site, all of the equipment listed in this section.
- G. In addition to the equipment specifically listed in this section, Contractor shall provide, mobilize to the project site, set up, operate, maintain in good working condition, and demobilize from the project site, all other equipment necessary for the successful completion of the project, but not directly related to any other bid item.
- H. All equipment to be used below ground shall be cleaned and disinfected prior to use.

## SECTION 12 CONDUCTOR CASING AND SANITARY SEAL

### 12.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Providing mill certifications and delivery tickets for conductor casing.
- (3) Drilling the conductor casing borehole, installing the conductor casing, installing the sanitary seal between the borehole and the conductor casing, and allowing the sanitary seal to cure for 24 hours.

### 12.02 Materials and Equipment

A. Contractor shall provide mill certificates, cement batch tickets, and delivery tickets to the Owner for the conductor casing.

B. Conductor Casing

- (1) Conductor casing shall be 34-inch outside diameter with a minimum thickness of 3/8-inch. Casing shall be round such that no measured diameter of the casing more than 1/8 inch larger or smaller than the specified diameter.
- (2) Conductor casing shall be new and shall be fabricated of steel plate that meets the requirements of ASTM A-139 Grade B. No hydrostatic testing of the conductor casing is required.
- (3) The conductor casing sections shall be a minimum of 20 feet long, unless a shorter length is required to obtain the specified total length of conductor casing.
- (4) Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.
- (5) For field assembly by welding, section ends shall have collars of the same thickness and physical properties as the corresponding casing section, or beveled machined ends. The inside edge of the collars and the outside edge of the adjacent casing section shall be ground or sufficiently scarfed to remove sharp edges and burrs. If collars are used, a minimum of three (3) peep holes shall be provided to ensure proper alignment of the casing during installation.

C. Centralizers

- (1) Centralizers shall be made of the same material as the adjacent casing section, and shall be welded directly to the casing.
- (2) Centralizers shall be nominally 3/8-inch thick, two (2) inches wide, 24-inches long, bent to have a minimum of one (1) linear foot of bearing surface parallel to and at least four and one-half (4 ½) inches away from the casing.

#### D. Sand-Cement Grout

- (1) Sand-cement grout shall consist of a mixture of ASTM C150, Type II cement, sand, and water in the proportion of not more than two (2) parts, by weight, of sand to one (1) part of cement with about seven (7) gallons of water per 94-pound sack of cement. This is equivalent to a 10.3-sack mix.
- (2) The water used to prepare the sand-cement grout shall be of drinking water quality, compatible with Type II cement, and free of contamination and suspended matter.
- (3) The sand-cement grout shall be well mixed and free of clumps.
- (4) Sand-cement grout shall not contain fly ash.

#### E. Cement Pump

- (1) The cement pump shall be capable of pumping the sand-cement grout under pressure to the specified depth.
- (2) The cement pump shall be equipped with a pressure gage to allow for assessment of the force being exerted by the cement pump.

### 12.03 Methods

#### A. Borehole Drilling

- (1) Contractor shall drill a 44-inch diameter borehole to a depth of 70 feet below ground surface.
- (2) The borehole shall be sufficiently plumb and of sufficient diameter that the conductor casing can be installed plumb with a minimum of four and one-half (4 ½) inches of annular space between the conductor casing and the borehole at all points.
- (3) The bottom of the conductor casing is intended to be installed in competent clay. Contractor shall notify the Hydrogeologist if the material at the bottom of the specified conductor casing borehole depth is not competent clay.

#### B. Formation Sample Collection

- (1) During borehole drilling, the Contractor shall collect formation samples every 10 feet **and** more frequently when significant changes in formation type occur.
- (2) Samples shall be laid out on filter fabric on a flat, well-drained area. The area shall be out of the way of construction activities, and shall not be adjacent to noisy equipment. The samples shall be laid out in a regular pattern so that the depth of each sample is clearly identifiable. The samples shall be adequately preserved at the site to allow for observation by the Owner and Owner's Hydrogeologist.
- (3) Each sample shall consist of two components:
  - a. One (1) gallon of drained, unwashed formation material. This sample shall be laid directly on the filter fabric.

b. One (1) pint of drained, unwashed formation material. This sample shall be placed inside a quart-sized plastic Ziploc<sup>®</sup> freezer bag. The Contractor shall provide the sample bag. The sample bag shall be labeled with the well name and the date, time, and depth interval of the sample.

(4) The Contractor shall retain the formation samples at the site until they are no longer required by the Owner's Hydrogeologist. The Contractor shall not be required to retain the formation samples after the completion of all work under this Contract.

(5) The Contractor shall prepare a "driller's log" of the formation samples. The "driller's log" shall include the depth interval and a description of each distinct formation type encountered in the borehole.

#### C. Conductor Casing Assembly and Installation

(1) Contractor shall weld a minimum of two (2) sets of four (4) centralizers onto the conductor casing assembly. Each set of four (4) centralizers shall be spaced equally around the circumference of the conductor casing. One set of centralizers shall be installed within five (5) feet of each end of the conductor casing assembly.

(2) Contractor shall lap-weld the conductor casing joints during installation, with a minimum of two (2) passes per circumference. All joints shall be watertight. All peep holes shall be welded closed, if collars are used.

(3) Contractor shall install the conductor casing plumb and centered in the conductor casing borehole.

#### D. Sanitary Seal

(1) Sanitary seal shall be pumped under pressure via tremie pipe. The tremie pipe shall be installed within five (5) feet of the bottom of the conductor casing borehole before placement of the seal begins. Tremie pipe shall be withdrawn as the seal is placed to avoid creating excessive pressure. Tremie pipe shall remain submerged in sand-cement grout throughout the entire seal placement.

(2) The Contractor shall place a grate or screen over the cement pump hopper to remove gravel and clumps from the sand-cement grout prior to placement.

(3) The sand-cement grout shall be pumped until it reaches ground surface. Once the sand-cement grout reaches ground surface, the Contractor shall withdraw the tremie pipe.

(4) The sanitary seal shall be allowed to cure undisturbed for a minimum of 24 hours.

#### E. Completion of the Conductor Casing and Sanitary Seal

(1) If the Contractor cuts any holes or windows in the conductor casing to facilitate well construction, these holes or windows in the conductor casing



shall be filled in and shall be made water-tight up to the ground surface prior to placement of the annular seal.

- (2) If the sanitary seal is not brought all the way to ground surface to facilitate well construction, the surface of the sanitary seal shall be thoroughly cleaned in the presence of the Owner or Hydrogeologist and the seal shall be brought up to ground surface prior to placement of the annular seal.

F. Security of the Conductor Casing

- (1) The Contractor shall protect the conductor casing and prevent foreign material from entering the conductor casing.
- (2) Until the well cover is installed, the Contractor shall maintain qualified personnel at the project site at all times to ensure that the conductor casing is protected and for safety reasons.
- (3) If the Contractor will not have qualified personnel at the project site at any time before the well cover is installed, the Contractor shall tack-weld a temporary cover over the conductor casing.

## SECTION 13 PILOT BOREHOLE DRILLING

### 13.01 Scope of Work

- A. This section include the following:
  - (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
  - (2) Drilling the production borehole, collecting formation samples, and monitoring and maintaining drilling fluid properties.

### 13.02 Materials and Equipment

- A. The Contractor shall provide a mud balance, Marsh funnel, sand content set, and all related equipment and materials for measuring drilling fluid properties. If the Contractor uses bentonite as a drilling fluid additive, the Contractor shall also provide a filter press and all related equipment and materials.
- B. The Contractor shall provide mud tanks with a minimum capacity equal to the maximum borehole volume, and a configuration that effectively settles out drill cuttings before fluids are recirculated.
- C. Drilling Fluid Control Equipment
  - (1) The Contractor shall provide any or all of the following equipment as necessary to maintain the specified drilling fluid properties:
    - a. A shear mixing system.
    - b. Shale shakers.
    - c. De-sanders and de-silters.
    - d. Any other equipment necessary to maintain the specified drilling fluid properties.
- D. Pilot Borehole Drift
  - (1) The Contractor shall provide a 3-degree Totco drift indicator, or approved equal, and all accessory equipment and supplies necessary to measure borehole drift during drilling.

### 13.03 Methods

- A. Drilling Fluid Control Program
  - (1) The purpose of the Drilling Fluid Control Program is to maintain a drilling fluid that facilitates removal of cuttings from the borehole, controls difficult drilling conditions, and protects the water-bearing formations.
  - (2) The Contractor shall prepare a Drilling Fluid Control Program that includes:
    - a. A diagram of the configuration of drilling fluid control equipment that the Contractor plans to use for the project. The diagram shall be

- annotated with descriptions of each piece of equipment; alternately, the Contractor shall submit a separate list of equipment.
- b. A written plan for maintaining the specified drilling fluid properties. The plan shall include:
    - (i) Water to be used in the drilling fluid, and any water treatment required.
    - (ii) A description of all drilling fluid additives that the Contractor anticipates using in borehole drilling, including the anticipated quantities and mix ratios.
    - (iii) Proposed development methods to remove drilling fluid additives from the completed well.
    - (iv) Methods that the Contractor intends to employ to control difficult drilling conditions such as lost circulations, water-sensitive clay formations, and any other difficult conditions the Contractor anticipates encountering during borehole drilling.
    - (v) Proposed drilling fluid properties for any portions of the borehole where the Contractor wishes to deviate from the specified drilling fluid properties (only for portions of the borehole that will be sealed against). The Contractor shall provide justification of why different drilling fluid properties are warranted in these portions of the borehole.
  - c. Safety Data sheets for all drilling fluid additives that the Contractor anticipates using during borehole drilling, including all drilling fluid additives that are stored at the project site.
- (3) Drilling fluid properties shall be within the following ranges:
- a. For all drilling fluids, including bentonite drilling fluids:
    - (i) Mud Weight: 8.6 – 9.1 pounds per gallon.
    - (ii) Marsh Funnel Viscosity: 28 – 34 seconds per quart.
    - (iii) Sand Content: less than 2% by volume.
  - b. For bentonite drilling fluids:
    - (i) Filter Cake Thickness (30 minutes at 100 PSI): 1/32 to 2/32 inch.
    - (ii) Water Loss/Filtrate (30 minutes at 100 PSI): less than or equal to 15 milliliters.

#### B. Record-Keeping

- (1) The Contractor shall maintain detailed records during borehole drilling, and shall make records available to the Hydrogeologist upon request.
- (2) The Contractor shall maintain the following records during borehole drilling:
  - a. Continuous record of drilling penetration rate.

- b. All measurements of drilling fluid properties.
- c. Time, depth, quantity, and description of any additives to the drilling fluid.
- d. Any difficult or unusual drilling conditions.
- e. Depth and description of formation samples.
- f. Depth and description of any observable changes in formation color.
- g. Time and reason for any interruptions in borehole drilling.

#### C. Pilot Borehole Drilling

- (1) Using the reverse rotary method, Contractor shall drill a 17.5-inch diameter borehole to a depth of 412 feet below ground surface.
  - a. The Contractor shall not drill below the specified depth. Should the Contractor drill below the specified depth, the Contractor shall backfill the borehole to the specified depth by installing bentonite chips via tremie pipe.
- (2) The Contractor shall select a drilling assembly (including collar weight) and drilling speed that allows the Contractor to maintain the plumbness and alignment of the borehole within the specified parameters. The Contractor shall make field checks of borehole drift at 100-foot intervals during drilling.

#### D. Drilling Fluid Control

- (1) Contractor shall measure drilling fluid properties (mud weight, viscosity, sand content, and water loss) a minimum of once every four (4) hours during borehole drilling.
- (2) The Owner's Hydrogeologist will measure drilling fluid properties periodically during borehole drilling. These measurements are intended to independently confirm the Contractor's measurements, and do not relieve the Contractor of the responsibility to measure drilling fluid properties.
- (3) If, at any time during borehole drilling, drilling fluid properties are not within the ranges specified above, the Contractor shall cease drilling and shall circulate and condition the drilling fluid until it falls within the specified ranges.
- (4) If the Contractor cannot maintain the specified drilling fluid properties, the Contractor shall employ a qualified drilling fluid engineer. The drilling fluid engineer shall consult with the Contractor, measure drilling fluid properties, and assist the Contractor with adjusting the drilling fluid as necessary to achieve the specified drilling fluid properties.
- (5) Drilling fluid additives must meet API Standard 13-A (Drilling Fluid Materials) or NSF Standard 60 (Drinking Water Treatment Chemicals), must be standard materials used in the water well drilling industry, and must be used in accordance with the manufacturer's recommendations.

- (6) The Contractor shall use only potable water to prepare drilling fluids, and shall treat the water as necessary before use.

#### E. Formation Sample Collection

- (1) During borehole drilling, the Contractor shall collect formation samples every 10 feet **and** more frequently when significant changes in formation type occur.
- (2) Samples shall be laid out on filter fabric on a flat, well-drained area. The area shall be out of the way of construction activities, and shall not be adjacent to noisy equipment. The samples shall be laid out in a regular pattern so that the depth of each sample is clearly identifiable. The samples shall be adequately preserved at the site to allow for evaluation by the Owner's Hydrogeologist.
- (3) Each sample shall consist of two components:
  - a. One (1) gallon of drained, unwashed formation material. This sample shall be laid directly on the filter fabric.
  - b. One (1) pint of drained, unwashed formation material. This sample shall be placed inside a quart-sized plastic Ziploc<sup>®</sup> freezer bag. The Contractor shall provide the sample bag. The sample bag shall be labeled with the well name and the date, time, and depth interval of the sample.
- (4) The Contractor shall not be required to retain the formation samples after the completion of all work under this Contract.
- (5) The Contractor shall prepare a "driller's log" of the formation samples. The "driller's log" shall include the depth interval and a description of each distinct formation type encountered in the borehole.

#### F. Final Conditioning of Drilling Fluids

- (1) Once the Contractor has drilled to the full specified well depth, the Contractor shall circulate and condition the drilling fluid until the drilling fluid properties are within the following ranges:
  - a. Mud Weight: less than 8.9 pounds per gallon.
  - b. Marsh Funnel Viscosity: less than 30 seconds per quart.
- (2) The Contractor shall continue to circulate drilling fluids, conditioning the fluids as necessary, until all of the following have occurred:
  - a. Fluid circulated out of the borehole does not contain drill cuttings.
  - b. Circulation has continued for a minimum of 60 minutes, or until two (2) borehole volumes have been circulated, whichever is longer.
  - c. Three (3) consecutive measurements of drilling fluid properties, made a minimum of 30 minutes apart, confirm that the specified drilling fluid properties have been obtained.

## **SECTION 14    GEOPHYSICAL SURVEYS (E-LOG & DEVIATION)**

### **14.01   Scope of Work**

- A. This section includes the following:
  - (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
  - (2) Providing deviation, spontaneous potential, and resistivity (single-point, 16-inch normal, and 64-inch normal) surveys and up to twenty-four (24) hours of idle time for the Owner's Hydrogeologist to interpret the geophysical surveys and select temporary aquifer zone intervals.

### **14.02   Materials and Equipment**

- A. Drawworks for Running Geophysical Surveys
  - (1) The drawworks shall measure the depth of the measurement tool to the nearest foot.
  - (2) The drawworks shall be calibrated such that the error in depth measurement does not exceed one (1) percent.
  - (3) The Contractor shall verify calibration of the drawworks upon request. Calibration shall be to within 0.25-percent.
- B. Electric Logging Tool
  - (1) The electric logging tool shall include equipment to perform spontaneous potential, gamma ray and resistivity (single-point, 16-inch normal, 64-inch normal) surveys.

### **14.03   Methods**

- A. Geophysical surveys shall be run to the full depth of the pilot borehole.
- B. The spontaneous potential and resistivity portions of the geophysical surveys shall be run in the pilot borehole. The caliper survey must be run in the full diameter reamed borehole.
- C. Geophysical surveys shall be run at a maximum rate of 40 feet per minute.
- D. The scale of the geophysical surveys shall be as follows:
  - (1) The vertical scale shall be 20 feet per inch.
  - (2) The horizontal scale is estimated to be 20 millivolts per inch for spontaneous potential, and 40 ohmmeter<sup>2</sup>/meter per inch for the 16-inch normal and 64-inch normal resistivity.
- E. The geophysical surveys shall measure the intended geophysical properties, and shall be presented in a manner that allows a full evaluation of the geophysical properties of the borehole for the purpose of finalizing the well design.

- F. Upon completion of the geophysical surveys, the Contractor shall provide the Owner with eight (8) field hard copies and electronic files (PDF and LAS) of the geophysical surveys.
- G. The Contractor may begin reaming of the borehole immediately upon completion of the geophysical surveys. The Contractor shall allow a maximum of 24 hours for Hydrogeologist to interpret the geophysical data and borehole lithology and to provide the final well design,

## **SECTION 15     BOREHOLE REAMING**

### 15.01 Scope of Work

- A. This section includes the following:
- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
  - (2) Reaming the pilot borehole.
  - (3) Monitoring and maintaining drilling fluid properties.

### 15.02 Materials and Equipment

- A. The Contractor shall provide the same materials and equipment as specified for “Section 13 – Pilot Borehole Drilling.”
- B. The Contractor shall provide a pilot bit as part of the reamer assembly.

### 15.03 Methods

#### A. Record-Keeping

- (1) The Contractor shall maintain detailed records during borehole reaming and shall make records available for review by the Owner’s Hydrogeologist upon request.
- (2) The Contractor shall maintain the following records during borehole reaming:
  - a. Continuous record of drilling penetration rate.
  - b. All measurements of drilling fluid properties.
  - c. Time, depth, quantity, and description of any additives to the drilling fluid.
  - d. Any difficult or unusual drilling conditions.
  - e. Time and reason for any interruptions in borehole drilling.

#### B. Borehole Reaming

- (1) Using the reverse rotary method, Contractor shall ream the pilot borehole to 30-inch diameter to a depth of 412 feet below ground surface.
- (2) The Contractor shall use a 17.5-inch pilot bit when reaming.
- (3) The completed borehole must be of sufficient diameter and sufficient plumbness such that when the well casing and screen assemblies are installed as specified and in compliance with the alignment requirement, there is a minimum of five (5) inches of annular space between the well casing and screen assemblies and the borehole wall at all points.
- (4) The Contractor shall not ream below the specified depth in order to avoid poorer water quality which may be present below that depth. Should the



Contractor drill below the specified depth, the Contractor shall backfill the borehole to the specified depth by installing bentonite chips via tremie pipe.

- (5) During reaming, the Contractor shall select a drilling assembly (including weight collars) and drilling speed that allows the Contractor to maintain the plumbness and alignment of the borehole within the specified parameters. The Contractor is encouraged to make field checks of plumbness during drilling.

C. Drilling Fluid Control

- (1) Drilling fluid control shall be as specified for “Section 13 – Pilot Borehole Drilling.”

D. Final Conditioning of Drilling Fluids

- (1) Once the Contractor has reamed and cleaned the borehole as specified, the Contractor shall circulate and condition the drilling fluid until the drilling fluid properties are within the following ranges:
  - a. Mud Weight: less than 8.9 pounds per gallon.
  - b. Marsh Funnel Viscosity: less than 30 seconds per quart.
- (2) The Contractor shall continue to circulate drilling fluids, conditioning the fluids as necessary, until all of the following have occurred:
  - a. Fluid circulated out of the borehole does not contain drill cuttings.
  - b. Circulation has continued for a minimum of 60 minutes, or until two (2) borehole volumes have been circulated, whichever is longer.
  - c. Three (3) consecutive measurements of drilling fluid properties, made a minimum of 30 minutes apart, confirm that the specified drilling fluid properties have been achieved.

## SECTION 16 CALIPER SURVEY

### 16.01 Scope of Work

- A. This section includes the following:
  - (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
  - (2) A caliper survey to measure the final diameter of the reamed borehole.

### 16.02 Materials and Equipment

- A. Drawworks for Running Geophysical Surveys
  - (1) The drawworks shall measure the depth of the measurement tool to the nearest foot.
  - (2) The drawworks shall be calibrated such that the error in depth measurement does not exceed one (1) percent.
  - (3) The Contractor shall verify calibration of the drawworks upon request. Calibration shall be to within 0.25 percent.
- B. Caliper Logging Tool
  - (1) The caliper logging tool shall be equipped with a minimum of three (3) measurement arms. Each measurement arm shall operate independently, and shall be separated by 120 degrees
  - (2) The caliper logging tool shall be capable of measuring borehole diameters of up to 50 inches.

### 16.03 Methods

- A. Caliper survey shall be run to the full depth of the production well.
- B. The caliper survey must be run in the full diameter borehole.
- C. Caliper survey shall be run at a maximum rate of 40 feet per minute.
- D. The scale of the caliper survey shall be as follows:
  - (1) The vertical scale shall be 20 feet per inch.
- E. The caliper survey shall measure the final borehole diameter and shall be presented in a manner that allows the Owner and Owner's Hydrogeologist to fully evaluate the size of the borehole for the purpose of analyzing borehole diameter.
- F. The caliper survey shall present an estimate of the total borehole volume and annular volume in cumulative cubic feet from the bottom of the borehole to ground surface.
- G. Upon completion of the caliper survey, the Contractor shall provide the Owner with four (4) field hard copies and electronic files of the geophysical surveys in LAS and PDF format.

- H. The Contractor shall provide the Owner's Hydrogeologist with an estimate of the volume of gravel required to construct the well as specified based on the actual borehole diameter as measured by the caliper survey.
- I. Immediately upon completion of the caliper survey, the Contractor shall install tremie pipe to the full well depth and begin to circulate drilling fluids. Alternately, if the Contractor is not prepared to begin well construction, the Contractor may make a wiper pass of the borehole and circulate drilling fluids until construction is ready to commence.

## SECTION 17 WELL CASING, WELL SCREEN, AND ACCESSORY PIPES

### 17.01 Scope of Work

- A. This section includes the following:
- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
  - (2) Installing well casing, well screen, and accessory pipes.
  - (3) Mill certifications and delivery tickets for well casing, well screen, and accessory pipes.
  - (4) Well screen design from manufacturer.

### 17.02 Materials and Equipment

- A. Contractor shall provide mill certificates and delivery tickets to the Owner for well casing, well screen, and accessory pipes.
- B. Contractor shall provide Owner with the well screen design from the manufacturer.
- C. Contractor shall provide a shop drawing of the sounding port entry box.
- D. Blank Well Casing (High Strength Low Alloy)
- (1) High Strength Low Alloy (HSLA) steel blank well casing shall be 16.625" outside diameter (O.D.) with a wall thickness of 5/16-inch and 3/8-inch, and shall be round such that no measured diameter of the casing is more than 1/8 inch larger or smaller than the specified diameter.
  - (2) Blank well casing shall be NSF Standard 61 certified.
  - (3) HSLA steel blank well casing shall be new and fabricated of Type 4 HSLA steel that meets the requirements of ASTM A-606.
  - (4) The casing sections shall be a minimum of 40 feet long, unless a shorter length is required to obtain the specified lengths of well casing.
  - (5) Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.
  - (6) The bottommost section of the well casing shall be equipped with an SE-Type (Semi-elliptical) end cap that is fabricated of the same thickness and physical properties of the corresponding casing section.
- E. Louvered Well Screen
- (1) HSLA steel well screen shall be 16.625" O.D. with a wall thickness of 5/16-inch and 3/8-inch, and shall be round such that no measured diameter of the casing is more than 1/8 inch larger or smaller than the specified diameter.
  - (2) Well screen shall be NSF Standard 61 certified.

- (3) HSLA steel well screen shall be new and fabricated of Type 4 HSLA steel that meets the requirements of ASTM A-606.
- (4) Well screen shall be louvered with a “Ful-Flo” perforation pattern.
- (5) Well screen slot size will be 0.055-inch.
- (6) Casing shall be round such that no measured diameter of the casing more than 1/8-inch larger or smaller than the specified diameter.
- (7) Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.
- (8)

#### F. Well Casing and Screen Collars

- (1) For field assembly by welding, well casing and screen section ends shall have collars of the same thickness and physical properties as the corresponding casing section. Collars shall be a minimum of five (5) inches wide for blank well casing and four (4) inches wide for well screen.
- (2) Clearance between the well casing or screen outside diameter and the adjacent collar inside diameter shall be between 1/32-inch and 3/32-inch.
- (3) The inside edge of the collars and the outside edge of the adjacent casing section shall be ground or sufficiently scarfed to remove sharp edges, burrs, and welding to allow for proper assembly of adjacent casing and screen sections.
- (4) Collars shall have three (3) peep holes to allow for proper alignment of adjacent casing sections. The peep holes shall be equally spaced around the circumference of the collar.
- (5) Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

#### G. Gravel Fill Pipe

- (1) Gravel fill pipe shall be three (3)-inch diameter Schedule 40 mild steel pipe.
- (2) For field assembly by welding, section ends shall be beveled for butt welding or have collars of the same thickness and physical properties as the corresponding casing section. If used, the collars and the outside edge of the adjacent casing section shall be ground or sufficiently scarfed to remove sharp edges and burrs.

#### H. Sounding Pipe

- (1) Sounding pipe shall be two (2)-inch diameter Schedule 10 Type 4 HSLA steel.
- (2) For field assembly by welding, section ends shall have collars of the same thickness and physical properties as the corresponding casing section. The

inside edge of the collars and the outside edge of the adjacent casing section shall be ground or sufficiently scarfed to remove sharp edges and burrs.

- (3) The Contractor shall provide “U”-shaped brackets, fabricated of the same material as the sounding pipe, to secure the sounding pipe to the well casing assembly during installation.

#### I. Sounding Port

- (1) The Contractor shall provide one (1) sounding port to serve as an inlet structure from the sounding pipe into the well casing.
- (2) The sounding port shall have the same thickness and physical properties as the corresponding well casing section.
- (3) The sounding port shall have no sharp edges or other obstructions that would cause damage to equipment, or otherwise impede the use of the sounding port to lower equipment into the well.
- (4) All inside edges shall be ground or sufficiently scarfed to remove sharp edges and burrs.
- (5) The sounding port dimensions shall be as shown in Sheet W-4 of the Plans.

#### J. Centralizers

- (1) Centralizers shall be made of the same material as the adjacent casing section, and shall be welded directly to the casing.
- (2) Centralizers shall be nominally 3/8 inch thick, two (2) inches wide, 24 inches long, bent to have a minimum of one (1) linear foot of bearing surface parallel to and at least four (4) inches away from the casing.

### 17.03 Methods

#### A. Maintaining Drilling Fluid Circulation

- (1) Prior to beginning the installation of the well casing, well screen, and accessory pipes, the Contractor shall circulate drilling fluids until all of the following have occurred:
  - a. Circulation has continued for a minimum of 30 minutes, or until one and one-half (1 1/2) borehole volumes have been circulated, whichever is longer.
  - b. Two (2) consecutive measurements of drilling fluid properties, made a minimum of 30 minutes apart, confirm that the specified drilling fluid properties have been obtained.
- (2) The Contractor shall continue to circulate drilling fluid through the tremie pipe throughout the installation of the well casing, well screen, and accessory pipes. The tremie pipe shall extend to the total depth of the borehole.

#### B. Welding Program

- (1) All welding shall be performed by certified welders.
- (2) All welding rods and techniques shall be appropriate for the material(s) being welded.
- (3) The Contractor shall prepare a Welding Program that includes:
  - a. Documentation of welder certification.
  - b. The type of welding rod to be used to connect each material in the well casing and screen assembly, and the accessory pipes.
  - c. Specific techniques appropriate to the various material types and thicknesses to be welded.
- (4) The Welding Program shall be provided to the Owner prior to the beginning of borehole drilling.

C. Orientation of Accessory Pipes

- (1) The orientation of the accessory pipes will be provided to the Contractor during the pre-construction meeting.
- (2) The accessory pipes shall be clearly labeled.

D. Gravel Fill Pipe

- (1) The gravel fill pipe shall be installed to the specified depth before installation of the well casing and screen assembly.
- (2) The gravel fill pipe joints shall be welded and shall be watertight. All peep holes (if used) shall be welded closed.
- (3) Nothing shall be added to the gravel fill pipe during construction.
- (4) The gravel fill pipe, when installed to the specified depth, shall extend two (2) feet above ground surface.

E. Well Casing and Screen Assembly

- (1) The well casing and screen assembly shall be suspended in tension from the surface throughout installation. The use of float plugs is prohibited. The Contractor shall not drive or “spud” the well casing and screen assembly.
- (2) The Contractor shall assemble the well casing and screen assembly as shown in the Plans, and shall install the well casing and screen assembly to the specified depth, so the screen sections are positioned at the depths shown in the Plans.
- (3) The Contractor shall install the sounding port as shown in the Plans, so the sounding port is positioned at the depth shown in the Plans. The joint between the sounding port and the well casing shall be watertight. All rough edges and burrs along the lower edge of the joint between the sounding port and the well casing shall be ground smooth.
- (4) Contractor shall lap-weld the well casing and screen joints during installation, with a minimum of two (2) passes per circumference. All joints

shall be watertight. All peep holes shall be welded closed. Welding rods shall be appropriate for the material(s) being welded.

- (5) The well casing and screen assembly, when installed to the specified depth, shall extend three (3) feet above ground surface.

#### F. Centralizers

- (1) Contractor shall weld sets of four (4) centralizers onto the well casing and screen assembly during installation.
- (2) Centralizers shall only be welded to the well casing, or welding rings. Centralizers shall not be welded to the well screen.
- (3) Each set of four (4) centralizers shall be spaced equally around the circumference of the well casing and screen assembly and shall be oriented the same.
- (4) Sets of centralizers shall be installed above and below the well screen section and every 80 feet along the well casing and screen assembly.

#### G. Sounding Pipe Assembly

- (1) The sounding pipe shall be installed concurrently with the well casing and screen assembly.
- (2) The sounding pipe shall be welded to the sounding port.
- (3) The sounding pipe joints shall be welded and shall be watertight.
- (4) The sounding pipe shall be retained adjacent to the well casing and screen assembly with “U”-shaped brackets that are welded to the well casing, retaining the sounding pipe parallel to the well casing and screen assembly but allowing for some vertical movement of the sounding pipe.
- (5) The “U”-shaped brackets shall not be welded to the well screen.
- (6) The “U”-shaped brackets shall be spaced no more than 80 vertical feet apart along the well casing and screen assembly, except where longer sections of well screen are present, in which case
- (7)
- (8) The sounding pipe shall not be welded to the “U”-shaped brackets or to the well casing and screen assembly.
- (9) The sounding pipe, when installed to the specified depth, shall extend two (2) feet above ground surface.
- (10) The sounding pipe shall not be retained against the well casing and screen assembly within 40 feet of ground surface. A spacer bar shall be welded between the well casing and the sounding pipe just below ground surface, so the sounding pipe rests against the conductor casing at ground surface.

#### H. Spacers



- (1) At the end of well casing and screen assembly installation, the Contractor shall weld one (1) set of four (4) spacers between the well casing and the conductor casing at ground surface.
- (2) The set of four (4) spacers shall be spaced equally around the circumference of the well casing.
- (3) Spacers shall be attached so that they center the well casing within the conductor casing and keep the well casing centered within the conductor casing during placement of the gravel envelope.
- (4) The Contractor shall install the spacers in the configuration shown in the plans.

I. Security of the Well Casing and Screen Assembly

- (1) The Contractor shall protect the installed well casing and screen assembly and prevent foreign material from entering the well casing and screen assembly.
- (2) The Contractor shall maintain qualified personnel at the project site at all times to ensure that the installed well casing and screen assembly is protected and for safety reasons.
- (3) If the Contractor will not have qualified personnel at the project site at any time, the Contractor shall install a locking cover or tack-weld a temporary cover over the well casing and screen assembly.

## SECTION 18 GRAVEL ENVELOPE AND TRANSITION SEAL

### 18.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Installing the gravel envelope between the borehole and the well casing and screen assembly, and performing initial consolidation of the gravel envelope.
- (3) Installing the fine sand seal between the borehole and the well casing and screen assemblies.

### 18.02 Materials and Equipment

A. Bentonite Chips

- (1) Bentonite chips for intermediate seals shall be graded to be between ¼- and 3/8-inch.
- (2) Bentonite chips shall not contain additives, binders, or coating. Compressed powder pellets shall not be used.

B. Gravel Envelope

- (1) Gravel envelope material shall have a gradation of 8 x 16..
- (2) Gravel envelope shall be NSF Standard 61 certified.
- (3) Gravel envelope material shall comply with the Manufacturer's Specifications.
- (4) Gravel envelope material shall be well-rounded, washed, and free of organic materials.
- (5) Contractor shall provide Owner a sieve analysis of a recent production run and 500 grams of gravel.
- (6) Contractor shall provide Owner an estimate of the volume of gravel required to construct a well as specified, based on the actual borehole diameter as measured during the caliper survey.
- (7) A minimum five (5) working days prior to beginning borehole drilling, Contractor shall provide a shop drawing illustrating the planned gravel envelope installation equipment and method.

C. Fine Sand

- (1) Fine sand shall be 30 mesh gradation and consist of sound, non-reactive material. Crushed aggregate will not be accepted. The sand shall be free of vegetative matter. A sample of the sand shall be provided to the Owner.
- (2) Fine sand shall be NSF Standard 61 certified.

D. Sodium Hypochlorite

- (1) Sodium hypochlorite shall be provided in a liquid solution. No powder or pellet products will be allowed.
- (2) “Regular” household bleach or liquid pool chlorine may be used. No fragranced products, “ultra” bleach, or other products with additives will be allowed.
- (3) Sodium hypochlorite shall contain no additives and shall be NSF Standard 60 certified.

E. Gravel Consolidation Tool

- (1) The Contractor shall provide a wire-line swab tool or bailer for initial consolidation of the gravel envelope.
- (2) The Contractor shall provide a shop drawing of the wire-line swab tool or bailer to be used to consolidate gravel envelope after placement. The selected wire-line tool shall be approved by the Hydrogeologist prior to use.

18.03 Methods

A. General Requirements

- (1) The Contractor shall not add anything other than fresh water to the gravel fill pipe.
- (2) The Contractor shall not add gravel to the gravel fill pipe.
- (3) Gravel envelope material shall be transported and stored in a manner that prevents foreign material from being mixed with the gravel envelope material.
- (4) Prior to placement of gravel envelope material, the Contractor shall lower a weighted bar to the bottom of the gravel fill pipe to confirm it open and free of material.

B. Lower Bentonite Seal Installation

- (1) The lower bentonite seal shall be installed prior to gravel envelope installation.
- (2) Bentonite chip material shall be placed in the borehole to form a lower bentonite seal, as specified in the Plans.
- (3) Bentonite chip material shall be placed through a tremie pipe. Bentonite chip materials shall be placed slowly to avoid plugging the tremie pipe. The tremie pipe shall be installed within five (5) feet of the bottom of borehole before placement of the bentonite chip material begins.

C. Gravel Installation

- (1) Gravel envelope material shall be placed in the annular space between the borehole and the well casing and screen assembly using a gravity feed system, from the bottom of the borehole to the depth of the annular seal, as specified in the Plans. Gravel pumping will not be allowed.

- (2) Gravel envelope material shall be placed through a tremie pipe. The tremie pipe shall be installed within ten (10) feet of the top of the lower bentonite seal before gravel placement begins, and shall be withdrawn as the gravel is placed. The tremie pipe shall be no more than forty (40) feet above the top of the gravel during placement.
- (3) Gravel envelope material shall be placed with conditioned drilling fluid. No contaminated fluid shall be used to place gravel envelope material. The Contractor shall exercise care to avoid creating a fluid density inversion during placement of the gravel envelope material.
- (4) Gravel envelope material shall be disinfected as it is installed by adding 1/4 gallon of 12.5% sodium hypochlorite solution to every 3,000 pound “super sack” of gravel. If a different concentration of sodium hypochlorite solution is used, this proportion shall be adjusted accordingly.
- (5) Once the gravel envelope has been placed as specified, the Contractor shall resume circulation of drilling fluid through the tremie pipe.

#### D. Initial Gravel Envelope Consolidation

- (1) The Contractor shall begin initial consolidation of the gravel envelope by working the selected wire-line gravel consolidation tool opposite the screen sections of the well. Initial consolidation shall continue for a minimum of 30 minutes, or until no measurable settling of the gravel envelope occurs with further initial consolidation.
- (2) The volume of gravel envelope material placed shall be equal to or greater than the calculated volume of the annular space being filled, based on the actual borehole diameter as measured in the caliper survey. If the volume of gravel envelope material placed is less than the calculated volume of the annular space being filled, it shall be considered an indication that voids are present in the gravel envelope, and the Contractor shall be required to perform additional consolidation of the gravel envelope, or other remedies. No such remedies shall be performed without the authorization of the Hydrogeologist.

#### E. Fine Sand Transition Seal Installation

- (1) Fine sand shall be installed immediately above the gravel envelope.
- (2) Fine sand shall be placed in the annular space between the borehole and the well casing, as specified in the Plans.
- (3) Fine sand material shall be placed through a tremie pipe. The tremie pipe shall be installed within five (5) feet of the gravel envelope before placement of the fine sand material begins.

## SECTION 19 ANNULAR SEAL

### 19.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Providing cement batch tickets to the Owner and Owner's Hydrogeologist prior to installing each batch delivered.
- (3) Installing the annular seal between the borehole/conductor casing and the well casing and screen assembly, and allowing the annular seal to cure for a minimum of 24 hours.

### 19.02 Materials and Equipment

A. Sand-Cement Grout

- (1) Sand-cement grout shall consist of a mixture of ASTM C150, Type II cement, sand, and water in the proportion of not more than two (2) parts, by weight, of sand to one (1) part of cement with about seven (7) gallons of water per 94-pound sack of cement. This is equivalent to a 10.3-sack mix.
- (2) The water used to prepare the sand-cement grout shall be of drinking water quality, compatible with Type II cement, and free of contamination and suspended matter.
- (3) The sand-cement grout shall be well mixed and free of clumps.
- (4) Sand-cement grout shall not contain fly ash.

B. Cement Pump

- (1) The cement pump shall be capable of pumping the sand-cement grout under pressure to the specified depth.
- (2) The cement pump shall be equipped with a pressure gauge to allow for assessment of the force being exerted by the cement pump.

### 19.03 Methods

A. Annular Seal

- (1) No fluid shall be introduced inside the well casing prior to or during annular seal placement.
- (2) Annular seal shall be placed in two lifts, to avoid creating excessive pressure on the well casing during placement.
- (3) Annular seal shall be pumped under pressure via tremie pipe. The tremie pipe shall be installed within five (5) feet of the top of the fine sand transition before placement of the seal begins. Tremie pipe shall be withdrawn as the seal is placed to avoid creating excessive pressure. Tremie

pipe shall remain submerged in sand-cement grout throughout the entire seal placement.

- (4) The Contractor shall place a grate or screen over the cement pump hopper to remove gravel and clumps from the sand-cement grout prior to placement.
- (5) The sand-cement grout shall be pumped until it reaches ground surface. Once the sand-cement grout reaches ground surface, the Contractor shall withdraw the tremie pipe.
- (6) The annular seal shall be allowed to cure undisturbed for a minimum of 24 hours.

## SECTION 20 WELL DEVELOPMENT

### 20.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Developing the well by open-ended airlifting, swab-airlifting, and pumping for the minimum times specified, or until the well meets the performance requirements, whichever is longer.
- (3) Providing and placing AQUA-CLEAR™ PFD, and allowing the well to remain idle for 24 hours.

### 20.02 Materials and Equipment

A. Swab-Airlifting Tool

- (1) The swab-airlifting tool shall attach to the end of the drill pipe, and shall consist of two rubber flanges. The rubber flanges shall be spaced no more than 10 feet apart. The outside diameter of the rubber flanges shall be no more than 1/8 inch smaller than the inside diameter of the well screen.

B. Dispersant Chemical

- (1) The only approved dispersant chemical is Baroid Industrial Drilling Products AQUA-CLEAR™ PFD. No other dispersant chemicals may be used.
- (2) The Contractor shall provide and utilize two (2) gallons of AQUA-CLEAR™ PFD.

C. Air Compressor

- (1) The air compressor and air injection piping used for airlifting shall be sufficient to allow development of at least 350 gpm. The air compressor shall have a minimum 375 cubic feet per minute (cfm) at 200 pounds per square inch (psi).

D. Turbidimeter

- (1) The Contractor shall provide a calibrated turbidimeter for the purpose of monitoring discharged water. Calibration of the turbidimeter shall be done at the beginning of each day and recorded on daily report. Contractor shall provide Owner or Owner's Hydrogeologist records upon request.

### 20.03 Methods

A. Record-Keeping

- (1) The Contractor shall maintain detailed records during well development, and shall make records available for review by the Owner or Owner's Hydrogeologist upon request.

- (2) The following parameters shall be recorded at the beginning of the day, before any water has been pumped during test pump development:
  - a. Static water level, measured to the nearest foot.
  - b. Depth to gravel envelope, measured to the nearest foot.
- (3) The following parameters shall be recorded at least every 30 minutes during air-lift well development:
  - a. Time, measured to the nearest minute.
  - b. Flow rate, estimated to the nearest 100 gallons per minute.
  - c. Water level, measured to the nearest foot.
  - d. Drawdown from static water level, calculated to the nearest foot.
  - e. Sand production observations.
  - f. Any observations of unusual or changed conditions, including: odor, gas bubbles, color, or other conditions.
- (4) The following parameters shall be recorded during test pump development:
  - a. Time, measured to the nearest minute.
  - b. Flow rate, measured to the nearest 100 gallons per minute.
  - c. Pumping water levels before surges, measured to the nearest 0.01 foot.
  - d. The number of surges.
  - e. Sand production per pumping cycle, measured to the nearest 0.01 cubic centimeter.
  - f. Any observations of unusual or changed conditions, including odor, gas bubbles, or other conditions.

#### B. Open-Ended Airlifting

- (1) The Contractor shall begin open-ended airlifting through the drill pipe within 36 hours of placement of the annular seal.
- (2) The Contractor shall begin open-ended airlifting gradually to avoid creating differential pressures that could lead to well casing collapse.
- (3) Open-ended airlifting shall continue for a minimum of three (3) hours, or until all of the following have occurred:
  - a. Drilling fluid is removed from the well.
  - b. No measurable settling of the gravel envelope occurs with further open-ended airlifting.
- (4) The Contractor shall airlift sediment out of the well sump before beginning swab-airlifting.

#### C. Swab-Airlifting



- (1) The Contractor shall begin swab-airlifting immediately after open-ended airlifting.
- (2) Swab-airlifting shall begin at the bottommost screen section and work upward. Swab-airlifting shall be conducted by moving the swab-airlifting tool slowly and uniformly up and down over one length of drill pipe for the specified time before continuing upward.
- (3) Swab-airlifting shall be performed as follows:
  - a. Swab-airlift for a minimum of six (6) minutes per foot of screen.
  - b. Swab in the specified amount of AQUA-CLEAR™ PFD evenly over the screens, diluting with 500 parts water to one (1) part AQUA-CLEAR™ PFD prior to placement.
  - c. Allow the well to remain idle for 24 hours.
  - d. Swab-airlift for a minimum of eight (8) minutes per foot of screen.
- (4) The Contractor shall continue swab-airlifting beyond the minimum requirements until the Contractor is confident that the turbidity and sand production requirements will be met after development pumping. If the turbidity and sand production requirements cannot be met after development pumping, the Contractor shall perform additional swab-airlifting and development pumping.
- (5) The Contractor shall airlift sediment out of the well sump before beginning test pump development.

#### D. Development Pumping

- (1) Development pumping shall begin within five (5) days of swab-airlifting.
- (2) Development pumping shall be conducted by alternately pumping and surging at a specific flow rate, until pumping and surging at that flow rate produces visibly clear water.
- (3) Development pumping shall begin at approximately 25 percent of the design capacity, and shall gradually increase to 150 percent of the design capacity.
- (4) Development pumping shall continue for a minimum of 24 hours, or until all of the following have occurred:
  - a. The pumped water complies with the turbidity and sand content requirements.
  - b. The well complies with the well efficiency requirement.
  - c. No movement of the gravel envelope has occurred during the last eight (8) hours of development pumping.
- (5) The Contractor shall flush the sounding pipe and gravel fill pipe during well development with clean water.

- (6) The Contractor shall lower a weighted bar with a brush to the top of the sounding port entry box and bottom of the gravel fill pipe to confirm the pipes are open and clear.
- (7) If either pipe is clogged, the Contractor shall provide clear any obstruction.
- (8) At the conclusion of development pumping, the Contractor shall determine the required settings to obtain the flow rates for well and aquifer testing.

## SECTION 21 TEST PUMP INSTALLATION & TEMPORARY DISCHARGE

### 21.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Transporting test pump personnel, equipment, and materials to the project site.
- (3) Installing and removing the test pump, discharge piping, and related equipment.
- (4) Removing foreign material and sediment from the well before installing and after removing the test pump.
- (5) Demobilizing test pump personnel, equipment and materials from the project site.

### 21.02 Materials and Equipment

A. General Requirements

- (1) Contractor shall provide, mobilize to the project site, set up, operate, maintain in good working condition, and demobilize from the project site, all of the equipment listed in this section.
- (2) The test pump and related equipment shall be capable of performing all development and test pumping as specified.
- (3) All measurement devices need to be appropriate for parameters measured.

B. Vertical Turbine Test Pump

- (1) The vertical turbine pump shall be set at a depth of 360 feet bgs.
  - a. The test pump setting depth was selected to allow greater drawdown while achieving pumping rates above the design capacity to maximize well development.
- (2) The vertical turbine test pump shall be capable of producing, and shall be equipped to produce, between 25 percent and 150 percent of the estimated design capacity (800 gpm).
- (3) No foot valve shall be installed on the column pipe.
- (4) The column pipe shall have a minimum diameter of six (6) inches.

C. Flowmeter

- (1) The flowmeter shall be equipped with a totalizer capable of measuring the volume of water produced during testing in gallons.
- (2) The flowmeter shall be capable of measuring flow rate in gallons per minute (i.e., gpm).

- (3) The Contractor must submit a certificate for the flowmeter demonstrating that the device is within acceptable calibration range.

D. Test Pump Engine and Drive Shaft

- (1) Test pump engine and drive shaft assembly shall be capable of continuously operating as required to produce the specified minimum flow rate and discharge head.
- (2) Test pump engine and drive shaft assembly shall be capable of pumping and surging, and shall not have a non-reverse ratchet installed.

E. Water Level Measurement Device

- (1) Water level measurement device shall be capable of measuring water levels to the nearest 0.01 foot, with measurements repeated every minute.

F. Stop Watch

- (1) Contractor must provide a stopwatch or other device for accurately measuring the elapsed time during development and test pumping to the nearest second.

G. Discharge Assembly

- (1) Discharge assembly shall be of suitable size, length, and configuration to direct the discharge during development and test pumping to the specified location shown in the Plans, without generating nuisance water at the project site.
- (2) Discharge assembly shall be equipped with a mechanical totalizer, flowmeter, and Rossum centrifugal sand tester. Equipment, as installed, shall be accurate for measuring instantaneous flow rate, total volume pumped, and sand content. Discharge assembly shall also be equipped with a tap for water quality sampling.
- (3) Discharge assembly shall be equipped with a gate valve that can be adjusted to allow the totalizer and flowmeter to function properly at flow rates between 25 percent and 150 percent of the design capacity.

H. Wire-Line Bailer

- (1) Contractor shall provide a wire-line bailer and all associated equipment to properly remove sediment from the well.

21.03 Methods

- A. Contractor shall provide, mobilize to the project site, set up, operate, maintain in good working condition, and demobilize from the project site, all of the equipment listed in this section.
- B. Before installing the test pump, the Contractor shall remove all sediment from the sump of the well using a wire-line bailer.

- C. After uninstalling the test pump, the Contractor shall remove all sediment from the sump of the well using a wire-line bailer. Contractor shall also remove any foreign material, including oil and grease, from the well.

## SECTION 22 WELL AND AQUIFER TESTING

### 22.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Performing well and aquifer testing.

### 22.02 Materials and Equipment

A. The equipment shall be the same as provided in Section 21.03 – Test Pump Installation & Temporary Discharge Piping.

### 22.03 Methods

A. General Testing Requirements

- (1) Well and aquifer testing shall begin within 12 to 60 hours of well development.
- (2) The well shall not have been pumped within 12 hours of the beginning of any well and aquifer test.
- (3) The flow rate shall be maintained within plus or minus five (5) percent of the specified flow rate for each test. If, at any time during the test, the flow rate does not fall within this range, the Contractor shall discontinue the test, allow for full water level recovery, and restart the test.
- (4) If any interruptions in pumping occur that are longer than one (1) percent of the elapsed duration of the test, the Contractor shall discontinue the test, allow for full water level recovery, and restart the test.

B. Record-Keeping

- (1) The Contractor shall maintain detailed records during well and aquifer testing, and shall make records available to the Owner and Owner's Hydrogeologist upon request.
- (2) The **actual time** when each measurement is made shall be recorded, even if it differs from the measurement schedule.
- (3) The following measurements shall be recorded at the beginning of each well and aquifer test, before any water has been pumped.
  - a. Static water level, measured to the nearest 0.01 foot.
  - b. Depth to gravel envelope, measured to the nearest foot.
  - c. Totalizer reading, measured to the smallest unit on the totalizer gauge.
- (4) The following measurements shall be recorded during well and aquifer testing:
  - a. Elapsed time, measured to the nearest 15 seconds.

- b. Flow rate, measured to the nearest 50 gallons per minute.
- c. Totalizer reading, measured to the smallest unit on the totalizer gauge.
- d. Water level, measured to the nearest 0.01 foot.
- e. Drawdown from static water level, calculated to the nearest 0.01 foot.
- f. Sand production, recorded to the nearest 0.01 cubic centimeter.
- g. Any adjustments to the flow rate, interruptions in pumping, or other changes in testing conditions.

C. Measurement Schedule

- (1) The times specified in this section are elapsed times since the pump is started or stopped. Measurements shall continue for the specified duration of pumping and recovery.
- (2) Elapsed time and water level measurements shall be made according to the following schedule:
  - a. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 minutes.
  - b. 14, 16, 18, and 20 minutes.
  - c. 25, 30, 35, 40, 45, 50, 55, and 60 minutes.
  - d. 70, 80, 90, 100, 110, and 120 minutes.
  - e. 150, 180, 210, 240, 270, 300, 330, and 360 minutes.
  - f. Every 60 minutes for the remainder of the test.
- (3) Sand production measurements shall be made at least once every five (5) minutes for the first 30 minutes of pumping, and every one (1) hour for the duration of each test.
- (4) Flow rate and totalizer measurements shall be made during pumping at least once for every three (3) water level measurements, or once every hour, whichever is more frequent. A final measurement shall be made after the pump is turned off.
- (5) Drawdown shall be calculated for each water level measurement. Drawdown may be calculated after a test is finished.

D. Short-Term Tests

- (1) The short-term tests shall consist of three (3) consecutive tests that each include two (2) hours of pumping followed by ½ hour of recovery measurements.
- (2) The flow rates for the short-term tests shall be approximately 600, 800, and 1,200 gpm, or as determined based on well development records.

E. Long-Term Test

- (1) The long-term test shall consist of 12 hours of pumping followed by a four hour recovery period.

- (2) The flow rate for the long-term test shall be at the estimated design rate of the well, 800 gpm.
- (3) The Owner or Owner's Hydrogeologist will collect water quality samples during the long-term test.



## SECTION 23 PLUMBNESS AND ALIGNMENT TESTING

### 23.01 Scope of Work

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Performing plumbness and alignment testing.

### 23.02 Materials and Equipment

A. Drawworks for Running Plumbness Tool

- (1) The drawworks shall measure the depth of the measurement tool to the nearest foot.
- (2) The drawworks shall be calibrated such that the error in depth measurement does not exceed one (1) percent.
- (3) The Contractor shall verify calibration of the drawworks upon request. Calibration shall be to within 0.25-percent.

B. Alignment Tool

- (1) The alignment tool shall be 40 feet long, and shall be rigid.
- (2) The outside diameter of the alignment testing tool shall be one (1) inch less than the inside diameter of the blank well casing.
- (3) The alignment tool shall be one of the following configurations:
  - a. A length of pipe with the specified outside diameter.
  - b. A “dummy”, consisting of a length of base pipe smaller than the specified diameter, with 12-inch-long sections (“rings”) of pipe with the specified outside diameter. Three (3) rings shall be rigidly attached to the base pipe so the axis of the base pipe is in line with the axes of the rings. The rings shall be located at each end of the base pipe, and in the center of the base pipe. A drawing of an acceptable alignment “dummy” is shown in the Plans.

C. Plumbness Tool and Data

- (1) The plumbness tool shall be a digital gyroscopic deviation device that accurately measures inclination, azimuth, true vertical depth, departures, and plane of closure (displacement).
- (2) The plumbness data shall be presented in full-color reports with plan, vertical, and three-dimensional views of the casing. Electronic data shall be viewable in the Drift-Pac<sup>®</sup> Viewer Module or pre-approved equal.

### 23.03 Methods

- A. Plumbness and alignment testing may be performed at any time after the annular seal has cured and before the video survey is performed.
- B. The plumbness and alignment tests shall accurately measure the plumbness and alignment of the completed well, and shall be presented in a manner that allows the Owner or Owner's Hydrogeologist to evaluate whether the well meets the plumbness and alignment requirements.
- C. Alignment Testing
  - (1) Alignment testing shall be performed by lowering the alignment tool into the well from the ground surface to the topmost well screen section. No part of the alignment tool shall be allowed to enter any section of well screen.
  - (2) Alignment testing shall also be performed by installing the test pump freely to the specified depth.
- D. Plumbness Testing
  - (1) Plumbness testing shall be performed by Pacific Surveys.
  - (2) Plumbness testing shall be performed by lowering the plumbness tool into the well from the ground surface to the full well depth.
  - (3) Measurements shall include station depth, inclination, azimuth, true vertical depth, departures, and plane of closure (displacement). Measurements shall be made every 10 feet from ground surface to the topmost well screen section. Measurements shall be made every 50 feet from the topmost well screen section to the full well depth.
  - (4) Upon completion of the plumbness testing, the Contractor shall provide the Owner or Owner's Hydrogeologist with two (2) field hard copy reports and one (1) electronic file of the plumbness test.

## **SECTION 24 VIDEO CAMERA SURVEY**

### **24.01 Scope of Work**

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Performing a video survey.

### **24.02 Materials and Equipment**

A. Video Survey Tool

- (1) Drawworks
  - a. The drawworks shall measure the depth of the measurement tool to the nearest foot.
  - b. The drawworks shall be calibrated such that the error in depth measurement does not exceed one (1) percent.
  - c. The Contractor shall verify calibration of the drawworks upon request. Calibration shall be to within 0.25 percent.
- (2) The video survey tool shall be equipped with centralizers, and shall include color cameras for the downhole and focusing side-scan views.
- (3) The camera shall be focused, and shall provide a clear view of the well casing with no blurs or other obstructions.

### **24.03 Methods**

A. Video Survey

- (1) The video survey shall be complete and of adequate quality to allow for complete inspection of the well structure so the Owner or Owner's Hydrogeologist can determine if the well meets all of the Contract requirements.
- (2) Before running the video survey, the Contractor shall run sufficient potable water into the well to allow for clear viewing of the well structure.
- (3) The video survey shall be run at a maximum rate of 30 feet per minute.
- (4) The downward pass of the video survey shall cover the entire well, and shall be conducted entirely with the downhole view. The depth of any features or anomalies shall be noted for further inspection on the upward pass.
- (5) The upward pass of the video survey shall cover the entire well, and shall be conducted with the side-scan view. The camera shall rotate while moving upward, to provide complete inspection of all well screens. Each casing joint shall be fully inspected with a 360-degree rotation of the side-scan camera. Any features or anomalies (including the sounding port) shall be fully inspected with the side-scan camera.

- (6) Immediately upon completion of the video survey, the Contractor shall provide the Owner or Owner's Hydrogeologist two (2) copies of the video survey in DVD format. Both copies shall show the full video survey with an accurate depth displayed to the nearest one (1) foot.

## **SECTION 25 SITE CLEANUP AND RECORDS**

### **25.01 Scope of Work**

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Performing site cleanup, providing complete well construction records, and securing the wellhead.

### **25.02 Materials and Equipment**

A. Well Cover

- (1) Contractor shall provide a lockable, removable well cover that secures the wellhead. The well cover shall be adequate to prevent tampering with the well or the introduction of foreign materials into the well, and to ensure that the well is not a hazard. The cover shall prevent rainwater from entering the well, but need not be watertight. The Contractor shall provide a lock and key for the well cover.

B. Accessory Pipe Covers

- (1) The Contractor shall provide screw-on caps for the gravel fill pipe and the sounding pipe.

### **25.03 Methods**

A. Site Cleanup

- (1) Contractor shall remove all materials that result from the Contractor's activities, whether on or off the project site, including waste materials, rubbish, and debris.
- (2) Contractor shall restore all areas where the Contractor has performed work to their approximate original condition.
- (3) Contractor shall leave all areas where the Contractor has performed work clean and ready for use by the Owner.
- (4) Contractor shall muck out and backfill any excavations, including mud pits (if used). Backfill shall be able to obtain a relative compaction of 90% per ASTM D-1557.

B. Wellhead Security

- (1) Contractor shall install and lock the well cover.
- (2) The Contractor shall provide the Owner with all keys to the well cover lock.

C. Labeling of Accessory Pipes

- (1) The Contractor shall clearly label the accessory pipes (not only on the cap).

D. Records

- (1) The Contractor shall provide the Owner with complete records and as-built construction information for the project.
  - a. California Department of Water Resources Well Completion Report.
  - b. All daily reports.
  - c. All records of drilling fluid measurements.
  - d. All mill certifications, cement tickets, and any other documentation of materials installed.
  - e. Contractor's tallies of materials installed.
  - f. All well development and testing records.
  - g. All final invoices for work completed.

## **SECTION 26 WELL DISINFECTION**

### **26.01 Scope of Work**

A. This section includes the following:

- (1) Provision of all labor, equipment, and materials necessary for the successful completion of this bid item.
- (2) Providing interim and final well disinfection.

### **26.02 Materials and Equipment**

A. Sodium Hypochlorite

- (1) Sodium hypochlorite shall be provided in a liquid solution. No granular or pellet products will be allowed.
- (2) “Regular” household bleach or industrial grade sodium hypochlorite may be used. No fragranced products or other products with additives will be allowed.
- (3) Sodium hypochlorite shall contain no additives and shall be NSF Standard 60 certified.
- (4) Sodium hypochlorite shall be provided in the original sealed container.
- (5) Sodium hypochlorite shall be recently purchased and properly stored to ensure the concentration of the solution has not degraded.

### **26.03 Methods**

A. Final Disinfection

- (1) Final well disinfection shall be accomplished by running hose or tremie pipe to the full depth of the well and evenly placing diluted sodium hypochlorite in the well while raising the hose or tremie pipe.
- (2) Sodium hypochlorite shall be diluted with water to obtain a solution that, when placed in the well, will provide a minimum concentration of 100 parts per million of available chlorine for at least 24 hours.
- (3) After placing the diluted sodium hypochlorite in the well, the Contractor shall run approximately 500 gallons of potable water into the well.

B. Interim Disinfection

- (1) Contractor shall provide interim disinfection of the well if it remains idle for more than three (3) days.
- (2) Interim disinfection shall be the same as final disinfection, except that only ten (10) percent of the amount of sodium hypochlorite used in final disinfection shall be used in interim disinfection.

C. Verification of Disinfection

- (1) At the Hydrogeologist's request, Contractor shall verify that a minimum of 100 parts per million of chlorine remain in the well after final disinfection.

D. Securing Wellhead

- (1) After final disinfection, Contractor shall secure the wellhead with the locking well cover.