



April 29, 2008

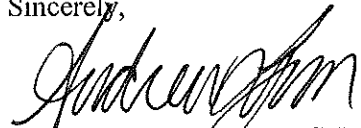
Mr. David King
St. Johns River Water Management District
Water Use Regulation Division
Palm Bay Service Center
525 Community College Parkway SE
Palm Bay, FL 32909

Re: Consumptive Use Permit No. 107643
City of Rockledge ASR
Aquifer Performance Test
Jones Edmunds Project No.: 08802-034-02

Dear Mr. King:

As required by Condition 18 of Exhibit A of the above-referenced permit, please accept this letter as notification of our plan to perform an aquifer performance test on ASR-1. Construction of the ASR system is ongoing. We are currently drilling an exploratory well to determine the storage interval of the ASR system. The aquifer performance test will follow the construction of the exploratory well (SZMW-2), monitoring wells (SZMW-1 and SMW-1), and the ASR well (ASR-1). We anticipate that drilling of the wells will be complete in August 2008. Enclosed is the section of the contract documents that details the aquifer performance test. As required by Condition 19 of Exhibit A of the above-referenced permit, we will notify you once a start date for the aquifer performance test has been scheduled. If you have any questions regarding this project, please feel free to call me at (352) 377-5821.

Sincerely,



Andrew G. Lynn, P.E., BCEE
Senior Project Manager

\\eaweb1\projects\08802-Rockledge\034-02 ASR Phase II\Correspondence\2008-04-29-LTR-DKing-APT-Notification.doc

Enclosure

xc: Duane Watroba, Florida Department of Environmental Protection (email only)
George Heuler, Florida Department of Environmental Protection (email only)
Nancy Marsh, Environmental Protection Agency (email only)
Alan LaDuke, City of Rockledge (email only)
Brian Hepburn, Jones Edmunds & Associates, Inc. (email only)

730 NE Waldo Rd
Gainesville, FL 32641

352.377.5821 Phone
352.377.3166 Fax
www.jonesedmunds.com

SECTION 02670
WELL CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE OF WORK

The work described herein is for the construction and testing of two Storage Zone Monitor Wells (SZMW-2 & SZMW-1), an Aquifer Storage and Recovery Well (ASR-1), and a Shallow Monitoring Well (SMW-1).

1.02 RELATED WORK

- A. Section 01340, Project Submittals and Approval
- B. Section 02600, Well Construction and Testing Plan
- C. Section 02671, Water Table Monitoring Well
- D. Section 02678, Well Development
- E. Section 02679, Geophysical Logging
- F. Section 02684, Well Acidization

1.03 SUBMITTALS

- A. Submittals to the Engineer for review shall include the following:
 - 1. Construction Permits
 - 2. Daily Driller's Log
 - 3. State of Florida Well Drilling Permit
 - 4. Lead Well Driller Resume
 - 5. Casing and Material Specifications
 - 6. Mill/Material Certificates
 - 7. Welder's ASME Boiler & Pressure Vessel Code Certification
 - 8. Water Quality Laboratory Reports
 - 9. Well Completion Report and As-Built Drawings

10. Plumbness and Alignment Test Forms
 11. Flow Meter Calibration Certification
 12. Water Level Data
 13. Packer Specifications
 14. Packer Pressure Gauge Calibration Certification
 15. Plans for Lined-Pad Containment System
 16. Shop Drawings for Closed Line Circulation System
 17. Waste Transportation Manifests
 18. Inclination Deviation Survey Disks
 19. Any other submittals as required herein.
- B. The Engineer will review proposed procedures, equipment, samples, and other submittals within 14 calendar days. The Engineer's review shall be only for conformance with the design concept of the Project and for compliance with the information provided within the Contract Documents.
- C. The Engineer's review shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and Engineer has given written concurrence and approval to the specific deviation.
- D. The Engineer's review shall not relieve the Contractor from the responsibility of meeting the well acceptance criteria and warranty requirements specified herein.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

- A. The latest revisions of the American Water Works Association (AWWA), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and American Petroleum Institute (API) standards shall apply as referenced in this Specification. Standards shall include but are not restricted to the following:
1. American Welding Society Standards

2. API Standard 10A
 3. ASTM D854, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
 4. ASTM D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 5. ASTM D2434, Standard Test Method for Permeability of Granular Soils (Constant Head)
 6. ASTM D7012, Test Method for Compressive Strength of Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures
 7. ASTM Portland Cement Standards, C 150
 8. AWWA Deep Well Standards, A100.
 9. CSA Standard B137.3
 10. NSF Standard 14
- B. All equipment and work performed on these wells and associated appurtenances shall comply with the requirements of ANSI/NSF International Standard 60 – “Drinking Water Chemicals” and ANSI/NSF International Standard 61 – “Drinking Water System Components,” hereby incorporated in this Specification by reference. These standards shall be applicable to all of the drinking water components of the project.
- C. The Contractor shall complete the work described in this Specification in accordance with applicable portions of the Rules of the SJRWMD including Chapter 40C-2 (Appendix F - APT Guidelines) and Chapter 40C-3. F.A.C and in accordance with the rules and regulations of the FDEP and other applicable regulatory agencies.
- D. All methods and materials used for the construction of ASR-1 and the monitoring wells shall be in accordance with the latest revisions of the American Water Works Association Standard for Water Wells (AWWA A100) as it applies to the particular needs or conditions encountered in the proposed work.

1.06 QUALITY ASSURANCE

- A. The sand content in the water from the completed ASR well shall not, at any time, exceed 5 mg/L during the 20-minute period after the pump starts pumping or 1 mg/L while the well is being pumped at 1400 to 2000 gpm. Sand content shall be

determined using a Rossum sand tester or approved equivalent centrifugal sand sampler as described in the Journal of the American Water Works Association, Vol. 46, No. 2, February 1954. The Contractor shall supply all sand testing equipment and perform the analysis in a method approved by the Engineer.

- B. The turbidity of the water from each completed well shall not exceed 1 NTU as measured on a calibrated Hach turbidimeter, or equivalent, while the well is being pumped at 1400 to 2000 gpm. The Contractor shall supply the turbidimeter and perform the analysis in a method approved by the Engineer.

- C. All wells (ASR-1, SZMW-1, SZMW-2 and SMW-1) shall be constructed and all casings and liners set round, straight, and plumb. To demonstrate compliance with the requirements, the Contractor shall perform the test described herein in conformance with AWWA A100, or equal. The Contractor shall provide all requirements of Appendix D of A100 including the Section D.5 items entitled "Items to be Furnished by Contractor." The test for plumbness and alignment shall be made following construction of the well and before test pump equipment is installed.
 - 1. Plumbness and alignment of all the well casings (ASR-1, SMW-1, SZMW-1 and SZMW-2) shall be tested via inclination survey as described in Paragraph 3.04 of this Section.

 - 2. Plumbness and alignment of the ASR well shall be tested by lowering into the well a section of pipe 40 feet long or a dummy of the same length, in conformance with AWWA A100, to approximately the lowest anticipated pump setting, or as directed by the Engineer. The outer diameter of the pipe or dummy shall be not more than 1 inch smaller than the inside diameter of that part of the casing or hole being tested. If a dummy is used it shall consist of a rigid spindle with three rings, each being 12 inches in length. The rings shall truly be cylindrical and shall be spaced one at each end of the dummy and one ring in the center. The central member of the dummy shall be rigid so that it shall maintain the alignment of the axes of the rings. The plumb line shall be suspended from the drilling rig or from a tripod with winch. An adjustable guide block shall be provided so that the test pipe or dummy shall hang in the exact center of the top of the well casing. As the pipe or dummy is lowered into the hole, the deflection of the plumb line from the exact center of the casing shall be measured every 10 feet. Upon completion of the running the 40-foot length of pipe or dummy as described above, the Contractor shall repeat Part 1, listed above, to the total depth of the well.

- D. Should the test pipe or dummy fail to move freely throughout the length of the casing or hole to a depth of 150 feet (lowest anticipated pump setting) or should the well vary from plumb in excess of 2/3 the smallest inside diameter of that part of the well being tested per 100 feet of depth, the plumbness and straightness of the well shall be

corrected by the Contractor at his sole expense. Should the Contractor fail to correct such faulty straightness or plumbness, the Engineer may refuse to accept the well.

- E. The Contractor shall conduct a hydrostatic pressure test of the final casing of each well (SZMW-2, SZMW-1, ASR-1, and SMW-1) as described in Paragraph 3.04 of this Section. Successful completion of the pressure test is necessary for Well Acceptance.
- F. No payment will be due to the Contractor for the well construction if the well fails to meet all of the above "Well Acceptance Criteria" requirements.

1.07 WARRANTIES

Warranties shall be in accordance with General Conditions, Supplemental Conditions, and Specification Section 01740, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be properly protected so that no damage or deterioration will occur during a prolonged delay from time of shipment until installation is completed and the well and equipment are ready for operation.
- B. Water samples shall be protected from freezing and shall be stored on ice at 4°C until received by the laboratory.
- C. Finished or machined iron or steel surfaces that are not painted shall be properly protected to prevent rust and corrosion.

1.09 QUALIFICATIONS

- A. The Contractor responsible for constructing the wells shall be licensed in Florida for at least three years as a water well Contractor employing only competent workers for the execution of this Work, and all such Work shall be performed under the direct supervision of an experienced well driller acceptable to the Owner and the Engineer. A copy of the Contractor's license shall be submitted at bid opening.
- B. The lead well driller shall be licensed in the State of Florida as a well driller for at least 5 years. The lead well driller shall be capable of identifying subsurface materials, maintaining complete and current well logs and daily notes for the well completion report, and developing and testing the well. A copy of the lead well drillers resume, documenting at least 5 years relevant work experience, shall be submitted at the time of bidding.

- C. The Owner and the Engineer may make any other investigations deemed necessary to determine the ability of the Contractor to perform the Work, and the Contractor shall furnish to the Owner and the Engineer all such information and data for this purpose as the Owner and Engineer may request.
- D. The Contractor shall, within 14 days of request, furnish satisfactory evidence that all materials to be furnished in performing the specified Work are new. All of the Contractor's equipment to be used in the performance of the Work shall be in good working order. If the Contractor's equipment malfunctions, the Contractor is responsible for re-performing work at no additional cost to the Owner.

1.10 PERMITS

- A. The Contractor shall, within 5 working days following receipt of Notice to Proceed from the Owner, apply for well construction permits from the SJRWMD office to construct the wells specified herein, in accordance with the Rules of the SJRWMD, Chapter 40C-3, F.A.C and from the Brevard County Department of Health. The Contractor shall also obtain all permits required by all other applicable regulatory agencies. The approved permits shall be available for inspection at the site at all times during construction. The Contractor shall be responsible for obtaining permit time extensions in accordance with the SJRWMD rule specified above if well construction drilling activities extend beyond the valid permit date.
- B. The Contractor shall be responsible for obtaining any additional federal, state, and local permits required for constructing the wells, discharging water from the site, and preparing the site (e.g. clearing the site for work or access).
- C. The Contractor shall not perform any drilling work on the wells until all required permits are obtained. Mobilization, above-grade site preparation, and site work can be performed before a permit is issued.
- D. The Contractor shall promptly furnish copies of all permits to the Owner and Engineer as the permits are received. Permits shall be submitted to Engineer via the shop drawing submittal in accordance with Paragraph 1.03 and Section 01340, Project Submittals and Approval.
- E. All work of this Section shall be in accordance with the conditions set forth in the permits. If permitting requirements conflict with the requirements of the Contract Documents, the Contractor shall notify Engineer in writing and await written instruction from Engineer before beginning work.

1.11 SAMPLES AND RECORDS

- A. Before the casing or materials are installed in the wells, the Contractor shall submit to the Engineer, in accordance with Paragraph 1.04, and Section 01340 Project Submittals and Acceptance, a legible written report listing the source and description of the materials to be used and the mill/material certificates.
- B. During drilling of the wells, the Contractor shall at all times maintain at the well site a complete and legible log setting forth the following:
 - 1. The daily water level elevation measurements from a known reference point before of drill rig starts.
 - 2. The reference point for all depth measurements in feet (NAVD).
 - 3. The depth at which changes of formation occur.
 - 4. The depth and interval of each cavity or void encountered during drilling.
 - 5. The identification of the material of which each stratum is composed.
 - 6. The depth interval from which each formation sample is taken.
 - 7. The depth interval from which each water sample is taken.
 - 8. The depth at which hole diameters change.
 - 9. The depth at which drilling method is changed from mud- to reverse-air-rotary.
 - 10. Other pertinent data requested by the Owner or Engineer.
- C. Formation samples shall be taken during drilling at 5 or 10-foot intervals as specified (depending upon well) and at formation changes, unless otherwise directed within the Specifications. Formation samples shall be collected and preserved in Hubco or equivalent sampling bags immediately upon retrieval in a manner approved by the Engineer. Three samples (split samples and cuttings) shall be collected from each interval and formation change. It is the Contractor's responsibility to deliver a set of formation samples to the Florida Geological Survey in Tallahassee and the St. Johns River Water Management District in Orlando. The third set will be retained by the Engineer. Each sample container shall be clearly and permanently labeled with the following information:

1. Physical location of the well (Rockledge WWTF)
 2. Name or number of the well (i.e., SMZW-2, SMZW-1, ASR-1 or SMW-1).
 3. Depth interval represented by the sample.
 4. Date taken.
 5. Time taken.
 6. Split number if split sample is collected.
- D. Core samples shall be collected and preserved immediately upon retrieval in a manner approved by the Engineer. The top and bottom of each core shall be clearly labeled. Each core box shall be clearly marked and permanently labeled with the following information:
1. Physical location of the well (Rockledge WWTF)
 2. Name or number of the well (i.e., SMZW-2, SMZW-1, ASR-1 or SMW-1).
 3. Depth interval represented by the sample.
 4. Date taken.
 5. Time taken.
- E. At SZMW-2 water quality samples shall be taken during drilling, in a method approved by the Engineer, at 10-foot intervals and at formation changes, unless otherwise specified herein. Samples shall be analyzed according to Schedule A of Table WQ-1 included at the end of Section 02600, Well Construction and Testing Plan.
- F. Water quality samples shall be collected and preserved immediately upon retrieval in accordance with FDEP Standard Operating Procedures and in a manner approved by the Engineer. Split samples shall be taken if directed by the Engineer. Laboratory-supplied water quality sample containers (sample kits) shall be provided by the Contractor. All samples are to be stored at 4°C at all times. It is the Contractor's responsibility to properly label, package, and ship the water quality samples to an offsite NELAC-certified laboratory. The Contractor shall direct the Laboratory to report water quality data directly to the Engineer. Proper Chain of Custody (COC) protocols are to be maintained at all times. Each sample container shall be clearly and permanently labeled with the following information:

1. Physical location of the well (Rockledge Wastewater Treatment Facility).
 2. Name or number of the well (i.e., SMZW-2, SMZW-1, ASR-1 or SMW-1).
 3. Depth interval represented by the sample.
 4. Date taken.
 5. Time taken.
 6. Split number, if split sample taken.
- G. Within 14 days of completion of the well, the Contractor shall also submit to the Engineer, in accordance with Section 01340, Project Submittals and Acceptance, a written report and as-built drawings to include the following minimum information:
1. The total depth of the borehole and the nominal borehole diameter of the borehole.
 2. The depth or location of any lost drilling fluid, drilling materials, or tools.
 3. The type and amount of drilling fluid additives used.
 4. The complete description (including, length, diameter, depth, and mill/material certificates) of all casings.
 5. The amount of cement (bags) used in grouting the well annulus, surface casing and pilot borehole, and the grouting method used.
 6. The type and placement depth of each packer assembly used during testing.
 7. The type, including make, size and horsepower, of each test pump used during well drilling and testing.
 8. A horizontal scale of 1" = 10" and a vertical scale of 1" = 10'.
 9. Other pertinent data as may be requested by the Engineer.

1.12 ADDITIONAL WORK

- A. At the option of the Engineer and/or Owner, additional work may be authorized. Additional work shall be completed at prices listed in the Bid Form or at prices not exceeding those of comparable work and materials, as authorized by Engineer if no bid prices are applicable.

PART 2 PRODUCTS

2.01 CASINGS

All well casings shall be fabricated as specified herein. A schematic diagram of the ASR well and the three monitor wells are included in the Contract Drawings. Table WCM-1 provided in this Section gives further details on the casing.

- A. Pit Casings: The Contractor may, at his option, install protective pit casings of sufficient diameter to accommodate the required surface casing drill bits for SZMW-2, SZMW-1, ASR-1, and SMW-1. The exact length, diameter, material, and installation shall be the Contractor's option subject to approval by the Engineer.
- B. Surface Casings:
1. SZMW-2: This casing shall be new, unused, steel, random length, 12-inches in diameter and have a minimum wall thickness of 0.375 inch. It shall be shop fabricated in not less than 20-foot lengths and shall contain one longitudinal seam parallel to the casing axis and not more than one circumferential seam in 10-feet. The ends of each joint shall be machine beveled perpendicular to the casing axis to insure the straightness of each assembled section. Approximately 150 feet of 12-inch surface casing will be installed in the exploratory/monitor well.
 2. SZMW-1: This casing shall be new, unused, steel, random length, 12-inches in diameter and have a minimum wall thickness of 0.375 inch. It shall be shop fabricated in not less than 20-foot lengths and shall contain one longitudinal seam parallel to the casing axis and not more than one circumferential seam in 10-feet. The ends of each joint shall be machine beveled perpendicular to the casing axis to insure the straightness of each assembled section. Approximately 150 feet of 12-inch surface casing will be installed in the monitor well.
 3. ASR-1: This casing shall be new, unused, steel, random length, 30 inches in diameter and have a minimum wall thickness of 0.375 inch. It shall be shop fabricated in not less than 20-foot lengths and shall contain one longitudinal seam parallel to the casing axis and not more than one circumferential seam in 10-feet. The ends of each joint shall be machine beveled perpendicular to the casing axis to insure the straightness of each assembled section. Approximately 150 feet of 30-inch surface casing will be installed in the well.
 4. SMW-1: This casing shall be new, unused, steel, random length, 12 inches in diameter and have a minimum wall thickness of 0.375 inch. It shall be shop

fabricated in not less than 20-foot lengths and shall contain one longitudinal seam parallel to the casing axis and not more than one circumferential seam in 10-feet. The ends of each joint shall be machine beveled perpendicular to the casing axis to insure the straightness of each assembled section. Approximately 150 feet of 12-inch surface casing will be installed in the monitor well.

C. Inner Casings:

1. SZMW-2: The inner casing shall be new, unused, schedule 40 PVC (Harvel Brand or equal), random length, 6 inches in diameter and have a minimum wall thickness of 0.280 inches. The casing shall meet the standards set in ASTM D1785 and meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid pipe for pressure applications, and shall bear those markings. The casing shall be installed at approximately 400 feet bls.
2. SZMW-1: The inner casing shall be new, unused, schedule 40 PVC (Harvel Brand or equal), random length, 6 inches in diameter and have a minimum wall thickness of 0.280 inch. The casing shall meet the standards set in ASTM D1785 and meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid pipe for pressure applications, and shall bear those markings. The casing shall be installed at approximately 400 feet bls.
3. ASR-1: The inner casing shall be new, unused, schedule 80 PVC (Harvel or equal), random length, 20 inches in diameter and have a minimum wall thickness of 1.031 inch. The casing shall meet the standards set in ASTM D1785 and meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid pipe for pressure applications, and shall bear those markings. The casing shall be installed at approximately 400 feet bls.
4. SMW-1: The inner casing shall be new, unused, schedule 40 PVC (Harvel or equal), random length, 6 inches in diameter and have a minimum wall thickness of 0.280 inch. The casing shall meet the standards set in ASTM D1785 and meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid pipe for pressure applications, and shall bear those markings. The casing shall be installed at approximately 250 feet bls.

Table WCM-1 Summary Of Materials Used For Well Construction						
Well ID	Casing String	Casing Material	Outside/Inside Diameter (inches)	Minimum Wall Thickness (Inches)	Weight (Lbs/Ft)	Approximate Depth BLS (feet)
SZMW-1	Surface	Steel	12.0 / 11.25	0.375		150
	Inner	Sch 40 PVC	6.625 / 6.031	0.280	3.73	400
SZMW-2	Surface	Steel	12.0 / 11.25	0.375		150
	Inner	Sch 40 PVC	6.625 / 6.031	0.280	3.73	400
SMW-1	Surface	Steel	12.0 / 11.25	0.375		150
	Inner	Sch 40 PVC	6.625 / 6.031	0.280	3.73	250
ASR-1	Surface	Steel	30.0 / 29.25	0.375		150
	Inner	Sch 80 PVC	20.0 / 17.814	1.031	41.047	400

- D. Welding: All welding shall be performed by an ASME Boiler and Pressure Vessel Code certified welder and the Contractor must supply proof of certification to the Engineer and the Owner prior to any installation of casing. All field welding shall be performed in accordance with the American Welding Society Standards. A minimum of two filler passes shall be made after laying the root bead and tack welding the joints together. If a continuous feed wire welding is used, the need for a second filler pass may be waived at the discretion of the Engineer.
- E. Mill Certificates: The Contractor shall supply the Engineer and the Owner copies of the mill certificates or certified test reports showing compliance with the physical and chemical properties of all casings specified herein prior to deliver of the casing to the WWTF.
- F. Centralizers: All casing shall be fitted with Halliburton-type centralizers with steel straps at 10 feet above the bottom of the casing and at 90-foot intervals to the top of the casing.

2.02 CEMENT GROUT

- A. All cement installed shall conform to the latest revision of ASTM C150, Type 2, confirming to API Standard 10A. Neat cement shall contain no more than 5.2 gallons of water per 94-pound bag. Lost circulation materials (flocel and/or gillsonite) and additives may be used once approved by the Engineer, but not in excess of 12 percent. Only 10 percent additives may be used with up to 2 percent accelerators. Cement additives will only be approved in zones of high permeability.

The bottom 200 feet of each casing will have no additives or fillers in the neat cement mixture.

- B. Cement Baskets: A cement basket of approved design will be attached to the base of the inner casings. The baskets will be opened with gravel through a tremmie pipe. Two feet of bentonite mud will be placed over the gravel before a minimal (5 feet) cement lift is installed.
- C. Cement Samples: One sample of each lift (one sample per lift) of cement shall be taken by the Contractor and submitted to the Engineer. The Contractor shall submit chemical analysis of the dry cement to the Engineer at least 72 hours prior to cementing operations.
- D. Cementing Program: The Contractor shall complete and submit a copy of a cementing program form to the Engineer prior to the cementing operations.
- E. Casing Integrity: If any of the casings should break or collapse or their integrity is not satisfactory and/or the grout emplacement is of poor quality, the casing shall be withdrawn and replaced at the Contractor's expense. If the casing can not be withdrawn, the Contractor will plug and abandon it at his own expense and in a manner approved by the Engineer. Another well will then be brought to the same level of completion, at another site selected by the City of Rockledge, at no additional cost.

2.03 TEST PUMPING EQUIPMENT

- A. Test Pump: For pumping tests conducted during the testing of the 12-inch pilot borehole supply a test pump adequate to discharge at least 800 gpm under atmospheric conditions and shall provide an enclosed conduit so that depth to water level during pumping may be measured using an electric tape or electronic water level data logger. The test pump and column pipe couplings shall be no more than 6 inches in diameter. The Contractor is advised that pump selection will depend upon the formation being tested and may result in changing to a larger or smaller capacity pump once testing has begun. The cost of changing pumps shall be included in the costs of the packer test.
- B. For the aquifer performance test (APT) and the pre- and post-acidization specific-capacity pump tests supply a test pump adequate to discharge at least 2100 gpm under atmospheric conditions and shall provide an enclosed conduit so that depth to water level during pumping may be measured using an electric tape or electronic water level data logger. The test pump and column pipe couplings shall be no more than 16 inches in diameter.

- C. The Contractor is responsible for supplying power to all construction and testing equipment. Any generator used for the test pumping of the well shall have the necessary capacity to adequately power the selected test pump through the pumping period and discharge range.
- D. Discharge pipe: shall be of a diameter and length adequate to transmit water from the well site to a designated discharge point located a minimum of 400 feet from the well and acceptable to all regulatory agencies. Coordinate with all regulatory agencies to determine an acceptable discharge location and the proper discharge method. Discharge pipe shall be in good condition and shall be free from leaks. A duplex hose bib suitable for collecting representative water samples shall be located on the discharge piping upstream of the flow meter and as approved by Engineer. Hoses shall not block or impede vehicular traffic.
- E. Flow Control Valve: provide a valve, located at the well head, suitable for controlling flow through the discharge pipe.
- F. Flow Meter: provide a flow meter calibrated for the range of the required test and designed flow and pipe size and capable of an accuracy of 5 % or better. Furnish the Engineer with flow meter calibration certificate for all flow meters used. Meter(s) shall have been calibrated within the last 3 months before testing activities. The flow meter shall be installed as specified by the flow meter manufacturer for accurate operation. The flow meter shall be located a minimum of 10 pipe diameters upstream from the flow control valve and 5 pipe diameters from any bend in the discharge line. The meter(s) shall be capable of accurately showing flow rates appropriate for the test being conducted, as approved by Engineer.
- G. Data Loggers: provide *Insitu Minitroll or Leveltrol (or equal)* data loggers to be used during testing. Data loggers shall be capable of measuring water levels accurately to within 0.01 feet and in both linear and logarithmic time scales. All devices shall be in good working condition and shall have been calibrated by factory within one year of test. Supply all associated hardware and software for operating data loggers.
1. Data from the logger will be given to Engineer on a compact disk in an ASCII tabular format or Microsoft Excel file format. The Contractor shall retain a copy of the data for their records.
 2. The Contractor is solely responsible for proper operation of the data logger. If the data logger fails during the test, the Contractor shall be required to re-run the tests as needed, without additional charge to the Owner, until such time that accurate data are collected. The Engineer shall be the sole judge as to data integrity.

2.04 PACKER AND PACKER TESTING

- A. Straddle Packer: Baker, TAM 3, Baski, YBI, or equivalent straddle packer, in good working condition, of a diameter appropriate for the size of the hole as calipered by the geophysical logging. The packer shall seal tightly against the borehole walls to effectively isolate the interval between the packers. The Engineer shall be the sole judge as to the effectiveness of the packer element's isolation of other sections of the borehole. The Contractor shall furnish drill pipe and all required fittings for running and setting the packer to the appropriate setting depth and as specified by the manufacturer. Packer element separations shall be between ten to sixty feet and shall include section of slotted pipe as approved by the Engineer.
- B. Off-bottom Packer: Baker, TAM J, Baski, YBI, or equivalent open-hole packer, or equal, in good working condition, of a diameter appropriate for the size of the hole as calipered by the geophysical logging. The packer shall seal tightly against the borehole walls to effectively isolate the interval below the packers. The Engineer shall be the sole judge as to the effectiveness of the packer element's isolation of other section of the borehole. The Contractor shall furnish drill pipe and all required fittings for running and setting the packer to the appropriate setting depth and as specified by the manufacturer.
- C. Packers shall be run on drill pipe or tubing having a minimum inside diameter of 6 inches from the surface to the appropriate testing depths.
- D. The Contractor shall furnish the Engineer with a packer schematic and manufacturer's recommended installation and operating information. This shall include at a minimum the recommended borehole size range of packer, the inflation pressures required to inflate the packer to its minimum and maximum diameter, recommended sealing pressure, inflation instructions detailing method of inflation (i.e., nitrogen, water, etc.), and methods for determining proper packer seating. Packer submittals shall be received by the Engineer at least 5 working days before packer testing activities.
- E. The Contractor shall furnish the Engineer with a calibration certificate for the gauge used for packer inflation. The gauge shall have been calibrated within the last 3 months before packer testing activities and be capable of measuring pressures from 0 to 150 % of required packer inflation pressure. The gauge shall have divisions of 10 psi or less and be certified accurate to plus or minus 2 % over its entire range.
- F. The Contractor shall provide three water level data loggers to be used during the packer testing as described in Paragraph 2.03 (Test Pumping Equipment). Data loggers will be set above, within, and below the packer.

2.05 TEMPORARY WELL COVERS

- A. Whenever work on the well is interrupted, such as during an overnight shutdown, the well opening shall be sealed with a substantially non-removable (i.e., except by Contractor) cover in accordance with the Rules of the SJRWMD, Chapter 40C-3, F.A.C. At all times during construction on the well, the Contractor shall use reasonable precautions to prevent tampering with the well and the entrance of foreign material into the well.

2.06 DRILLING FLUIDS AND HANDLING FACILITIES

- A. The use of special drilling mud, fluid additives, or lost circulation material must have prior approval by the Engineer and must be universally acceptable for use in raw water supply wells providing potable water to a municipal system.
- B. All water used in the construction of the well shall be clear, chlorinated water. The Contractor shall be responsible for providing any piping or water hauling vehicles (tankers) needed to convey this water to the site of the work.
- C. The ASR well and Floridan aquifer monitor wells will have a tendency to flow after the installation of the surface casing. The Contractor will be required to prevent the spillage of formation waters onto the land surface. Steel lined temporary drilling pads or an alternate fluid containment system shall be proposed by the Contractor to the Engineer for approval. The system should be of sufficient size to accommodate all drilling equipment, including pumps, engines, generators, tanks, fluid handling devices, etc., and be of sufficient size to accommodate the well drilling activities. The water table monitoring well (WTMW-1) will be sampled weekly by the Contractor according to Schedule A of Table WQ-1 of Section 02600, Well Construction and Testing Plan in a manner approved by the Engineer. If spillage of fluids is observed, recorded and/or detected the Contractor will be required to restore the natural resident water quality to the water table aquifer at his own expense and in a method approved by the Engineer.
- D. When drilling mud is used in drilling, only high grade approved clays in common usage for oil field drilling shall be used in the makeup of the drilling fluid. Drilling with a mixture of water and unprocessed mud, clay, or other objectionable material, will not be permitted. The drilling fluid shall possess such characteristics as are required to adequately condition the walls of the hole to prevent caving of the well as drilling progresses.
- E. The Contractor shall supply a closed, steel lined circulation system for all drilling operations. To facilitate water quality collection, the reverse circulation system will be a semi-closed system meaning that only a minimal amount of formation fluid will

be allowed to recirculate during drilling in non-productive intervals. The cuttings will be removed and fluids either returned to the drill hole or disposed of in a manner approved by the Engineer. Steel tanks or leak proof containers of sufficient capacity to store a minimum of 20,000 gallons of fluid and cuttings will be a part of this system. The system will also have suitable devices for the removal of cuttings from drilling fluids such as; shale shakers, settling tanks and/or screens. The Contractor shall submit for the Engineer a shop drawing of the circulation system.

PART 3 EXECUTION

3.01 GENERAL

- A. The drilling and testing plan for SZMW-2 will be similar to that of an Exploratory Well. If the results of exploratory drilling and testing at SZMW-2 indicate that suitable zones for aquifer storage and recovery exist then the three other wells SZMW-1, ASR-1, and SMW-1 shall be constructed.
- B. The water table monitor well (WTMW-1) described in Section 02671, Water Table Monitoring Well will be constructed prior to the wells described in this Section.

3.02 WELL LOCATIONS

- A. The wells will be located on the southern portion of the Rockledge WWTF property as depicted in the contract drawings. The location of the sites will be clearly marked by the Engineer for the Contractor to review prior to mobilization. The Contractor shall accept these locations as shown and it is his responsibility to familiarize himself with the actual site conditions before commencing work. The City of Rockledge reserves the right to change the location of the new wells to a similar site on the property. The proposed unit prices shall remain the same even if the well locations are changed.
- B. It shall be the Contractor's responsibility to engage a registered Professional Surveyor to locate the horizontal position of the wells on the Rockledge WWTF property and vertical measurement points for the drilling and logging operations. Elevations shall be referenced to North American Vertical Datum of 1988 (NAVD 88). The well locations shall be surveyed prior to the onset of drilling activities.

3.03 MOBILIZATION

- A. Permits: The Contractor is responsible for obtaining all permits necessary to conduct the work described herein. The City of Rockledge will reimburse the Contractor the costs of all permit fees.

- B. Site Preparation: The Contractor shall clear all shrubs, trees, stumps, timber, brush, and any other objects in the site area as approved by the Engineer or the Owner. These materials shall be moved to an off site disposal area, as approved by the Engineer.
- C. Install Pit Casings: The Contractor may install a protective pit casing with an inside diameter capable of appropriately accommodating the surface casing and drill bits for each well. The pit casings, if installed, shall remain in place.
- D. Construct Drilling Pads: Temporary steel lined drilling pads or other temporary fluid containment systems will be constructed to prevent any spillage of fluids during construction as described in Part 2.06 of this Section. The Contractor shall propose a containment system for approval by the Engineer.
- E. Set-up Well Drilling Rigs: Drilling equipment capable of performing the described construction activities will be supplied and set-up by the Contractor. The equipment will be in first class working condition and capable of handling the largest load placed upon it during construction activities. The drilling rig will be equipped with a geograph capable of recording depth, drilling time, and weight of the tool string during drilling of the pilot and reamed holes. The Contractor will also be required to use drill string of the same diameter with no hole restrictions in collars, hoses, and/or fittings. Air compressors used during reverse air drilling will be of adequate size to remove cuttings and fluids from the borehole. A back-up air compressor capable of producing over 240 psi shall be available at the site for the duration of drilling.
- F. Cement Placement: The grout shall be placed in the wells by a qualified cementing subcontractor approved by the Engineer. Before grouting, water or other fluids shall be circulated in the annular space sufficiently to clear obstructions. The cementing method used shall conform to those specified in SJRWMD Chapter 40C-3, F.A.C. When tremmies are used each lift shall be allowed to harden for a minimum of 12 hours and be tagged before continuing with cementing. After the well casings are cemented to the surface they must remain undisturbed for 24 hours. Pit casings if (installed) shall have a minimum curing time of 24 hours. All cementing operations will be carried out in the presence of the Engineer.

3.04 DRILLING AND TESTING

- A. The reverse air circulation method of drilling shall be required after installing the surface casing. No salt shall be utilized as a drilling fluid.
- B. After proper settling and filtration, excess drilling fluid produced during drilling below the surface casings can be discharged to the Rockledge Wastewater Treatment Facility. The Contractor will be responsible for the installation and maintenance for all conveyance piping to the Owner's system in a method approved by the Engineer.

- C. The discharge line shall be equipped with a calibrated in-line flow meter (6-digit, straight reading totalizer registering in units of 100 gallons). The meter will also be equipped with a flow rate indicator (gpm) suitable for the expected flow range.
- D. Bentonite or other materials shall not be utilized without approval by the Engineer. If utilization of these materials is necessary due to lost circulation or other drilling problems that may arise, the Contractor shall submit the procedure to the Engineer for review.
- E. A blow-out preventer will be kept on site during the drilling operation. The blow-out preventer will be placed on the well during lapses in the drilling operation. The Contractor will be required to demonstrate that all of the drill crews are capable of installing the blow-out preventer within 15 minutes. It shall be the Contractor's responsibility to clean up any spillage of formation fluids that are recorded or detected in the shallow (water table) monitor well at his expense.
- F. A short term (15 to 30 minute) air lift, specific capacity test shall be conducted by the Contractor prior to each drilling rod change during the reverse air drilling operations. Water levels will be measured from a known reference point each day prior to starting drilling activities during reverse air drilling.
- G. Excess cuttings, mud and/or water may be temporarily stored in a settling tank for all drilling and testing operations. The excess from the settling tank shall be properly transported off-site for disposal at a site approved by the Engineer. The Contractor will be required to obtain all necessary permits for the use of a disposal site and submit written evidence to the Engineer showing compliance with such. Discharge of mud, water, and cuttings will not be allowed at the site on the land or adjacent bodies of water at any time during construction.
- H. Deviation Surveys: During the drilling of pilot holes and reaming of the open holes to the total depth of the well a straight hole (drift indicator shur-shot, with 3 degree targets or equivalent) survey will be made every 60 feet. Records of the deflection readings will be made a part of the permanent record. The original disks will be kept by the Engineer. The maximum allowable inclination from vertical at any portion of the hole shall be less than 1 degree. Any deviation of 1 degree or greater shall be corrected by the Contractor to the satisfaction of the Engineer and at no expense to the Owner prior to further deepening of the well.
- I. The Contractor will utilize appropriate bottom hole assembly and staged reaming bit assembly to ensure pilot hole is properly tracked and encompassed by the reamed hole.

- J. The Contractor shall obtain water samples at 30 foot intervals starting at the base of the surface casing (approximately 150 feet bls) to the base of the pilot hole at each well. Each sample shall be collected in accordance with Paragraph 1.07 of this Section and analyzed according to Schedule B of Table WQ-1 of Section 02600, Well Construction and Testing Plan.
- K. The Contractor shall collect core barrel samples as described in this Section.
1. Drilling shall be stopped to collect these core samples, no standby time shall be charged by the Contractor.
 2. The core barrel samples shall have a minimum length of ten feet and diameter of 4 inches.
 3. The core barrel shall be advanced by being rotated its full length into the undisturbed formation.
 4. Once the core has been withdrawn, recovered, properly marked, and stored in approved core boxes, it shall be given to the Engineer for analysis. The Contractor will be paid only for footage recovered.
 5. The core shall then be sampled by the Engineer and shipped to a laboratory approved by the Engineer (such as CORE LAB, in Houston, Texas) for analysis at the Contractor's expense.
 6. The analysis that shall be done on all core samples from the well will include; vertical and horizontal permeability (ASTM D2434), porosity, specific gravity (ASTM D854), elastic modulus (ASTM D7012) and compressive strength (ASTM D7012).
- L. For each monitor well the Contractor will be required to propose a method of cementing the final casing in place. The method must prevent cement from accidentally sealing off the proposed monitor zone.
- M. The Contractor shall conduct a hydrostatic pressure test of the final casing of each well (SZMW-2, SZMW-1, ASR-1, and SMW-1) after cementing. The casing shall be filled with water and placed under maximum of 50 psig for a period of 60 minutes.
1. The criterion for acceptance of the well is no greater than 5 percent of test pressure for the period of the test. If the pressure changes or if there is some other indication of leakage in the equipment, the Contractor shall take steps to locate the leak and make repairs in a manner approved by the Engineer.

2. The Contractor shall provide a Baker, TAM J, Baski, YSI, or equal, inflatable down-hole packer, in good working condition, and of a diameter appropriate for the inside diameter of casing to be tested. The packer shall seal tightly against the casing walls to effectively isolate the interval of casing to be pressure tested. The down-hole packer must be seated within the bottom 5-feet of the casing string to pressurize all casing joints during the casing pressure test. The Contractor shall provide drill pipe and all required fittings for running and setting the packer to the appropriate setting depth and as specified by the manufacturer.
3. Pressure test apparatus will consist of a wellhead assembly equipped with a pressure gauge that can seal the wellhead without leak to a pressure of 50 psig, a water line with valve that can be used to shut in the well when the pressure reaches maximum available pressure, and a potable water source and pump that can be used to increase the pressure in the well to the desired level. The certified pressure gauge shall have a range from 0 to 100 psi with 1 psi increments.
4. The test shall consist of increasing the pressure in the casing to at least 50 psi, shutting in the well, and monitoring the pressure for 1 hour. The pressure measured at the wellhead shall be recorded every 5 minutes for the entire period of the test. The Contractor shall notify the Engineer at least 72 hours before the start of the test.
5. The Contractor shall conduct a preliminary test to determine if the test apparatus leaks. All apparatus shall be leak free before the pressure test commences.
6. The Contractor shall notify the Engineer at least 12 hours before starting the preliminary test.
7. If the well fails the pressure test described above, the Contractor must re-run the test until the well passes within the range of acceptance stated above. In the event that the pressure in the well cannot be maintained, the Contractor will set a mechanical (inflatable) packer at another depth and repeat the test. This procedure will be repeated until the leak is located.

3.05 WELL COMPLETIONS

- A. Final Capping: After the wells have been completed, the Contractor shall furnish and install suitable connections and materials for capping the wells. The wells shall be capped in a manner to prevent leakage from the well. Top of casing shall be not less than 2 feet above ground level. The wells shall be capped and completed as depicted in the contract drawings.

3.06 WELL ABANDONMENT

In the event the Contractor is directed to abandon a well(s) for failure to sink the well to the specified depth, failure to meet the requirements of the specifications, or loss of drilling tools, he shall remove salvageable materials from the well(s) and fill the abandoned hole(s) with cement in a method approved by the Engineer and required by Federal, State (SJRWMD Ch. 40C-3), and local regulations. He shall then move to a site selected by the City of Rockledge and bring a new well(s) to the same level of completion as the first at his own expense. Salvageable material(s) shall not be reused on the project. The following procedures will be utilized to abandon the wells:

- A. Calculate the quantity of neat cement needed to fill the open hole below the base of the inner casing.
- B. Suppress the flow in the well(s) with weighting materials.
- C. Remove wellhead and monitor water level closely.
- D. Run tremmie pipe to the base of the well.
- E. Pump the calculated quantity of neat cement plus 10% into the well(s).
- F. Pull tremmie up above pumped cement and circulate with fresh water. Let cement cure for eight hours then tag with tremmie pipe.
- G. Cement well(s) back to surface.

3.07 AQUIFER PERFORMANCE TEST

- A. Once well construction is complete, an aquifer performance test (APT) will be performed and water samples collected. The APT will be conducted under the general guidelines set forth in SJRWMD Ch. 40C-2 (Appendix F).
- B. The APT will consist of both a 48-hour constant rate discharge test and a 10-hour step drawdown test. The Contractor shall equip the wells with an electronic data logging pressure transducer capable of displaying the downhole pressure in real time. The pressure data shall also be simultaneously captured in an electronic format (such as In-Situ, Hermit, or Diver) for downloading as an ASCII file for the Engineer in accordance with Subpart 2.03 of this Section.
- C. The Contractor shall furnish an electrical depth gauge, capable of indicating depths to water to the nearest one-hundredth foot, with sounding tube placed to the maximum depth to water anticipated in the ASR (pumping well) and shall also furnish an air source and air line having a direct reading gauge calibrated in feet.

- D. The Contractor shall provide access to the wells for the placement of pressure transducers. Transducers located in the pumping well shall be housed in a PVC stilling well with an I.D. that is at least 3/8" larger than the O.D. of the transducer. A period of time (3 days) is required for pump shut down and water level recovery between the final well development of SMW-1 and the constant rate pumping test. There will be no additional payment for rig time or standby time during these periods of well recovery.
- E. A 10-hour step drawdown test shall commence after the water level in SMW-1 has recovered from well development pumping for at least 3 days.
1. Before the pumping phase of the step drawdown test, 24-hours of background water level data will be recorded.
 2. Background water level data will be recorded on 15-minute intervals. Up to five (5) pumping rates will be utilized during the step drawdown test. The pumping rates will be determined by the Engineer.
 3. The Contractor shall assure that the pumping rates selected remains constant throughout each step test. The pumping phase of each step test shall have a duration of at least 2-hours.
 4. When the test is completed and the pump stopped, the Contractor shall not remove the test pump from ASR-1 for a period of approximately 24 hours while recovery data is being recorded by the transducers.
 5. The data loggers will be set to record on a decaying logarithmic scale during each pumping phase and during the recovery phase of the test.
- F. Once the step drawdown test is complete, a continuous, 48-hour, constant rate, time-drawdown test shall commence.
1. Before the pumping phase of the APT 24-hours of background water levels (in addition to the recovery data from the step drawdown test) will be recorded by the transducers.
 2. Background water level data will be recorded on 15-minute intervals.
 3. The rate of pumping will be determined by the Engineer. The Contractor shall assure that the pumping rate selected remains constant throughout the test.

4. The pumping phase of the test shall have a duration of 48 hours. When the test is completed and the pump stopped, the Contractor shall not remove the test pump from ASR-1 for a period of approximately 24 hours while recovery data is being recorded by the transducers.
 5. The data loggers will be set to record on a decaying logarithmic scale during both the pumping and recovery phases of the test.
 6. During the 48-hour constant rate pump test the Contractor will collect water quality samples at the beginning, middle and end of the test for analysis according to Schedule C of Table WQ-1, Section 02600, Well Construction and Testing Plan.
- G. The Contractor shall record the discharge rate with a calibrated in-line flowmeter device equipped with a totalizer.
- H. In addition to these measurements, the Engineer may require the Contractor to periodically record the temperature of the discharge water or collect water samples.
- I. During the test, the Contractor shall record the water levels during according to the following schedule, at a minimum, for the initial 4 hours:
1. 0 to 10 minutes (every minute).
 2. 10 to 40 minutes (every 5 minutes).
 3. 40 to 240 minutes (every 10 minutes).
 4. After 4 hours and for the duration of pumping phase of the APT water level measurements will only be collected twice hourly.
- J. During the recovery phase of the APT, the Contractor shall measure the recovering water levels according to the following schedule, at a minimum, for the initial 4 hours:
1. 0 to 10 minutes (every minute).
 2. 10 to 40 minutes (every 5 minutes).
 3. 40 to 240 minutes (every 10 minutes).
 4. After 4 hours and for the duration of recovery phase of the APT water level measurements will only be collected twice hourly.

- K. If the measurements are not made exactly at the times specified, the actual time of each measurement shall be recorded. On completion of pumping, recovery measurements shall be made according to the above drawdown schedule.
- L. The Contractor shall provide supervision of the APT on a continuous basis by qualified personnel.
- M. If either test is aborted or interrupted for any reason, the test shall be stopped. The water level will be allowed to recover, background water levels will be recorded, and the test will be restarted as described above. No payment will be made to the Contractor for interrupted pumping tests.
- N. After the test pump has been removed, the Contractor shall remove any accumulated sediment from the well.

3.08 DEMOBILIZATION

The Contractor shall demobilize, remove all equipment from the site and restore the site to preconstruction condition as specified herein.

END OF SECTION