July 14, 2015

BOARD OF COUNTY COMMISSIONERS
ORANGE COUNTY, FLORIDA

IFB Y15–790 PH, ADDENDUM NO. 5

MALCOLM ROAD WATER SUPPLY FACILITY PRODUCTION WELLS MR1, MR2, MR3, MR5, AND MR6 DRILLING AND TESTING

REVISED BID OPENING DATE: July ~~16~~ 21, 2015

This Addendum is hereby incorporated into the bid documents of the project referenced above. The following items are clarifications, corrections, additions, deletions, and/or revisions to and shall take precedence over the original documents. Additions are indicated by **underlining**.

A. The Bid Opening date is changed to July 21, 2015 at 2:00 P.M.

B Questions and Answers

Question No. 1: The general specifications call for a 5 year warranty on parts and workmanship while Section 2050-1.10.F calls for only a 1 year warranty. Can you please clarify which is correct? There is also a contradiction between this section and Section 2050-1.15.A. The 5 year warranty will require a higher bond cost should it be correct?

Response No. 1: ***The warranty on parts and workmanship shall be for a period of five (5) years from the date of final acceptance by the OWNER. Section 02050 has been revised to reflect this change and the changes have been underlined within 02050.***

Question No. 2: The lithology for Well MR-LF-1 provided in Addendum No. 3 seems to stop at a depth of 460 feet when the well was drilled to a depth of 980 ft per the drawing also provided in Addendum No. 3. Looks like only 12 of the 34 page litholog was attached to the addenda. Can you please provide the remainder of the lithology if available?

Response No. 2: ***A Copy of the test well lithology is provided with this addendum.***

C. Attachments:

1 Section 02050

2. Geologic Logs

D. ACKNOWLEDGEMENT OF ADDENDA

a. The Proposer shall acknowledge receipt of this addendum by completing the applicable section in the solicitation or by completion of the acknowledgement information on the addendum. Either form of acknowledgement must be completed and returned not later than the date and time for receipt of proposal.

b. All other terms, conditions and specifications remain the same.

c. Receipt acknowledged by:

_____ _____

Authorized Signature Date Signed

_____

Title

_____

Name of Firm

SECTION 02050

MALCOLM ROAD WSF LOWER FLORIDAN AQUIFER PRODUCTION WELLS

PART I – GENERAL

1.01 THE REQUIREMENT

A. General: The work described herein consists of constructing public supply wells in accordance with the Specifications and Figures (Figures 1 through 3) contained herein. The work shall be performed by a licensed Florida Water Well Contractor with equipment which is adequate to complete all phases of well construction. All work shall be performed under the direct supervision of an experienced well driller and an adequate number of competent helpers. If the CONTRACTOR's equipment is not capable of satisfactorily performing the work provided for in these Specifications, the CONTRACTOR at his own expense shall substitute equipment satisfactory to the OWNER. All work shall be completed in full conformance with St. Johns River Water Management District (SJRWMD) and Florida Department of Environmental Protection (FDEP) rules and regulations for water wells, or this Specification, whichever is greater or more restrictive.

B. Site Access: The CONTRACTOR shall make arrangements with the OWNER in order to gain access to the site. The contact person is Mark Paquette (407-254-9786).

C. Production Wells: The CONTRACTOR shall provide all equipment, labor and materials to construct, develop, test, and log, five (5) lower Floridan aquifer (LFA) production wells at the Malcolm Road Water Supply Facility (MRWSF). The well, and all appurtenant work, will be constructed in accordance with the requirements of the Contract Documents, Specifications, and Figures contained herein.

D. Sound Proofing: The CONTRACTOR shall provide mufflers on equipment, and take whatever other steps necessary during drilling, pumping, testing, and all other work incidental there to ensure that noise levels conform to any County or other applicable noise ordinances. The CONTRACTOR will take necessary measures to limit access to the drilling site to minimize public hazards. Refer to Section 01500.

E. Work Hours: The CONTRACTOR shall limit work hours between 7:00 a.m. and 7:00 p.m. Monday through Friday, unless given approval by the OWNER.

F. The CONTRACTOR shall complete the work, disinfect where applicable, and prepare the well for continuous service. The CONTRACTOR shall make repairs, replacements and restoration required as a result of any damages caused during construction and/or testing. The CONTRACTOR will restore all areas disturbed during progress of work.

G. The OWNER/ENGINEER/GEOLOGIST reserves the right to move to an alternate site for drilling and constructing a well if unfavorable subsurface hydrogeologic conditions are encountered at the site.

H. The CONTRACTOR shall notify the SJRWMD and Orange County Department of Health, as required by regulations, prior to placement of any cement grout, and whenever else required for the construction of the well.

1.02 SCOPE OF SERVICES

A. The Work to be performed under this Section includes the furnishing of all labor, materials, equipment, and all other facilities and incidentals necessary to construct, develop, and test five production wells with approximate construction specifications as summarized below.

Well	Casing Length	Total Depth	Casing Diameter
Production Well MR-1	1,050'	1,300'	24"
Production Well MR-2	1,050'	1,300'	24"
Production Well MR-3	1,050'	1,300'	24"
Production Well MR-5	1,050'	1,300'	24"
Production Well MR-6	1,050'	1,300'	24"

The production wells will be located at the Malcolm Road Water Supply Facility (MRWSF) in west Orange County, Florida as shown in **Figure 1**.

Casing for the production wells shall be constructed of new black steel pipe. The production wells shall each be capable of producing 3,500 gpm with the lowest practical amount of drawdown. The 24-icnh casing for the production wells shall be set a minimum of 10 feet into competent limestone. A combination of the mud rotary method and the reverse air method shall be used to construct the wells. Alternate drilling methods may be proposed by the CONTRACTOR, but are not to be utilized unless prior approval from the ENGINEER/GEOLOGIST is provided. A detailed well location map is provided as **Figure 2**. Typical well construction details are shown in **Figure 3**.

The proposed well shall be constructed to public supply standards as described by the St. Johns River Water Management District (SJRWMD) and Florida Department of Environmental Protection (FDEP) rules and regulations, and shall comply with any other applicable federal, state and local rules and regulations.

B. The CONTRACTOR shall establish his work sequence based on the use of crews to facilitate completion and testing within the allotted contract time.

C. A series of geophysical logs will be performed on the production wells during construction and a final suite of geophysical logs plus a video log will be performed on each well after completion. The geophysical logs performed during construction will include caliper, gamma ray, spontaneous potential and resistivity. The final suite of geophysical logs performed after construction will include caliper, flow (dynamic and static), gamma ray, spontaneous potential, resistivity, acoustic, and temperature. The video log will be made with a color video camera with 360° directional side viewing capability and be performed while the well is flowing.

D. A step drawdown test will be performed on each production well and shall be conducted in order to show proper development. The Work includes furnishing all labor, materials, equipment, and all other facilities and incidentals necessary to perform the step-drawdown test.

E. A 24-hour constant rate discharge test will be performed on only one (1) production well yet to be determined after all production wells are installed and developed. The Work includes furnishing of all labor, materials, equipment, and all other facilities and incidentals necessary to perform the constant rate discharge test

F. The Work includes the furnishing of all labor, materials, equipment and all other facilities and incidentals necessary to disinfect each well and bacteriologically clear them after pump removal, as required by FDEP.

G. Location of all existing utilities will be the CONTRACTOR's responsibility. Damage to any utilities shall be repaired at the CONTRACTOR's expense.

H. Water quality samples shall be collected in specially designated and approved sample containers provided to the CONTRACTOR by OCU LABORATORY for the specific parameters required by these specification documents. The CONTRACTOR is responsible for contacting the LABORATORY ahead of time in order to pick up the sample containers. All sample containers shall be requested by phone (407-254-9550) two (2) business days in advance of when they are to be picked up by the CONTRACTOR, as directed by the ENGINEER/GEOLOGIST or the OWNER's REPRESENTATIVE. Business hours are 8 am to 5 pm Monday through Friday, excluding holidays.

I. These Specifications are intended to be a general description of the required work, but may not cover all contingencies that may occur during well construction. Changes or variations from the work plan shall be approved by the ENGINEER/GEOLOGIST, prior to execution.

1.03 REFERENCE TO STANDARDS

A. AWWA, ASTM, ANSI, and API standards shall apply as referenced herein. Standards shall include, but are not restricted to the following:

1. AWWA Water Well Standards, A100-97 and A100-90.
2. ASTM Pipe Standards A53, D2241 and F480.
3. API Pipe Standards, 5L.
4. ASTM Portland Cement Standards, C 150-92.

B. The wells shall be disinfected to remove bacteriological contamination in accordance with AWWA Water Well Standards AWWA C654-2013.

1.04 SUBMITTALS

A. General: All CONTRACTOR submittals shall conform to the applicable requirements as specified by OWNER and the supplementary requirements specified. All measurements for depths shall be referenced to ground surface at the well site.

B. Schedule: The CONTRACTOR shall submit a work schedule that includes the major components of the project. The work schedule shall be submitted to the OWNER and ENGINEER/GEOLOGIST as specified under Part F-Article 18 and Section 010310 of the specifications.

C. Materials and Shop Drawings: Copies of all materials required to establish compliance with the Specifications shall be submitted. Submittals shall at least include descriptive literature, bulletins, and/or catalogs providing description of all materials and mill certifications by material and specification (e.g., ANSI). These submittals shall include, but not be limited to the surface casing, well casing, and drilling fluid products.

D. Supplier's List: The CONTRACTOR shall submit a complete list of all proposed vendors, and suppliers, along with corresponding material specifications to be used in the work. The Materials and Supplier's List shall be submitted to the OWNER and ENGINEER/GEOLOGIST one week prior to mobilizing the rig to the site.

E. Applications for Payment: The CONTRACTOR shall submit copies of all applications for payment to the OWNER.

F. Subcontractor's List: The CONTRACTOR shall submit a complete list of all proposed subcontractors to be used in the work, for acceptance by the OWNER, one week prior to mobilizing the rig to the site. The CONTRACTOR may be required to submit additional information or a resume of qualifications for any of the subcontractors proposed.

G. Welders: Prior to the start of work, the CONTRACTOR shall submit a list of the welders he proposes to use during well construction, and the type of welding for which each has been qualified, along with current certification documents for each welder listed.

H. Daily Log: The CONTRACTOR shall maintain a detailed daily log of events for his activities on the site during well construction and testing. The information shall be recorded on Daily Drilling Report forms. Failure to keep this log up to date on a weekly basis shall be grounds for the ENGINEER/GEOLOGIST to stop drilling operations. No standby time will be paid. The report forms should include information on bit assembly and drill string, drilling mud and additives, fluid losses, water- and fluid- level changes, footage drilled and formations encountered, change in formation, hard and soft zones, and cementing operations. Installed quantities of items identified on the Bid Form should be included in the daily log. In addition, information relative to maintenance and repair time, along with details of repair, CONTRACTOR'S personnel/sub-contractors personnel, and other pertinent information shall be included. Development and pump testing records shall also be included and attached. One legible form (with any attachments) suitable for photocopying shall be submitted to the ENGINEER/GEOLOGIST on a weekly basis

I. Mill Certificates: Casing mill certificates shall be submitted to the ENGINEER/GEOLOGIST for all casings, one week prior to the installation of the casing in the ground. Heat numbers on casing joints shall be readily visible and legible or the casing will not be accepted by the ENGINEER/GEOLOGIST.

J. Welding Procedures: The CONTRACTOR shall submit to the ENGINEER/GEOLOGIST proposed procedure specifications and qualification records for welding activities for all pipe and casing welding to be performed under this section, in accordance with Section IX, Article II of the ASME Boiler and Pressure Vessel Code. Materials shall be submitted to the ENGINEER/GEOLOGIST no less than one week prior to the proposed welding activity.

K. Geological Samples: The CONTRACTOR shall collect label and store, samples of all geological formations encountered in ten foot increments during drilling operations. Before collecting each sample, stop drilling and circulate drilling fluid until all cuttings are removed from the hole, then resume drilling and collect sample when cuttings reach the surface. Each sample shall be clearly labeled and indicate well number, date, time, and the exact depth from which the sample was taken. Two sets of samples shall be collected in zip lock or cloth bags and stored in a protected place near the drilling site.

L. Geophysical Logging: The CONTRACTOR shall submit 2 draft field copies of all geophysical logs to the ENGINEER/GEOLOGIST within 24 hours following logging activities, and 6 final copies and an electronic file (pdf electronic file and Excel spreadsheet or txt binary file) within 10 days of logging. For each geophysical log suite performed, the ENGINEER/GEOLOGIST may request the CONTRACTOR to obtain a brief descriptive report from the service company interpreting the results of the log or logs. Caliper log reports must indicate borehole volume. Static and pumping flow logs must have discharge rate plotted on log in gallons per minute. Flow stations through the middle semi-confining unit in to the lower Floridan aquifer will be required. The printed reports must be submitted to the ENGINEER/GEOLOGIST within 72 hours of completion of logging. The logs to be performed are listed in Part 3-Execution.

M. Abandonment: During back plugging or plugging of a well, daily reports shall be maintained by the CONTRACTOR and provided to the ENGINEER/GEOLOGIST. The daily report shall contain the following information: (a) number of feet plugged; (b) amount of cement and aggregate used; and (c) any other pertinent data that the CONTRACTOR may record or the ENGINEER/GEOLOGIST may request.

N. Laboratory Analyses and Testing: The CONTRACTOR will coordinate with the ENGINEER/GEOLOGIST for the collection of water samples during reverse-air circulation drilling of the Floridan aquifer system for analysis by Orange County Utilities' at 9124 Curry Ford Road.

O. Calibration Data: Calibration records for each measuring instrument used in the construction of the well shall be submitted to the ENGINEER/GEOLOGIST for review one (1) week prior to the installation or use of the instruments. Calibration of instruments shall have been performed within 30 days prior to use in testing. The calibration records shall contain the following information:

a. Flow meter calibration sheet: Serial Number, Model Number, Gears, Test apparatus size, Meter reading and flow rate for at least three (3) steps, Percent error for each step, Tester's name and title.

b. Pressure gauge calibration sheet: Serial Number, Model Number, Scale range, Meter reading and inches of mercury for at least three steps covering the entire range of the gauge, Percent error for each step, Tester's name and title.

c. Inclination tools and geophysical logs: Each downhole instrument used in testing the wells during construction shall demonstrate acceptable calibration before use. Where possible, this calibration record shall be included on the output of the test or on the log.

P. Operations: The CONTRACTOR shall submit for the ENGINEER/GEOLOGIST's approval plans for cementing operations and casing installation, at least 72 hours prior to commencing work on those operations. These plans shall include the following information:

a. Cementing Program: Top and bottom of each interval to be cemented, pre-flush and spacer, composition of cement to be used in each interval and volume to be pumped, method of emplacement of cement, expected fill-up, expected pressures, and any additives to be used.

b. Casing Installation: Tabulation of casing on site and the length of each section, weight of each joint, cumulative string weight, order of installation of casing sections, locations of centralizers and casing tabs.

Q. Well Development Description and Test Records: A description of the Well Development procedure shall be submitted to the ENGINEER/GEOLOGIST one (1) week prior to development activities. Development and test records shall be recorded on a half-hour basis, showing production rates, static water level (pre-development and post-development), pumping level, drawdown, production of sand with centrifugal sand separating meter, and all other pertinent information concerning development and testing methods. This data shall be recorded on a form to be provided to the ENGINEER/GEOLOGIST.

R. Permits: It is the CONTRACTOR's responsibility to obtain all permits with local and state regulatory agencies associated with the construction and testing of the facility. The CONTRACTOR shall not perform work on the well until these permits are obtained. The CONTRACTOR shall furnish copies of all permits to the OWNER and ENGINEER/GEOLOGIST as the permits are obtained. As required by law, the CONTRACTOR shall retain and/or post copies of the permits at the site.

S. Plumbness and Alignment Tests: A plumbness and alignment test, as described in AWWA Specification A-100-90, Standard for Water Wells, and any other regulatory agencies that may have jurisdiction, shall be provided to the ENGINEER/GEOLOGIST after the well has been completed and before its acceptance. In addition, the latest revisions of standards by the AWWA shall apply. During the plumbness and alignment testing, Daily Report forms shall be maintained by the CONTRACTOR and submitted to the ENGINEER/GEOLOGIST. The

reports shall provide a description of number of hours on the job, measurements recorded and other pertinent data specified in advance by the ENGINEER/GEOLOGIST. Upon completion of the plumbness and alignment testing of the well, the CONTRACTOR shall submit to the ENGINEER/GEOLOGIST written test data sheets within 24 hours. Test sheets shall include the horizontal deflection test results.

T. Final Description: The final well descriptions shall show the following: diameter, wall thickness, depths and lengths of casings installed; borehole diameters; cemented casings; centralizer locations; depths and thickness' of annular seals; quantity of material removed during development operations; and all other pertinent details, and shall be submitted to the ENGINEER/GEOLOGIST prior to acceptance of the well.

U. Records Required by Law: The CONTRACTOR shall maintain all records required by governmental agencies having jurisdiction, and shall submit such records to them as may be required. Two copies of all such material shall also be furnished to the ENGINEER/GEOLOGIST.

V. Record Figures: Record Figures shall be submitted in accordance with the relevant section of the technical specifications and Figures.

W. Completion Report Required: A Water Well Completion Report (Form 41.10-410(2)) must be filed with the appropriate agencies within 30 days of well completion.

X. Drilling Waste Disposal: The CONTRACTOR shall notify the ENGINEER/GEOLOGIST of a drilling waste disposal location for approval by OWNER two (2) weeks prior to disposal.

Y. Costs: All costs for meeting the provisions of the regulatory agencies having jurisdiction in this project shall be included in the lump sum bid. Should any action by the CONTRACTOR be necessary to meet these requirements during construction and testing, the entire cost of compliance shall be borne by the CONTRACTOR.

Z. Video Survey: The CONTRACTOR shall perform a video survey on the well from land surface to the base of the well following drilling and development activities. Six (6) copies of the completed survey, in DVD format, shall be provided by the CONTRACTOR to the ENGINEER/GEOLOGIST for distribution within 30 days of completion of the video survey.

1.05 REVIEW

A. The proposed method of well disinfection must be submitted to the ENGINEER/GEOLOGIST for approval thirty (30) days prior to well disinfection. The method of disinfection should comply with the latest AWWA C654.

B. The proposed method and setup for the step drawdown and constant rate discharge testing must be submitted to the ENGINEER/GEOLOGIST for approval thirty (30) days prior to running these tests. The submittals must include plans for accessing all well included in the particular tests, routing of discharge water, pump equipment, meters, water level indicators, pressure transducers, data loggers and scheduling.

1.06 PERMITS

A. The CONTRACTOR shall be responsible for obtaining and shall, within thirty days (30) working days following notice to proceed, apply for the well construction permits from the SJRWMD to construct the well specified herein, in accordance with the Rules of the SJRWMD, Chapter 40C-3, F.A.C. The permit shall be available for inspection at the site during construction and shall be kept on-site at all times. The CONTRACTOR shall be responsible for obtaining permit time extensions in accordance with the rule specified above, if well construction extends beyond the valid permit date.

B. The CONTRACTOR shall be responsible for obtaining any additional federal, state, or local permits required for constructing the wells or discharging water from the site. If a generic discharge permit is required by the FDEP, the CONTRACTOR shall be responsible for obtaining the permit and for the compliance of all permit conditions.

C. The CONTRACTOR shall not perform any work on the wells until these permits are obtained and SJRWMD notified 24 hours before construction begins.

D. The CONTRACTOR shall furnish separate copies of all permits to the ENGINEER/GEOLOGIST as the permits are received.

E. The CONTRACTOR is responsible for all permit fees.

1.07 QUALIFICATIONS

A. The CONTRACTOR responsible for constructing the wells shall be licensed by the SJRWMD as a water well CONTRACTOR employing only competent workmen for the execution of this Work, and all such Work shall be performed under the direct supervision of an experienced well driller satisfactory to the OWNER and ENGINEER/GEOLOGIST.

B. The CONTRACTOR's well driller shall be capable of identifying lithologic samples, maintaining complete and current well logs and daily notes for the well completion report, and developing and testing the well, as required by these specifications. A well completion report shall be submitted to the ENGINEER/GEOLOGIST and the SJRWMD.

C. The ENGINEER/GEOLOGIST 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 ENGINEER/GEOLOGIST all such information and data for this purpose as the ENGINEER/GEOLOGIST may request.

D. The CONTRACTOR shall furnish satisfactory evidence upon request that all materials to be furnished in performing the specified Work are new and all equipment to be used is in good working order.

E. The CONTRACTOR shall complete the Work described in this Section in accordance with (a) the American Water Works Association Standard for Water Well (AWWA A100-97),

(b) applicable portions of the Rules of the SJRWMD, Chapter 40C-3, F.A.C., and (c) applicable portions of the Rules of the FDEP, Chapter 62-555, and 62-532 F.A.C.

1.08 PROJECT RECORDS

A. Before installing the casing or materials in the wells, a report listing the source and description of the materials to be used and the mill certificates shall be submitted to the ENGINEER/GEOLOGIST.

B. During drilling of the wells, the CONTRACTOR shall maintain at the well site a complete log setting forth the following:

1. The surveyed reference point for all depth measurements.
2. The depth at which changes of formation occur.
3. The depth and interval of each cavity encountered during drilling.
4. The identification of the material of which each stratum is composed.
5. The depth interval from which each formation sample is taken.
6. The depth interval from which each water sample is taken.
7. The depth at which hole diameters change.
8. Depth at which drilling method is changed.
9. Other pertinent data requested by the ENGINEER/GEOLOGIST.

C. Lithologic samples and water quality samples shall be collected and preserved immediately upon retrieval. Lithologic samples shall be preserved in separate air tight jars or ziplock bags of at least 1.0 pound capacity for each interval specified by the CONTRACTOR. Lithologic samples shall be taken during drilling at 5-foot intervals in the siliceous surficial sediments, 10-foot intervals in the Floridan aquifer, and at lithologic changes. The CONTRACTOR will coordinate with the ENGINEER/GEOLOGIST for the collection of water samples during reverse-air circulation drilling of the lower Floridan aquifer starting at approximately 950 feet below land surface. Samples will be collected every 80 ft within the lower Floridan aquifer and be clearly and legibly labeled with the following information:

1. Location of the well.
2. Name or number of the production well.
3. Depth interval represented by the sample.
4. Date taken.
5. Time taken.

Water quality samples will also be collected from each production well by the CONTRACTOR once development has been completed for primary and secondary drinking water standards.

D. Upon completion of the wells, the CONTRACTOR shall also submit to the ENGINEER/GEOLOGIST a report and as-built drawings to include the following:

1. The total depth of the borehole and the length of casing installed in each well.
2. The nominal hole diameter.

3. The depth or location of any lost drilling fluid, drilling materials, or tools.
4. The type and amount of drilling fluid additives used.
5. The depth and diameter of any surface casing.
6. The amount of cement (cubic yards) used in grouting the well annulus and/or surface casing.
7. The complete description (including length, diameter, depth, and mill certificates) of each well casing.
8. Other pertinent data requested by the ENGINEER/GEOLOGIST.
9. Any and all other pertinent information for a complete and accurate log (e.g., temperature, pH, and appearance (color) of any water samples taken).

E. Formation sample jars or bags shall be provided and properly labeled by the CONTRACTOR.

F. Blank well completion report forms can be obtained by written application to the Florida Department of Environmental Protection, 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida, 32301, or the St. Johns River Water Management District. Well completion reports shall be submitted by the CONTRACTOR to the SJRWMD and ENGINEER/GEOLOGIST within 30 days of well completion.

G. A daily detailed driller's report shall be maintained and delivered upon request to the ENGINEER/GEOLOGIST or the OWNER's REPRESENTATIVE at the well site. The report shall give a complete description of all lithologies encountered, number of feet drilled, number of hours on the job, shutdown time due to breakdown or other cause, the fluid level in the hole measured daily before starting pumps, the properties of the drilling fluid, feet of casing set, and such other pertinent data as requested by the ENGINEER/GEOLOGIST.

H. The CONTRACTOR shall provide, install and maintain erosion controls for the duration of the well construction work as needed and to prevent sediment and turbidity from entering surface water bodies and to avoid erosion problems by directing flow away from the drilling site and adjacent properties. Refer to Section 01500.

1.09 HANDLING OF MATERIALS

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. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

1.10 QUALITY ASSURACE

A. Subcontractor's List: Each subcontractor listed shall be approved by the ENGINEER/GEOLOGIST. The ENGINEER/GEOLOGIST reserves the right to disapprove the use of any subcontractor proposed.

B. Tests: The CONTRACTOR shall conduct performance tests to demonstrate well soundness prior to acceptance.

C. Instrumentation: The CONTRACTOR shall provide calibration records of all instruments used during testing to the ENGINEER/GEOLOGIST one (1) week prior to installation.

D. Video Survey: The video camera to be used for the video survey will be centralized and of a type that is capable of focusing on the diameter of open borehole or casing upon which the survey is being performed, having sharp contrast and good resolution. The borehole video survey shall be accomplished using a color, radial view, 360-degree camera, with tilt capability of up to 85 degrees from vertical. The borehole camera shall have remote focus ability. Mirrors shall not be used to accomplish this range of view.

E. Geophysical Logs: All geophysical logs shall be run by a qualified service company experienced (having performed at least 10 surveys) in the type of logs they are to perform. The firm retained to run the geophysical survey shall perform all geophysical requirements for the project. The logs will be run using accurate instruments of resolution sufficient to allow detailed interpretation of the logs. The correct calibration of each instrument shall be demonstrated at the time of logging, and a record of the calibration shall be included on the logs, where possible. The logs shall be run at no more than 30 feet per minute and shall be output at 20 feet per inch. A repeat section shall be included on each log to demonstrate the sensitivity of the instrument to variations in the properties of the intervals being logged and to demonstrate repeatability of the logs. The caliper tool shall include a minimum of 3 arms. Borehole volume shall be indicated on the reamed borehole caliper log, and shall be provided to the ENGINEER/GEOLOGIST for cementing calculations.

F. Guarantee: The CONTRACTOR guarantees that the work performed under this section of the Contract, and the workmanship, materials and equipment supplied or used in the execution of the work, is free from defects or flaws and is furnished in strict accordance with the Contract Documents in every respect. The CONTRACTOR further guarantees that the performance test requirements of the Contract Documents shall be fulfilled. The CONTRACTOR shall repair, correct, or replace all damage to the work covered by failures covered by the guarantee. The guarantee shall remain in effect for a period of 1 year from the date of final acceptance by the OWNER. **The guarantee shall remain in effect for a period of 5 years from the date of final acceptance by the OWNER.**

G. Sand Production: Sand production during well development shall be recorded on a form for pump development and testing. Sand production, shall be measured by a centrifugal sand separating meter as described in the AWWA A-100-90 Standard for Water Wells and Groundwater and Wells (Driscoll, 1986), and should not exceed 5 parts per million during the 30-minute period after the pump starts pumping at the design discharge rate, or as determined appropriate by the ENGINEER/GEOLOGIST. Should the well produce sand exceeding 5 parts per million, additional well development will occur at a discharge rate and for a time period determined appropriate by the ENGINEER/GEOLOGIST.

H. Cement: Material used for sealing the casing shall consist of a neat cement grout using Type II Portland cement conforming to ASTM C 150. Neat-cement grout shall contain no more than 5.2 gallons of fresh water per 94 pound sack of cement yielding a weight of roughly 15.6 lbs/gal for neat cement grout. A maximum of 9.1 gallons of fresh water shall be added to a 94 pound sack of cement with 6 percent bentonite added to yield a weight of approximately 13.5 lbs/gal for cement bentonite grout. Mixes between the two grout mixtures shall comply with manufacturer recommendations and shall yield weights between 13.5 and 15.6 lbs/gal. Grout samples shall be collected by the CONTRACTOR and checked with a Fluid Density Balance in accordance with API Spec. 10. Grout samples shall be collected a minimum of three (3) times during each cement stage: prior to pumping, in the middle, and near end of the stage. The specified slurry density shall match the specified slurry density indicated on the delivery certificate.

1.11 MATERIALS DELIEVERY, STORAGE and PROTECTION OF MATERIALS

A. All materials shall be delivered in an undamaged condition and stored to provide protection against damage. All defective or damaged materials shall be replaced with new materials at the CONTRACTOR'S expense.

B. All materials must be properly protected against damage during a prolonged period at the site.

C. The CONTRACTOR shall prepare an area, within the limits of a location approved by the ENGINEER/GEOLOGIST, for the storage of materials required for this work.

1.12 CONTRACTOR EQUIPMENT

A. Storage Area: The CONTRACTOR shall prepare an area, within the limits of a location approved by the ENGINEER/GEOLOGIST, for the storage of materials required for this work.

B. Protection: The CONTRACTOR is responsible for protecting his own work including materials from theft, vandalism, and unauthorized entry.

C. Equipment Use: The equipment shall be provided with all sound deadening devices reasonably possible. The rig engines and all other power plant equipment shall have mufflers, and metal parts of the rig that may encounter casing or drill pipe shall be protected through the use of wood, or other sound absorbent material, where possible. CONTRACTOR shall provide complete rotary drilling units, combination rig drilling units, cable tool drilling rig, all tools, accessories, power, pumps, lighting, water and other equipment necessary to conduct efficient drilling and testing operations.

D. Equipment Requirements: The CONTRACTOR's drilling rig shall have a lift capacity exceeding the greatest load required during construction of the well. The rig shall be equipped with drill string weight and drilling speed recorder.

I. CONTRACTOR shall make necessary arrangements to acquire construction water as specified under Section 01500. The LFA monitor well MR-LF-1 and the MR-LF-4

production well at the site may be available for this project subject to OWNER approval and SJRWMD notification. Any water used from MR-LF-4 has to be metered and reported to the OWNER.

1.13 MOBILIZATION, PERSONNEL AND OPERATING REQUIRMENTS

A. Mobilization: The CONTRACTOR shall mobilize its equipment and personnel to effectively commence its drilling operations within the time limit specified.

B. Personnel Requirements: The CONTRACTOR shall furnish capable personnel, experienced in the work required by these specifications. In addition, the following shall apply:

1. The CONTRACTOR shall provide an adequate number of competent helpers.

2. The drillers shall be capable of keeping good and clean well logs, and reports of the drilling, developing and pump testing operations as instructed by the ENGINEER/GEOLOGIST.

3. Welders: All welding shall be performed according to the American Welding Society standards and American Society for Testing and Materials standards. All welding shall be conducted by certified welders of the AWS, ASTM, ASME, or approved equal.

4. Well Drillers: All well drillers shall possess a current State of Florida Water Well Contractor License, issued by the one of the five water management districts. The drillers must have prior experience operating the drilling equipment selected for the project and should be capable of identifying and describing local geologic formations, maintaining complete and current well logs and daily notes for the well completion reports. The Bidder must provide a minimum of four (4) references for recent work completed (within the last ten years) for the construction of 12-inch diameter or greater LFA production wells within Central Florida, similar in scope and complexity to the work requested in this IFB. References must be individuals that can be readily contacted and have first-hand knowledge of the bidder's performance on the specific project performed by the bidder. At the minimum the Bidder must supply the following:

Owner Name:
Address:
Contact Person:
Contact Phone Number:
Project Name and Location:
Commencement Date:
Completion Date:
Description of Work Performed:
E-mail Address of the contact Person;

C. Work Hours: The CONTRACTOR shall limit work hours between 7:00 a.m. and 7:00 p.m. Monday through Friday, unless given approval by the OWNER. The CONTRACTOR is not allowed to have personnel onsite before 7:00 a.m. and after 7:00 p.m.

D. Service Companies: Where possible, the CONTRACTOR shall utilize the skills of a specialist service company, expert in the type of service for which they are employed. The name and the background of the company and the individuals providing the services shall be submitted to the ENGINEER/GEOLOGIST for approval prior to beginning work. The ENGINEER/GEOLOGIST reserves the right to reject any service company. At a minimum, service companies shall be employed for the following:

1. Geophysical Logging;

2. Video Surveying;

3. Cementing, unless the CONTRACTOR can demonstrate previous experience and expertise in cementing.

E. Water Samples: The CONTRACTOR will coordinate with the ENGINEER/GEOLOGIST for collection of water quality samples during construction. The samples will be analyzed by OCU Laboratories for chloride, sulfate, total dissolved solids, nitrate and nitrite. Samples will be collected every 80 feet within the Floridan aquifer system. The CONTRACTOR is responsible for contacting the LABORATORY ahead of time in order to pick up the sample containers. All sample containers shall be requested by phone (407-254-9550) two (2) business days in advance of when they are to be picked up by the CONTRACTOR, as directed by the ENGINEER/GEOLOGIST. Business hours are 7 am to 4 pm Monday through Friday, excluding holidays. Samples shall be delivered to the lab within 20 hours of collection and they shall be dropped off at the lab no earlier than 7 am and no later than 4 pm. The CONTRACTOR shall coordinate pickup and delivery of samples with ENGINEER/GEOLOGIST.

1. The sample containers shall be clearly labeled with the well identification, and the depth interval below ground surface from which the sample was collected and the time and date of sample collection.

2. Chain of Custody forms shall be completed and accompany all water samples delivered to the LABORATORY. All persons handling the samples shall be required to sign the Chain of Custody form.

4. The CONTRACTOR shall be aware of applicable water sampling holding times for the samples for which they are responsible and CONTRACTOR shall be responsible that the samples are transmitted to the LABORATORY within these time periods. Samples shall be delivered to the LABORATORY on the same day collected.

F. Work Area: The CONTRACTOR shall prepare an area, within the limits of the location delineated in the field by the ENGINEER/GEOLOGIST, for the work described in these Technical Specifications.

G. Cuttings and Fluid Disposal: It shall be the CONTRACTOR'S responsibility to arrange for an approved disposal site for drill cuttings, fluid from drilling, fluid from well development, and fluid from well production testing that complies with all applicable regulations. No drilling operations can commence without an approved disposal site by

the OWNER or ENGINEER/GEOLOGIST. The CONTRACTOR shall be responsible for providing and maintaining all necessary tank trucks, dump trucks, pipe, pumps and equipment necessary to pump and haul excess pad drainage, drilling fluid, drill cuttings and pumped water to a pre-determined disposal site in accordance with federal, state and local regulations, or sub-contract with a firm capable of providing these services when necessary.

H. Construction Safety Program: The CONTRACTOR shall comply with the OSHA regulations contained in 29CFR Section 1910 for General Industry Regulations and 29CFR Section 1926 for Construction Regulations.

1.14 WELL ACCEPTANCE CRITERIA

A. The sand content in the water pumped from the completed production wells shall not, at any time, exceed 1 mg/L while each well is being pumped at 3,500 gpm.

B. The turbidity of the water from the completed production wells shall not exceed 1 NTU as measured on a calibrated turbidimeter when each well is being pumped at its design capacity of 3,500 gpm.

C. The CONTRACTOR must supply the equipment necessary to test, in the field, sand and turbidity concentrations.

D. The well efficiency of the completed wells shall not be less than seventy percent (70%) at the design pump rates (3,500 gpm) as calculated by the Hantush-Bierschenk's method.

E. The casing and borehole for each well shall be constructed round, plumb and true to line; the wells shall comply with AWWA A100-97. The wells shall be tested for plumbness and alignment by the CONTRACTOR in accordance with Appendix D of the American Water Works Association (AWWA) Standard A100-97.

F. The CONTRACTOR shall demonstrate that the wells are properly disinfected and bacteriologically cleared by passing five consecutive microbiological samples as described in Paragraph 3.11 of this Section.

1.15 WARRANTY

A. All materials supplied under this Section shall be warranted for a period of five (5) years by the CONTRACTOR and material manufacturers. The manufacturer's warranty period shall run concurrently with the CONTRACTOR's warranty period. The warranty period shall commence on the Final Completion Date, as specified in the Contract or upon completion and acceptance by the OWNER of testing or remedial procedures.

B. The materials shall be warranted to be free from defects in workmanship and design. Any materials that fail during the warranty period shall be replaced and the unit(s) restored to service at no expense to the OWNER.

1.16 SITE CLEANUP, PRESERVATION AND RESTORATION

A. Unused Materials and Equipment: During construction, the CONTRACTOR shall regularly remove from the site all accumulated debris and surplus materials of any kind which results from his operations. Unused tools or equipment shall be stored at the CONTRACTOR's yard or base of operations for the project.

B. Periodic Cleaning: The CONTRACTOR shall perform clean-up work on a regular basis and as frequently as requested by the ENGINEER/GEOLOGIST.

C. Basic site restoration in an area shall be accomplished immediately following installation or substantial completion of the required facilities in that area. Also, such work shall be performed, when requested by the ENGINEER/GEOLOGIST, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

D. If the CONTRACTOR fails to perform periodic clean-up and basic restoration of the site to the ENGINEER/GEOLOGIST's satisfaction, he/she may, upon five days written notice to the CONTRACTOR, employ such labor and equipment as he/she deems necessary for the intended purpose at the CONTRACTOR's expense.

E. Work Completion: Upon completion of work at the site, the CONTRACTOR shall promptly remove all equipment and unused materials. CONTRACTOR shall dismantle any temporary structures erected for purposes not part of the final product. CONTRACTOR shall promptly provide minor repairs and leave the site in a manner acceptable to the ENGINEER/GEOLOGIST, within one month after the completion of drilling and testing.

1.17 ADDITIONAL WORK

A. At the option of the OWNER, additional work may be authorized. Additional work shall be completed at prices not exceeding those of comparable work and materials contained in the CONTRACTOR's bid or as determined by the ENGINEER/GEOLOGIST.

PART 2 - PRODUCTS

2.01 INNER WELL CASING

A. The well casing for each production well shall be new black steel pipe having perfect roundness and uniform thickness. Well casing shall have a nominal diameter of 24 inches, and a minimum wall thickness of 0.375 inches. The well casing shall conform to ASTM A53B or API 5L, Grade B, seamless or electric resistance welded, for black steel casing.

B. The well casing shall be as manufactured by U.S. Steel Corporation, or an approved equal. Copies of the mill certificates shall be submitted by the CONTRACTOR to the OWNER/ENGINEER/GEOLOGIST for approval prior to shipment of casing to the site.

C. Casing lengths shall be joined watertight by a method appropriate to the material used, as selected by the CONTRACTOR, so that the resulting joints shall have the same structural integrity as the casing itself. If metallic casing is welded, the standards of the American Welding Society and AWWA C206 shall apply. Casing ends shall be coupled by field welding and shall be beveled. If threaded and coupled joints are used, couplings shall be API or equivalent, made up so that, when tight, all threads will be buried in the lip of the coupling. Should the joints fail or break, the CONTRACTOR shall be responsible for abandonment, repair or replacement of the well.

D. No well casing shall be ordered or delivered to the site until approval has been provided by the ENGINEER/GEOLOGIST or the OWNERS REPRESENTATIVE. This is required due to the potential for quantity and size changes.

2.02 INTERMEDIATE CASING

A. The intermediate casing for each production well shall be new black steel pipe having perfect roundness and uniform thickness. Well casing shall have a nominal diameter of 30 inches, and a minimum wall thickness of 0.375 inches. The well casing shall conform to ASTM A53B or API 5L, Grade B, seamless or electric resistance welded, for black steel casing.

B. The well casing shall be as manufactured by U.S. Steel Corporation, or an approved equal. Copies of the mill certificates shall be submitted by the CONTRACTOR to the OWNER/ENGINEER/GEOLOGIST for approval prior to shipment of casing to the site.

C. Casing lengths shall be joined watertight by a method appropriate to the material used, as selected by the CONTRACTOR, so that the resulting joints shall have the same structural integrity as the casing itself. If metallic casing is welded, the standards of the American Welding Society and AWWA C206 shall apply. Casing ends shall be coupled by field welding and shall be beveled. If threaded and coupled joints are used, couplings shall be API or equivalent, made up so that, when tight, all threads will be buried in the lip of the coupling. Should the joints fail or break, the CONTRACTOR shall be responsible for abandonment, repair or replacement of the well.

D. No well casing shall be ordered or delivered to the site until approval has been provided by the ENGINEER/GEOLOGIST or the OWNERS REPRESENTATIVE. This is required due to the potential for quantity and size changes.

2.03 PIT AND SURFACE CASING

A. Use of a pit casing will be left to the discretion of the CONTRACTOR. If used, the following criteria shall apply.

B. The pit casing for each production well shall be black steel and shall have a nominal diameter of 42 inches and a minimum wall thickness of 0.375 inches. The pit casing shall conform to ASTM A53B or API 5L, Grade B, seamless or electric resistance welded, for black steel casing.

C. The surface casing for each production well shall be black steel and shall have a nominal diameter of 36 inches, and a minimum wall thickness of 0.375 inches. The surface casing shall conform to ASTM A53B or API 5L, Grade B, seamless or electric resistance welded, for black steel casing.

D. Casing lengths shall be joined watertight by a method appropriate to the material used, as selected by the CONTRACTOR, so that the resulting joints shall have the same structural integrity as the casing itself. If metallic casing is welded, the standards of the American Welding Society and AWWA C206 shall apply. Casing ends shall be coupled by field welding and shall be beveled. If threaded and coupled joints are used, couplings shall be API or equivalent, made up so that, when tight, all threads will be buried in the lip of the coupling. Should the joints fail or break, the CONTRACTOR shall be responsible for abandonment, repair or replacement of the well.

E. The pit and surface casing shall be as manufactured by U.S. Steel Corporation, or an approved equal. Copies of the mill certificates shall be submitted by the CONTRACTOR to the OWNER/ENGINEER/GEOLOGIST for approval prior to shipment of casing to the site.

F. If any surface casing is intended for construction purposes only, it shall be reasonably watertight, and of such weight and design as necessary to prevent entrance of sand and unconsolidated material, and to permit its installation without distortion or rupture to the specified depth and dimension.

G. No surface casing for the production wells shall be ordered or delivered to the site until approval has been provided by the ENGINEER/GEOLOGIST or the OWNERS REPRESENTATIVE.

2.04 DRILLING FLUID

A. The drilling fluid shall possess such characteristics as are required to adequately maintain the walls of the hole, to prevent caving of the wall as drilling progresses, and to permit recovery of representative samples of cuttings. The fluid shall be consistent with AWWA A100-90 standards.

B. Bentonite- or native-clay-based drilling fluids shall have residual chlorine content not less than 10 mg/L. The CONTRACTOR may select a drilling fluid (consistent with these Specifications) for completion of the boreholes below the surface casing to total cased depth.

C. The CONTRACTOR shall provide all materials and equipment for mixing, circulating and testing the drilling fluid and for maintaining its properties. The drilling fluid shall be maintained within limits that allow their complete removal from the well, if necessary, and shall not damage the potential capacity, efficiency, or quality of the well.

D. All additives used to maintain the properties of the drilling fluid shall be approved by the ENGINEER/GEOLOGIST and specifically recommended by the manufacturer for use in

water well drilling. No additive shall be used which causes persistent bacterial growth in the well and aquifer. Makeup water shall be from an approved source.

2.05 CEMENT GROUT

A. Grout shall be Type II (ASTM C150) neat Portland cement and proportioned in accordance with AWWA A100. The grout mixture may contain up to 6 percent (by volume) of bentonite clay and will be subject to testing at the discretion of the ENGINEER/GEOLOGIST. Grout not meeting the specification shall be rejected. The CONTRACTOR shall have an approved method of testing density of grout on site.

B. Approximately 5.2 gallons of fresh water shall be added to a 94-lb sack of cement yielding a weight of roughly 15.6 lbs/gal for neat cement grout. A maximum of 9.1 gallons of fresh water shall be added to a 94-lb sack of cement with 6 percent bentonite added to yield a weight of approximately 13.5 lbs/gal for cement bentonite grout. Mixes between these two grout mixtures shall comply with manufacturer recommendations and shall yield weights between 13.5 and 15.6 lbs/gal.

2.06 TEST PUMPING EQUIPMENT

A. The CONTRACTOR shall provide a test pump capable of pumping at least 4,000 gpm under atmospheric conditions after the maximum drawdown in each well and all piping head losses have been accounted for to test each production well. Additionally, the CONTRACTOR shall provide an opening or fitting such that depth to water level or potentiometric surface pressure may be measured using a pressure transducer during pumping.

B. The CONTRACTOR shall provide a generator to power the test pump(s). If electric power is available at the site, the CONTRACTOR may use it at his option and expense. Any generator used for the test pumping shall have the necessary capacity to adequately power the selected test pump through the pumping period and discharge range.

C. Discharge pipe shall be of a diameter and length adequate to transmit water at the maximum discharge rate specified herein from the well site to a designated discharge point up to 5,000 feet down gradient from the wells for the furthest site at a location to be determined by the OWNER. Discharge pipe shall be in good condition, shall be free from leaks and adequately restrained to withstand the maximum anticipated pressure without bursting of the pipe or separation of the joints. A hose bib suitable for collecting representative water samples shall be located on the discharge upstream from the flow meter. A ¼-inch diameter NPT threaded tap suitable for the installation of a sand tester shall be located on the horizontal centerline of the discharge pipe at a location approved by the ENGINEER/GEOLOGIST or the OWNER's REPRESENTATIVE. The discharge pipe layout and discharge point must be approved by the OWNER's REPRESENTATIVE at least seven (7) days prior to the start of the test.

D. A gate valve suitable for controlling flow through the discharge pipe shall be provided and shall be located at the well head, downstream of the calibrated flowmeter.

E. The CONTRACTOR shall provide a totalizing flow meter calibrated for the design flow and pipe size and capable of an accuracy of 5% or better. The meter shall have been calibrated within 90 days of the proposed use. The flow meter shall be installed as specified by the manufacturer for accurate operation. The meter shall be located a minimum of 5 pipe diameters upstream and 10 pipe diameters downstream from any flow obstructions.

F. The test pump shall be set a minimum of 100 feet below land surface. This requirement may be waived if pumping at a rate of 4,000 gpm in each 24-inch production well results in pumping water level drawdowns, which are considerably less than 100 feet below land surface.

G. The CONTRACTOR shall provide one (1) data logging pressure transducer with appropriate pressure ranges for the measurement of water level changes or potentiometric pressure changes during the step-drawdown variable rate discharge testing. The CONTRACTOR shall provide eight (8) data logging pressure transducers with appropriate pressure ranges for the measurement of water level changes or potentiometric pressure changes during the constant rate discharge test.

H. The data logger(s) shall be capable of recording measurements according to the schedule of variable time intervals as listed below:

Interval	Number of Readings	Total Elapsed Time (min)
1 sec	120	2
2 sec	120	6
5 sec	48	10
10 sec	60	20
30 sec	80	60
1 min	60	120
2 min	60	240
5 min	60	540
10 min	90-378	1440

I. All test pumping equipment shall remain the property of the CONTRACTOR.

2.07 WELL COVERS

A. Whenever work on the wells is interrupted, such as during an overnight shutdown, each well opening shall be tack welded with a substantial cover in accordance with the Rules of the SJRWMD, Chapter 40C-3, F.A.C. At all times during construction of each well, the CONTRACTOR shall use reasonable precautions to prevent both tampering with the well and entrance of foreign material into the well.

B. The cover shall be watertight, restrict the positive upward pressure, and stop any potential flowing conditions at the wellhead.

2.08 DISINFECTANT

A. Disinfectant solution shall be prepared for a minimum concentration of 50 mg/L of Sodium Hypochlorite chlorine for the full length of each well. A disinfection plan must be submitted to the OWNER and/or ENGINEER for approval prior to implementation.

PART 3 – EXECUTION

3.01 BOREHOLE CONSTRUCTION

A. Each production well shall be constructed by a combination of the mud rotary and the reverse air rotary drilling methods. Alternate drilling methods may be proposed by the CONTRACTOR, but are not to be utilized unless prior approval from the ENGINEER/GEOLOGIST is provided.

B. Eight inch (8") minimum diameter pilot holes shall be utilized to determine the seating depths of all casing strings.

C. If 42-inch pit casing is to be installed at a well, the nominal borehole diameter shall be approximately 48 inches for the production well (**Figure 3**). The annular space between the borehole and the pit casing shall be a minimum of three (3) inches.

D. When 36-inch surface casing is installed at a well, the nominal borehole diameter shall be approximately 42 inches for the production well. The annular space between the borehole and the surface casing shall be a minimum of three (3) inches.

E. The nominal diameter of the borehole in which the 30-inch intermediate casing shall be set will be 36 inches for each production well. The annular space between the borehole and the well casing shall be a minimum of three (3) inches.

F. The nominal diameter of the borehole in which the final well casing shall be set will be 24 inches for each production well. The annular space between the borehole and the well casing shall be a minimum of three (3) inches.

G. The nominal diameter of the open borehole shall be 24 inches in each production well.

H. Each borehole shall be drilled using clean, uncontaminated equipment in good working order and free from fuel, oil, and hydraulic fluid leaks or discharges. The drill bit, bottom hole assembly, and rod shall be in good condition and appropriate for rapid and correct completion.

I. Drilling fluid shall be prepared using fresh uncontaminated water and approved additives. The flow of water at the site during drilling will be controlled to prevent excessive flooding of the site. At the earliest time possible after the Floridan aquifer has been penetrated, drilling with mud additives will be discontinued and drilling will continue using the reverse air method. Heavy mineral additives such as barite or ilmenite may be used to increase the density of the drilling fluid in order to restrict the flowing conditions of the well.

J. An 8-inch minimum diameter pilot hole shall be advanced from the bottom of each pit casing, if used, to approximately 110 feet below land surface to verify the depth to set the surface casing.

K. An 8-inch minimum diameter pilot hole shall be advanced from the bottom of surface casing to approximately 220 feet below land surface to verify the depth to set the intermediate casing.

L. An 8-inch minimum diameter pilot hole shall be advanced from the bottom of intermediate inner casing to approximately 1,075 feet below land surface to verify the depth to set the inner well casing.

M. An 8-inch minimum diameter pilot hole shall be advanced from the bottom of inner casing to approximately 1,300 feet below land surface.

N. The 8-inch pilot hole will then be reamed out to a diameter of approximately 24 inches to a depth to 1,300 feet below land surface.

O. All drilling procedures must comply with all applicable local, state and federal requirements, and be in accordance with the standards of AWWA A100.

P. Drilling fluids shall be contained and recirculated with a closed loop system during construction activities. During reverse air drilling, the fluids recirculated back into the well shall have a turbidity concentration of 100 NTU or less.

3.02 SURFACE CASING INSTALLATION

A. Once a borehole has been advanced to slightly below the depth at which the surface casing is to be set, the CONTRACTOR shall perform necessary work to condition the borehole, including as a minimum circulating cuttings out of the borehole.

B. The CONTRACTOR shall lower the casing into the hole and hold plumb and center by use of welded steel centralizers. These centralizers will be placed within 5 feet of the bottom and the top of the casing and at approximately 40-foot intervals in between.

C. The surface casing shall extend 12 inches above land surface.

3.03 INTERMEDIATE CASING INSTALLATION

A. Once a borehole has been advanced to slightly below the depth at which the intermediate casing is to be set, the CONTRACTOR shall perform necessary work to condition the borehole, including as a minimum circulating cuttings out of the borehole.

B. The CONTRACTOR shall lower the intermediate casing into the hole and hold plumb and center by use of welded steel centralizers. These centralizers will be placed within 5 feet of the bottom and the top of the casing and at approximately 40-foot intervals in between.

C. The intermediate casing shall extend 12 inches above land surface.

3.04 INNER WELL CASING INSTALLATION

A. Each inner well casing will be installed to an approximate depth of 1,050 feet or to another depth at the instruction of the ENGINEER/GEOLOGIST. The well casing shall be set at least 10 feet into competent limestone, and shall extend at least 36 inches above land surface at completion.

B. Each inner well casing shall be lowered into the hole and held plumb and centered by the use of commercially available stainless steel centralizers. These centralizers will be placed within 5 feet of the bottom and the top of the casing and at approximately 40-foot intervals in between.

3.05 ALTERNATE INNER WELL CASING INSTALLATION

A. If during the drilling of a nominal 24-inch diameter borehole there are problems with formation stability and production of fine sand due to geologic conditions, it may be necessary to install an additional inner steel casing of 18-inch in diameter.

B. The additional inner well casing shall be lowered into the hole and held plumb and centered by the use of commercially available stainless steel centralizers. These centralizers will be placed within 5 feet of the bottom and the top of the casing and at approximately 40-foot intervals in between.

3.06 GROUTING

A. Each production well shall be grouted in accordance with the Rules of the SJRWMD, Chapter 40C-3, F.A.C.

B. All grouting and sealing of each well shall be performed in the presence of the ENGINEER/GEOLOGIST and a Department of Health or SJRWMD representative, if available. The grouting shall be done in a manner that will ensure that the annular space will be filled completely in one continuous operation. No drilling operations or other work in a well will be permitted until at least 24 hours after grouting the well.

C. The CONTRACTOR shall flush the annular space with drilling fluids or water until clear and free of cuttings prior to the start of well grouting.

D. Before proceeding with placement of the grout, the CONTRACTOR shall secure the ENGINEER/GEOLOGIST approval of the proposed method of placement. No method will be approved that does not specify the forcing of grout from the bottom of the space to be grouted towards the surface.

E. The CONTRACTOR shall be responsible for any damage to well casing resulting from cementing operations and for the cost required to correct such damages.

3.07 WELDING

A. The standards of the American Welding Society, Structural Welding Code (AWS D1.1) shall apply for all welded joint casing and accessories. All welds shall conform to the latest revision of ANSI B31.1. All welded casing joints shall be made by certified welders of the AWS, ASTM, ASME, or approved equal.

B. Casing Connection: All casing shall be handled using drilling rig tools that are equipped with a weight indicator. Each casing joint shall be able to support the weight of the casing below. The casing joints shall be made with the casing properly aligned and using casing tabs to insure alignment and sufficient strength at the joint. Each weld shall be made with sufficient tensile strength to support the weight of the casing below and with sufficient burst strength to contain water at a pressure of 300 psi without leaking.

C. Tension: The casing shall be suspended in tension from the surface by means of a landing clamp. The bottom of the casing shall be at a sufficient distance above the bottom of the reamed hole as to insure that none of the casing will be supported from the bottom of the hole.

D. Weld Reinforcement: Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions.

E. Failure to Complete: If the casing cannot be landed in the correct position or at a depth acceptable to the ENGINEER/GEOLOGIST, the CONTRACTOR shall construct another well immediately adjacent to the original location and complete this well in accordance with the Contract Documents at no additional cost to the OWNER. The abandoned hole shall be sealed in accordance with all State of Florida regulations at CONTRACTOR's expense.

F. Collapsed Casing: If the casing should collapse for any reason prior to well completion, it shall be withdrawn and replaced at the CONTRACTOR'S expense.

G. Casing Installation: The casings shall be lowered into the borehole open-ended and the weight of the casing shall be supported by the drilling rig. The hook load of the drilling rig must exceed the maximum casing weight to be encountered during the construction of the well. Alternative methods of casing installation may be proposed by the CONTRACTOR by submitting the proposed method to the ENGINEER/GEOLOGIST for approval.

H. Centralizers (Applicable only to Standard Rotary Casing Installations): All casings in the well shall be centralized in the borehole using strap-type centralizers (or approved equal) installed at intervals along the pipe at 0, 90, 180 and 270 degrees around the casing at each position. The four centralizers spaced at 90 degrees around the casing constitute a centralizer group. These centralizers will be placed within 5 feet of the bottom and the top of the casing the casing strings and at approximately 40-foot intervals in between.

I. Alignment: All centralizer groups shall be vertically aligned, one above the other in order to permit the passage of tremie pipes alongside the casing to the bottom of the borehole.

J. All welders and welding operators shall be qualified by a qualified testing laboratory at the CONTRACTOR's sole expense before performing any welding under this section. Qualification tests shall be in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code. Welders and operators shall be qualified for making groove welds in carbon steel pipe in position 6G for each welding process to be used.

K. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the ENGINEER/GEOLOGIST. CONTRACTOR shall retest any welders at any time the ENGINEER/GEOLOGIST considers the quality of the welder's work substandard. When the ENGINEER/GEOLOGIST requests the retest of a previously qualified welder, the labor costs for the retest will be at the OWNER's expense if the welder successfully passes the test. If the welder fails the retest, all costs shall be at the CONTRACTOR's expense.

L. There shall be a minimum of three (3) weld passes on all pipe. Welded joints shall be allowed to cure for not less than 30 minutes before weld is placed in contact with water.

M. When the reaming operation has been completed, blank casing shall be installed. The lengths and intervals of each casing type will be determined by the ENGINEER/GEOLOGIST. All casings shall be installed as shown in the Figures and in accordance with the Technical Specifications.

3.08 WELL DEVELOPMENT

A. Each production well shall be developed by surging and interrupted over-pumping, or other methods approved by the ENGINEER/GEOLOGIST. Over-pumping shall be at various rates up to 4,000 gpm or greater. Development shall continue until each well produces less than 1 mg/L of sand at 3,500 gpm. It shall also continue until turbidity in each well is below 1 NTU after 5 minutes of uninterrupted pumping at 3,500 gpm. The CONTRACTOR shall test the turbidity and sand content at least every four hours during development and report the results to the ENGINEER/GEOLOGIST or the OWNERS REPRESENTATIVE. If the method of development employed by the CONTRACTOR is not yielding satisfactory results, which, in the opinion of the ENGINEER/GEOLOGIST, will produce levels of sand and turbidity that meet the acceptance criteria following the specified development period, the ENGINEER/GEOLOGIST may suspend work, at no additional cost to OWNER, and request that the CONTRACTOR modify his development procedure prior to continuation of further development.

B. Sand content shall be determined in each well using a Rossum sand tester or approved equivalent. The CONTRACTOR shall demonstrate that the well meets the acceptance criteria under Paragraph A of this Section. It is the responsibility of the CONTRACTOR to secure prior written approval from the ENGINEER/GEOLOGIST for any changes in the sand content testing method.

C. If a diesel engine is used to drive the test pumps, it shall be equipped with a clutch to allow instantaneous disengagement of the drive shaft and free spooling of the impellers. If an electric motor is used, it will not be equipped with an anti-reverse ratchet, therefore allowing the impellers to backspin when the motor is turned off.

D. Pumping for the turbidity test for well acceptance will begin after a rest period of at least 5 minutes.

E. Well development shall be deemed complete when sand content and turbidity are below the levels specified in Paragraph 1.10 G and well efficiency as calculated by the Hantush-Bierschenk's method is greater than the level specified in Paragraph 1.14 D at the design pump rate. Development shall be proved by step drawdown testing. It is the responsibility of the CONTRACTOR to attempt to meet the development criteria by the methods outlined.

F. If the development criteria are not met after the time specified on the bid form for aggressive development using methods approved by the ENGINEER/GEOLOGIST, the ENGINEER/GEOLOGIST and CONTRACTOR shall meet to evaluate alternative development methods. It is not the intent of these criteria to place the entire burden on the CONTRACTOR for circumstances and events beyond his control. If, after due diligence by the CONTRACTOR and ENGINEER/GEOLOGIST, the development criteria cannot be met, these criteria may be waived.

3.09 GEOPHYSICAL AND VIDEO LOGGING

A. A series of geophysical logs will be performed on each production well during construction, and another series of geophysical logs and a video log will be performed on each production well after completion of the well and initial development. The geophysical logs to be performed prior to setting of the 30-inch intermediate casing and the 24-inch inner casing will include caliper, gamma ray, spontaneous potential and resistivity. The final suite of geophysical logs will include caliper, static flow, dynamic flow, gamma ray, spontaneous potential, resistivity, acoustic, and temperature.

B. The dynamic flow log shall be performed at least 2,000 gpm. If the well does not naturally flow at this rate, the CONTRACTOR shall pump the well during the dynamic flow log to attain the desired flow rate.

C. An additional video log will be performed on each production well after interval and final development of the well.

D. All data from the geophysical logging will be provided to the ENGINEER/GEOLOGIST data CD or DVD in ASCII format, in hard copy log format (six (6) copies), and with a graphics log viewer program with logs on CD.

E. The video logs will be made with a color video camera with 360° directional side viewing capability. It will include inspection of the casing and open hole. The well will be allowed to flow during the video log to allow for inspection of highly transmissive zones that may be flowing and to help select zones for interval development. Four (4) copies of each video log will be provided.

F. Water from the geophysical and video logging will be controlled by the CONTRACTOR in a manner similar to the one used for the step-drawdown and constant rate discharge testing.

G. Geophysical logging shall be performed by experienced and well-trained personnel. Those performing the logging operations shall have a minimum of 10 years' experience. Five (5) years of the required experience shall be waived if the logger is a Florida registered Professional Geologist (P.G.) or Professional Engineer (P.E.). Training shall include more than the minimum training offered by manufacturers with the purchase of new logging equipment. The geophysical logging contractor shall submit a copy of their professional registration.

3.10 STEP DRAWDOWN TESTING

A. Two step drawdown tests will be conducted on each well to determine performance. The tests will consist of step-drawdown tests in which each well will be pumped at four (4) escalating rates. The first will be done after each borehole has been reamed out prior to installation of the conductor case and will test the upper Floridan aquifer. The second step drawdown test will be conducted within one week of the completion and development of each well and will test the lower Floridan aquifer.

1. The discharge rates shall be as follows (or higher if the test pump will allow):

Step	Pump Rate
1	1,750 gpm
2	2,625 gpm
3	3,500 gpm
4	4,375 gpm

2. The pump used in the step-drawdown tests shall be capable of producing the discharge rates listed above.

3. Water levels, discharge rates, and totalizer flow meter readings shall be manually measured and recorded every 10 minutes through each step by the CONTRACTOR.

4. Each pumping step shall last until stabilization of drawdown occurs or two hours whichever occurs first.

5. Each well will be allowed to recover a minimum of 1 hour or to within 0.05 feet of the original static water level at the end of the last step.

6. Water quality samples might be collected at the conclusion of the step drawdown test at the discretion of the OWNER.

B. Prior to the start of well testing, the CONTRACTOR shall install test data collection equipment. The pump and all measuring or testing equipment must be disinfected prior to being placed in each well.

1. A gate valve shall be installed in the discharge pipe located at the well head. The valve shall be in good condition and shall be capable of controlling the discharge rate of the well.

2. A totalizing flow meter calibrated to read within 5% of actual discharge shall be installed in the discharge pipe to measure the discharge during testing.

3. The pressure transducer shall be setup in the pumping well and connected to the data logger. The data logger will be setup to record measurements every 5 seconds for the duration of the test and recovery period.

C. During testing of each well, the CONTRACTOR will record discharge rates and water levels in the well at predetermined times. For this purpose, the CONTRACTOR shall operate the pump without interruption, at no more than 2 percent fluctuation in the designated rates of discharge, during the full period of the step-drawdown test. If a test is started, but must be stopped due to equipment breakdown or inadequate supervision by the CONTRACTOR, no extra payment will be made for the time spent pumping before the test had to be stopped, or the time spent waiting for recovery before the test is restarted. If any part of the pumping equipment fails to operate properly or impairs the proper functioning of another element or instrument involved in the test, the equipment shall be removed and repaired at the expense of the CONTRACTOR and no extra payment will be made for the delay.

D. If, as a result of step-drawdown test analysis, the ENGINEER/GEOLOGIST determines that a pumping well has not been fully developed, the CONTRACTOR shall continue well development using the test pump or other means. No additional payment will be due the CONTRACTOR for time in setting up and conducting the additional step-drawdown test which will be required for well acceptance following this additional development.

E. A copy of the test data collected by the data logger will be provided to the ENGINEER/GEOLOGIST for reduction and analysis in its raw form on a data CD or DVD in ASCII or Microsoft® Excel format. A copy of all other data, hand written or otherwise, collected for the test will also be provided to the ENGINEER/GEOLOGIST for reduction and analysis.

3.11 CONSTANT RATE DISCHARGE TESTING

A. One constant rate discharge test (CRDT) will be conducted on only one production well to be selected by the ENGINEER/GEOLGIST and the OWNER's REPRESENTATIVE. The CONTRACTOR shall submit to the ENGINEER/GEOLGIST and the OWNER's REPRESENTATIVE the CRDT plan at least seven (7) days prior to the start of the test. The test will consist of pumping the well at a constant rate for a specified period or until the water level drawdown stabilizes in the production well. The discharge rate will be based on the results of the step drawdown testing though it is anticipated the well will be

pumped at the design capacity of 3,500 gpm. The CRDT will be performed after the step drawdown tests of the lower Floridan aquifer are completed at each production well. The duration of the CRDT will be 24 hours.

1. The CONTRACTOR shall wait a minimum of 24 hours following the completion of all step-drawdown testing before beginning the CRDT to allow the well to recover and the collection of background water levels by the CONTRACTOR.

2. Background and pumping test water levels shall be obtained by the pressure transducers with data loggers from the pumped production well, the other five production wells, the lower Floridan monitor well MR-LF-1, and upper Floridan monitor well MR-UF-1. Up to four additional data collection points may be selected at surrounding wells and/or piezometers at the COUNTY's discretion.

3. Daily rainfall data will be collected by the CONTRACTOR during the background water level measurement, during the CRDT, and during the test recovery period.

4. Discharge rates shall be measured and recorded periodically throughout the test by the CONTRACTOR. The totalizing flow meter reading shall be recorded every half-hour for the duration of the test.

5. Water levels in the production well shall be measured with pressure transducers with appropriate operating ranges and recorded by the data loggers. Water levels shall be collected manually by the CONTRACTOR at the production well every hour for the duration of the test.

6. Static water levels, drawdown, and recovery from the test shall be measured by the CONTRACTOR to the nearest 0.01-foot by pressure transducers in the observation wells. The measurement schedule will be followed during the CRDT and restarted for the recovery period.

7. Water levels shall be collected by the CONTRACTOR at the end of the discharge test until the pumping well recovers within 0.05 feet of the original static water level or for a minimum of 24 hours.

8. A copy of the test data collected by the data logger will be provided to the ENGINEER/GEOLOGIST for reduction and analysis in its raw form on data CD or DVD in ASCII or Microsoft® Excel format. A copy of all other data, hand written or otherwise, collected for the test will also be provided to the ENGINEER/GEOLOGIST for reduction and analysis.

B. Prior to the start of well testing, the CONTRACTOR shall install test data collection equipment. The pump and all measuring or testing equipment must be disinfected prior to being placed in the wells.

1. A 1¼-inch nominal diameter pipe, open only at the top and bottom and suitable for water-level measurement using a pressure transducer, shall be installed in

the pumping production well. The top of the pipe shall be installed at or slightly above land surface and be accessible during the pumping test as directed by the ENGINEER/GEOLOGIST. A fitting allowing for the watertight sealing of the access pipe around the transducer cable must be provided. The bottom of the pipe shall be 3 feet above the top of the pump bowl assembly. The inside of the pipe shall be smooth and unobstructed and the pipe shall be sufficiently plumb and straight so that there will be no interference with measurement.

2. A gate valve shall be installed in the discharge pipe located at the well head. The valve shall be in good condition and shall be capable of controlling the discharge rate of the well.

3. A totalizing flow meter calibrated to read within 5% of actual discharge shall be installed in the discharge pipe to measure the discharge during testing.

C. During testing of the well, the CONTRACTOR will record discharge rates and water levels in the well at predetermined times. For this purpose, the CONTRACTOR shall operate the pump without interruption, at no more than 2 percent fluctuation in the designated rate of discharge, during the full period of the test. If a test is started but must be stopped due to equipment breakdown or inadequate supervision by the CONTRACTOR, no extra payment will be made for the time spent pumping before the test had to be stopped, or the time spent waiting for recovery before the test is restarted. If any part of the pumping equipment fails to operate properly or impairs the proper functioning of another element or instrument involved in the test, the equipment shall be removed and repaired at the expense of the CONTRACTOR and no extra payment will be made for the delay.

D. Pump rates for the CRDT shall be 3,500 gpm for the production well. This rate may be modified based on the results of the step drawdown tests.

3.12 PLUMBNESS AND ALIGNMENT

A. Surface, conductor, and well casings shall be set round, straight, and plumb. To demonstrate compliance with this requirement, the CONTRACTOR shall perform the test described herein in conformance with AWWA A100-97. The final test for plumbness and alignment would be made following construction of each well and before test pump equipment is installed. The CONTRACTOR may, at his option and expense, perform such a test at other times, such as prior to cementing surface casing. Such additional testing would not replace final testing after construction of each well. The CONTRACTOR shall notify the ENGINEER/GEOLGIST and the OWNER's REPRESENTATIVE at least seven (7) days prior to the start of the test.

B. Alignment shall be tested by lowering into each well a section of pipe 40 feet long or a dummy of the same length, in conformance with AWWA A100-97. Plumbness shall be tested by lowering into the well a cylindrical plummet to the specified depth. The plummet shall consist of a rigid spindle with round plates at both ends. The outer diameter of the end plates shall be 0.5-inches smaller than the inside diameter of that part of the casing or hole being tested. The distance between the end plates shall be

approximately 1.25 times the diameter of that part of the casing or hole being tested. The plummet shall be heavy enough to keep the plumb line taut. The plumb line is attached to the plummet at the exact center of the top end plate and shall be of uniform diameter.

C. The plumbness and alignment of a well would be corrected by the CONTRACTOR at his sole expense under the following conditions:

1. The plummet fails to move freely throughout the length of the casing or hole.

2. The well varies from plumb more than two thirds the smallest inside diameter of that part of the well being tested per 100 feet of depth.

3. Alignment is not satisfactory for successful operation of pumping equipment provided by the OWNER.

4. Does not meet specifications described in AWWA A100-97.

Should the CONTRACTOR fail to correct such faulty plumbness or alignment, the ENGINEER/GEOLOGIST may direct that the well be abandoned and replaced at no expense to the OWNER.

D. The CONTRACTOR may propose an alternative method at no extra cost, such as inclinometer survey, capable of demonstrating to the satisfaction of the ENGINEER/GEOLOGIST that the well is plumb and straight as described in this Section and Appendix D - AWWA A100-97.

3.13 DISCHARGE CONTROL

A. Discharge pipe shall be laid from the wells to a discharge location as shown on Figure 2. A more convenient location may be determined by the OWNER and OWNER's REPRESENTATIVE at their discretion and discussed with the CONTRACTOR four weeks prior to the start-up of any test that involves discharge flow.

B. The quality of water discharged from each production well and allowed to flow to the surface water discharge points shall be monitored by the CONTRACTOR. Both dissolved oxygen and turbidity concentrations are a concern with the proposed discharge. The CONTRACTOR shall be responsible for maintaining conditions at the point of discharge within acceptable limits of the FDEP.

C. If water is discharged to any surface water body, dissolved oxygen concentrations shall be maintained by the CONTRACTOR at a minimum of 5 mg/L at the points of discharge. This shall be achieved by injecting compressed air in the discharge line a minimum of 500 feet upstream of the end of the discharge pipe. Alternate methods of aeration may be approved by the ENGINEER/GEOLOGIST, if the ultimate goal of dissolved oxygen concentration can be achieved. Discharge pipe shall be laid from the wells to a distance of up to 5,000 feet at a location to be determined by the OWNER's REPRESENTATIVE.

D. Turbidity shall be maintained by the CONTRACTOR at a maximum of 25 NTU at the points of discharge. This shall be achieved by filtration through hay bales or some other means in the discharge stream upstream of the actual points of discharge.

E. Discharge shall be discontinued until these water quality conditions can be met.

F. Dissolved oxygen and turbidity concentrations shall be monitored with calibrated dissolved oxygen meter and turbidimeter, respectively. The quality of the discharge water shall be recorded and maintained by the CONTRACTOR twice a day during periods of discharge.

G. The CONTRACTOR shall provide, install and maintain erosion controls for the duration of the well construction work as needed and to prevent sediment and turbidity from entering surface water bodies and to avoid erosion problems by directing flow away from the drilling site and adjacent properties.

3.14 WELL DISINFECTION

A. Following completion of testing, each well shall be disinfected using sodium hypochlorite to remove bacteriological contamination in accordance with AWWA C654-2013. Each well shall also be disinfected at any time when work on the well is stopped and not expected to recommence for a period of greater than 5 days. A disinfection plan must be submitted to the OWNER and ENGINEER for approval prior to implementation.

B. The Sodium Hypochlorite solution shall be prepared and applied so that a minimum concentration of 50 mg/L of available chlorine shall be maintained for the entire depth of each well. The solution shall be allowed to remain in the well for at least 2 hours as a minimum holding time.

C. A sufficient volume of disinfectant must be applied to the well bore and aquifer to disinfect each well in accordance with the latest revision of Chapter 62-555.315, F.A.C.

D. After a well has been chlorinated and pumped to waste or allowed to free flow for a minimum of 15 minutes with zero chlorine residual, duplicate analyses shall be taken not less than 30 minutes apart and the samples tested for the presence of coliform in accordance with Standard Methods for the Examination of Water and Wastewater. Additional samples shall be collected until samples collected on two consecutive days do not show the presence of coliform bacteria. When no coliforms are present for two consecutive days disinfection shall be considered complete.

E. Chlorinated water from each well must be impounded or neutralized with sodium bisulfite or sulfur dioxide to reduce the residual to less than 0.02 mg/L prior to discharge.

3.15 WATER QUALITY ANALYSIS

A. Water quality samples shall be collected from each production well during advancement of the pilot hole every 80 feet within the lower Floridan aquifer for the following parameters: chloride, sulfate, iron, hydrogen sulfide, total dissolved solids, nitrate and nitrite. Once development has been completed samples will also be collected and delivered to the OCU Laboratories for analysis of primary and secondary drinking water parameters as defined in FDEP Chapter 62-550.310, F.A.C. and Chapter 62-550.320, F.A.C., respectively. In addition to the primary and the secondary water drinking standards, the parameter shall also include SOC.s, VOC's and Radiologicals.

B. The water samples shall be collected from a smooth sample port while the well is being discharged at the design pump rate.

C. The CONTRACTOR shall be responsible for coordination with the state-approved analytical laboratory for the delivery of the required sample containers, appropriate storage and delivery of samples to the laboratory, and for all the analytical costs.

D. The CONTRACTOR will perform bacteriological sampling following disinfection and pump off. The CONTRACTOR shall be responsible for providing a pump capable of sampling each well and all appurtenances as per AWWA C654-2013. Each well requires a total of four (4) bacteriological samples collected over two (2) consecutive days at least six hours apart. If the sample contains unacceptable levels of bacteria, the CONTRACTOR shall re-disinfect the well at no additional cost to the OWNER.

3.16 WELLHEAD COMPLETION

A. Immediately after removing the test pump, the CONTRACTOR shall weld a capping plate to the production well casing. The temporary capping plate is to secure the well and prevent entrance of any foreign material prior to installation of the permanent pump. The capping plate shall be welded to the top of the production casing in a continuous bead weld. A two-inch threaded steel pipe shall be welded to the top of the capping plate to allow access for water level measurement. A threaded cap shall be installed on the pipe. A schematic has been provided (Figure 3) showing the details for the completion of the top of casing protection.

3.17 WELL ABANDONMENT

A. In the event that the CONTRACTOR fails to complete any well to the depth specified or to such lesser depth as requested by the ENGINEER/GEOLOGIST due to equipment failure, or fails to set or grout the casing to SJRWMD and FDEP standards, or must abandon a well because of loss of tools or for any other cause, he shall, if requested by the ENGINEER/GEOLOGIST, plug the well in accordance with standards and procedures specified in the Rules of the SJRWMD, Chapter 40C-3, F.A.C.

B. The well casing of any well to be abandoned may, at the CONTRACTOR's option, be salvaged and become the property of the CONTRACTOR. Such casing shall not be reused without approval by the ENGINEER/GEOLOGIST.

C. No hourly rate will be paid for pulling casing or reconditioning the open borehole unless the ENGINEER/GEOLOGIST directs that the casing be pulled.

D. If the CONTRACTOR must abandon a well through fault of the CONTRACTOR or his employees or SUBCONTRACTORS, costs of drilling and abandonment will be borne by the CONTRACTOR.

3.18 PROTECTION AND SITE CLEAN-UP

A. At all times during the progress of the Work the CONTRACTOR shall use all reasonable precautions to prevent tampering with a well or entrance of foreign material into it. The CONTRACTOR shall also maintain the site in a clean and orderly fashion at all times so that no adverse aesthetic impacts are created upon adjacent private properties or the adjacent public right-of-way. The OWNER reserves the right to suspend work and have the site cleaned prior to proceeding, at no additional expense to OWNER, if the site is not properly maintained.

C. Immediately upon disinfection of all wells, the CONTRACTOR shall remove all of his equipment, materials, and supplies from the site of the Work, remove all surplus materials and debris, fill in all holes or excavations, and regrade the site to conform to the contours of the land which existed before work started. The site shall be thoroughly cleaned and made ready for the contractors on succeeding work. Not more than two weeks will be allowed for this site restoration, and the CONTRACTOR shall complete all site restoration work within that time.

3.19 SANITARY FACILITIES

A. The CONTRACTOR shall provide temporary sanitary facilities at the site for the needs of all construction workers and others preforming work or services in connection with this project. Sanitary facilities shall be of reasonable capacity, and properly maintained throughout the construction period. The CONTRACTOR shall place the sanitary facilities such that they are obscured from public view to the greatest practical extent. A least one (1) chemically-treated type toilet will be provided for every ten (10) employees. The CONTRACOTR shall enforce the use of such sanitary facilities by all personnel at the site. All toilets, regardless of type, must have self-contained waste storage facilities.

END OF SECTION

Ardaman & Associates, Inc.
Geotechnical Environmental and Materials Consultants

GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 1 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4
COUNTY ORANGE **STATE** Florida
DATE STARTED 1/4/11 **COMPLETED** 3/16/11
DEPTH TO WATER: -- **DATE** --
DEPTH TO WATER: -- **DATE** --
REMARKS

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air
CASING TYPE
DRILLER/RIG Dave Adkins
TIME --
TIME --

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
114	5									Gray (6/1), poorly graded sand, (SP) with roots.		
109	10											
104	15									Very pale brown (6/3), silty sand (SM), trace yellow clay.		
99	20											
94	25									Dark greenish gray (4/1), clayey sand (SC), with pale brown clay inclusions.		
89	30											
84	35									Dark greenish gray (4/1), clayey sand (SC), with cemented sands and shells.		

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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Geotechnical, Environmental and Materials Consultants

GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 2 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
79	40									Dark greenish gray (4/1), clayey sand (SC), with cemented sands and shells. *(continued)*		
74	45									Gray, cemented sands and shells, interlayered with pale brown silty sand (SM).		
69	50											
64	55									Gray, cemented sands and shells, trace gray, clayey sand (SC).		
59	60											
54	65									Gray (6/1), clayey sand (SC).		
49	70									Greenish gray, low to medium plasticity clay (CL).		

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 3 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
44	75									Greenish gray, low to medium plasticity clay (CL). *(continued)*		
39	80											
34	85											
29	90											
24	95									Gray, high plasticity fat clay (CH), with trace limestone.		
19	100											
14	105									Light green, high plasticity fat clay (CH), with trace cemented clay.		
9	110											
										Light gray, low to high plasticity clay (CL/CH), with limestone.		

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 4 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
4	115											
-1	120									Light gray, low to high plasticity clay (CL/CH), with limestone. *(continued)*		
-6	125											
-11	130											
-16	135									Greenish gray, low plasticity clayey sand (SC), with few shell fragments.		
-21	140											
-26	145									Greenish gray, low plasticity sandy clay (CL), with trace dark gray, poorly indurated limestone.		
-31	150											
										Dark gray, stiff, low plasticity clay (CL), with limestone fragments.		

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 5 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-36	155									Dark gray, stiff, low plasticity clay (CL), with limestone fragments. *(continued)*		
-41	160									Light brown, moderately indurated limestone, with trace low plasticity clay.		
-46	165											
-51	170									Light brown, poorly indurated limestone, with trace low plasticity clay.		
-56	175											
-61	180									Light brown, poorly indurated, fossiliferous limestone (wackestone).		
-66	185											
-71	190											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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Geotechnical, Environmental and Materials Consultants

GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 6 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-76	195									Light brown, poorly indurated, fossiliferous limestone (wackestone). *(continued)*		
-81	200											
-86	205									Light brown, moderately indurated, slightly fossiliferous limestone (wackestone).		
-91	210											
-96	215											
-101	220									Light brown, moderately indurated, slightly fossiliferous limestone (wackestone), with *Dictyoconus americanus.* Top of Avon Park Formation		
-106	225											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 7 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-111	230				6.8	202			130			
										Light brown to brown, moderately indurated, fossiliferous limestone (wackestone) with *Dictyoconus americanus* and echinoids. With gray, dolomitic limestone.		
-116	235											
-121	240									Light brown to brown, moderately indurated limestone (mudstone/wackestone). With gray, dolomitic limestone.		
-126	245											
-131	250				6.2	223			144	Light brown to brown, moderately indurated limestone (mudstone). With gray, dolomitic limestone.		
-136	255											
-141	260									Light brown, poorly indurated limestone (wackestone). With gray, dolomitic limestone.		
-146	265											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 8 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-151	270				7.0	210			136	Light brown, poorly indurated limestone (wackestone). With gray, dolomitic limestone. *(continued)*		
-156	275											
-161	280											
-166	285											
-171	290				6.7	224			146	Very light brown, poorly indurated limestone (mudstone). With gray, dolomitic limestone.		
-176	295											
-181	300											
-186	305											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 9 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-191	310				6.9	225			147	Very light brown, poorly indurated limestone (mudstone). With gray, dolomitic limestone. *(continued)*		
-196	315									Light brown and gray, moderately indurated dolomitic limestone. With light brown, limestone (mudstone).		
-201	320											
-206	325									Light brown, moderately indurated, vuggy dolomite. With light brown, moderately indurated limestone, and gray, moderately indurated dolomitic limestone. *Dictyoconus americanus* present.		
-211	330				8.6	262	17	0	188			
-216	335									Light brown, moderately indurated, fossiliferous limestone (wackestone). With gray, dolomitic limestone. Few echinoid fragments and some *Dictyoconus americanus.*		
-221	340											
-226	345									Light brown, moderately indurated, fossiliferous limestone (wackestone). With gray dolomitic limestone, and some *Dictyoconus americanus.*		

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 10 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
FILE NO. 113-07-10-0036
CLIENT Orange County Utilities
ELEVATION 119 feet (NGVD)
BORING LOCATION N 1512333.5; E 455369.4
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-231	350				8.9	239	17	0	167	Light brown, moderately indurated, fossiliferous limestone (wackestone). With gray dolomitic limestone, and some *Dictyoconus americanus. (continued)*		
-236	355									Light brown, moderately indurated, fossiliferous limestone (wackestone/packstone). With gray dolomitic limestone and *Dictyoconus americanus* present.		
-241	360											
-246	365									Light brown, moderately indurated, fossiliferous limestone (mudstone) with echinoids, and gray dolomitic limestone.		
-251	370				8.4	228	17	0	163			
-256	375									Light brown, poorly indurated, slightly fossiliferous limestone (wackestone) with echinoids, and gray dolomitic limestone.		
-261	380									Light brown, moderately indurated, slightly fossiliferous limestone (wackestone/packstone). With gray dolomitic limestone.		

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GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 11 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4
FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-266	385											
-271	390				8.3	233	19	0	166	Light brown, moderately indurated, slightly fossiliferous limestone (wackestone/packstone). With gray dolomitic limestone. *(continued)*		
-276	395											
-281	400											
-286	405									Light brown, slightly vuggy, moderately indurated dolomitic limestone. With light brown, moderately indurated, slightly fossiliferous limestone, and gray, well indurated, massive dolomitic limestone.		
-291	410				8.1	232	18	0	166			
-296	415									Brown, well indurated, slightly vuggy dolomite. With gray, moderately indurated, massive dolomite, and light brown limestone.		
-301	420									Gray to brown, well indurated, slightly vuggy dolomite. With light brown, moderately indurated limestone, and gray to brown chert.		

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 12 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-306	425									Gray to brown, well indurated, slightly vuggy dolomite. With light brown, moderately indurated limestone, and gray to brown chert. *(continued)*		
-311	430				8.4	242	22	0	173			
-316	435									Light brown, slightly vuggy, well indurated dolomite. With light brown limestone, and gray massive dolomite.		
-321	440											
-326	445									Light brown to gray, moderate to well indurated dolomite. With limestone.		
-331	450				8.3	292	23	0	203			
-336	455									Light brown, well indurated, dolomitic limestone. With light brown, well indurated, slightly vuggy dolomite.		
-341	460											

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GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 13 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4
FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-346	465									Light brown, well indurated, dolomitic limestone. With light brown, well indurated, slightly vuggy dolomite. *(continued)*		
-351	470				8.2	445	46	0	316	Light brown to brown, slightly vuggy to massive dolomite. With light brown, slightly fossiliferous limestone, gray massive dolomite, dark brown organic clay and gray-green clay, and limestone (mudstone).		
-356	475									Light brown, massive to slightly vuggy, slightly fossiliferous dolomite. With gray, massive dolomite, and brown, lean clay.		
-361	480											
-366	485									Light brown, limestone. With Light brown, massive to slightly vuggy dolomite, and gray, massive dolomite.		
-371	490				8.4	452	47	0	322			
-376	495									Light brown, massive to slightly vuggy dolomite. With brown, lean clay, and light brown, limestone.		
-381	500											

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 14 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
FILE NO. 113-07-10-0036
CLIENT Orange County Utilities
ELEVATION 119 feet (NGVD)
BORING LOCATION N 1512333.5; E 455369.4
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-386	505											
-391	510				8.2	433	53	0	308	Brown, well indurated, dolomitic limestone.		
-396	515											
-401	520									Brown, moderately indurated, dolomitic limestone.		
-406	525									Light brown, moderately indurated, limestone.		
-411	530				8.3	439	51	0	312	Gray to brown, moderately indurated dolomitic limestone.		
-416	535									Light brown, moderately indurated limestone.		

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 15 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-421	540											
-426	545											
-431	550				8.3	445	50	0	316			
-436	555											
-441	560									Light brown, moderately indurated limestone. *(continued)*		
-446	565											
-451	570				8.3	486	55	0	346			
-456	575											

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 16 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-461	580											
-466	585											
-471	590				8.3	489	54	0	347			
-476	595									Light brown, moderately indurated limestone. *(continued)*		
-481	600											
-486	605											
-491	610				8.3	491	52	0	349			
-496	615											

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 17 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-501	620											
-506	625									Light brown, moderately indurated limestone. *(continued)*		
-511	630				8.3	486	49	0	345			
-516	635											
-521	640											
-526	645											
-531	650				8.3	486	55	0	346	Brown, moderately indurated, dolomitic limestone.		
-536	655											

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 18 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-541	660									Brown, moderately indurated, dolomitic limestone. *(continued)*		
-546	665									Light brown, well indurated, massive, micrtic limestone.		
-551	670				8.3	482	48	0	343			
-556	675											
-561	680									Brown, well indurated, dolomitic limestone.		
-566	685											
-571	690				8.1	493	50	0	350			

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GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 19 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-576	695											
-581	700											
-586	705											
-591	710				8.4	486	55	0	345			
-596	715									Brown, well indurated, dolomitic limestone. *(continued)*		
-601	720											
-606	725											
-611	730				8.4	493	51	0	350			

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 20 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-616	735											
-621	740									Brown, well indurated, dolomitic limestone. *(continued)*		
-626	745											
-631	750				8.9	488	50	0	346			
-636	755									Light brown, poorly indurated, massive to slightly vuggy dolomitic limestone. With light brown, poorly indurated, moldic limestone.		
-641	760											
-646	765									Light brown, poorly indurated, moldic limestone. With light brown, poorly indurated, massive dolomitic limestone.		
-651	770											
										Light brown, poorly indurated limestone.		

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 21 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4
FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
					8.2	478	49	0	340			
-656	775											
-661	780									Light brown, poorly indurated limestone. *(continued)*		
-666	785											
-671	790				8.2	478	51	0	341			
-676	795									Light brown, poor to moderately indurated limestone. With light brown, moderately indurated, slightly vuggy dolomitic limestone.		
-681	800											
-686	805									Light brown, poor to moderately indurated limestone. With light brown, poor to moderately indurated, slightly vuggy dolomitic limestone.		
-691	810											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

Ardaman & Associates, Inc.
Geotechnical Environmental and Materials Consultants

GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 22 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4
FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
					8.3	497	50	0	352			
-696	815											
-701	820									Light brown to gray, moderately indurated dolomite. With light brown, moderately indurated limestone.		
-706	825											
-711	830				8.3	500	49	0	355			
-716	835											
-721	840									Light brown, moderately indurated, slightly vuggy dolomite. With light brown limestone.		
-726	845											

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Geotechnical Environmental and Materials Consultants

GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 23 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-731	850				8.3	487	50	0	351	Light brown, moderately indurated, slightly vuggy dolomite. With light brown limestone. *(continued)*		
-736	855											
-741	860									Light brown, moderately indurated, slightly moldic limestone.		
-746	865											
-751	870				8.1	509	53	0	362			
-756	875									Light brown, moderate to well indurated, massive to slightly vuggy dolomite. With light brown, moderately indurated, moldic limestone with echinoids present.		
-761	880											
-766	885									Light brown, moderate to well indurated, massive to slightly vuggy dolomite. With light brown, moderately indurated, moldic limestone.		

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Geotechnical, Environmental and Materials Consultants

GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 24 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-771	890				8.2	491	53	0	344	Light brown, moderate to well indurated, massive to slightly vuggy dolomite. With light brown, moderately indurated, moldic limestone. *(continued)*		
-776	895											
-781	900											
-786	905											
-791	910				8.2	488	55	0	349	Light brown, moderate to well indurated, massive to slightly vuggy dolomite. Trace limestone.		
-796	915											
-801	920											
-806	925											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 25 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-811	930				8.2	479	56	0	343			
-816	935											
-821	940											
-826	945									Light brown, moderate to well indurated, massive to slightly vuggy dolomite. Trace limestone. *(continued)*		
-831	950				8.3	490	48	0	346			
-836	955											
-841	960											
-846	965											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 26 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
										Light brown, moderate to well indurated, massive to slightly vuggy dolomite. Trace limestone. *(continued)*		
-851	970				8.3	490	47	0	344			
-856	975											
-861	980											
-866	985											
										Light brown, poor to moderately indurated, massive to slightly vuggy dolomite.		
-871	990				8.3	487	46	0	347			
-876	995											
-881	1000											

GTGS LOG - ARDAMAN ORLANDO.GDT - 10/25/11 14:10 - W:\PROJECTS\2007\07-036 SOUTHWEST WELLFIELD\GINT\MALCOLM ROAD WELLFIELD.GPJ

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Geotechnical Environmental and Materials Consultants

GEOLOGIC LOG

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 27 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4
FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-886	1005									Light brown, poor to moderately indurated, massive to slightly vuggy dolomite. *(continued)*		
-891	1010				8.2	397	44	0	282	Light brown, well indurated, vuggy, slightly fossiliferous, dolomitic limestone.		
-896	1015									Brown, well indurated, massive dolomitic limestone.		
-901	1020									Light brown, well indurated, slightly vuggy, dolomitic limestone.		
-906	1025									Brown, well indurated, massive, slightly moldic, dolomitic limestone. With pinpoint porosity.		
-911	1030				8.2	312	31	0	221	Brown, well indurated, massive, moldic, dolomitic limestone.		
-916	1035									Light brown to gray, very well indurated, massive crystalline dolomite. With very light brown, limestone.		
-921	1040									Brown, well indurated, slightly vuggy, dolomitic limestone.		

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 28 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-926	1045									Brown, well indurated, slightly vuggy, dolomitic limestone. *(continued)*		
-931	1050				8.1	318	32	0	226			
										Light brown, well indurated, dolomitic limestone.		
-936	1055											
										Light grayish brown, moderately indurated, massive limestone.		
-941	1060											
										Light grayish brown, well indurated, massive limestone. With 10-12% very dark brown, organic, silty clay.		
										Light brown, silt to very friable siltstone. With trace clay.		
-946	1065									Light brown, massive limestone, with 2% silt and clay and few white calcite crystals.		
-951	1070				8.3	312	34	0	220			
										Very light brown, very well indurated, massive limestone.		
-956	1075											
-961	1080											

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 29 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-966	1085									Very light brown, very well indurated, massive limestone. *(continued)*		
-971	1090				8.3	298	30	0	210			
-976	1095									Brown, well indurated, dolomitic limestone. With light brown, well indurated, massive limestone.		
-981	1100											
-986	1105											
-991	1110				8.1	278	32	0	197			
										Light brown, well indurated, dolomitic limestone.		
-996	1115									Light gray, very well indurated chert.		
-1001	1120									Brown to dark brown, slightly vuggy dolomite.		

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 30 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-1006	1125									Light brown, well indurated, dolomitic limestone.		
-1011	1130				8.3	273	25	0	194			
-1016	1135									Light brown, well indurated, massive to vuggy dolomite. With light brown limestone, and organic peat.		
-1021	1140											
-1026	1145									Light brown to gray, massive to vuggy dolomite. With light brown, moldic limestone.		
-1031	1150				8.2	279	26	0	198			
-1036	1155									Light brown, massive to slightly vuggy dolomite.		
										Gray, very well indurated chert. With light brown dolomite.		

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 31 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-1041	1160									Light brown, massive to slightly vuggy dolomite.		
-1046	1165									Light brown to gray, slightly vuggy to massive dolomite. With organic peat.		
-1051	1170				8.3	272	20	0	193	Light brown to gray, massive dolomite.		
-1056	1175											
-1061	1180											
-1066	1185									Light brown to gray, well to very well indurated, massive to vuggy dolomite. With light brown limestone.		
-1071	1190				8.2	278	21	0	198			
-1076	1195											

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GEOLOGIC LOG

ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 32 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-1081	1200											
-1086	1205											
-1091	1210				8.3	341	32	0	242			
-1096	1215											
-1101	1220									Light brown to gray, well to very well indurated, massive to vuggy dolomite. With light brown limestone. *(continued)*		
-1106	1225											
-1111	1230				8.3	340	26	0	241			
-1116	1235											

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ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 33 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586 Blows/6 in	N Value	Sample Number	Field Data pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-1121	1240									Light brown to gray, well to very well indurated, massive to vuggy dolomite. With light brown limestone. *(continued)*		
-1126	1245									Dark brown, very well indurated, dolomite.		
-1131	1250				8.3	308	30	0	217	Light brown, moderate to well indurated, slightly vuggy, dolomite.		
-1136	1255									Brown, moderate to well indurated dolomite. With 10% calcite crystals.		
-1141	1260									Dark brown, very well indurated, massive dolomite.		
-1146	1265									Dark brown to brown, well indurated, slightly vuggy to massive dolomite.		
-1151	1270				8.2	300	31	0	213	Gray, brown to light brown, very well indurated chert. With dolomite and few calcite crystals.		
-1156	1275									Light brown to brown, slightly vuggy to massive dolomite. With 5-10% calcite crystals.		
										Light brown to brown, well indurated dolomite.		

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ORANGE COUNTY GOVERNMENT FLORIDA

BORING NO: MR-LF-1
TOTAL DEPTH: 1310.0 ft.
SHEET 34 OF 34

PROJECT Malcolm Road (Southwest) Wellfield
CLIENT Orange County Utilities
BORING LOCATION N 1512333.5; E 455369.4

FILE NO. 113-07-10-0036
ELEVATION 119 feet (NGVD)
BORING TYPE Mud Rotary/Reverse Air

Elevation	Depth (ft)	Standard Pen. Test ASTM D1586: Blows/6 in	N Value	Sample Number	Field Data: pH (Units)	Specific Conductance (mS/cm)	Chloride (mg/L)	H_2S (mg/L)	TDS (mg/L)	Soils Descriptions and Remarks	Depth (ft)	Graphic Log
-1161	1280									Light brown to brown, well indurated dolomite. *(continued)*		
-1166	1285											
-1171	1290				7.9	314	31	0	223	Dark brown, very well indurated dolomite. With 10-12% dark brown organic peat.		
-1176	1295											
-1181	1300									Brown, very well indurated dolomite. With light brown, well indurated limestone and few calcite crystals.		
-1186	1305											
-1191	1310				8.3	310	28	0	227			
										BORING TERMINATED AT 1310.0 FEET BELOW GROUND SURFACE		

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