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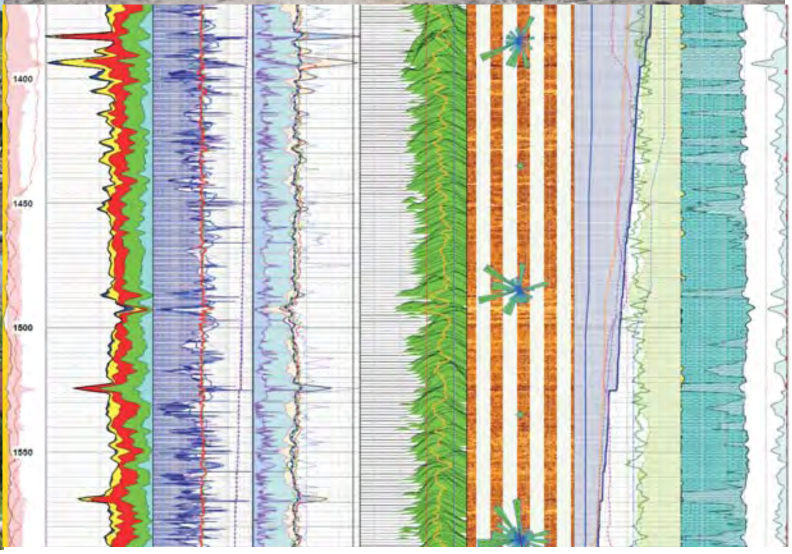
City of Hialeah
Reverse Osmosis Water Treatment Plant Hydrogeologic Investigation of the Upper Floridan Aquifer



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Reverse Osmosis Water Treatment Plant
Hydrogeologic Investigation
of the Upper Floridan Aquifer

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Contents

Appendices

Figures

Tables

Section 1
Executive Summary

1.1 Executive Summary

The proposed City of Hialeah reverse osmosis water treatment plant project is a major component of the City's capital improvement program. Reverse osmosis treatment of brackish groundwater will be used to help meet the potable water demands of the City's annexation area and growth within the Miami-Dade Water and Sewer Department (MDWASD) service area. The City and MDWASD recognized the need for additional water and have partnered together to share the cost of constructing the new treatment facility. Large-scale development of fresh groundwater sources near the major population centers in South Florida is no longer feasible due to competing uses, the potential for saline water intrusion problems, and perceived impacts to wetlands or other environmentally sensitive areas. The South Florida Water Management District (SFWMD) encourages the use of alternative water supplies and has supported this project by issuing grants to help cover portions of the construction costs. The design capacity of the water treatment facility is 17.5 million gallons per day (Mgd) and it is anticipated that the initial plant capacity will be 10.0 Mgd. Raw water pumpage rates of 23.33 and 13.33 Mgd will be required based on an assumed recovery efficiency of 75% for the reverse osmosis process. The development of brackish water for public supply purposes includes three major components: a reverse osmosis treatment facility, a concentrate disposal system, and the raw water supply wellfield. This report addresses the testing and evaluations conducted in order to design the raw water supply wellfield.

Brackish water is known to occur within the Floridan Aquifer at depths of approximately 1,000 feet below land surface and greater in Dade County based on the results of previous hydrogeologic investigations conducted in the area. However, aquifer yield and water quality conditions can vary greatly over relatively small distances and with depth. A detailed program of testing and analyses was developed to: identify one or more groundwater sources suitable for reverse osmosis treatment; assess the quantity of water available for public supply use; estimate the pumpage induced, long-term changes in water quality with time; and to collect sufficient data to insure the long-term viability of the water source(s). The hydrogeologic investigation included the drilling of five deep test wells to various depths near the proposed water treatment plant site, collection of aquifer yield and water quality data, computer modeling to evaluate the impacts of the proposed pumpage, and development of wellfield design scenarios. The proposed water treatment plant and wellfield site is located near the intersection of NW 170th Street and NW 97th Avenue in Hialeah.

The Floridan Aquifer is suitable for use as a raw water supply source for a reverse osmosis treatment facility based on the results of the investigation conducted. The Floridan Aquifer was penetrated to a depth of 1,733 feet below land surface (bls) in a test/production well constructed at the plant site. The upper portion of the Floridan Aquifer was tested between the depths of approximately 1,080 feet and 1,490 feet bls during the investigation. The transmissivity was determined to range from approximately 3,700 to 6,200 ft^2/day indicating the aquifer has a moderate yield capacity. The total dissolved solids (TDS) and chloride concentration of the water produced during aquifer performance testing of the Upper Floridan Aquifer were approximately 3,500 milligrams per liter (mg/L) and 1,650 mg/L, respectively. Salinity levels increase with depth within the aquifer system. The Upper Floridan Aquifer is considered the primary source of feedwater for the proposed reverse osmosis water treatment facility. A limestone unit encountered between the approximate depths of 497 and 620 feet during drilling was also tested as part of the investigation. The unnamed limestone unit has water quality similar to the underlying Upper Floridan Aquifer, but very low yield potential so it is not considered a viable source of feedwater for the reverse osmosis plant.

Hydraulic and solute transport computer models of the Floridan Aquifer System were developed to estimate water level and water quality changes that might occur due to long term brackish water withdrawals. A proposed wellfield alignment consisting of 14 production wells producing a maximum of 23.33 Mgd was simulated for a period of 30 years. The model results indicate that aquifer drawdowns of up to 107 feet may occur due to sustained withdrawals at the maximum anticipated pumping rate. Drawdowns in the production wells will be greater due to well losses and pumping water levels of 150 feet below land surface or more may occur near the center of the wellfield alignment. The average simulated TDS of the water produced from the wellfield increases from approximately 3,500 mg/L to 4,310 mg/L over a 30 year period based on the model results. Sensitivity analyses were conducted in order to evaluate how variations of the model input parameters impact the model results and thus estimates of future water quality from the wellfield. A range of estimated water quality changes that might occur from the wellfield over a 30 year period were determined based on the sensitivity analyses results. The upper end scenario indicates that average TDS values from the wellfield may increase to as high as 6,420 mg/L over a 30 year period due to sustained pumpage at a rate of 23.33 Mgd.

The water level drawdown and water quality projections presented in this report are based primarily on data collected during a hydrogeologic investigation conducted in the vicinity of the proposed reverse osmosis plant. The investigation was limited in size and scope due to the typical time and budget restraints associated with a project of this type. Existing data from other areas in South Florida were also utilized but the amount of existing information available is not extensive. The designers of the membrane process and plant operators should consider the anticipated range of water quality from the wellfield. It would be prudent to specify piping and other equipment capable of treating water with the highest salinity anticipated. The model results should be compared to actual water level and water quality data obtained from the wellfield after it has been in operation for approximately two years. The model should be updated and calibrated to the actual operational data at that time and additional simulations conducted to predict future wellfield performance, if necessary.

1.2 Conclusions

- An investigation of the Upper Floridan Aquifer was successfully performed at the future City of Hialeah reverse osmosis water treatment plant site. Brackish groundwater from the Upper Floridan Aquifer will adequately supply the future raw water demands of the water treatment plant. The reverse osmosis treatment process is anticipated to be 75 percent efficient and will require a raw water supply of 13.33 Mgd to produce a finished water flow capacity of 10 Mgd and a raw water supply of 23.33 Mgd to produce a finished water flow capacity of 17.5 Mgd.

- One test-production well (TP-1) and three monitor wells (F-1, F-2, and F-3) were constructed in the Upper Floridan Aquifer at the project site. The wells were constructed and tested to evaluate yield and quality of groundwater from the Upper Floridan Aquifer. The test-production well was designed to enable conversion to a future production well.

- An unnamed aquifer was identified in the Intermediate Confining Unit during test-production and monitor well construction at the project site. Recognizing the potential value of a freshwater source to supplement brackish groundwater, a test well was subsequently constructed and cased with an open hole ranging from 497 to 620 feet below land surface (bls). The aquifer had low yield characteristics and similar water quality to the Upper Floridan Aquifer. The aquifer is not considered a viable raw water source for the water plant due to its low yield potential.

- The Upper Floridan Aquifer consists primarily of porous limestone and dolomite. The top of the aquifer occurs at an approximate depth of 1,050 feet bls at the project site. Dissolved chloride and total dissolved solids (TDS) were measured at concentrations of approximately 1,650 milligrams per liter (mg/L) and 3,500 mg/L, respectively, in the test-production well. The overall testing results indicate that the transmissivity of the production zone at the project site ranges from approximately 3,700 to 6,200 ft^2/d and that the storage coefficient is roughly 5×10^{-4}. The calculated leakance values ranged from 1.5×10^{-4} to 4.1×10^{-4} d^{-1}.

- The potentiometric surface in the Upper Floridan Aquifer ranged between an approximate altitude of 47 and 52 feet referenced to the National Geodetic Vertical Datum of 1929, which is equivalent to approximately 39 to 44 feet above land surface. Wells constructed in the Upper Floridan Aquifer are artesian and will flow freely at land surface.

- Hydraulic and solute transport computer models of the Upper Floridan Aquifer were developed to simulate aquifer response in terms of drawdown and water quality changes that may result from a raw water withdrawal rate of 13.33 and 23.33 Mgd. A proposed design for the wellfield was evaluated using a groundwater flow model to estimate the amount of drawdown that would occur in the aquifer based on the proposed withdrawal rates. A solute transport model was used to estimate salinity changes over a 30-year period. A maximum drawdown of approximately 107 feet is anticipated in the aquifer based on the modeling results with a 23.33 Mgd withdrawal rate. The solute modeling indicated that TDS concentrations from the wellfield may increase from an average initial value of 3,500 mg/L to approximately 4,310 mg/L over the 30-year period at a withdrawal rate of 23.33 Mgd.

- A sensitivity analysis was performed to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of aquifer parameters, stress, and boundary conditions. The sensitivity analysis was performed by varying longitudinal and vertical dispersivities, effective porosity, and the vertical hydraulic conductivity value of the Middle Confining Unit that directly underlies the proposed pumping zone. The sensitivity analysis results indicate that the model is most sensitive to the vertical hydraulic conductivity of the Middle Confining Unit. Based on the results of sensitivity analysis, the average TDS concentration of raw water withdrawn from the wellfield could reach 6,420 mg/L. The maximum drawdown may reach 117 ft according to one sensitivity analysis run in which the vertical hydraulic conductivity of the underlying confining unit was reduced by 50%.

1.3 Recommendations

- A total of 14 production wells should be utilized to meet a raw water demand of 23.33 Mgd. Two of the 14 production wells should serve as backup supply wells that provide a redundant supply capacity in the event one or more of the production wells are not operational. All of the production wells and backup wells should be used on a rotational basis. The individual wells should be constructed with a minimum spacing of approximately 1,250 feet and a configuration that maximizes separation to the extent possible. A proposed wellfield alignment is provided in this report.

- The production wells should be constructed with a cased depth of approximately 1,080 feet bls with an open hole to approximately 1,490 feet bls. The depth to the top of the Upper Floridan Aquifer will vary across the proposed wellfield site. Therefore, the final casing and open hole depths should be determined by a geologist based on actual lithology at each individual production well site. A cost effective well design should be considered that enables installation of a submersible pump while minimizing casing diameter below the submersible pump. A common design includes a larger diameter (e.g., 16-inch diameter) casing installed to approximately 200 feet, in which the submersible pump is installed, and below which the casing size is reduced (e.g., 12-inch diameter).

- Step-drawdown pump tests should be performed on each newly constructed production well. Pumping rates during the tests should range between approximately 1,000 and 1,500 gallons per minute (gpm). Specific capacity values calculated based on the test results can be used to assess individual well yields and confirm withdrawal rates. All of the production wells should be disinfected following development and step-drawdown pump testing. Submersible pumps equipped with electric motors should be installed in the wells with the intakes set at depths determined based on the specific capacity test results. Variable frequency drive controllers should be used to adjust production rates as needed. Intake setting depths of 100 to 150 feet bls are anticipated. Recommended withdrawal rates for the Upper Floridan Aquifer production wells when the reverse osmosis water treatment plant is in full operation may range between 1.5 to 2.0 Mgd.

- A letter modification of the existing South Florida Water Management District water use permit should be submitted to document the number and locations of proposed production and monitor wells. The existing Miami-Dade water use permit (SFWMD No. 13-00017-W) includes the proposed withdrawals from the Upper Floridan aquifer at the project site.

- The monitor wells constructed during this investigation should be preserved and be used to monitor future water levels and water quality, if possible. Monitoring may be required by limiting conditions of the SFWMD water use permit. An additional monitoring well located distant from the wellfield should be designated as a background well.

- The project design and management strategy should be sufficiently flexible to accommodate the maximum salinity change predicted by the model. Based on the results of sensitivity analysis, the average TDS concentration of raw water withdrawn from 14 proposed wells could reach 6,420 mg/L after 30 years of pumpage ranging from 13.33 to 23.33 Mgd. It is recommended that the design of the 17.5 Mgd RO plant accommodate raw water with a TDS concentration of at least 6,420 mg/L.

- Additional sensitivity analyses and model calibration may be necessary when more operational data from the water treatment plant become available. The hydraulic and solute transport models should be updated and recalibrated when more data, especially the actual drawdown and water quality data, become available after the proposed RO plant is in operation, if necessary. Actual monitoring data add to the reliability of the predicted changes in water quality.

Section 2
Introduction

2.1 Background

The Biscayne Aquifer is an unconfined, highly permeable aquifer, underlying approximately 4,000 square miles of Miami-Dade, Broward, and southeastern Palm Beach counties (Miller, 1986). Due to the aquifer productivity and the relative ease with which this water can be withdrawn and treated, it is the dominant source of public water supply for many utilities in southeast Florida. In addition, the aquifer is widely used for commercial, industrial, and agricultural purposes. The high permeability and unconfined nature of the aquifer causes it to be susceptible to contamination by salt-water intrusion and infiltration of contaminants from the extensive system of canals used for drainage and flood control and other anthropogenic sources (Miller, 1986).

Due to the large demands from this aquifer, as well as potential impacts accompanying continued and additional withdrawals from the Biscayne Aquifer, the SFWMD continues to encourage utilities to seek alternative water supplies, including RO treatment of brackish water. The SFWMD, along with funds from the State Water Protection and Sustainability Program, provide funding to off-set the cost of alternative water supply projects. To meet the alternative use objective, the City of Hialeah and Miami-Dade County entered into a joint participation agreement in December 2007 to develop a 17.5 Mgd RO water treatment plant (WTP). A site located near the Florida Turnpike was selected for the RO plant and wellfield (**Figure 2-1**). The plant will treat brackish water obtained from production wells completed in the Upper Floridan Aquifer. The RO treatment process is anticipated to be approximately 75% efficient and therefore, a raw water supply of approximately 23.3 Mgd will be required at buildout. A 10 Mgd RO WTP capacity will initially be built, which will require a 13.33 Mgd raw water supply.

Hydrogeologic data for the Upper Floridan Aquifer near the proposed RO WTP is relatively limited. Therefore, an investigative program was conducted to obtain information on the Upper Floridan Aquifer and identify the preferred production zone for the wellfield. A test-production well (TP-1) was constructed to serve this purpose. In addition, three Upper Floridan Aquifer monitor wells were constructed, at variable distances from TP-1, to function as monitor wells during aquifer performance testing to obtain additional water quality data, and to assess aquifer heterogeneity. The construction and testing of these wells is documented in this report.

2.2 Scope of Work

The scope of work completed for this project included: 1) a compilation and review of available geologic, hydraulic, and water quality data, 2) construction of test wells in the Upper Floridan Aquifer, 3) collection and analysis of lithologic, geophysical, and water quality data during well construction and testing, 4) aquifer performance testing to determine pertinent aquifer hydraulic characteristics for the Upper Floridan Aquifer, 5) groundwater modeling to estimate drawdown and water quality impacts associated with wellfield pumpage, and 6) preparation of a report summarizing the results of the investigation. In addition to testing of the Upper Floridan Aquifer, an unnamed aquifer in the Intermediate Aquifer System was identified during this

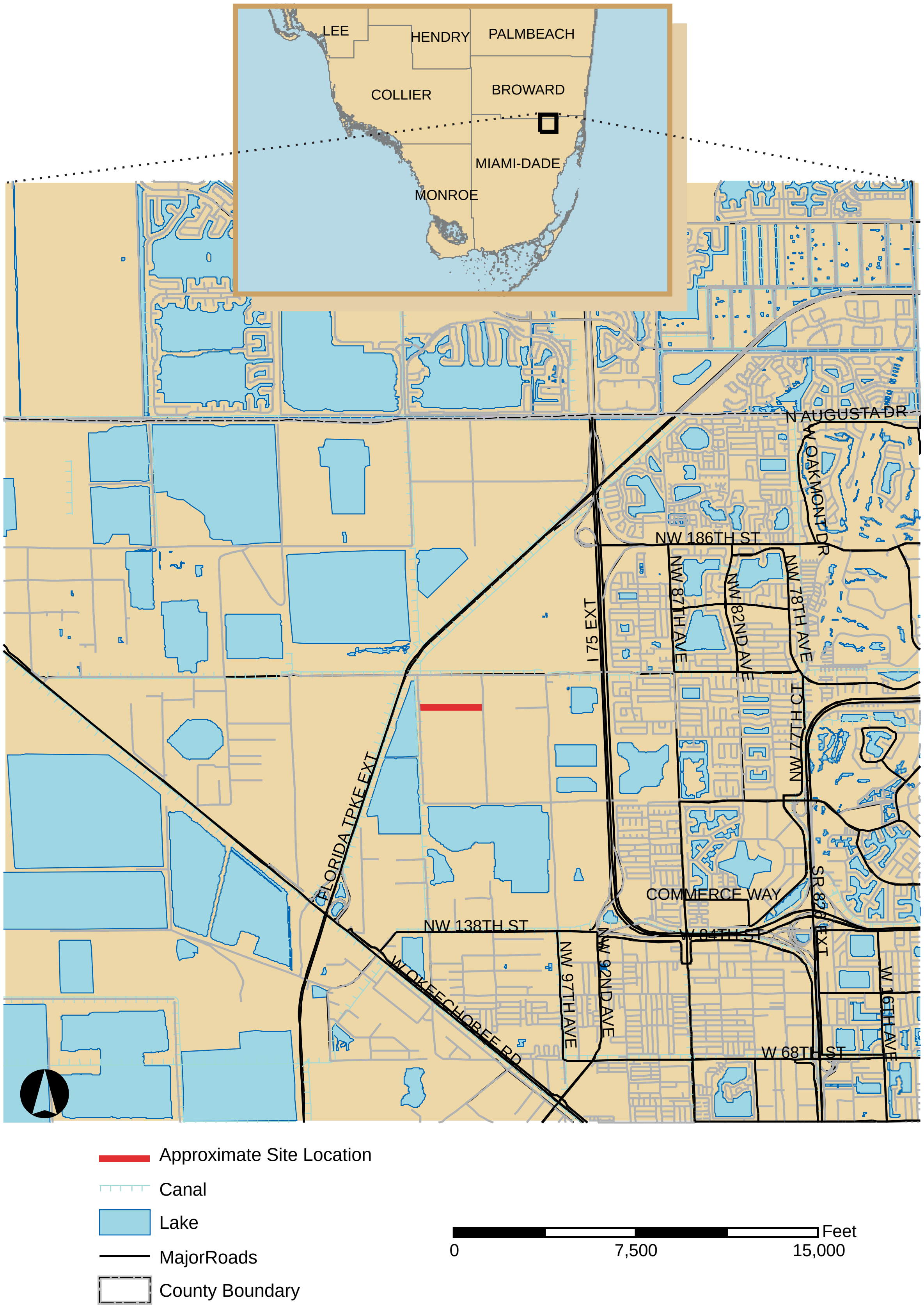

Figure 2-1
City of Hialeah
Site Location Map

investigation. Recognizing the potential value of an alternative source to blend with the brackish groundwater from the Upper Floridan Aquifer, approval to construct a test well in the unnamed aquifer was granted by the City of Hialeah.

Additional tasks that remain to be completed for wellfield development as part of the overall RO WTP expansion project include: 1) preparation of technical specifications for construction of the RO WTP production wells and assistance in the bid process, 2) modification of the water use permit to include the new wellfield, 3) provision of construction services during production well construction, and 4) start-up services for the raw water supply wellfield. The Miami-Dade County water use permit contains an allocation for this wellfield. It is anticipated that a minor modification must be obtained to show a revised configuration for the wellfield.

Section 3
Methods of Investigation

3.1 Existing Data Compilation and Review

Geologic and hydrologic data available near the project site were compiled and evaluated as part of a preliminary assessment of the Upper Floridan Aquifer. The data sources included publications from the United States Geological Survey (USGS), Florida Geological Survey (FGS), and SFWMD, which are referenced in Section 6 of this report. Information obtained from the preliminary assessment was used to design the hydrogeologic investigation and prepare technical specifications for test-production well (TP-1) and monitor wells (F-1, F-2 and F-3).

3.2 Test Drilling

Diversified Drilling Corporation was selected by the City of Hialeah, based on a competitive request for proposals evaluation, to construct the test-production and monitor wells. Schlumberger Water Services (SWS) prepared the well designs and technical specifications, and supervised all drilling operations, casing installation and cementing, water quality testing, geophysical logging, and aquifer performance testing. The wells were designed and constructed in accordance with the requirements of Chapter 62-532, Florida Administrative Code and generally in accordance with the American Water Works Association Standards for Water Wells (AWWA A100-06). An aerial photograph showing the locations of the test-production well and monitor wells is provided as **Figure 3-1**.

All wells were constructed using conventional closed-circulation mud rotary drilling through the Surficial Aquifer System and the Intermediate Confining Unit, and open-circulation reverse air drilling through the Upper Floridan Aquifer and Middle Confining Unit. Discharge water generated during open-circulation reverse air drilling was conveyed through a settling tank, filter, and piped to an existing mine pit located to the west of the project site. A permit was obtained from Miami-Dade Department of Environmental Management (DERM) prior to discharging to the existing mine pit.

3.2.1 Upper Floridan Aquifer Test-Production Well (TP-1)

Construction of test-production well TP-1 was initiated on March 29, 2009 and completed on June 7, 2009. The test-production well was constructed to evaluate the Upper Floridan Aquifer and allow for later conversion of the well to a production well to supply raw water to the RO WTP.

A 42-inch borehole was drilled to 19 feet below land surface (bls) and a 34-inch diameter (0.375-inch wall steel) pit casing was grouted at a depth of 18 feet bls. A 32-inch diameter borehole was then drilled using mud-rotary drilling to a depth of 220 feet bls. A 26-inch diameter (0.375-inch wall steel) surface casing was then pressure grouted in place at a depth of 212 feet bls. A 25-inch diameter borehole was then drilled using the mud-rotary drilling method and a 17.4-inch outside diameter Certa-Lok SDR-17 PVC casing was pressure grouted in place with neat cement to a depth of 1,082 feet bls using a narrow diameter pipe that was run through the well casing.

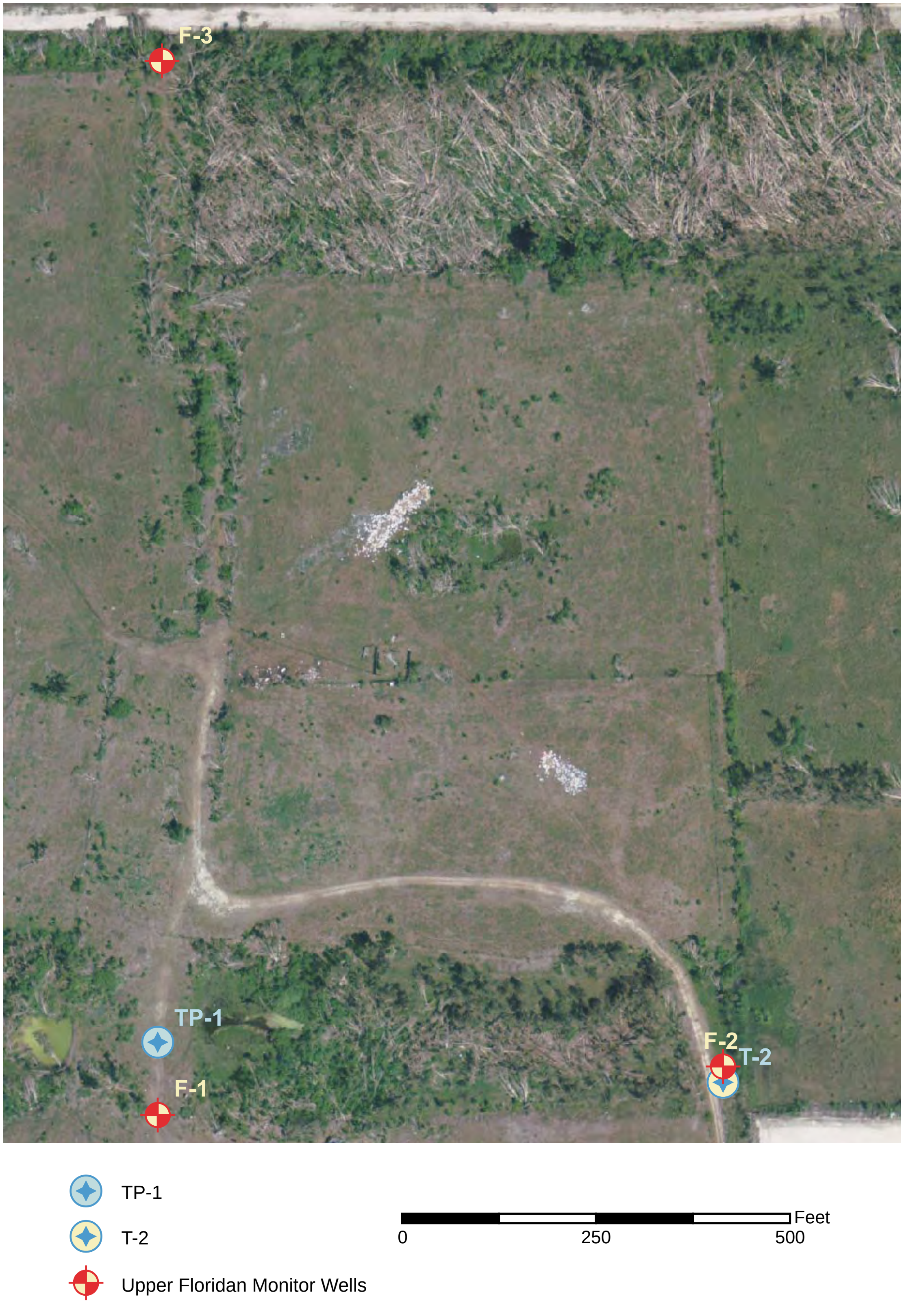

Figure 3-1
City of Hialeah
Test-Production and Monitor Well Location Map

The remaining annular space was grouted in about 10 stages using a collarless tremie pipe. The number of stages was necessary to avoid damage to the PVC pipe from heat of hydration created during grouting. Some bentonite was allowed in the tremie installed grout stages to reduce heat of hydration. The drilling rig was converted to reverse air and a 12.25-inch diameter pilot hole was completed to a depth of 1,733 feet bls. Discharge from reverse air drilling was conveyed through a settling tank, filter, and piped to an existing mine pit located to the west of the project site.

The full pilot hole was logged using advanced borehole geophysics to obtain the best quality hydraulic and water quality data possible. The pilot hole was then back-plugged with cement to a depth of 1,490 feet bls and then reamed using a 15-inch diameter bit to a total depth of 1,490 feet bls. The test-production well was purposely overdrilled to obtain water quality data from the zone below the anticipated open hole portion of the production well. Water quality data obtained from the overdrilled pilot hole was used in a three-dimensional density-dependent groundwater flow and solute transport model developed for this project. The final well depth was determined by an on-site SWS hydrogeologist based on lithology, geophysical data, water quality, and well yield. An as-built diagram for the test-production well is provided as **Figure 3-2**. As-built construction details for the test-production well are provided in **Table 3-1**. The well was air developed for several hours from within the casing until the produced water was clear and free of sediment. Rossum Sand Sampler and Silt Density Index (SDI) tests were performed during the aquifer performance test.

3.2.2 Upper Floridan Aquifer Monitor Wells (F-1, F-2, and F-3)

Three Upper Floridan Aquifer monitor wells (F-1, F-2, and F-3) were constructed on the project site (**Figure 3-1**) at varying distances from test-production well (TP-1). The monitor wells were constructed to measure water level changes in response to pumping of the test-production well and obtain spatial water quality and hydrogeologic data. The monitor wells were constructed by Diversified Drilling Corporation under the supervision of SWS staff.

The monitor wells were constructed using similar methods for each well. A 25-inch diameter borehole was constructed to approximately 20 feet bls, using mud-rotary drilling. A 20-inch diameter pit (0.375-inch steel wall) casing was installed to a depth of 19 feet bls in each monitor well. An 18.75-inch diameter borehole was drilled and a 12-inch (0.250-inch steel wall) casing was grouted to a depth of 267 feet bls in F-1, 210 feet bls in F-2, and 209 feet bls in F-3. A 12-inch nominal diameter borehole was then drilled to approximately 1,080 feet bls or greater to the top of the Upper Floridan Aquifer using mud-rotary drilling. The variation in the borehole depth was based on localized changes in the geology as observed by the on-site geologist. A 6.625-inch Certa-Lok SDR-17 PVC casing was grouted to a depth of 1,082, 1,080, and 1,085 feet bls in monitor wells F-1, F-2, and F-3, respectively. A nominal 6-inch diameter open borehole was drilled using reverse air to a depth of 1,489, 1,358, and 1,368 feet bls for monitor wells F-1, F-2, and F-3, respectively. The final well depth was determined by an on-site SWS hydrogeologist based on lithology, geophysical data, water quality, and well yield. The initial cement stage was installed by pressure grouting using a narrow diameter PVC pipe that was run through the well casing, while the remaining annular space was grouted in stages using a collarless tremie pipe. As-built diagrams for the monitor wells are provided as **Figure 3-3**. As-built construction details

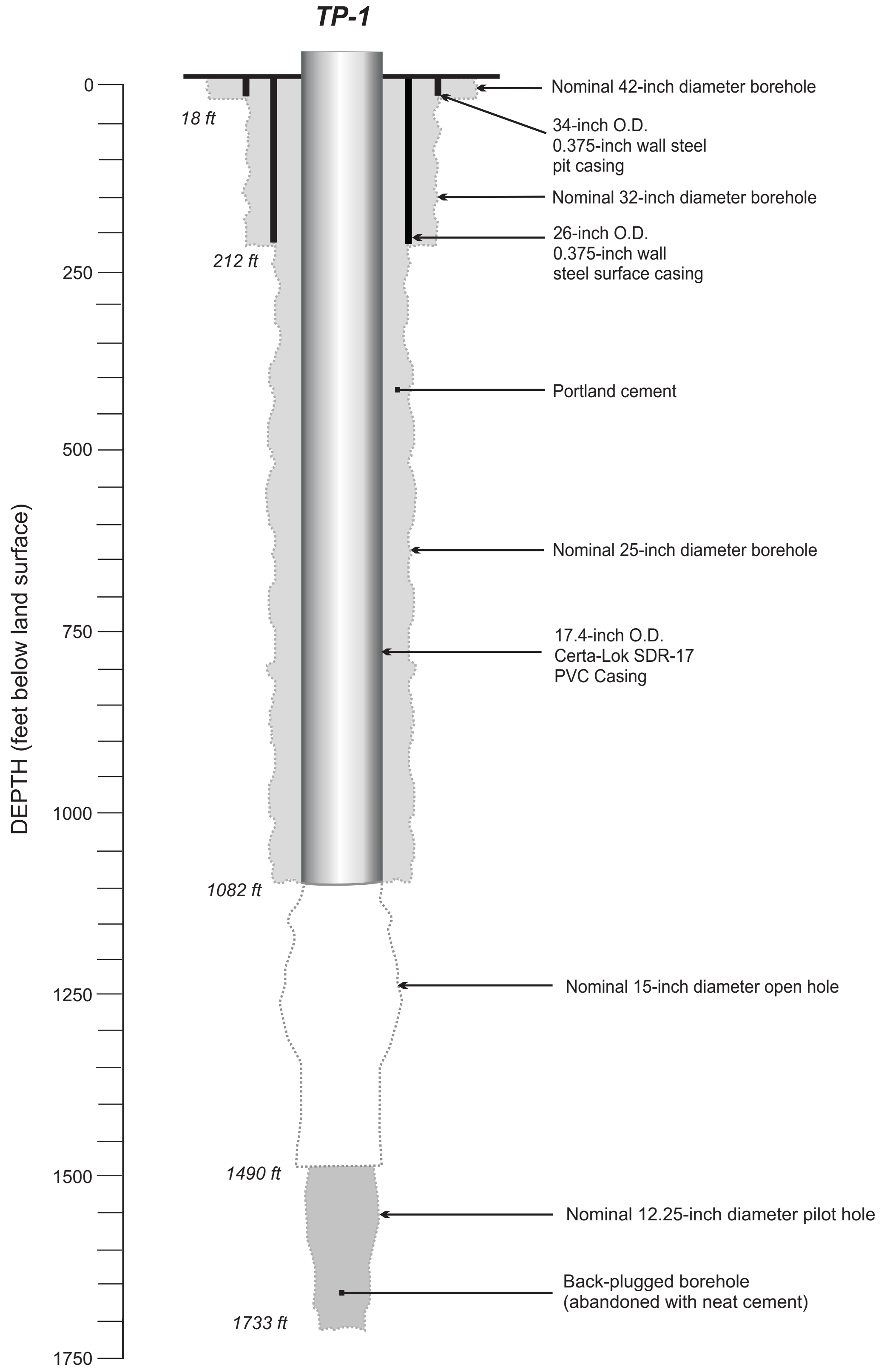

Figure 3-2
City of Hialeah
Test-Production Well TP-1 Construction Diagram

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Table 3-1 Well Construction Details

Well ID	Lat/Long	Distance from TP-1	Construction Date	Pit Casing	Surface Casing	Final Casing	Open Hole
TP-1	25.9241/80.3699		3/29/09-6/7/09	34-in, 18 ft	26-in, 212 ft	17.4-in, 1082 ft	15-in, 1490 ft
F-1	25.9239/80.3700	93	5/14/09-6/29/09	20-in, 19 ft	12-in, 210 ft	6.625-in, 1083 ft	6-in, 1488 ft
F-2	25.9239/80.3679	731	3/27/09-5/14/09	20-in, 19 ft	12-in, 210 ft	6.625-in, 1080 ft	6-in, 1358 ft
F-3	25.9275/80.3699	1266	3/30/09-5/21/09	20-in, 19 ft	12-in, 209 ft	6.625-in, 1085 ft	6-in, 1368 ft
T-2	25.9238/80.3677	732	8/19/09-9/3/9	12.75-in, 22 ft		6.625-in, 497 ft	6-in, 620 ft

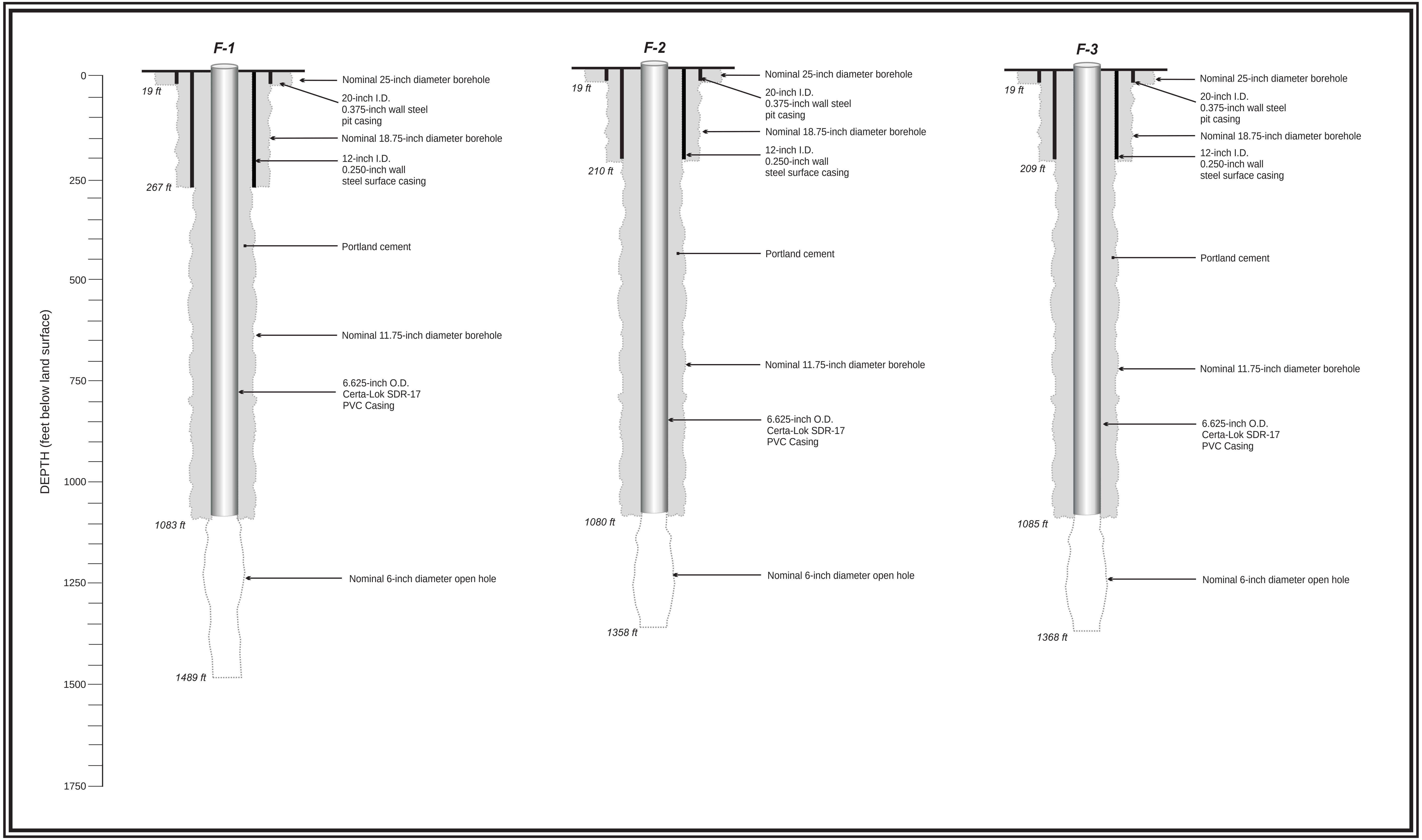

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Figure 3-3
City of Hialeah
Monitor Well F-1, F-2, and F-3 Construction Diagrams

for the monitor wells are provided in **Table 3-1**. The wells were air developed for several hours from within the casing until the produced water was relatively clear and free of sediment.

3.2.3 Unnamed Aquifer Test Well (T-2)

An unnamed aquifer in the Intermediate Confining Unit was observed at a depth of approximately 480 to 633 feet bls during construction of the test-production and monitor wells. The aquifer consists of limestone characterized as a moderately hard, sandy, wackestone with medium apparent moldic macroporosity. Recognizing the potential value of an alternative source to blend with brackish groundwater from the Upper Floridan Aquifer, the City of Hialeah granted approval to construct a test well in the unnamed aquifer. A test well (T-2) was subsequently installed and tested to determine the hydraulic characteristics and water quality in the unnamed aquifer and its potential use as a raw water source.

A 12.75-inch diameter steel surface casing was set to 22 feet bls. A 6-inch diameter PVC casing was then grouted to 497 feet bls with an open hole constructed to 620 feet bls. An as-built diagram for the test well is provided as **Figure 3-4**. As-built construction details for the test well are provided in **Table 3-1**. The test well was air developed for several hours from within the casing until the produced water was clear and free of sediment.

3.3 Lithological Logging

Drill cuttings were collected at 10-foot intervals, or at changes in lithology, and described by an on-site SWS geologist. The descriptions included lithology, color, hardness, and apparent porosity and permeability. Geologist's logs of the sediments encountered during drilling of test-production well TP-1 are provided in **Appendix A** of this report. The classification system of Dunham (1962) was used to classify limestone intervals. Colors of the drill cuttings were described using the Geological Society of America's Rock Color Chart, which is based on the Munsell system.

3.4 Water Quality

Groundwater samples were collected every 30 feet during reverse-air drilling of the test-production (TP-1) and monitor wells (F-1, F-2, and F-3). The groundwater samples were field tested for specific conductance (conductivity) using a calibrated conductivity meter. Eight-ounce samples were also retained to conduct laboratory analysis for dissolved chloride concentration and conductivity. Dissolved chloride and conductivity measurements were also made during aquifer performance testing. The reverse-air water quality data for a given depth is not necessarily representative of the formation water quality at that particular depth due to mixing with water produced higher in the borehole. However, changes in the composition of the reverse-air discharge can provide qualitative information regarding formation water quality. Samples were collected from the test-production well near the completion of the aquifer performance test for laboratory analytical testing of primary and secondary drinking water standards and water quality parameters critical to the RO WTP design.

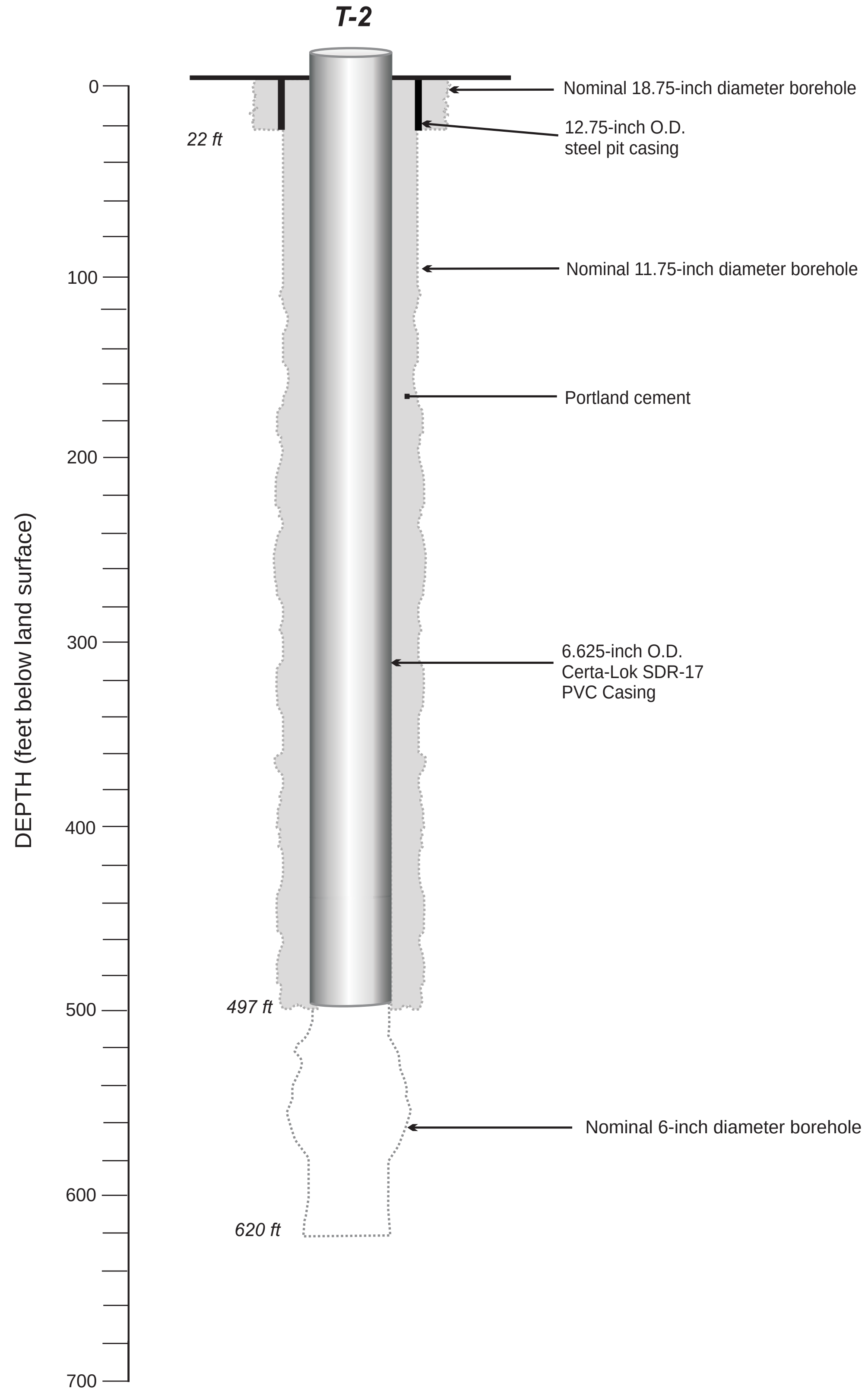

Figure 3-4
City of Hialeah
Test Well T-2 Construction Diagram

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3.5 Geophysical Logging

The borehole geophysical logging program implemented during the construction and testing of test-production well TP-1 was designed to collect information on the hydrogeology and water quality of the penetrated strata and information on borehole geometry and volume that would assist in the setting and cementing of casing strings.

Two suites of geophysical logs were run on the test-production well. The first set of geophysical logs was completed by MV Geophysical Surveys, Inc. on April 9, 2009 and included X-Y caliper, gamma ray, and dual induction. The logs were run in a 12.25-inch diameter mudded pilot hole that was completed to 1,113 feet bls. Copies of the geophysical logs are provided in **Appendix C**.

A second suite of geophysical logs was completed by Schlumberger on June 8, 2009 and included caliper, gamma ray, combinable resonance tool, dipole sonic imager, elemental capture sonde, fullbore micro imager, hostile natural gamma ray sonde, platform express (array induction/ MCFL/ spontaneous potential/ neutron/ density/ and gamma ray), three detector lithodensity, compensated neutron, and flow meter log. The logs were run in a 12.25-inch diameter pilot hole completed to 1,733 feet bls. A SWS field geologist was present during geophysical logging. Copies of the geophysical logs are provided on a DVD in **Appendix C**.

3.6 Aquifer Hydraulic Testing

3.6.1 Short-Term Aquifer Performance Test

A short-term aquifer performance test (APT) was performed in the 12.25-inch diameter pilot hole of the test-production well at a depth between 1,082 and 1,208 feet bls. The well was allowed to flow at a rate of approximately 150 gpm for approximately 2 hours. A pressure transducer/datalogger was set inside the drill pipe to monitor water level change in response to pumping. The water level was allowed to stabilize and a two hour constant rate APT was initiated. At the end of the pumping phase, a groundwater sample was collected and analyzed for specific conductance and chloride. The recovery of water levels was monitored for one hour after the pump was turned off using the pressure transducer/datalogger.

3.6.2 Step-Drawdown Test

A step-drawdown test was performed on test-production well TP-1 to obtain aquifer and well yield information and to aid in selecting appropriate pumping rates for the constant rate aquifer performance test. The well had been back plugged to a depth of 1,490 feet bls and reamed to a nominal diameter of 15 inches prior to the step-drawdown test. The step-drawdown test was performed on June 24, 2009 using a 100-horsepower submersible pump set at 100 feet bls. The test consisted of three steady (1,000, 1,200, and 1,400 gpm) steps lasting 2 hours each. Water levels were recorded with pressure transducer/dataloggers installed in the test-production well. Discharge was measured using a flowmeter calibrated to within 2 percent of full scale. Discharge was piped to the existing mine lake located to the west of the project site.

3.6.3 Long-Term Constant Rate Aquifer Performance Test

A long-term constant rate APT was completed to determine the hydraulic coefficients for the Upper Floridan Aquifer. Test-production well TP-1 was pumped at a constant rate of 1,150 gpm using a 100 horsepower submersible pump for 6,954 minutes (4.8 days). The APT was completed between June 30, 2009 and July 5, 2009 under the supervision of SWS personnel. Time and potentiometric surface data from the test-production well TP-1 and monitor wells F-1, F-2, and F-3 were measured and recorded using pressure transducers/dataloggers. Discharge from the APT was piped to the existing mine lake to the west of the project site. Silt density index (SDI) tests were performed on the discharge water along with testing of the sand concentration using a Rossum Sand Sampler. Prior to and after conducting the APT, background potentiometric surface data were recorded for a minimum of 24 hours in order to measure natural fluctuations of the potentiometric surface.

A constant rate APT was also performed using a single test well (T-2) constructed in the unnamed aquifer. The APT was performed using a centrifugal pump at a constant rate of 23 gpm for 1.5 hours. Water levels in the pumping well were recorded using pressure transducers/dataloggers installed above and below the pump intake.

Section 4
Investigation Results

4.1 Geology

The geology and hydrogeology of Miami-Dade County have been described in a number of investigations conducted by the USGS, FGS, SFWMD, and various consultants. A list of key references is provided in Section 6.0 of this report. The geologic descriptions provided below are based on a combination of the above sources and the analysis of drill cuttings collected during drilling. The classification scheme of Dunham (1962) was used to describe the limestones encountered during well construction. The stratigraphic and hydrogeologic terminology used in this report conforms to that recommended by the Southeastern Geological Society Ad Hoc Committee (1986).

A description of the geologic formations, aquifers, and confining beds encountered during the drilling of test-production well TP-1 is provided below in order from youngest to oldest. **Figure 4-1** shows a hydrostratigraphic column of test-production well TP-1.

<u>Fill</u>
The shallow subsurface (0-3 feet bls) near and surrounding the test-production well TP-1 and monitor wells (F-1, F-2, and F-3) is characterized as fill consisting of loose sand, peat and silt along with demolition debris.

<u>Miami (Oolite) Limestone/Fort Thompson Formation/Key Largo Limestone (Undifferentiated)</u>
The thin fill is underlain by Pleistocene-aged strata consisting of interfingered and often discontinuous bodies of shallow-water deposits. Fish and Stewart (1991) assigned these strata to the Miami (Oolite) Limestone, Fort Thompson Formation and Key Largo Limestone. However, these subsurface strata are lumped together in this discussion because they bear no real significance to this investigation. According to Fish and Stewart (1991), the largest component of the very highly permeable units in eastern Miami-Dade County is the Fort Thompson Formation, which is partly or completely replaced with the Miami (Oolite) Limestone or Key Largo Limestone near the coast. The undifferentiated strata extend to an approximate depth of 100 feet bls at the project site.

<u>Tamiami Formation</u>
The Pliocene Tamiami Formation is characterized by Parker et al (1955) as a creamy white limestone and green-gray clayey and calcareous marl locally hardened to limestone, silty sands, and shelly sands. Fish and Stewart (1991) point out that the upper part of the Tamiami Formation along coastal Miami-Dade County consists of highly permeable limestone, calcareous sandstone, and sand. The highly permeable portions of the Tamiami Formation form the lower part of the Biscayne Aquifer at the project site.

The upper portion (100 to 130 feet bls) of the Tamiami Formation consists of light to medium gray sandy fossiliferous packstone with medium to high moldic macroporosity. The porosity of the Tamiami Formation decreases with depth as the formation grades into a wackestone at 130 to 140 feet bls.

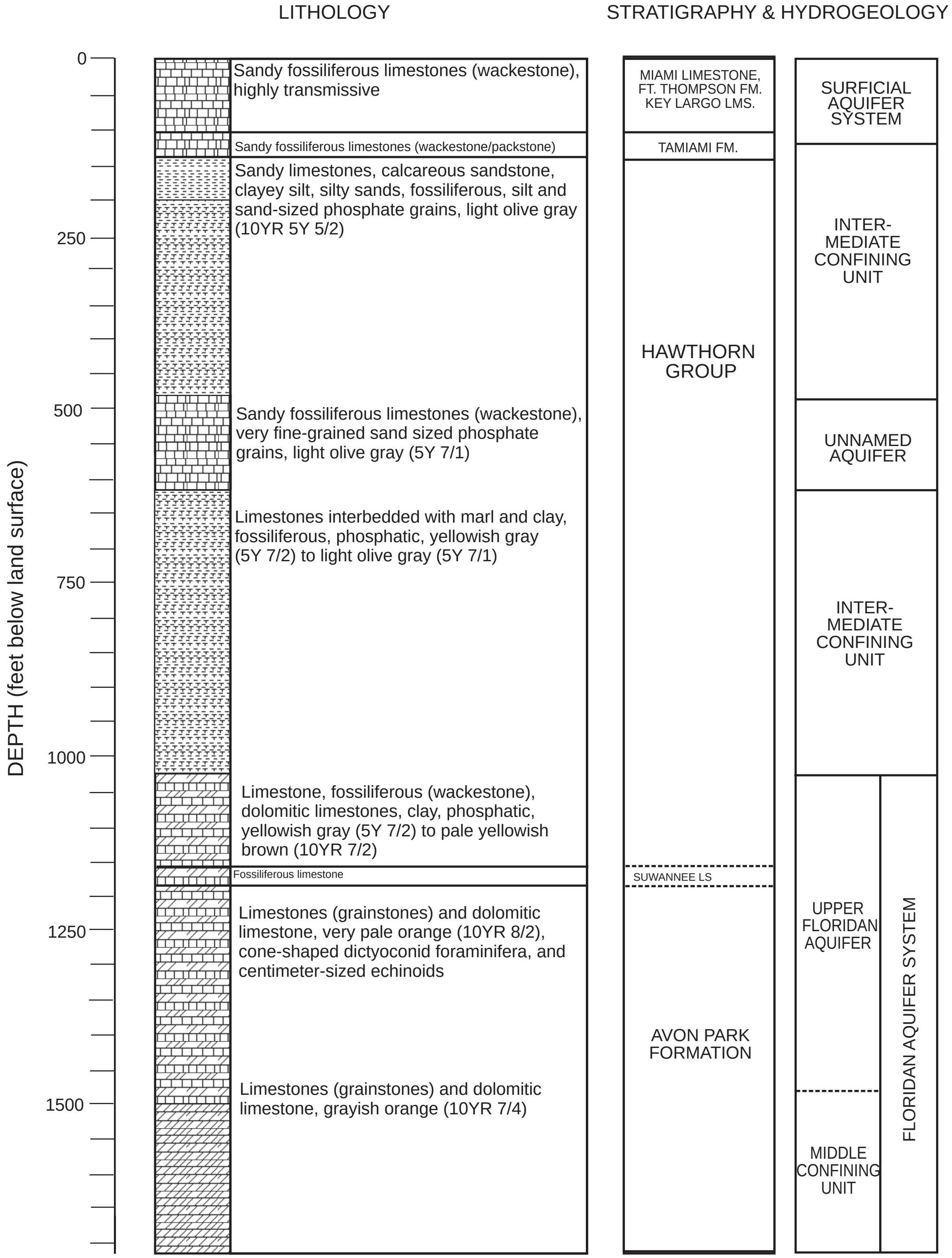

Figure 4-1
City of Hialeah
Test-Production Well TP-1 Hydrostratigraphic Column

Hawthorn Group

The Hawthorn Group is regionally extensive and lies unconformably beneath the Tamiami Formation. The Hawthorn Group is characterized by a predominant greenish color and higher clay content than the Tamiami Formation. It is a lithologically diverse unit that contains varying sequences of limestones, sands, sandstones, marls, clays, and phosphates. The commonly high phosphate concentration of numerous beds within the Hawthorn Group results in these beds having a distinctive high gamma ray log response.

The contact between the Tamiami Formation and the Hawthorn Group occurs at approximately 140 feet bls at the project site and is marked by a lithological transition downward from a light gray wackestone to a light olive gray limestone/calcareous sandstone with very fine sand-sized phosphate grains. All phosphatic clays, silts, sands, and limestones are considered part of the Hawthorn Group in this investigation. The base of the Hawthorn Group is identified at a depth of 1,155 feet bls based on a decrease in visible phosphate and natural gamma ray activity in geophysical logs. The basal portion (1,080 to 1,155 feet bls) of the Hawthorn Group is characterized by phosphatic limestones with medium to high macroporosity. It is not possible to separate the Peace River Formation from the Arcadia Formation, as defined by Scott (1988), which may not be present beneath the site.

Suwannee Limestone

A thin interval of very light colored fine-grained packstone with good porosity was identified below the Hawthorn Group at a depth between 1,155 and 1,177 feet bls. The interval exhibited low natural radioactivity measured by gamma ray logs and no visible phosphate. The interval lacks the diagnostic fossils characteristic of the subjacent Avon Park Formation.

There is a lack of consensus among local workers as to the presence or absence of the Suwannee Limestone in southeastern Florida because of marine erosion by the Florida current (Reese and Richardson, 2008). The Suwannee Limestone is regionally overlain by the Ocala Limestone except in the southern part of southeastern Florida, including most of Miami-Dade County (Reese and Richardson, 2008). Based on the documented absence of the Ocala, lack of visible phosphate and natural radioactivity, and lack of diagnostic fossils that would place the interval in the Avon Park Formation, the interval is placed in the early Oligocene-aged Suwannee Limestone.

Avon Park Formation

The top of the middle Eocene-aged Avon Park Formation is located at an approximate depth of 1,177 feet bls at the project site. The boundary between the Avon Park Formation and overlying limestones is subtle. Limestones of the Avon Park Formation are characterized by the presence of the distinctive cone-shaped dictyoconid foraminifera, which were first encountered in cuttings at a depth of 1,177 feet bls. The centimeter-sized echinoid *Neolaganum dali* was found by Vernon (1951) to be very abundant in the upper 50 feet of the Avon Park Formation in Florida peninsula wells. *Neolaganum dali* is abundant in the cuttings obtained from 1,192 to 1,218 feet bls at the project site.

The Avon Park Formation is a lithologically diverse unit. The bulk of the Avon Park Formation penetrated in the test-production well consists of very pale orange (10YR 8/2) to grayish orange

(10YR 7/4) colored limestones that are classified as grainstones. Dolomitic limestone beds are thin (<5 foot), dark gray, and exhibit medium permeability. The entire thickness of the Avon Park Formation was not penetrated at the project site. The FGS placed the base of the Avon Park Formation at a depth of 2,743 feet bls based on cuttings from a SFWMD test well located approximately 6 miles to the west of the project site (Lukasiewicz, 2003).

4.2 Hydrogeology

There are two major aquifer systems underlying the project site from land surface to a depth of approximately 3,500 feet bls; the Surficial Aquifer System and the deeper, artesian Floridan Aquifer System. These two aquifer systems are separated by a confining sequence referred to as the Intermediate Confining Unit. The Intermediate Confining Unit contains aquifers suitable for freshwater or brackish water supply in some areas of Florida (where it is referred to as the Intermediate Aquifer System). The Floridan Aquifer System is underlain by low transmissivity carbonate and evaporite strata. A hydrostratigraphic column of TP-1 is provided as **Figure 4-1**.

4.3 Surficial Aquifer System

The Surficial Aquifer System in Florida is defined as the “permeable hydrogeologic unit contiguous with land surface that is comprised principally of unconsolidated clastic deposits” (Southeastern Geological Society Ad Hoc Committee, 1986). The Surficial Aquifer System consists predominantly of Pleistocene to late Pliocene-aged sands, sandstones, and fossiliferous limestones that were mostly deposited in shallow-water depositional environments. The base of the Surficial Aquifer System is marked by a significant decrease in the average hydraulic conductivity.

The Surficial Aquifer System in northeastern Miami-Dade County contains one major aquifer, the Biscayne Aquifer. Another aquifer referred to as the Gray Limestone Aquifer is found deeper than the Biscayne Aquifer and is not found at the project site. The Gray Limestone Aquifer thins towards eastern Miami-Dade County and pinches out to west of the project site.

4.3.1 Biscayne Aquifer

The Biscayne Aquifer was defined by Parker (1951) as the hydrologic unit of water-bearing rock that carries unconfined groundwater in southeastern Florida. Parker et al., (1955) later amended the definition of the Biscayne aquifer to specifically consist of water-bearing rock of Pleistocene to later Miocene age that includes all or parts of the following formations: Tamiami Formation (uppermost part only), Caloosahatchee Marl, Fort Thompson Formation, Anastasia Formation, Key Largo Limestone and Pamlico Sand. The “Biscayne Aquifer”, as originally defined is synonymous with “Surficial Aquifer System”. Fish and Stewart (1991) restrict the term “Biscayne Aquifer” to only those areas where there is at least 10 feet of section that has a hydraulic conductivity of 1,000 feet per day (ft/d) or more. Modern revisions of ages and formations have limited the Biscayne Aquifer to the Fort Thompson, the Miami (Oolite) Limestone, the Key Largo Limestone, and the Tamiami Limestone ranging in age from Late Pleistocene to Pliocene.

The Biscayne Aquifer has been designated as a sole source aquifer and is the principal potable water source in Miami-Dade and Broward Counties. The Biscayne Aquifer in general, is wedge-shaped, increasing in thickness towards the coast where it is 300 feet or more thick. The Biscayne Aquifer is absent in westernmost Miami-Dade and Broward County (Fish, 1988; Fish and Stewart, 1991). The regional groundwater flow direction in the project site vicinity is towards the east or southeast (Fish and Stewart, 1991).

The Biscayne aquifer is approximately 140 feet thick in the project site area and consists mostly of fossiliferous limestones, which Fish and Stewart (1991) in their regional cross-sections assigned Miami (Oolite) Limestone, Fort Thompson Formation, and locally to the Key Largo Limestone. Fish and Steward (1991) also indicate that along coastal Miami-Dade County, the upper part of the Tamiami Formation is highly permeable and is included in the Biscayne Aquifer. The upper portion (100 to 130 feet bls) of the Tamiami Formation at the project site consists of light to medium gray sandy fossiliferous packstone with medium to high moldic macroporosity and forms the base of the Biscayne Aquifer at the project site.

4.4 Intermediate Confining Unit

The Intermediate Confining Unit is defined as including "all rocks that lie between and collectively retard the exchange of water between the overlying Surficial Aquifer System and the underlying Floridan Aquifer System" (Southeastern Geological Society Ad Hoc Committee, 1986). In eastern Miami-Dade County, the boundary between the Surficial Aquifer System and Intermediate Confining Unit essentially coincides with the boundary between the Tamiami Formation and underlying Hawthorn Group (Fish and Stewart, 1991), which is located at approximately 140 ft bls at the project site.

The Intermediate Confining Unit consists of phosphatic clays, silts, marls, and limestones of the Hawthorn Group. The base of the Intermediate Confining Unit is located at an approximate depth of 1,042 to 1,048 feet bls based on lithologic log from the test-production and monitor wells. The difference between the depths of the Intermediate Confining Unit is due to different land surface elevations across the project site. Therefore, the base of the Intermediate Confining Unit is flat across the project site. Additional information on the lithology of the Intermediate Confining Unit near the project site is available from the aquifer storage and recovery (ASR) wells installed near the Hialeah WTP on Okeechobee Road and West 3rd Avenue (Merritt, 1997). The Intermediate Confining Unit was reported by Merritt (1997) to consist of the Hawthorn Group and approximately the upper 25 feet of the Suwannee Limestone. Merritt (1997) placed the boundary between the Intermediate Confining Unit and Floridan Aquifer System at approximately 975 ft bls. Lukasiewicz (2003) identified the base of the Intermediate Confining Unit at a depth of 1,135 feet bls at the SFWMD test site six miles to the west.

4.4.1 Unnamed Aquifer

An unnamed aquifer was identified within the Intermediate Confining Unit during construction of the test-production well and monitor wells at the project site. This aquifer is technically considered part of the Intermediate Aquifer System. Recognizing the potential value of an alternative water source to blend with brackish groundwater from the Upper Floridan Aquifer, the City of Hialeah granted approval to construct a test well in the aquifer. A test well (T-2) was subsequently installed and tested to determine the hydraulic characteristics and water quality of the aquifer and its potential use as a raw water source.

4.4.1.1 Aquifer Description

The top of the unnamed aquifer occurs at a depth of approximately 480 feet bls and is separated from the Biscayne Aquifer by approximately 340 feet of clays, silts, and sands of the Hawthorn Group. The aquifer consists of limestones characterized as a moderately hard sandy wackestone with low to medium apparent moldic macroporosity. The base of the aquifer occurs at a depth of approximately 620 feet bls at the project site. Lukasiewicz (2003) identified this same permeable zone during construction of a SFWMD test well in the Floridan Aquifer approximately 6 miles to the west of the project site and referred to it as the mid-Hawthorn interval. Permeability indicators in the SFWMD test well included the loss of some drilling fluids while drilling, rapid drill bit penetration and relatively pure limestones in the return cuttings. The SFWMD constructed a monitoring interval (DF-3: 516-620 feet bls) in the aquifer as part of a tri-zone monitor well.

4.4.1.2 Water Levels

Static water level in test well (T-2) was observed at the land surface on September 3, 2009. The estimated land surface and water level is approximately 7 feet referenced to NGVD-29.

4.4.1.3 Water Quality

Water quality samples were collected from test well (T-2) on September 14, 2009 and analyzed for dissolved chloride concentration and specific conductance. Dissolved chloride concentrations ranged between 1,560 and 1,580 milligrams per liter (mg/L) and specific conductance ranged between 5,270 and 5,280 micromhos/cm (umhos/cm).

4.4.1.4 Aquifer Hydraulics

Water levels in the unnamed aquifer declined approximately 16.9 feet in response to a constant pumping rate of 23 gpm resulting in a specific capacity of 1.4 gallons per minute per foot (gpm/ft). A transmissivity of 375 ft^2/day was estimated for the unnamed aquifer based on the specific capacity. The SFWMD tested the same zone in their test well (DF-3) and measured a specific capacity of 1.9 gpm/ft.

4.5 Floridan Aquifer System

The Floridan Aquifer System is one of the most productive aquifers in the United States and underlies all of Florida and parts of Georgia and South Carolina for a total area of about 100,000 square miles. The Southeastern Geological Society Ad Hoc Committee of Florida Hydrostratigraphic Unit Definition (1986) defines the Floridan Aquifer System as a thick carbonate sequence which includes all or part of the Eocene to middle Miocene Series and functions regionally as a water-yielding hydraulic unit. The system in northeastern Miami-Dade

County consists of the following formations in ascending order: Oldsmar Formation of early Eocene age, Avon Park Formation of middle Eocene age, Suwannee Limestone of Oligocene age, and the basal portion of the Hawthorn Group of late Oligocene to Miocene age. The Ocala Limestone of late Eocene age appears to be absent at the project site. The base of the Floridan Aquifer System is generally placed at the top of the uppermost evaporite (anhydrite) bed in the Cedar Keys Formation, which ranges from about 3,500 to 3,700 ft bls in depth in eastern Miami-Dade County (Miller, 1986).

The Floridan Aquifer System is quite heterogeneous as far as hydraulic conductivity (Bush and Johnston, 1988). Flowmeter log data show that the aquifer consists of a number of zones with very high hydraulic conductivities, which are commonly either solution riddled or fractured, separated by confining or semi-confining intervals of rock with low hydraulic conductivities (Miller, 1986). Confining units within the Floridan Aquifer System in south Florida vary greatly in thickness and vertical continuity. Thin clay beds may provide a much higher degree of confinement than much thicker marly and/or dense limestones. Some dolomitic intervals may provide very effective vertical confinement within the Floridan Aquifer System of South Florida because the matrix permeability of dolomite is often an order of magnitude or more less than that of limestone (Maliva and Walker, 1998, 2000; Maliva et al., 2007). Dolostone beds with common vugs or small cavities may be very effective confining units or may have high permeabilities depending upon the degree to which the vugs or cavities are interconnected. Vertical fractures and solution features are locally present within apparent confining units, which may result in high degrees of connections between aquifers.

The Floridan Aquifer System can be subdivided into three main units based on their relative permeabilities; the Upper Floridan Aquifer, the Middle Confining Unit, and the Lower Floridan Aquifer (Miller, 1986). This discussion is limited to the Upper Floridan Aquifer and the Middle Confining Unit. The Lower Floridan Aquifer was not penetrated during test well construction or tested during this investigation.

4.5.1 Upper Floridan Aquifer

4.5.1.1 Aquifer Description

The top of the Upper Floridan Aquifer was identified at an approximate depth of 1,042 to 1,048 feet bls based on lithologic logs from the test-production and monitor wells. The range in depth of the top of the Upper Floridan Aquifer is due to different land surface elevations across the project site. The Upper Floridan Aquifer is located within limestones of the basal portion of the Hawthorn Group, Suwannee Limestone and upper Avon Park Formation.

The Upper Floridan Aquifer in southeastern Florida is often interpreted to include only a relatively thin Suwannee Limestone and the upper part of the Avon Park Formation (Reese and Alvarez-Zarikian, 2007). An alternative interpretation described by Reese and Alvarez-Zarikian (2007) is that the Suwannee Limestone is absent in parts of southeastern Florida (Miller, 1986; Reese and Memberg, 2000) or equivalent to the lower part of the basal Hawthorn unit (Reese, 2004), and that the Upper Floridan Aquifer begins in the basal Hawthorn Group. While this investigation agrees that the Upper Floridan Aquifer begins in the basal Hawthorn Group, there is also evidence that a thin interval (1,155 to 1,177 foot bls) below the Hawthorn Group consists of the Suwannee Limestone.

Reese (2008) points out that commonly, one or two major flow zones (typically <20 feet thick) provide most of the productive capacity and that these zones occur within the upper part of the Upper Floridan Aquifer. Flowmeter logs performed in test-production well TP-1 confirm an apparent flow zone in the upper part of the Upper Floridan Aquifer at a depth of 1,112 to 1,140 feet bls. In addition, Miller (1986) identifies unconformities at the top of the Suwannee Limestone and Avon Park Limestone, which Meyer (1989) points out are associated with zones of dissolution and increased permeability. The identified flowmeter zone in the test-production well is located near the top of the Suwannee Limestone.

The basal boundary of the Upper Floridan Aquifer is difficult to define objectively and appears to be gradational (Reese, 2008). According to Reese (2008), the basal boundary is placed above a thick limestone unit that shows gradual but substantial borehole enlargement on caliper logs that is characteristic of fine-grained, poorly cemented limestone of relatively low permeability. For the purposes of this investigation, the base of the Upper Floridan Aquifer is set at a depth of 1,489 feet bls below which a thin, dense, limestone layer was observed. This limestone layer may minimize the upward flow of poorer quality groundwater. The overdrilled pilot hole section of test-production well TP-1 was subsequently backplugged to a depth of 1,489 feet bls. Thus, test-production well TP-1 fully penetrates the Upper Floridan Aquifer. For comparison, Lukasiewicz (2003) placed the base of the Upper Floridan Aquifer at 1,370 feet bls in the SFWMD test well based on the flow logs, which indicate flow stops entering the borehole below this depth.

4.5.1.2 Water Levels

Water levels in the test-production well and monitor wells were measured using a pressure gauge installed on the wellhead and by adding the height of the gauge from land surface. The land surface elevation was estimated to the nearest foot referenced to NGVD-29 using a USGS topographic map. Water levels ranged between approximately 47 and 52 feet NGVD-29 during June and July of 2009. Water levels are higher than land surface and therefore the wells will flow freely at land surface. Fluctuations of water levels in the Upper Floridan Aquifer are minimal. The SFWMD recorded a water level fluctuation of 1.5 feet over a period of two years in the test well located six miles to the west (Lukasiewicz, 2003). The potentiometric surface does vary slightly with tidal fluctuations.

4.5.1.3 Water Quality

Water samples were collected from the test-production well during drilling, step drawdown testing, and during the APT. SWS staff analyzed the samples for dissolved chloride concentration using an argentometric titration technique (Standard Methods 4500-Cl^- B, 1997) and specific conductance using a calibrated conductivity meter. Results of the water quality testing provide a general assessment of salinity conditions within the aquifer.

Water samples were collected every 30 feet during open-circulation reverse air well drilling of the open hole of test-production well TP-1 and monitor wells F-1, F-2, and F-3. A plot of dissolved chloride concentrations in mg/L versus depth is provided as **Figure 4-2**. A plot of specific conductance versus depth is provided as **Figure 4-3**.

Dissolved chlorides remain at a nearly constant concentration of 1,210 to 1,260 mg/L between the depths of 1,115 to 1,300 feet bls in test-production well TP-1. Dissolved chlorides increase gradually to a concentration of 1,700 mg/L at a depth of 1,515 feet bls in test-production well TP-1. Chloride concentrations then increase 250 mg/L in the next 30 foot interval ending at 1,547 feet bls and steadily increase to a concentration of 2,170 mg/L at a maximum drilled depth of 1,733 feet bls. Specific conductance shows a similar increasing trend with depth.

Samples collected during the step-drawdown test of TP-1 showed a dissolved chloride concentration of 1,288 mg/l during the first step completed at 1,000 gpm. Dissolved chloride concentrations then increased and remained nearly constant with a range of 1,620 to 1,648 mg/L for the remaining steps completed at 1,200 and 1,400 gpm. Likewise, water samples collected periodically during the duration of the 4.8-day APT show a nearly constant dissolved chloride concentration ranging between 1,600 and 1,630 mg/L. Conductivity was also measured during the APT and results show a result ranging between 5,850 and 5,990 umhos/cm. The lower chloride concentration measured in the first step is likely due to the introduction of freshwater during drilling of the pilot hole.

Water quality samples were collected from test-production well TP-1 near the end of the APT on July 5, 2009. The samples were analyzed for primary and secondary drinking water quality standards. The results are summarized in **Table 4-1**. In addition, water quality samples were collected from TP-1 on September 3, 2009 and subsequently analyzed to determine the concentration of chemical parameters critical to the RO WTP design. Total dissolved solids (TDS) of the samples obtained on July 5, 2009 were measured by the analytical laboratory at a concentration of 3,416 mg/L. The SFWMD measured a similar TDS concentration of 3,460 mg/L in an Upper Floridan Aquifer well constructed, approximately six miles to the west, with an open hole interval between 1,140 and 1,230 feet bls (Lukasiewicz, 2003). Four silt density index tests were performed between July 2, 2009 and July 5, 2009 during the long-term APT. The results ranged between 1.60 and 1.86. Copies of the laboratory analytical results are provided in **Appendix B**.

4.5.1.4 Aquifer Hydraulics

An APT was performed to obtain site-specific data on key aquifer hydraulic parameters; transmissivity (T), leakance (L), and storage coefficient (S; storativity). The APT was accomplished by pumping the test-production well TP-1 while recording changes in water levels in the three observation wells (F-1, F-2, and F-3). Wells F-1, F-2, and F-3 are located approximately 93, 730, and 1,265 feet, respectively, from well TP-1. Water levels were recorded using self-contained pressure transducers and data loggers (Schlumberger MicroDivers™). In Situ LevelTroll®500 dataloggers were also installed in each well for back-up data recording purposes. The data from both devices yielded a similar overall trend of water levels during the APT.

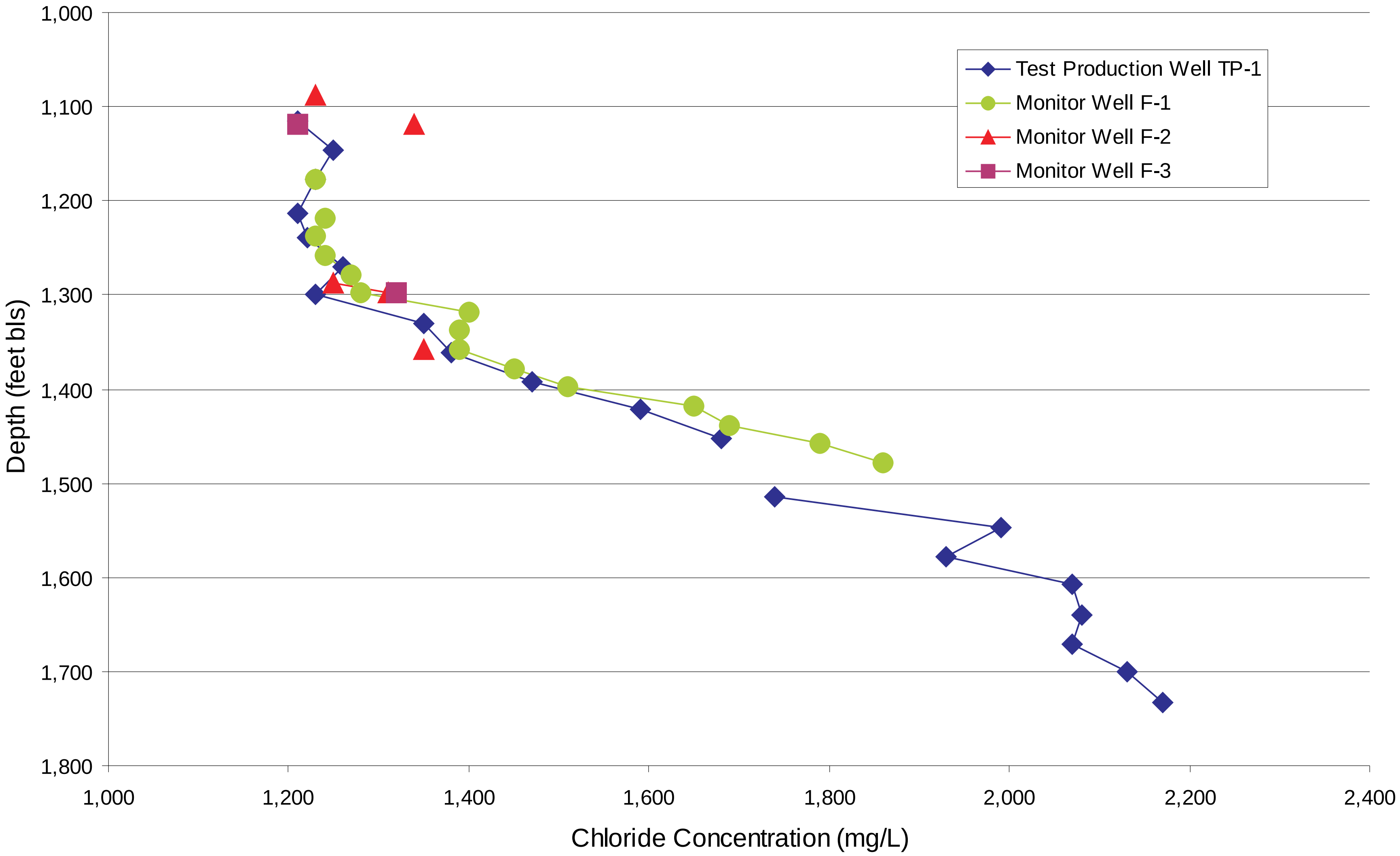

Figure 4-2. Reverse Air Drilling Dissolved Chloride Concentrations

Schlumberger
WATER SERVICES

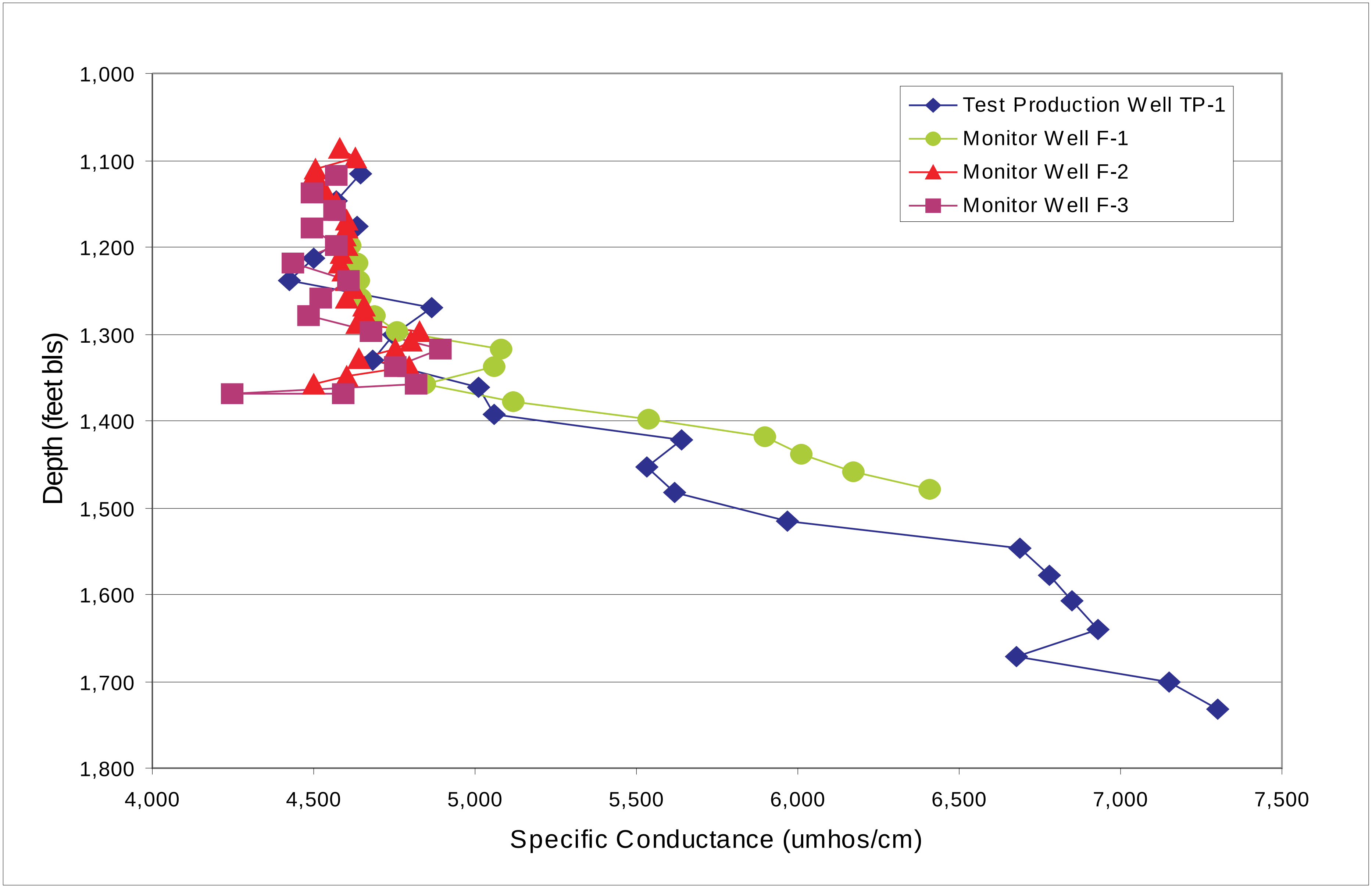

Figure 4-3. Reverse Air Drilling Specific Conductance

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Table 4-1 Laboratory Analytical Data for Test Production Well TP-1

Parameter	Result	Units
Coliform-Total (E-Coli)	Absent	-
Specific Conductance (Field)(grab)	5560	uS/cm
pH (field)	6.70	units
Temperature (Field)	22.1	Degree C
Turbidity (field)	1.4	NTU
Oxygen, Dissolved (field)	7.9	mg/L
Carbofuran	U	ug/L
Oxamyl (Vydate)	U	ug/L
Glyphosate	U	ug/L
Diquat	U	ug/L
Total Dissolved Solids (TDS)	3416	mg/L
Chloride	1430	mg/L
Fluoride	1.11	mg/L
Nitrate (as N)	U	mg/L
Nitrate+Nitrate (as N)	U	mg/L
Nitrate (as N)	U	mg/L
Ortho-Phosphate (as P)	0.42	mg/L
Sulfate	460	mg/L
Alkalinity, Total (CaCO3) Endpoint 4.3	122	mg/L
Bicarbonate	122	mg/L
Carbonate	0.16	mg/L
Nitrogen (Ammonium, NH4+)	0.41	mg/L
Sulfide	3.61	mg/L
Color/pH (Lab)	U	Pt-Co
Odor (Lab) at 40 Degrees C	8	TON
Cyanide, Total	0.0043	mg/L
Silica	10.8	mg/L
Organic Carbon, Dissolved	1.5	mg/L
Organic Carbon, Total	2.0	mg/L
MBAS Surfactants	0.12	mg/L
Hardness, Total	792	mg/L
Aluminum	0.021	mg/L
Calcium	94.4	mg/L
Copper	U	mg/L
Iron	0.023	mg/L
Magnesium	135	mg/L
Manganese	U	mg/L
Potassium	59.5	mg/L
Silver	U	mg/L
Sodium	958	mg/L
Strontium	11.3	mg/L
Zinc	0.002	mg/L
Arsenic	0.0015	mg/L
Barium	0.0100	mg/L
Cadmium	U	mg/L
Chromium	0.0021	mg/L
Lead	U	mg/L
Nickel	U	mg/L
Selenium	U	mg/L
Antimony	U	mg/L
Beryllium	U	mg/L
Thallium	U	mg/L
Mercury	U	mg/L
Ultraviolet Absorption Method	0.070	l/cm
Gross Alpha	21.8 ± 5.1	pCi/L
Radium-226	5.2 ± 0.6	pCi/L
Radium-228	0.8U ± 0.5	pCi/L

Sample collected after pumping TP-1 for 6,954 minutes (4.8 days) at 1,150 gallons per minute

U - Analyzed for but not detected

The APT test was conducted for approximately 4.8 days between June 30, 2009 and July 5, 2009. The average pumping rate was 1,150 gpm (1.7 Mgd), which was measured using a totalizing flow meter. The pumping rate was adjusted using a gate valve as needed to maintain a near constant rate. The recovery of water levels was recorded after the termination of pumping for approximately 18 hours.

The time-drawdown data were analyzed using the Hantush-Jacob (1955) and Walton (1960, 1962) modification of the Theis non-equilibrium equation (Hantush-Williams solution), which is a curve matching procedure. The time-drawdown data were also analyzed using the Cooper-Jacob (1946) modification of the Theis non-equilibrium equation (also known as the 'straight-line' method). Copies of the APT analyses for F-1, F-2, and F-3 are provided as **Figure 4-4, 4-5, and 4-6**, respectively. The time-recovery data were analyzed using a method similar to the Cooper-Jacob method with the exception that residual drawdown (s') is plotted against equivalent time (t*), rather than drawdown versus time (Theis, 1935). Analysis of the APT recovery data for the three monitor wells is provided as **Figure 4-7**.

The results of the APT are summarized in **Table 4-2**. Calculated transmissivity values increased with the distance of the observation well from the pumped well, which is a common pattern for APTs in the Floridan Aquifer System. The overall testing results indicate that the transmissivity of the production zone at the project site is approximately 5,500 to 6,500 ft^2/d and that the storage coefficient is roughly $5 X 10^{-4}$. For comparison, Lukasiewicz (2003) calculated a transmissivity of approximately 7,100 ft^2/d from an APT performed on a flow zone identified between 1,140 and 1,230 feet bls in a well constructed approximately 6 miles to the west.

The calculated leakance values ranged from $1.5 X 10^{-4}$ to $4.1 X 10^{-4} d^{-1}$. The leakance value is critical as it is a measure of the potential for vertical fluid migration into the production zone, such as more saline water from underlying strata. The leakance value reflects the total leakage of water into the production zone from both underlying and overlying strata during the APT. However, inasmuch as the strata that overlies the production zone is significantly less permeable than the underlying strata, the leakance value likely reflects primarily vertical leakage upward into the production zone from below.

A short-term APT was performed in the 12.25-inch diameter pilot hole of the test-production well at a depth between 1,082 and 1,208 feet bls. The APT was performed at 150 gpm for two hours on May 27, 2009. The maximum drawdown of 30.4 feet was recorded during the test resulting in a specific capacity of 5 gpm/ft. A transmissivity of approximately 1,300 ft^2/day was estimated from the specific capacity.

4.5.2 Middle Confining Unit

The top of the Middle Confining Unit is placed at the approximate depth of 1,489 feet bls and is difficult to distinguish from the overlying Upper Floridan Aquifer. The Middle Confining Unit predominantly consists of soft to hard very pale orange to grayish orange limestones with low to medium macroporosity. Dolomitic limestones and dolomite are also located in the confining zone. The Middle Confining Unit consists of the middle and lower parts of the Avon Park Formation and upper part of the Oldsmar Formation. The porosity and permeability of the

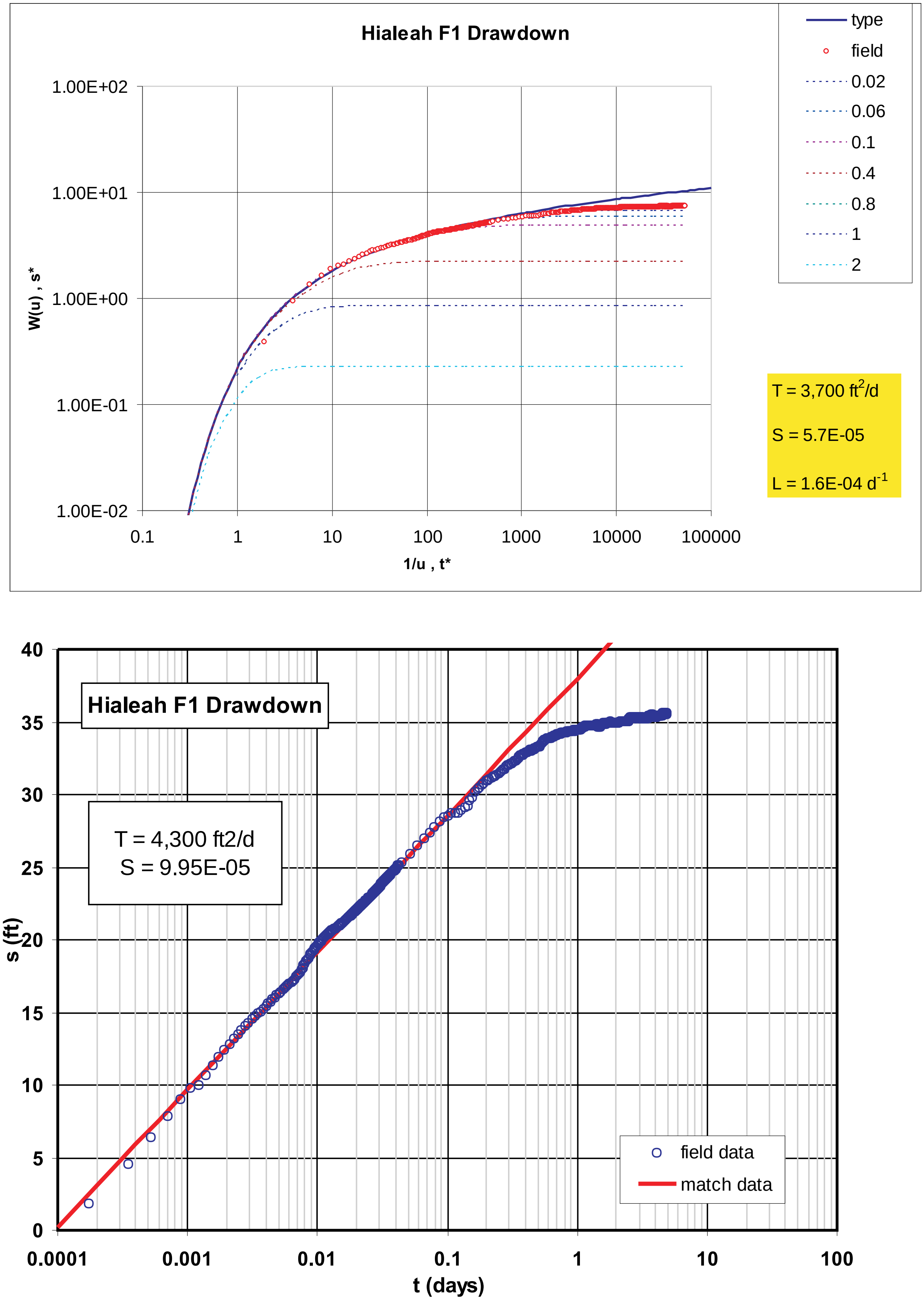

Figure 4-4: Analysis of APT Drawdown Data from Monitor Well F-1

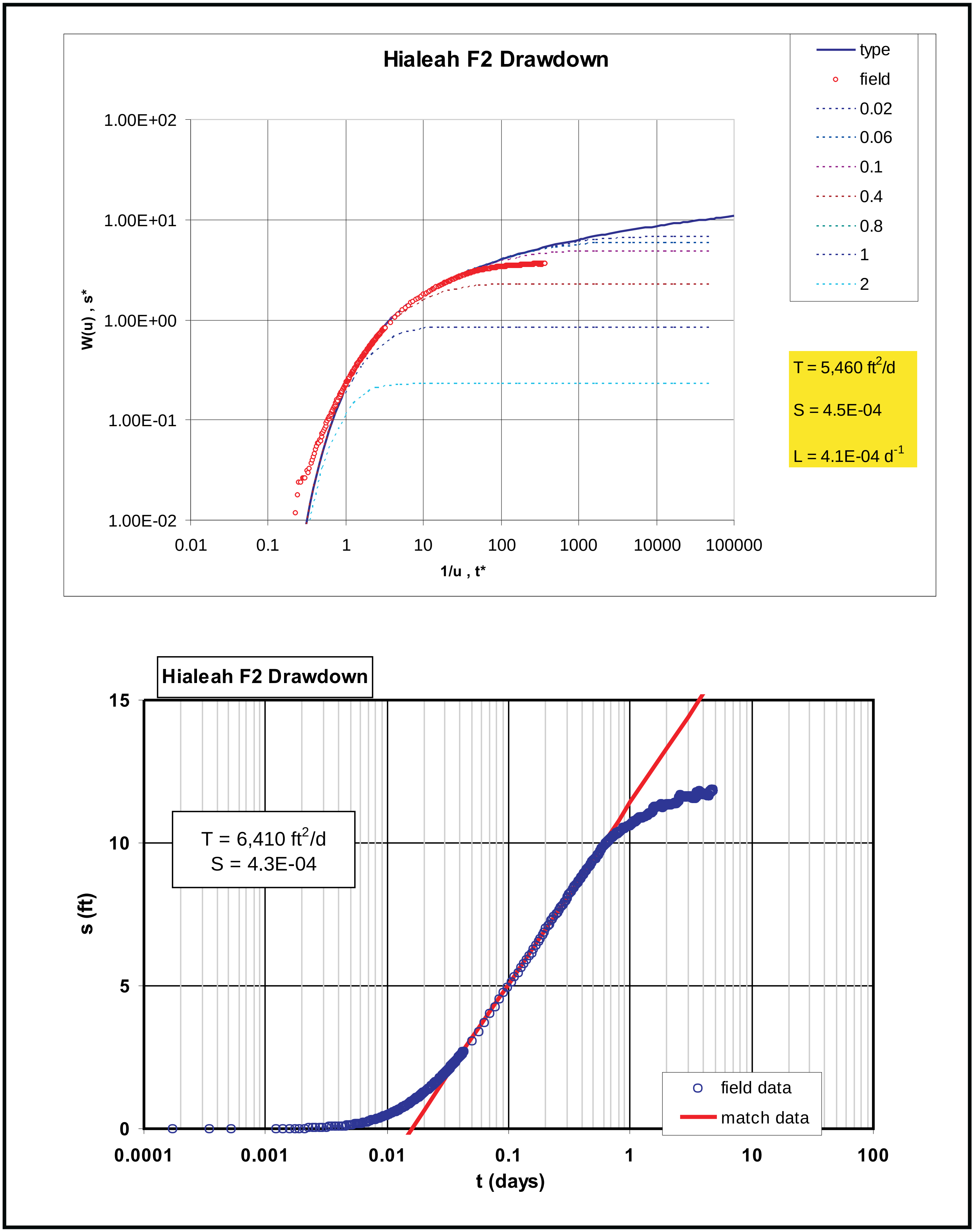

Figure 4-5: Analysis of APT Drawdown Data from Monitor Well F-2

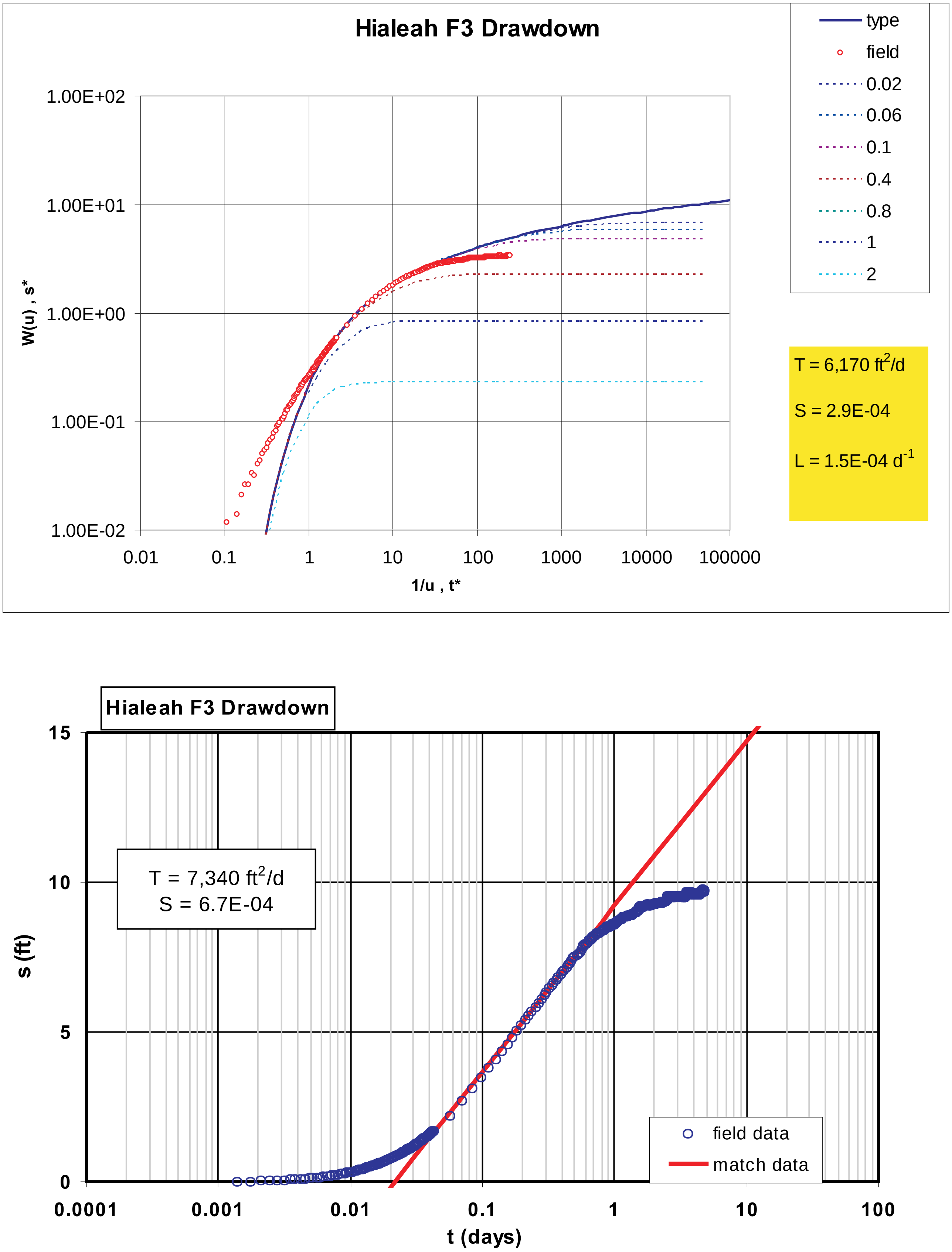

Figure 4-6: Analysis of APT Drawdown Data from Monitor Well F-3

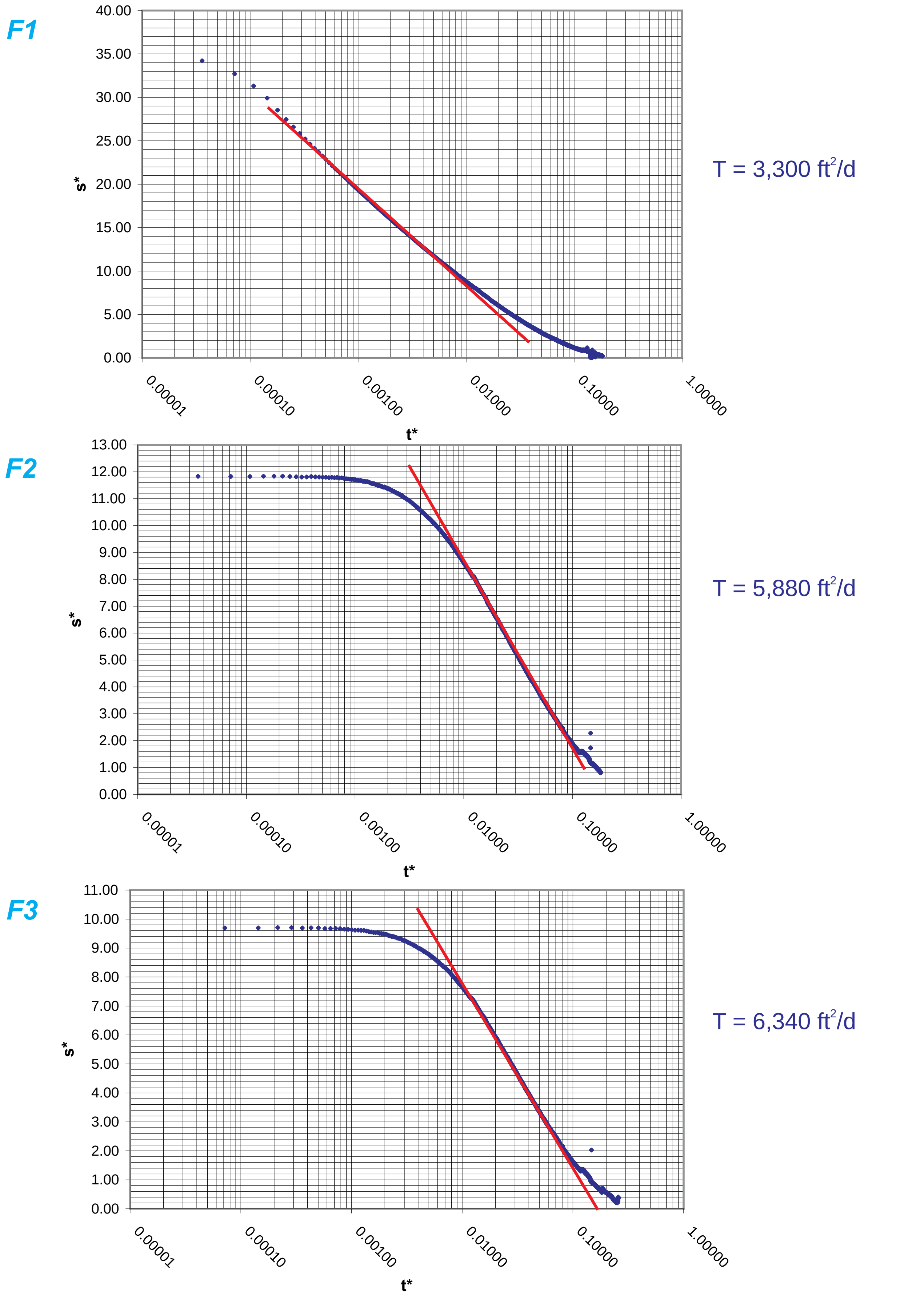

Figure 4-7: Analysis of APT Recovery Data

Table 4-2 Aquifer Performance Test Summary

Method/Well		F-1	F-2	F-3
Pumping Phase				
Hantush-Walton	Transmissivity	3,700 ft^2/d	5,460 ft^2/d	6,170 ft^2/d
	Storage coefficient	5.7 X 10^{-5}	4.5 X 10^{-4}	2.9 X 10^{-4}
	Leakance	1.6 X 10^{-4} d^{-1}	4.1 X 10^{-4} d^{-1}	1.5 X 10^{-4} d^{-1}
Cooper-Jacob	Transmissivity	4,300 ft^2/d	6,410 ft^2/d	7,340 ft^2/d
	Storage coefficient	9.95 X 10^{-5}	4.3 X 10^{-4}	6.7 X 10^{-4}
Recovery Phase				
Theis	Transmissivity	3,300 ft^2/d	5,880 ft^2/d	6,340 ft^2/d

individual beds of the Middle Confining Unit are variable, but the overall vertical hydraulic conductivity of the unit is low. Reese (2007) indicates that the Middle Confining Unit provides leaky confinement. The geophysical logs completed on test-production well TP-1 indicate that the hydraulic conductivity decreases with depth below the Upper Floridan Aquifer and into the Middle Confining Unit.

The base of the Middle Confining Unit was not penetrated during the construction of test-production well TP-1. The pilot hole was advanced to a total depth of 1,733 feet bls to record water quality below the proposed open hole section of the future production wells. The test well was backplugged using neat cement to a depth of 1,489 feet bls. According to Lukasiewicz (2003), the base of the Middle Confining Unit and top of the Lower Floridan Aquifer was identified at a depth of 2,510 feet bls at the SFWMD test well site.

Section 5
Groundwater Model

5.1 Introduction

A three-dimensional groundwater flow model with variable density and solute transport was developed to study the long-term changes of water quality at the proposed wellfield constructed in the Upper Floridan Aquifer. The model was run using a withdrawal rate of 13.33 Mgd and 23.33 Mgd. This model was developed based on a calibrated regional model (Golder Associates, 2008), and updated with local hydraulic parameters and water quality data collected during the field study. The model was developed using the USGS SEAWAT code that is capable of simulating flow with variable density.

Local calibration was performed so that the model could mimic the drawdown observed in the APTs completed at the project site. The local model calibration was based on the five-day APT conducted at the site between June 30, 2009 and July 5, 2009. During model calibration, hydraulic parameters were adjusted so that simulated drawdowns matched the drawdowns observed in the on-site monitor wells.

After the model calibration, the model was used to predict the long-term water quality changes of mixed raw water from 14 proposed production wells tapping the Upper Floridan Aquifer at the site. A series of sensitivity analysis model runs were also performed. Dispersivity, effective porosity and vertical hydraulic conductivity were tested during sensitivity analysis.

5.2 Code Selection

The target aquifer, the Upper Floridan Aquifer contains mostly brackish water (Myers, 1989; Reese, 1994; Reese and Richardson, 2004). The groundwater movement in the Floridan Aquifer System is impacted by the fluid density. Therefore, a computer code capable of simulating flow with variable density is required.

SEAWAT is a computer program that couples two popular codes, MODFLOW (McDonald and Harbaugh 1988) and MT3DMS (Zheng and Wang 1998) for flow with variable density. SEAWAT, widely used throughout the world (Guo and Bennett, 1998; Guo and Langevin 2002; Langevin et al., 2003) was used to construct the model.

SEAWAT solves two coupled partial differential equations (Guo and Langevin 2002; Langevin et al., 2003). The governing equation for the flow in terms of freshwater head is:

$$\nabla \cdot \rho K_f \left(\nabla h_f + \frac{(\rho - \rho_f)}{\rho_f} \nabla z \right) = \rho S_f \frac{\partial h_f}{\partial t} + n \frac{\partial \rho}{\partial C} \frac{\partial C}{\partial t} - \rho_s q_s$$

where h_f is the equivalent freshwater head [L], K_f the hydraulic conductivity [LT^{-1}]; ρ the fluid density [ML^{-3}]; ρ_f the freshwater density [ML^{-3}]; S_f the storage coefficient in terms of freshwater head; ρ_s [ML^{-3}] q_s represents the volumetric flow rate per unit volume of aquifer representing source and/or sink terms [T^{-1}]; C the salt concentration [ML^{-3}], and t represents time [T].

The governing equation for solute transport in porous media is:

$$\frac{\partial C}{\partial t} = -\nabla \cdot (\vec{v}C) + \nabla \cdot (D \cdot \nabla C) - \frac{q_s}{\theta} C_s + \sum_{k=1}^{N} R_k$$

where D is the hydrodynamic dispersion coefficient tensor [L^2T^{-1}]; $\vec{v}$ the flow velocity [LT^{-1}]; Cs the source concentration and θ the effective porosity.

The fluid density is defined as a linear function of salt concentration (Guo and Langevin, 2002). Under most natural conditions, salt concentration is represented as the concentration of total dissolved solids (TDS):

$$\rho = \rho_f + \frac{\partial \rho}{\partial C}(C - C_o)$$

where Co is the salt concentration for freshwater [ML^{-3}]. Practically Co is equal to zero. Typically, the fluid density of seawater is 1,025 kg/m^3 and the density of fresh water is 1,000 kg/m^3. The change of water viscosity due to salt concentration change is not considered in this study.

5.3 Regional Model ECFAS

There are many groundwater models that cover the study area, but most of these models were developed for the Surficial Aquifer System. For example, a variable density flow model was developed by the USGS to study the freshwater discharge to Biscayne Bay (Langevin, 2003). The SFWMD has developed a number of MODFLOW-based groundwater flow models for this area (SFWMD, 2006).

Recently, several large-scale groundwater flow models with variable density were developed for the Upper Floridan Aquifer System. A regional scale groundwater flow and solute transport model, the East Coast Floridan Aquifer System Model (ECFAS) was recently developed for the SFWMD (Golder Associates, 2008) using the computer code SEAWAT 2000 (Guo and Langevin 2002; Langevin et al., 2003). It is a three-dimensional groundwater flow and solute transport model. In addition, the U.S. Army Corps of Engineers (USACE, 2006) recently finished the first phase of development of a regional scale groundwater flow model using both SEAWAT2000 and WASH123D codes for the feasibility study of aquifer storage and recovery (ASR) wells as one of the key components of the Comprehensive Everglades Restoration Plan (CERP).

The development of the ECFAS model was completed in two phases. Phase I, LEC Floridan Aquifer System model (HydroGeologic, 2006) was the SFWMD's first attempt to develop a density-dependent groundwater flow model for the Floridan Aquifer System. The Phase I model covered the area of the Lower East Coast (LEC). The Phase II modeling effort included both the Lower East (LE) and the Upper East (UE) regions and the modeling tasks were undertaken by Golder Associates, Inc. (Golder Associates, 2008). Both the Phase I and Phase II models used the USGS computer code SEAWAT 2000 (Guo and Langevin, 2002; Langevin et al., 2003) allowing simulation of density-dependent flow so that the movement of freshwater and brackish water within the aquifer as well as the seawater boundary conditions of the Atlantic Ocean and the underlying Boulder Zone could be simulated.

The model domain includes all or part of Okeechobee, Indian River, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade Counties, Florida (as shown in **Figure 5-1**). The model has 542 rows and 192 columns. A regular grid spacing of 2,400 feet was applied in both the row and the column directions.

The model has 14 layers that were constructed using the hydrogeological unit geometry and properties compiled by the USGS and the SFWMD. The 14-layer model simulates the FAS only. The deeper so-called "Boulder Zone" was simulated as a constant head and constant concentration boundary. Similarly, the overlying Surficial Aquifer System was also simulated as a constant head and constant concentration boundary condition representing the average head and concentration in the Surficial Aquifer (Golder Associates, 2008).

The structure and typical values of some hydraulic parameters in the vicinity of the project site are summarized in **Table 5-1**. The aquifer named SAS stands for the "Surficial Aquifer System", ICU for the "Intermediate Confining Unit", UFA for the "Upper Floridan Aquifer"; MCU1 and MCU2 for the "First and Second Middle Confining Unit", respectively, APPZ stands for "Avon Park Permeable Zone"; LF1 stands for "the Lower Floridan Aquifer", LFCU1 for the "Lower Floridan Confining Unit" and BZ for the "Boulder Zone".

The model includes specified head boundaries along the northern and western sides for all FAS aquifers and general head boundaries at the Atlantic Ocean outcrop. The initial conditions for the model were established using available observed water levels and water quality data from the monitoring wells as well as results from multiple model simulations.

The model calibration included long-term transient model runs (approaching pseudo-steady-state conditions) over a 365 year period, long-term transient runs from 1999 to 2004 and local-scale calibration at six selected aquifer test locations.

5.4 Development of the Site-Specific Model

5.4.1 TMR Approach and Local Model Development

The regional groundwater flow and solute transport model, as described in the previous section, covers a large area of southeast Florida. In order to focus on the hydraulic impact analysis of proposed groundwater withdrawals, the zoom approach was utilized so that a small portion of the regional groundwater model was selected as the local model. The proposed wellfield site is located at the center of this local model. This approach is often referred to as the telescope mesh refinement method (TMR) (Ward et al, 1987; Anderson and Woessner, 1992). This approach does not only help to more accurately locate wells, but also significantly saves computational time and data storage. Typically, the local and regional models are connected by setting up either constant heads or constant fluxes along the local model borders whose values are obtained from the regional model at a specific time. For this study, constant head and constant concentration boundary conditions were specified along the parameters of the local model. The values of heads and concentrations were derived from the regional model.

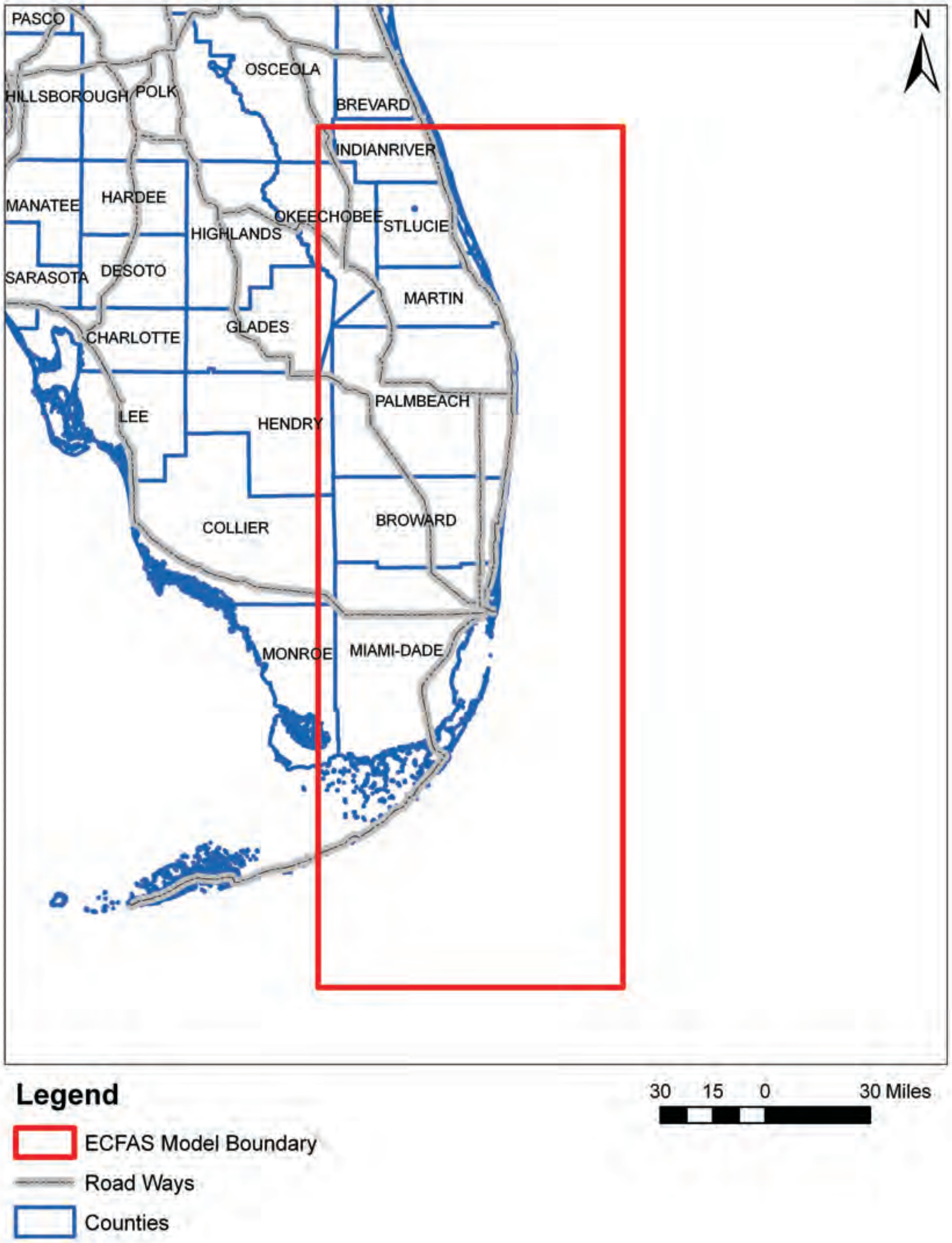

Figure 5-1: Model Domain of SFWMD ECFAS Model

Table 5-1 ECFAS Model Structure and Hydraulic Parameters at Proposed Wellfield

Model Layer	Top Elevation (ft, NGVD)	Bottom Elevation (ft, NGVD)	Thickness (ft)	Aquifer	Boundary Conditions	H. Hydraulic conductivity (ft/day)	V. Hydraulic conductivity (ft/day)	Specific storativity (1/ft)	Effective Porosity
1	10	-194	204	SAS	constantHead	10	10	0.00125	0.25
2	-194	-1072	878	ICU	variable	0.006	0.0006	9.00E-07	0.35
3	-1072	-1207	135	UFA	variable	90	9	5.25E-07	0.18
4	-1207	-1341	134	UFA	variable	90	9	5.25E-07	0.18
5	-1341	-1494	153	MCU1	variable	0.01	0.002	9.00E-07	0.35
6	-1494	-1647	153	MCU1	variable	0.01	0.002	9.00E-07	0.35
7	-1647	-1721	74	APPZ	variable	450	45	7.50E-07	0.18
8	-1721	-1795	74	APPZ	variable	450	45	7.50E-07	0.18
9	-1795	-2000	205	MCU2	variable	0.3	0.0015	9.00E-07	0.35
10	-2001	-2207	206	MCU2	variable	0.3	0.0015	9.00E-07	0.35
11	-2207	-2412	205	MCU2	variable	0.3	0.0015	9.00E-07	0.35
12	-2412	-2514	102	LF1	variable	300	30	7.50E-07	0.18
13	-2514	-2977	463	LFCU1	variable	0.002	0.0002	9.00E-07	0.35
14	-2977	-3177	200	BZ	const Head	10000	10000	7.50E-07	0.18

The site-specific local model developed for this study is shown in **Figure 5-2a.** In order to reduce the uncertainty associated with boundary conditions, the model borders of the local model were set relatively far away from the site. The local model has 106 rows and 112 columns. Irregular grid spacing was used for the local model, as also shown in **Figure 5-2b**, so that the monitor and production wells used in the APT tests could be accurately located. The grid spacing applied in the local model varies from 75 feet to 2,400 feet.

The 14 model layers from the original regional model were maintained. However, the depths of some layers were adjusted based on the field data obtained for this study.

5.4.2 Local Model Modification

During the development of the local model from the regional model, the hydraulic parameters were translated from the regional model and preserved in the local model. After the local model was created, the properties, including the layer top and bottom elevations, and hydraulic parameters, including the hydraulic conductivity and specific storativity, were revised based on the field data collected for this study. In the original model, the bottom of the Upper Floridan Aquifer is located at approximately -1,341 ft NGVD-29 while the field drill data indicates the bottom of Upper Floridan Aquifer is located at an approximately 1,470 ft NGVD-29. The model layer thickness was changed to reflect this.

The local model was updated with the water quality data collected during the field program. A constant value of TDS concentration 3,500 mg/L was applied for the Upper Floridan Aquifer in the vicinity of proposed wellfield based on the field data. The TDS concentration for the confining unit (MCU or model layer 6) is 4,750 mg/L, which was obtained from the regional model and verified by the field data.

5.4.3 Local Model Calibration

An APT was conducted at the site between June 30, 2009 and July 5, 2009. The duration of the APT was 6,954 minutes (4.8 days). Test-production well (TP-1) was pumped continuously at a constant rate of 1,150 gpm. Drawdowns at three monitor wells (F-1, F-2 and F-3) were measured during the APT. The location of the test-production well (TP-1) and the three monitor wells are shown in **Figure 3-1**. The maximum drawdown at these three monitor wells are shown in **Table 5-2**. A discussion on the APT was provided in Section 4.5.1.4 of this report. The local model calibration information is presented here.

During the local model calibration, some of the hydraulic parameters including horizontal and vertical hydraulic conductivity and specific storativity values, were adjusted manually in order to minimize the difference between simulated and observed drawdown at the three monitor wells. The adjustment of hydraulic parameters was made within a patch representing the area where the APT data should be valid. It should be noted that a relatively small area, called TP1_Zone, was created around well TP-1 during the model calibration. The location of the patch and TP1_Zone are shown in **Figure 5-3**.

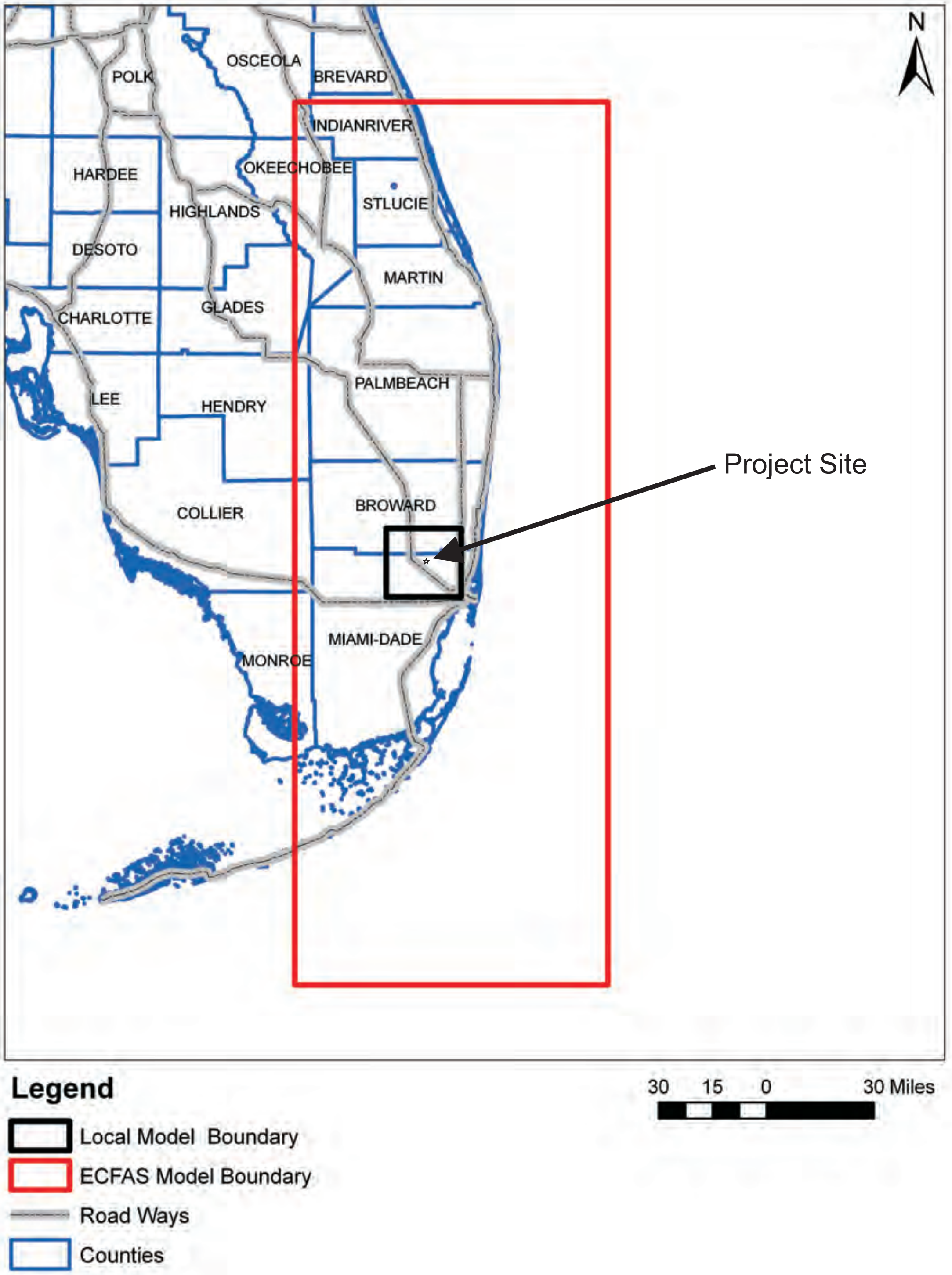

Figure 5-2a: Location of the Site-Specific Local Model

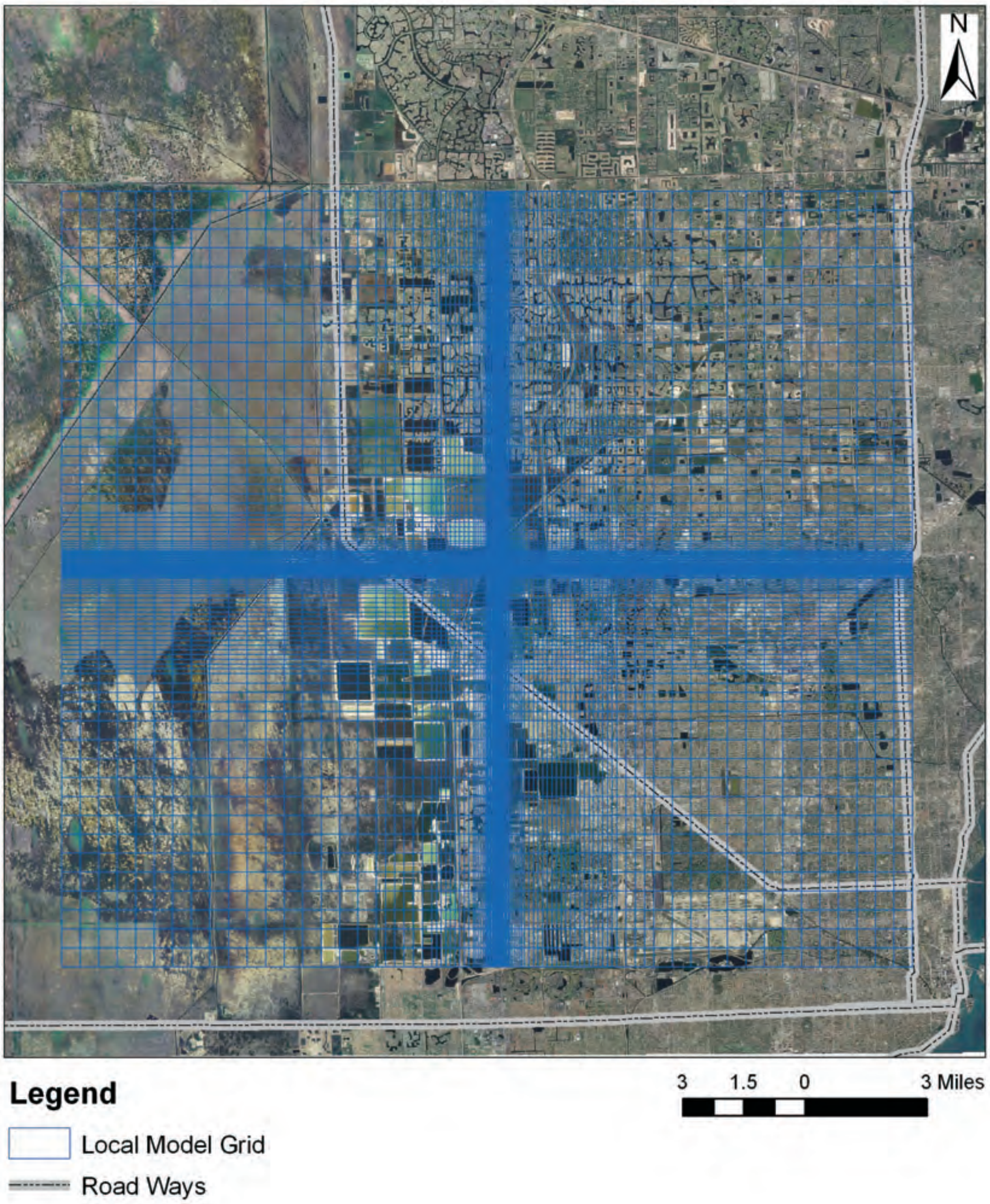

Figure 5-2b: Model Grid System

Table 5-2 Locations and Maximum Drawdown Observed in Monitor Wells

Well	Type	X (ft)	Y(ft)	Distance (ft)	Time (min)	Drawdown (ft)
TP-1	Test Production Well	579605.69	863248.44			
F-1	Monitor Well	578512.78	863248.44	93	6954	35.61
F-2	Monitor Well	578574.67	863978.3	731	6951	11.85
F-3	Monitor Well	579871.38	863253.85	1266	6941	4.82

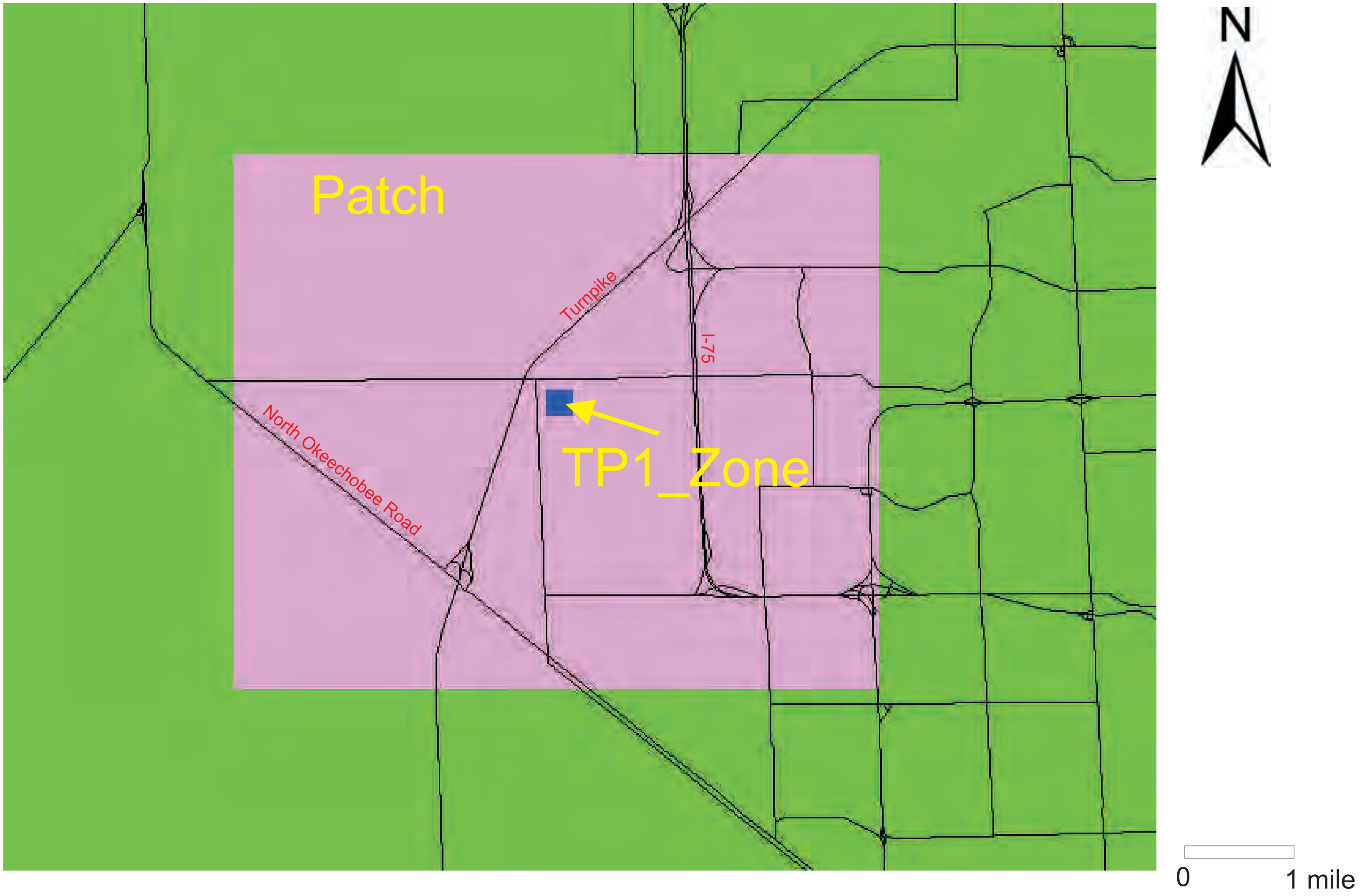

Figure 5.3: Locations of Patch and TP1_Zone.

Figures 5-4 through **5-6** display simulated drawdown and observed drawdown at the three monitor wells, respectively. From the results of the local model calibration, the simulated and observed drawdowns are in general agreement, although the model tends to predict smaller drawdown at early times. The difference between simulated drawdown and observed drawdown becomes smaller towards the end of the five-day aquifer test. It should also be noted that the model likely over-predicts the drawdown in a long-term simulation. Therefore, the results would likely be more conservative in terms of both drawdown and water quality change.

Table 5-3 shows the hydraulic parameters in the vicinity of the project site after model calibration. The horizontal hydraulic conductivity in the vicinity of the test-production well TP-1 and monitor well F-1 has a lower value of 10 ft/day. The test zone is approximately 400 ft thick, so the transmissivity value in the close vicinity of these two wells is about 4,000 ft^2/day. That is close to the value of 3,701 ft^2/day derived using graphic methods in aquifer test analysis.

For the area where F-2 and F-3 are located, the horizontal hydraulic conductivity value is 32 ft/day (or 8,840 ft^2/day for transmissivity) for the upper portion of the UFA (Layers 3 and 4) and 10 ft/day for the lower portion of FAS (Layer 5). This calibrated value is slightly higher than the transmissivity values derived using graphic methods in the aquifer test analysis (5,500 ft^2/day for F-2 and 6,168 ft^2/day for F-3, respectively). However, using the transmissivity values derived from APT analysis would generate much higher drawdown at wells F-2 and F-3.

5.5 Model Predictions

After the model was calibrated, it was used to evaluate the long-term changes of water quality and drawdown impacts associated with the proposed wellfield withdrawals. The proposed wellfield includes 14 wells (including 12 primary production wells and 2 backup wells) with a total pumping capacity of 23.33 Mgd. In this study, pumpage was distributed among all of the 14 wells. All the proposed production wells are constructed in the Upper Floridan Aquifer, which is located approximately between 1,080 ft to 1,480 feet bls (corresponding to the model layers 3 through 5). Therefore, a total number of 42 well cells were used in the model to represent the proposed 14 production wells. The locations of these 14 proposed production wells are shown in **Figure 5-7**.

All the prediction simulations were run for 30 years. The total proposed pumping rate for the wellfield increases with time as shown below:

Years	Pumping Rates (MGD
0-6	13.33
7-17	20.00
18-30	23.33

The total proposed pumpage was evenly distributed among the 14 proposed wells. These wells were assumed to open to the whole Upper Floridan Aquifer (model layers 3 through 5). The distribution of pumpage in each well, however, depends on the transmissivity ratio of each layer

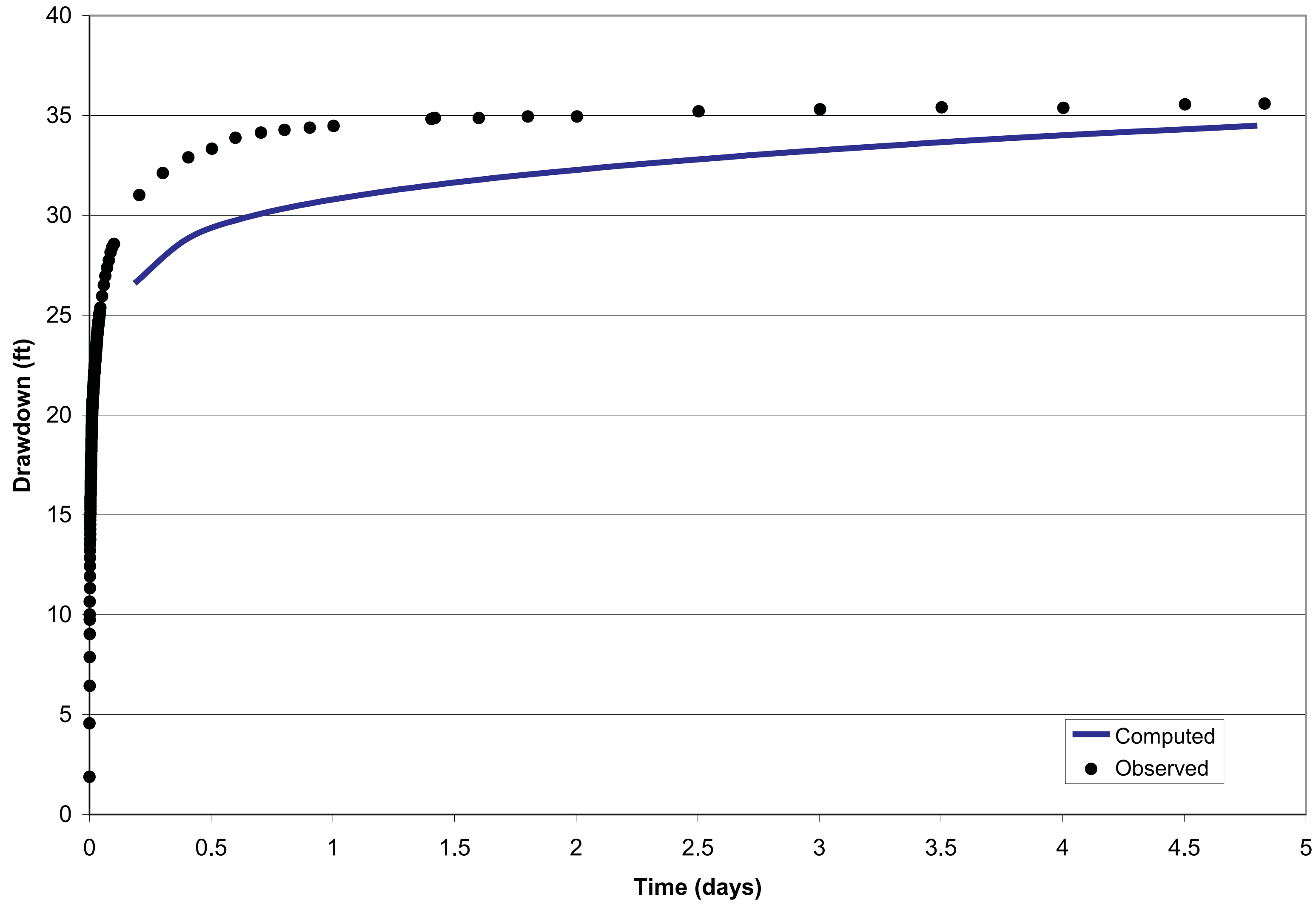

Figure 5-4: Simulated and Observed Time-Drawdown Curves at F-1

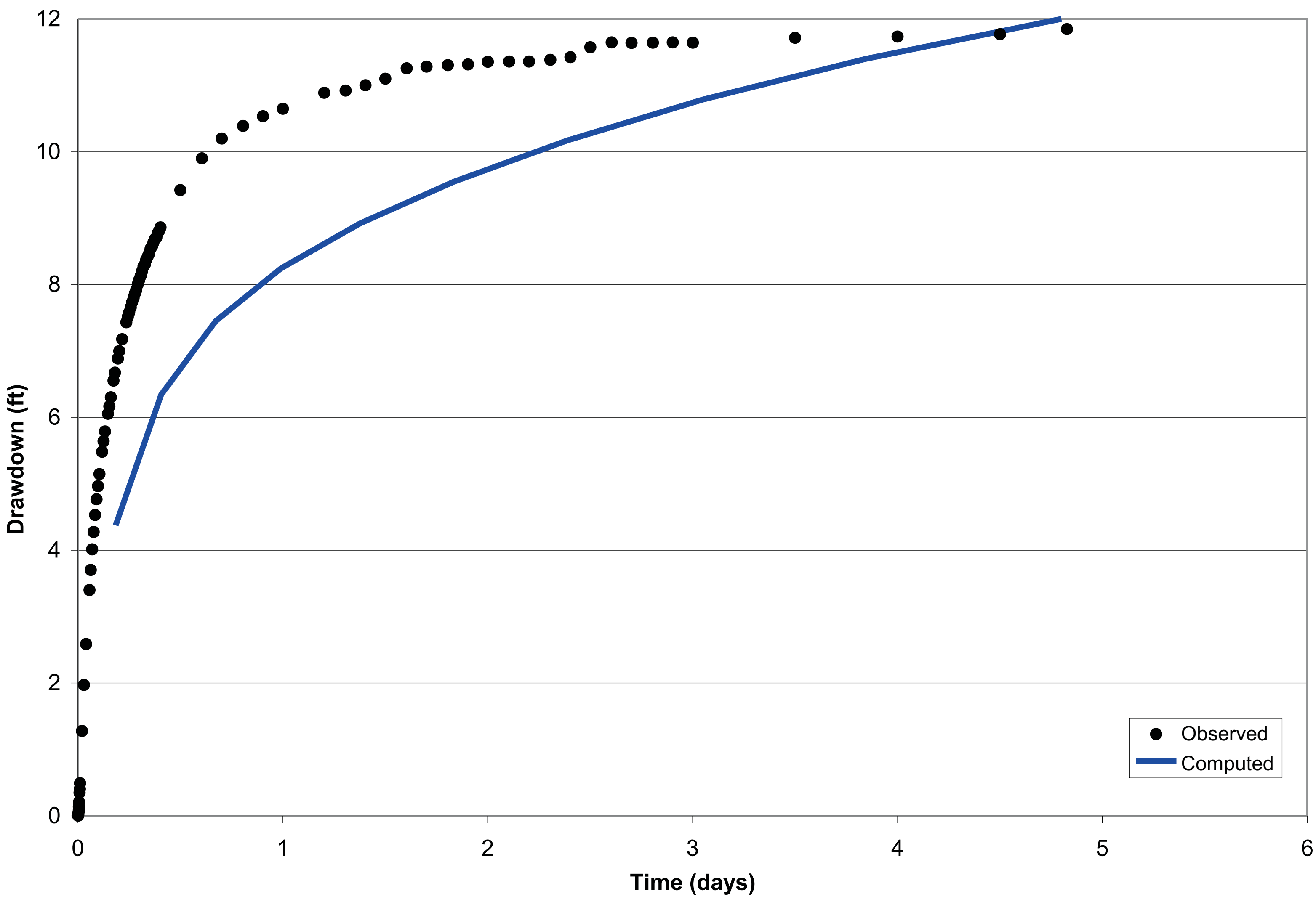

Figure 5-5: Simulated and Observed Time-Drawdown Curves at F-2

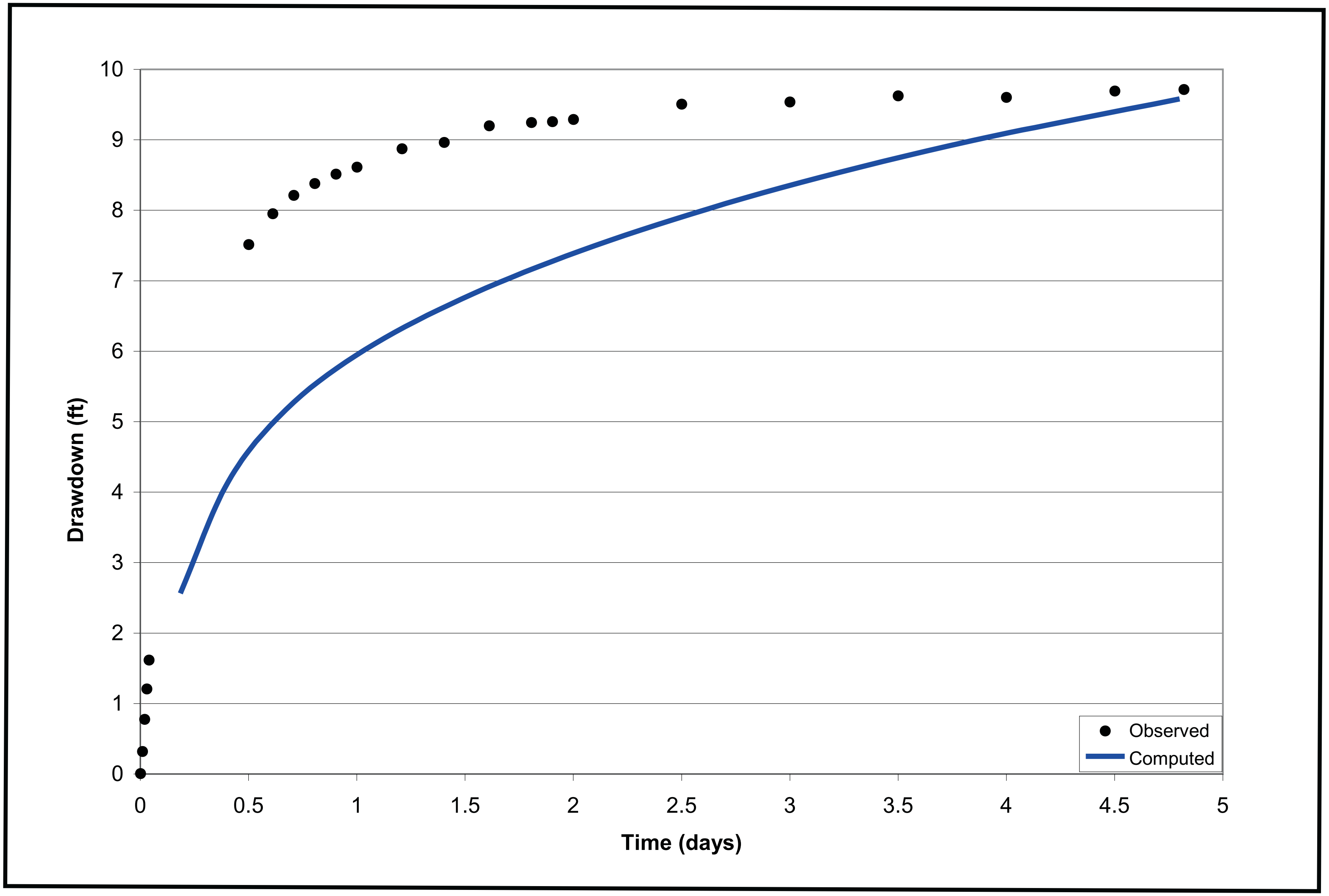

Figure 5-6: Simulated and Observed Time-Drawdown Curves at F-3

Table 5-3 Revised Hydraulic Parameters at Proposed Wellfield

Layer	Bottom elevation (ft NGVD)	Kx (Ky) (TP1_Zone) (ft/day)	Kz (TP1_Zone) (ft/day)	Kx (ky) (Patch) (ft/day)	Kz (Patch) (ft/day)	Ss (1/ft)	Effective Porosity	Initial Concentration (TDS, mg/l)
1	-196	10	10	10	10	0.00125	0.25	350
2	-1080	0.006	0.0006	0.006	0.0006	9.00E-07	0.35	1520
3	-1210	10	2	32	4	3.00E-06	0.1	3500
4	-1300	10	2	32	4	1.00E-07	0.1	3500
5	-1480	10	10	10	10	1.00E-07	0.1	3500
6	-1550	0.01	0.01	0.01	0.01	1.00E-07	0.1	3900
7	-1721	450	45	450	45	7.50E-07	0.18	4600
8	-1795	450	45	450	45	7.50E-07	0.18	4600
9	-2000	0.3	0.0015	0.3	0.0015	9.00E-07	0.35	18410
10	-2207	0.3	0.0015	0.3	0.0015	9.00E-07	0.35	18410
11	-2412	0.3	0.0015	0.3	0.0015	9.00E-07	0.35	18410
12	-2514	300	30	300	30	7.50E-07	0.18	35000
13	-2977	0.002	0.0002	0.002	0.0002	9.00E-07	0.35	35000
13	-3177	10000	10000	10000	10000	7.50E-07	0.18	35000

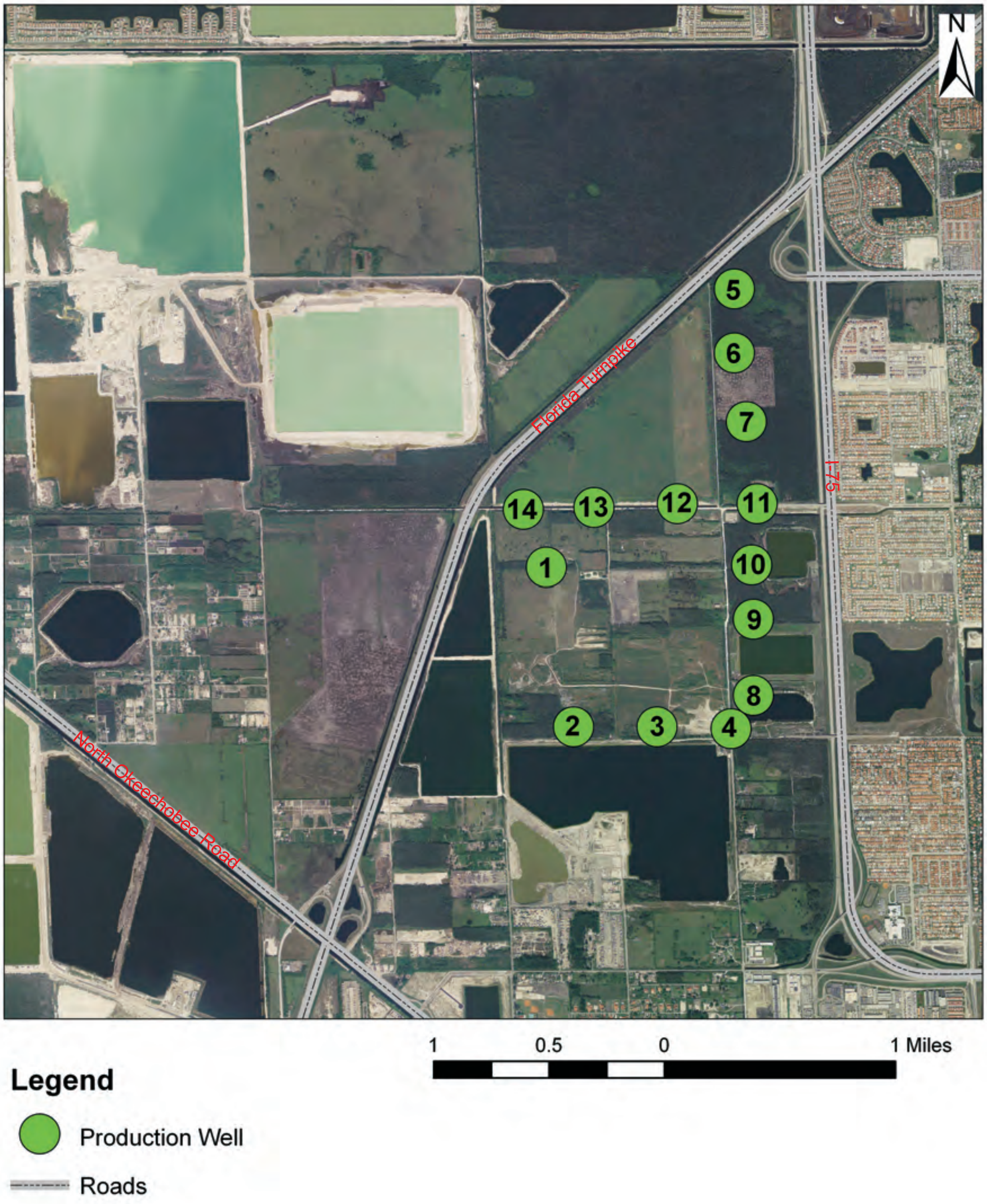

Figure 5.7: Locations of Proposed Production Wells

to the total transmissivity of the entire pumping zone. **Table 5-4** shows the pumpage distribution of the proposed pumping wells.

An additional prediction simulation was run with a constant pumping rate of 13.33 Mgd for the entire duration of 30 years.

Based on the field data, the initial head in the vicinity of the proposed wellfield was set as 48 ft NGVD and the initial TDS concentration was set as 3,500 mg/L for the UFA.

5.5.1 Simulated Drawdown

Figures 5-8a, 5-8b, and 5-8c show the model calculated drawdown (ft) in model layers 3, 4 and 5, respectively, after 30 years of simulation, due to proposed withdrawals from the Upper Floridan Aquifer. The maximum drawdown, (107 ft), appears at test-production well TP-1 in model layer 5 after 30 years with variable pumping rates. The drawdown in all three layers are relatively similar. **Figures 5-8d, 5-8e, and 5-8f** show the model calculated drawdown (ft) in model layers 3, 4, and 5, respectively, after 30 years of simulation, due to a constant pumping rate of 13.33 Mgd. The maximum drawdown, (65.02 ft), appears at test-production well TP-1 in model layer 5 after 30 years at a constant pumping rate.

5.5.2 Long-Term TDS Concentration

The solute transport model, as part of SEAWAT model, was run in predictive mode with the 14 wells from the proposed brackish water wellfield. The model uses mass fraction of total dissolved solids (TDS) as the primary variable for solute transport simulation and fluid density calculation.

The TDS concentration of mixed water from the proposed production wells is calculated as:

$$C_{ave}= \Sigma C_i Q_i / \Sigma Q_i$$

where C_{ave} is the TDS concentration of mixed water, C_i is the simulated TDS concentration of well cell i, and Q_i is the production rate of well cell i. There are 42 well cells to represent the 14 proposed production wells.

Figure 5-9a shows the model predicted average TDS concentration of mixed raw water from the 14 proposed wells with variable pumping rates. The results indicate that the average TDS concentration from the wells will gradually increase with time, from an initial value of 3,500 mg/L to approximately 4,310 mg/L over a 30-year period with variable pumping rates. **Figure 5-9b** shows the model predicted average TDS concentration of 3,987 mg/L resulting from a 13.33 Mgd pumping rate over 30 years. There is no apparent stabilization of the long-term change in TDS concentration. The major reason for the increase of salinity is likely due to the vertical fluxes from the layers below the production zone that have a higher chloride concentration.

Table 5-4 Pumping Distribution at 23.33 Mgd

Well name	Layer	Row	Column	Q (ft3/day)
TP-1	3	52	54	-72141.561
TP-1	4	52	54	-50322.974
TP-1	5	52	54	-100320.46
PW-10	3	51	77	-105325.59
PW-10	4	51	77	-73050.048
PW-10	5	51	77	-44409.364
PW-14	3	38	47	-104489.75
PW-14	4	38	47	-72887.736
PW-14	5	38	47	-45407.513
PW-11	3	38	77	-105325.59
PW-11	4	38	77	-73050.048
PW-11	5	38	77	-44409.364
PW-13	3	38	65	-104860.43
PW-13	4	38	65	-73014.839
PW-13	5	38	65	-44909.731
PW-12	3	38	73	-104860.43
PW-12	4	38	73	-73014.839
PW-12	5	38	73	-44909.731
PW-6	3	26	76	-106491.12
PW-6	4	26	76	-71822.11
PW-6	5	26	76	-44471.772
PW7	3	29	77	-106076.73
PW7	4	29	77	-72245.494
PW7	5	29	77	-44462.778
PW-2	3	72	62	-101783.04
PW-2	4	72	62	-75717.999
PW-2	5	72	62	-45283.958
PW-3	3	72	72	-101777.29
PW-3	4	72	72	-76316.281
PW-3	5	72	72	-44691.432
PW-4	3	72	76	-101792.03
PW-4	4	72	76	-76900.179
PW-4	5	72	76	-44092.791
PW-9	3	64	77	-103125.39
PW-9	4	64	77	-75443.131
PW-9	5	64	77	-44216.474
PW-8	3	70	77	-101792.03
PW-8	4	70	77	-76900.179
PW-8	5	70	77	-44092.791
PW-5	3	24	76	-106491.12
PW-5	4	24	76	-71822.11
PW-5	5	24	76	-44471.772

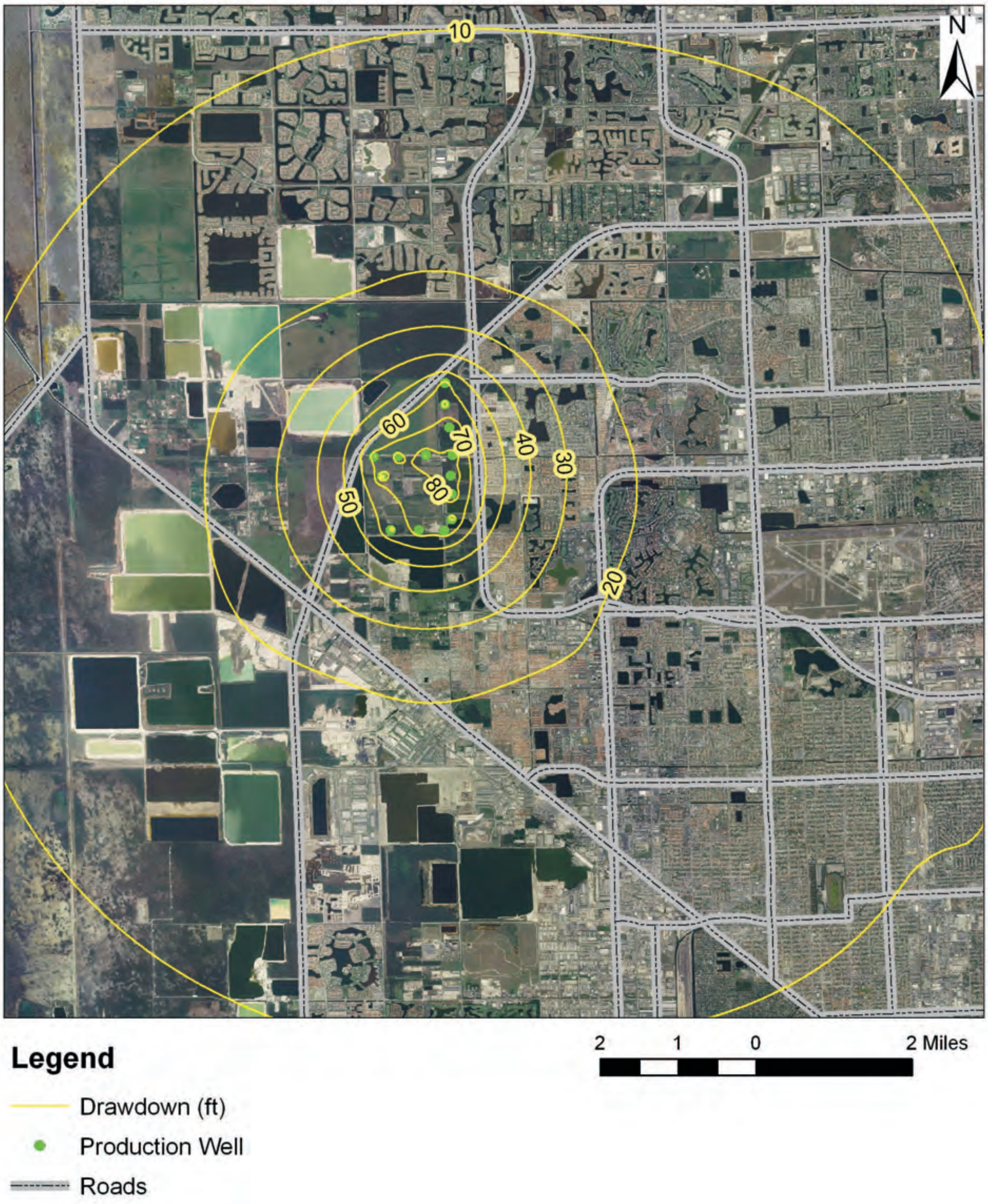

Figure 5-8a: Simulated drawdown (ft) in Model Layer 3 due to Proposed Pumping up to 23.33 mgd from the UFA after 30 Years

Legend

- Drawdown (ft)
- ● Production Well
- Roads

Figure 5-8b: Simulated drawdown (ft) in Model Layer 4 due to Proposed Pumping up to 23.33mgd from the UFA after 30 Years

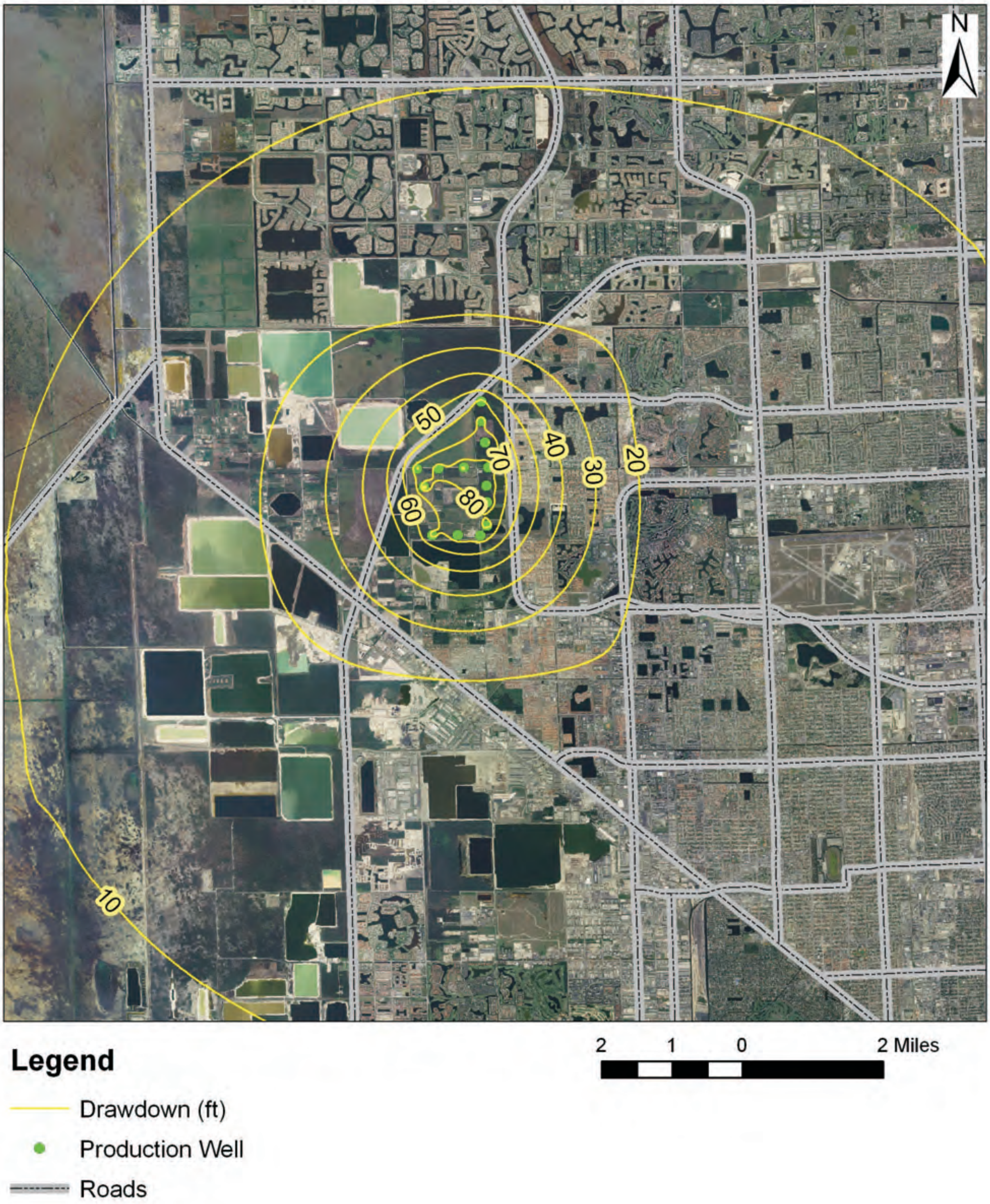

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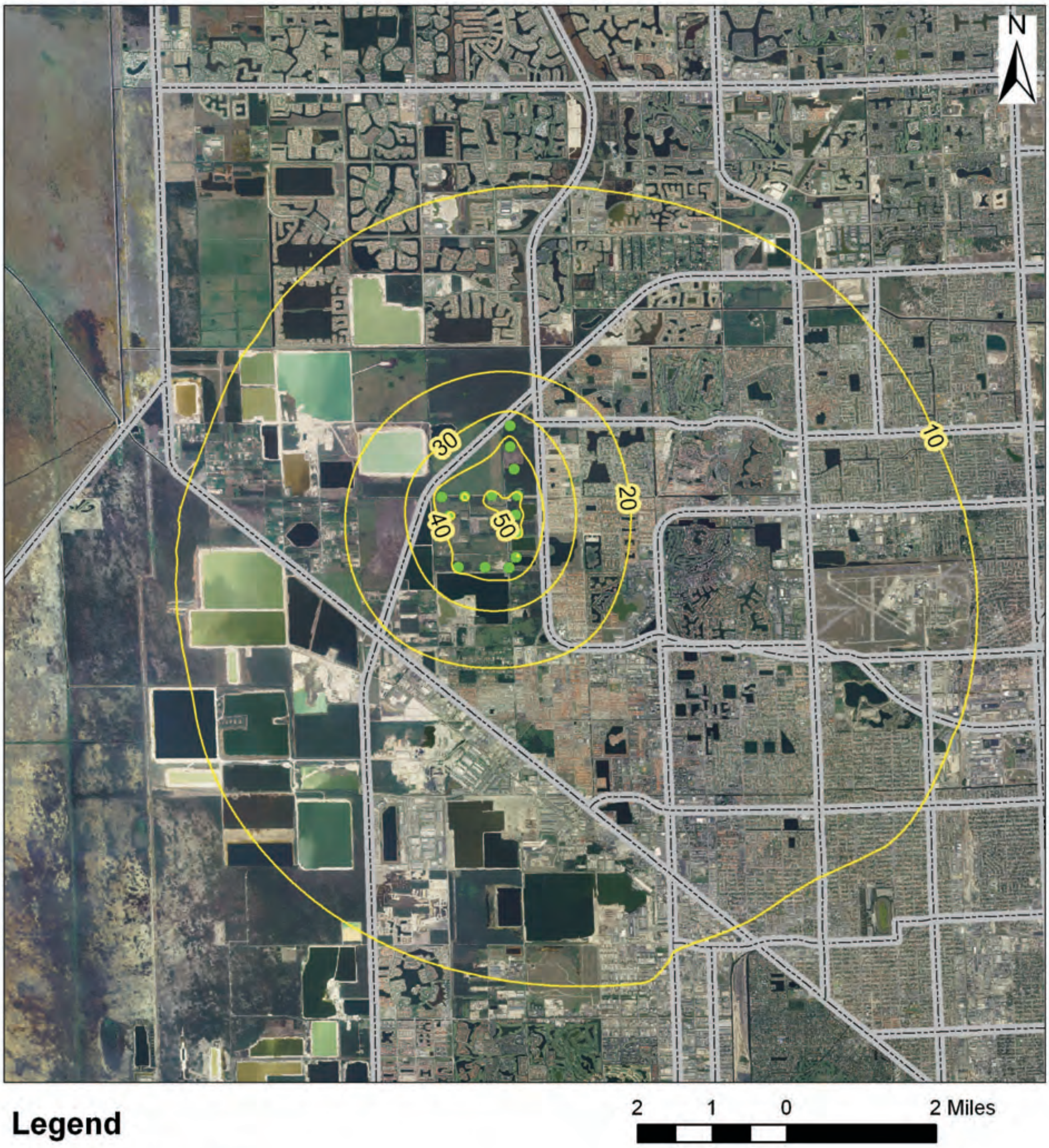
Figure 5-8c: Simulated drawdown (ft) in Model Layer 5 due to Proposed Pumping up to 23.33 mgd from the UFA after 30 Years



Legend

Drawdown (ft)

● Production Well

Roads

Figure 5-8d: Simulated drawdown (ft) in Model Layer 3 due to Pumpage of 13.33 MGD from the UFA after 30 Years

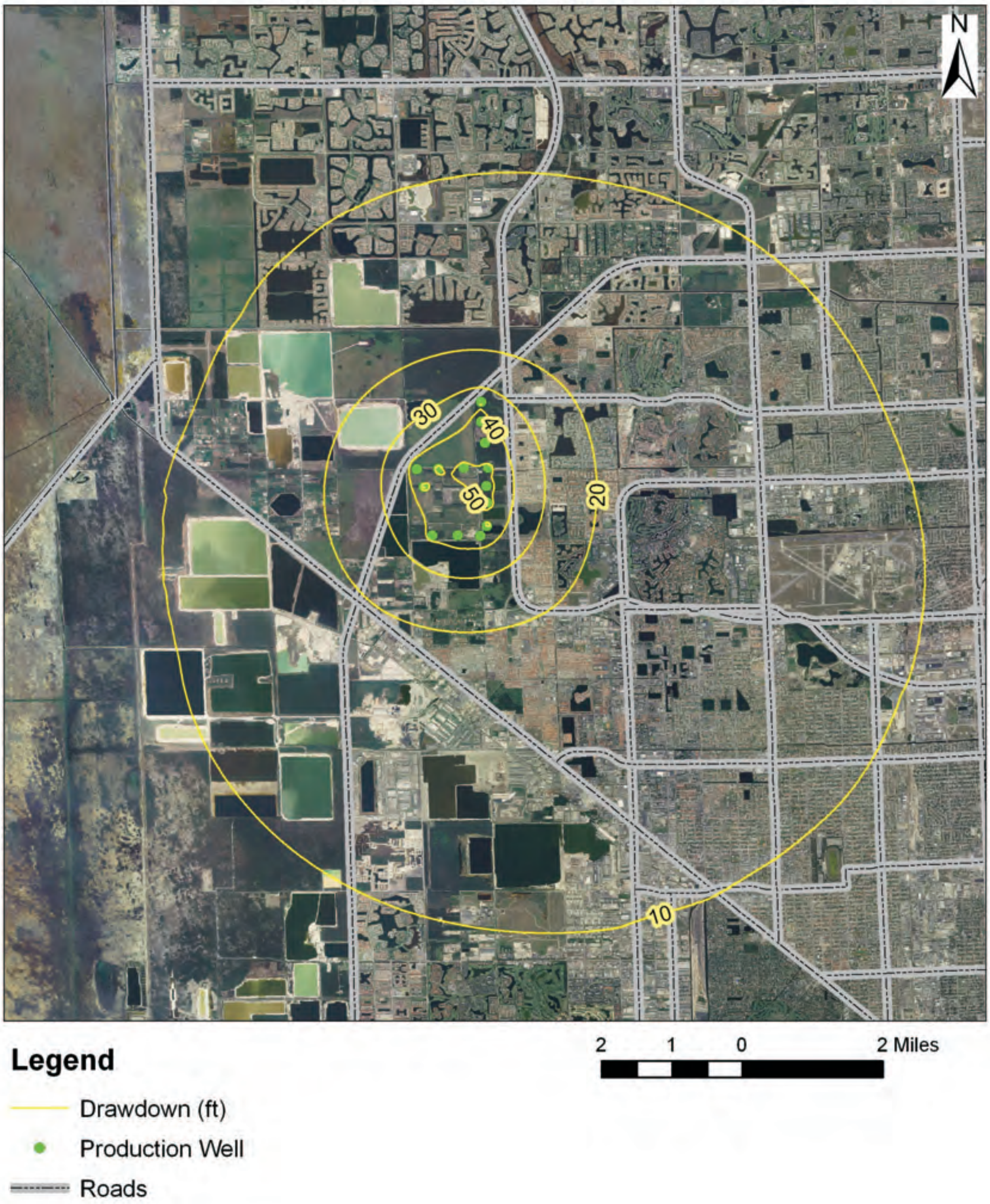


Figure 5-8e: Simulated drawdown (ft) in Model Layer 4 due to Pumpage of 13.33 MGD from the UFA after 30 Years

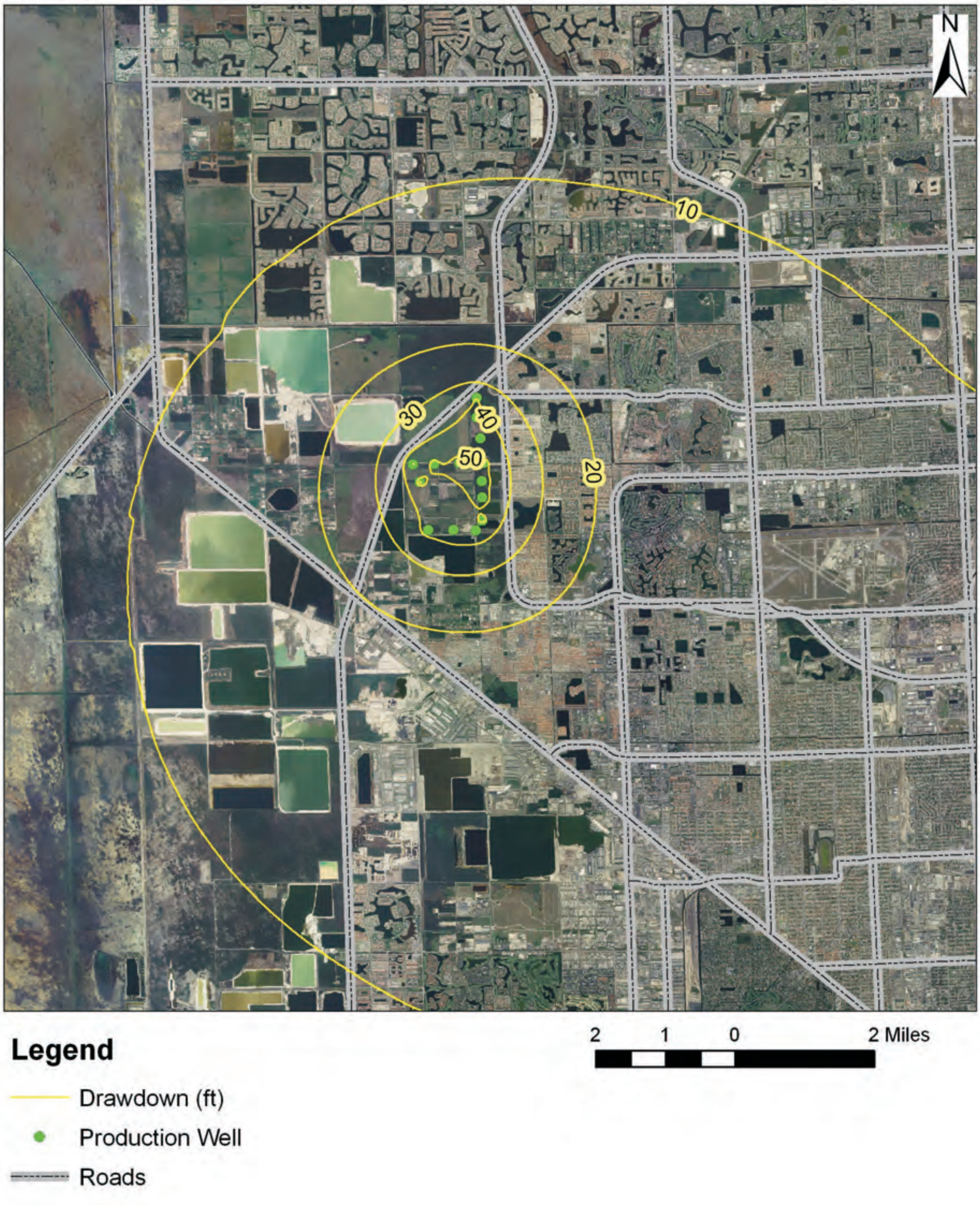


Figure 5-8f: Simulated drawdown (ft) in Model Layer 5 due to Pumpage of 13.33 MGD from the UFA after 30 Years.

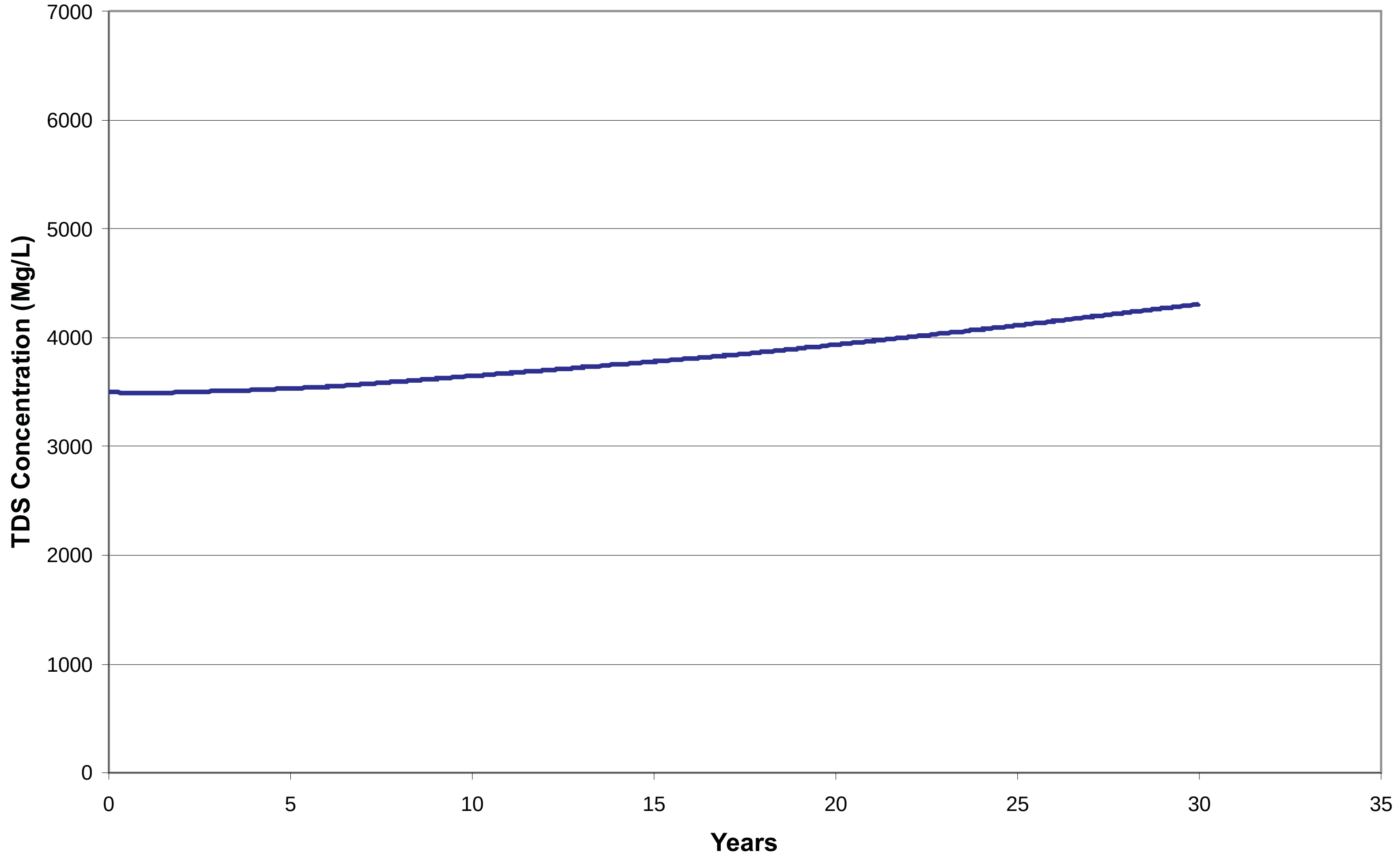


Figure 5-9a: Simulated Long-term Changes of TDS Concentration (Mg/L) from Proposed Wellfield Pumping up to 23.33 mgd (Baserun)

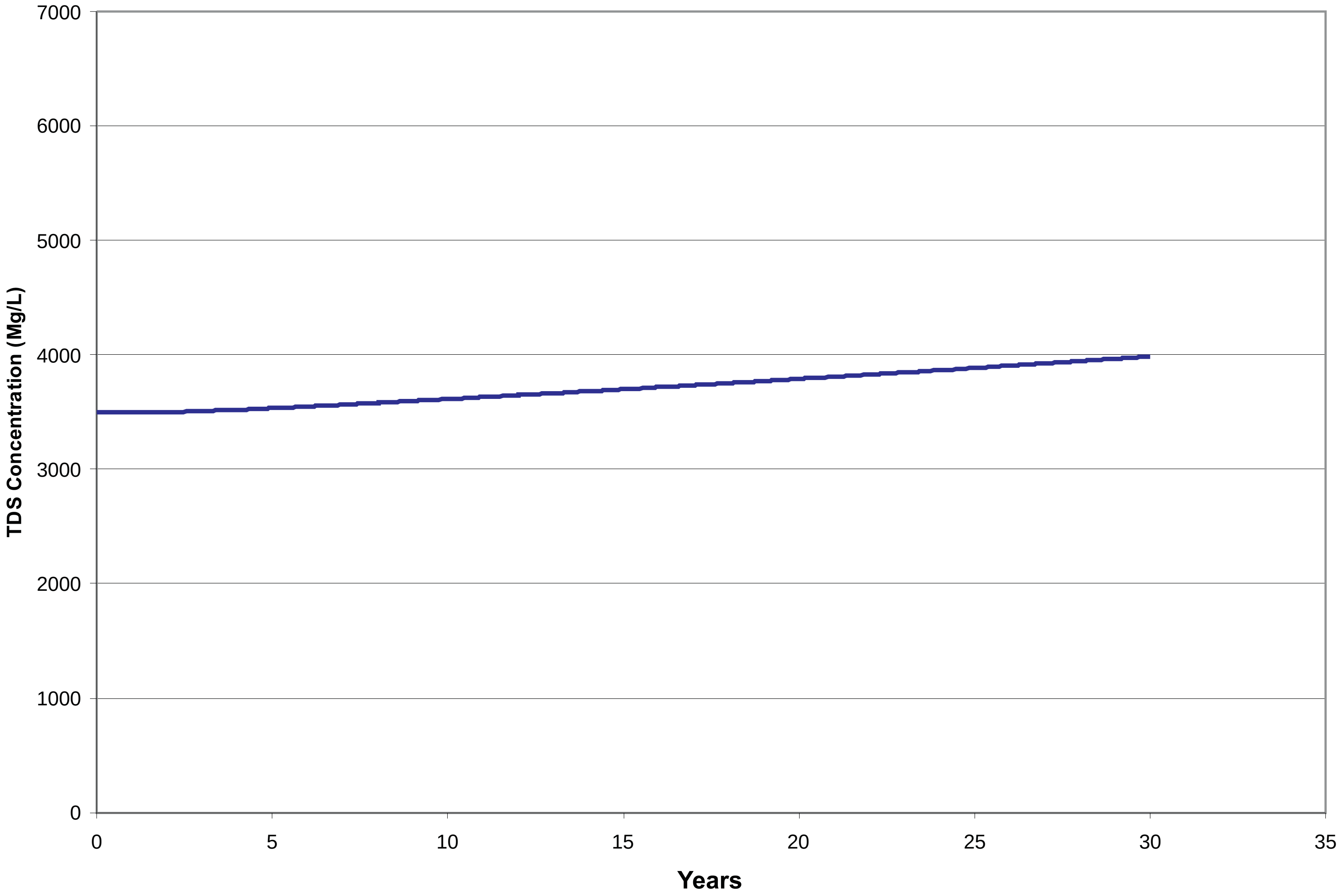


Figure 5-9b: Simulated Long-term Changes of TDS Concentration (Mg/L) from Proposed Wellfield Pumping 13.33 MGD

5.6 Model Sensitivity Analysis

All numerical model simulations are subject to some degree of uncertainty. Hydraulic and transport parameters and boundary conditions are never known in sufficient detail. The flow and solute transport models were built based on the available hydraulic and salinity data, and calibrated to known conditions. These data were collected from specific locations and in some cases at different times. To populate all of the model cells, the available data were estimated through a kriging process. The distributions of initial chloride concentration, transmissivity, and layer thicknesses obtained from the kriging process may generate distortion in areas where data are not available. Like any other model, assumptions and simplifications of the natural system were made during model development. Therefore, there is some degree of uncertainty involved in the model prediction results.

The purpose of sensitivity analysis is to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of aquifer parameters, stress, and boundary conditions. During a sensitivity analysis, calibrated values for initial chloride concentration, longitudinal and vertical dispersivities, vertical hydraulic conductivity of confining units underlying the proposed pumping zone, etc. are systematically changed within a plausible range.

A number of model simulations were performed during the sensitivity analysis for this study by changing one parameter value at a time. The parameters tested include the longitudinal dispersivity and vertical dispersivity, effective porosity of the pumping zone, and the vertical hydraulic conductivity values of model layer 6 that is directly underlying the pumping zone. The results of the sensitivity analysis indicate that the predicted TDS concentration is very sensitive to these parameters. The model sensitivity analysis was performed using a variable pumping rates.

Due to the limitation of data availability, time and budget constraints, not all the parameters used in the model were tested for their sensitivity to the model results. The sensitivity of the spatial distribution of initial TDS, horizontal and vertical hydraulic conductivity was not assessed in this study.

5.6.1 Longitudinal Dispersivity

Longitudinal dispersivity is one of the key input parameters used in the solute transport model. This parameter is rarely measured in the field, but often estimated through model calibration or simply by literature review. The values of longitudinal, transverse and vertical dispersivity used in the base run were 30 ft, 3 ft and 3 ft, respectively.

Figure 5-10 shows the model results using different values of longitudinal dispersivity. For the run with longitudinal dispersivity value of 100 ft and transverse and vertical dispersivity of 10 ft, the TDS concentration would reach 5,109 mg/L after 30 years of pumping. For the run with longitudinal dispersivity value of 3 ft and transverse and vertical dispersivity of 0.3 ft, the TDS concentration would reach 3,916 mg/L after 30 years of pumping. The results indicate that the greater the longitudinal dispersivity used the higher the modeled salinity concentrations would be.

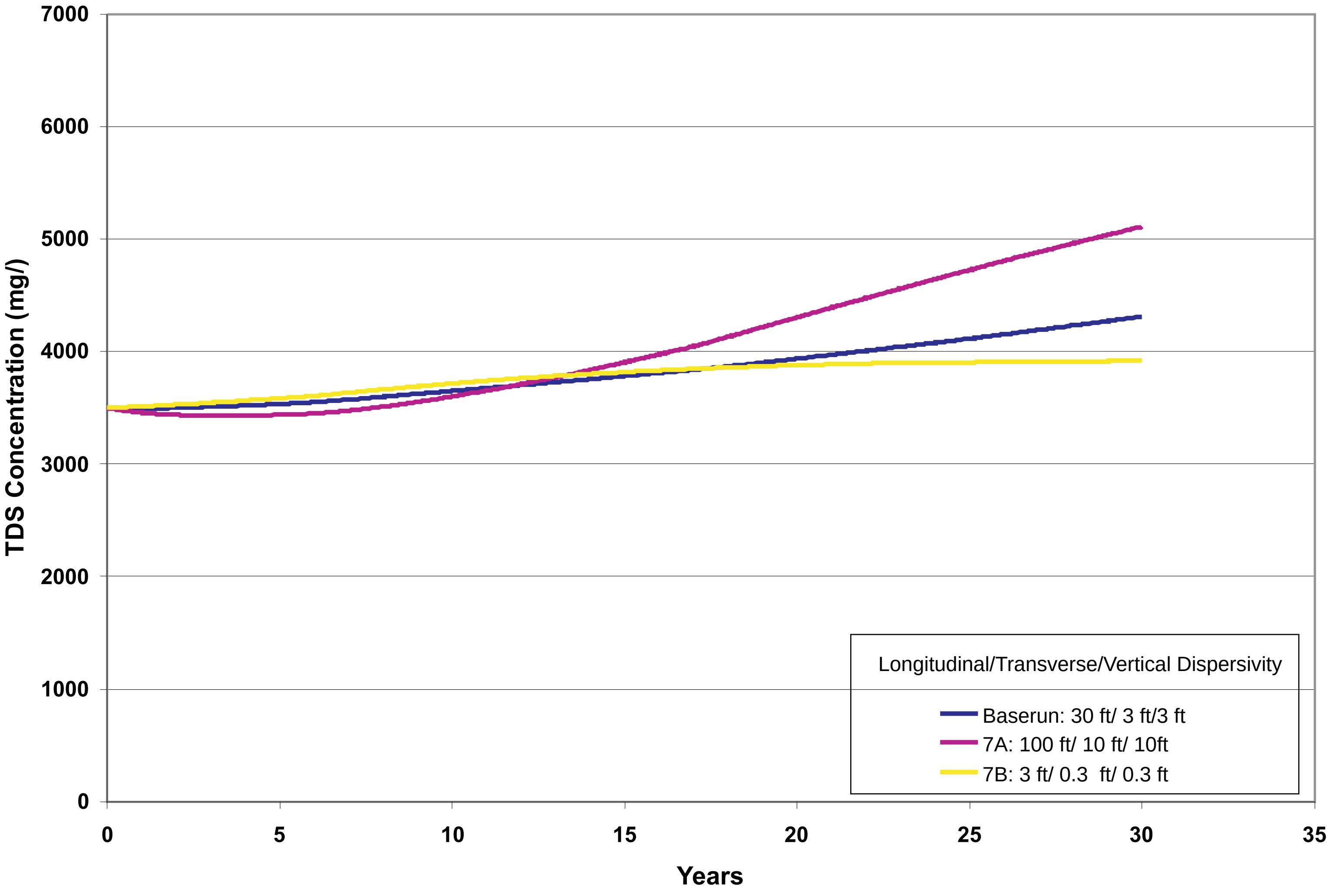


Figure 5-10: Sensitivity Analysis 1: Longitudinal Dispersivity

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5.6.2 Vertical Dispersivity

For the sensitivity analysis of vertical dispersivity ratio, two simulations were conducted to evaluate the uncertainty of this parameter on the model results. In the first run, the ratio of vertical dispersivity to longitudinal dispersivity was reduced from 0.1 in the base-run case to 0.01. In the second simulation, this ratio was increased from 0.1 to 0.5.

Figure 5-11 shows the results using different values of vertical dispersivity. For the run with longitudinal dispersivity value of 30 ft, transverse dispersivity of 3 ft and vertical dispersivity of 0.3 ft, the TDS concentration would reach 3,917 mg/L after 30 years of pumping. This is expected since a smaller value of vertical dispersivity will likely reduce the vertical movement of solute from the Middle Confining Unit. For the run with longitudinal dispersivity value of 30 ft and transverse and vertical dispersivity of 15 ft, the TDS concentration would reach 5,294 mg/L after 30 years of pumping. This result is also expected since higher vertical dispersivity will likely bring more salt from the Middle Confining Unit below that has a higher TDS concentration.

The results shown in **Figure 5-11** indicate that the greater the vertical dispersivity ratio used, the higher the modeled salinity concentration would be because the major source of salinity increase is due to leakage from deeper layers.

5.6.3 Effective Porosity

Effective porosity is another important parameter used in solute transport simulation. It is most commonly considered to represent the porosity of a rock or sediment that is available to actually contribute to groundwater movement through the rock or sediment. The larger the value of effective porosity, the slower the advective solute transport, because flux is reversely proportional to the value of effective porosity as shown in the equation below:

$$v = \frac{q}{n_e}$$

where v is the groundwater flow velocity or pore water velocity (L/T); q is the Darcy velocity (L/T) simulated by the MODFLOW portion of SEAWAT and n_e is the effective porosity (Batu, 2005).

Similar to dispersivity values, effective porosity is rarely measured in the field but often estimated from literature review or model calibration. Two simulations were conducted to evaluate the uncertainty of this parameter on the model results. In the base run, a value of effective porosity 0.1 was used. This value is relatively low, therefore higher values of effective porosity were used in the sensitivity analysis.

In the first run, the effective porosity was increased from 0.1 in the base-run to 0.15. In the second simulation, this ratio increased from 0.1 to 0.25. **Figure 5-12** shows the results using different values of effective porosity. The results indicate that the higher effective porosity value was used, the lower the simulated TDS concentration. In the run with an effective porosity of 0.15, the simulated TDS concentration is 4,148 mg/L after 30 years. In the run with an effective porosity of 0.25, the simulated TDS concentration is 3,925 mg/L. These results would be

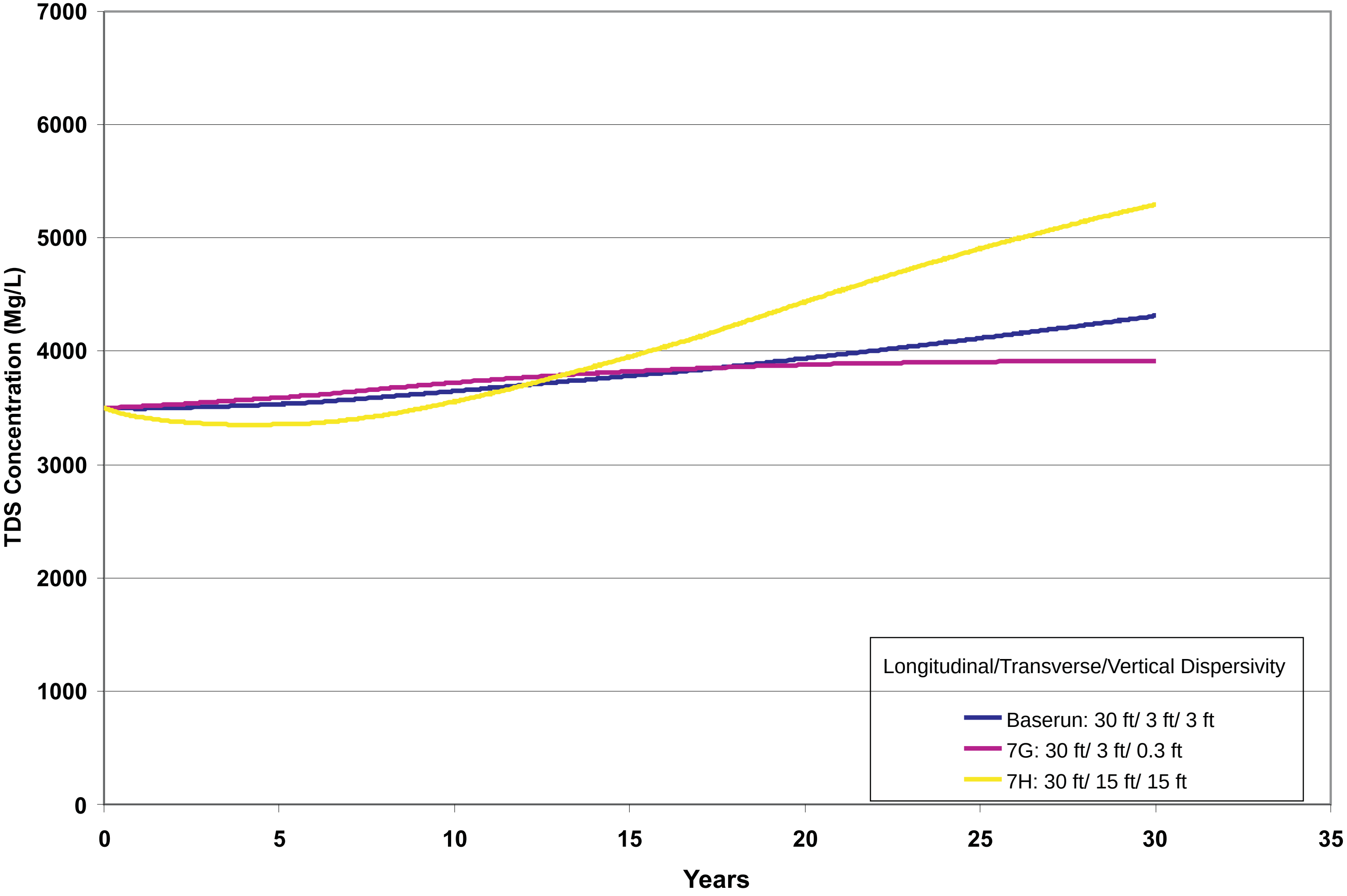

Figure 5-11: Sensitivity Analysis 2: Vertical Dispersivity

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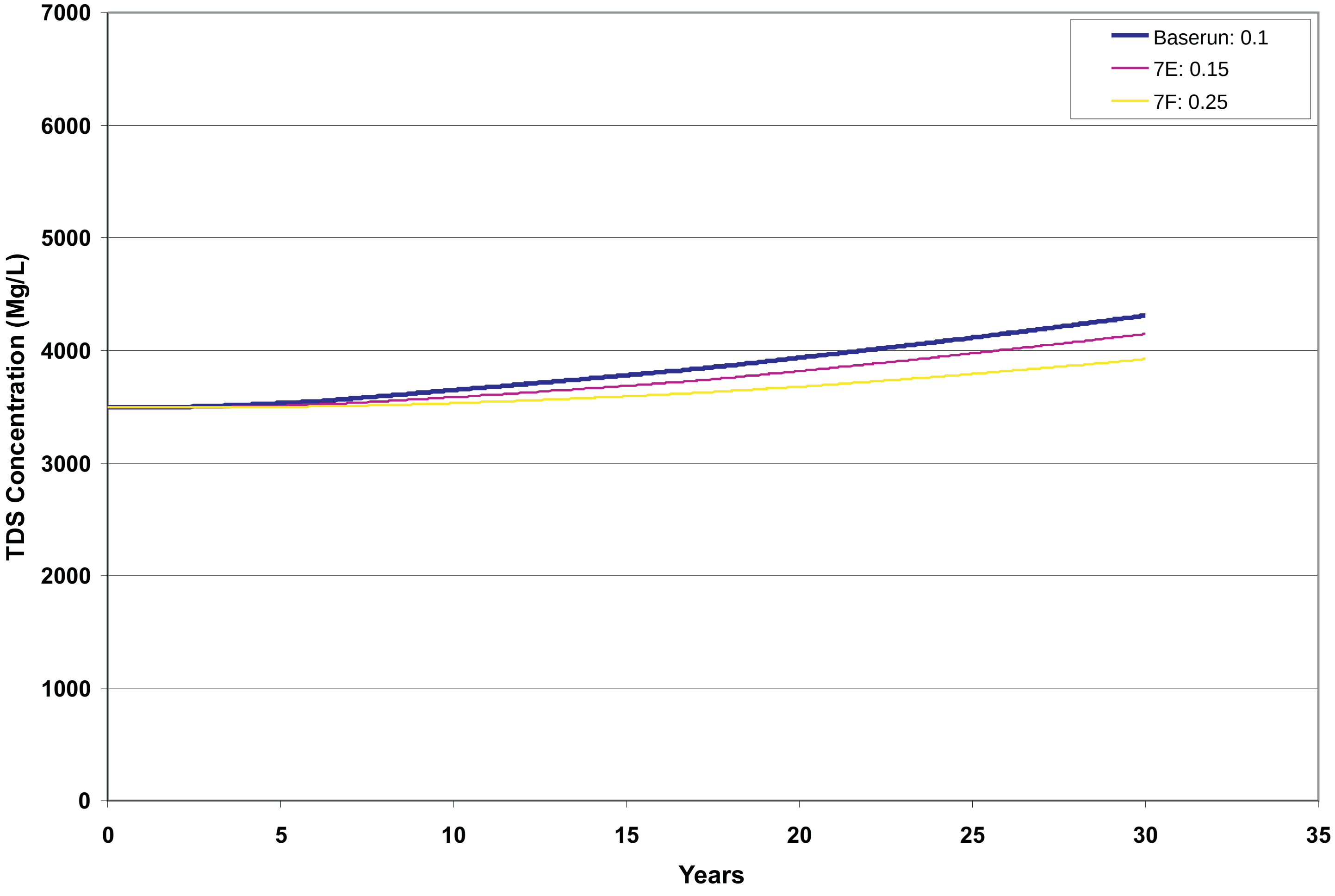

Figure 5-12: Sensitivity Analysis 3: Effective Porosity

expected since the higher the effective porosity, the slower the groundwater seepage velocity and thus a reduction in the advective solute transport.

5.6.4 Vertical Hydraulic Conductivity

Model layer 6 represents a semi-confining unit (Middle Confining Unit) that directly underlies the proposed production zone in the model. The vertical hydraulic conductivity of this confining unit does not only have a strong impact on the long-term water quality changes by limiting upward migration of the water with higher TDS concentrations from deeper layers, but also has a direct impact on the drawdown corresponding to the proposed maximum pumpage rate of 23.33 Mgd from the Upper Floridan Aquifer.

The vertical hydraulic conductivity was 0.01 ft for the Middle Confining Unit. To assess the sensitivity of vertical hydraulic conductivity to the simulation results, different values were used in the sensitivity analysis. In one run, the value was increased from 0.01 ft/day used in the base run to 0.05 ft/day; in another run, the value was reduced from 0.01 used in the base run to 0.005 ft/day.

The simulation results, together with the result from the base run, are shown in **Figure 5-13**. As expected, the higher the vertical hydraulic conductivity for the Middle Confining Unit, the higher predicted TDS concentration, because the vertical hydraulic conductivity controls the vertical upward movement of groundwater in response to the proposed pumping in the Upper Floridan Aquifer. When the value of vertical hydraulic conductivity of the Middle Confining Unit was reduced from 0.01 ft/day to 0.005 ft/day, the simulated TDS concentration was 3,712 mg/L after 30 years of simulation, while the maximum drawdown increases to 117 ft at well TP-1. It is clear that a lower value of the vertical hydraulic conductivity of the underlying confining unit will increase the drawdown in the production and reduce the upward migration of saltier water from the lower layers to the production zone so the TDS of mixed water will remain low. When the value of vertical hydraulic conductivity increased from 0.01 ft/day to 0.05 ft/day, the simulated TDS concentration would increase significantly to 6,420 mg/L after 30 years of simulation. It is clear that the simulation results are very sensitive to the value of vertical hydraulic conductivity.

Figures 5-14 and **5-15** show that simulated drawdown, in feet, in the lower portion of the proposed production zone (model layer 5) resulting from the runs using vertical hydraulic conductivity values within model layer 6 of 0.005 ft/day and 0.05 ft/day, respectively. The maximum predicted drawdown for the run with a vertical hydraulic conductivity of 0.005 ft/day is 117 ft and the maximum predicted drawdown for the run with vertical hydraulic conductivity of 0.05 ft/day is 85 ft

5.6.5 Overall Prediction of Long-term Changes of TDS Concentration

Figure 5-16 is a summary of all of the sensitivity simulation runs. The shaded area shown suggests the possible ranges of simulated TDS concentration based on the sensitivity analysis. As discussed earlier, among the parameters tested, the vertical hydraulic conductivity of the Middle Confining Unit has the most significant influence on the simulation results. **Figure 5-17** shows the possible ranges of simulated chloride concentrations, based on the assumption that

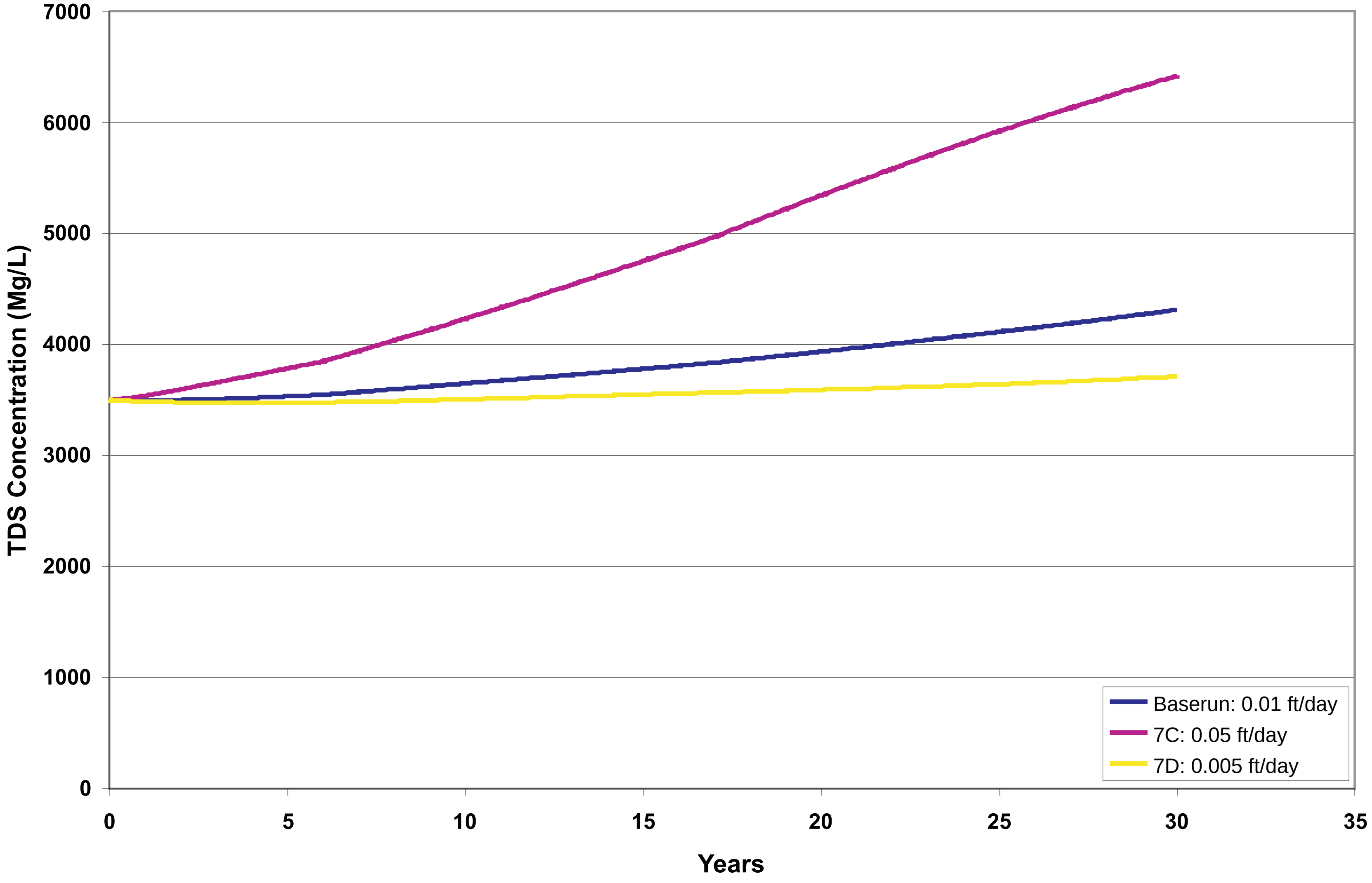

Figure 5-13: Sensitivity Analysis 4: Vertical Hydraulic Conductivity of MCU

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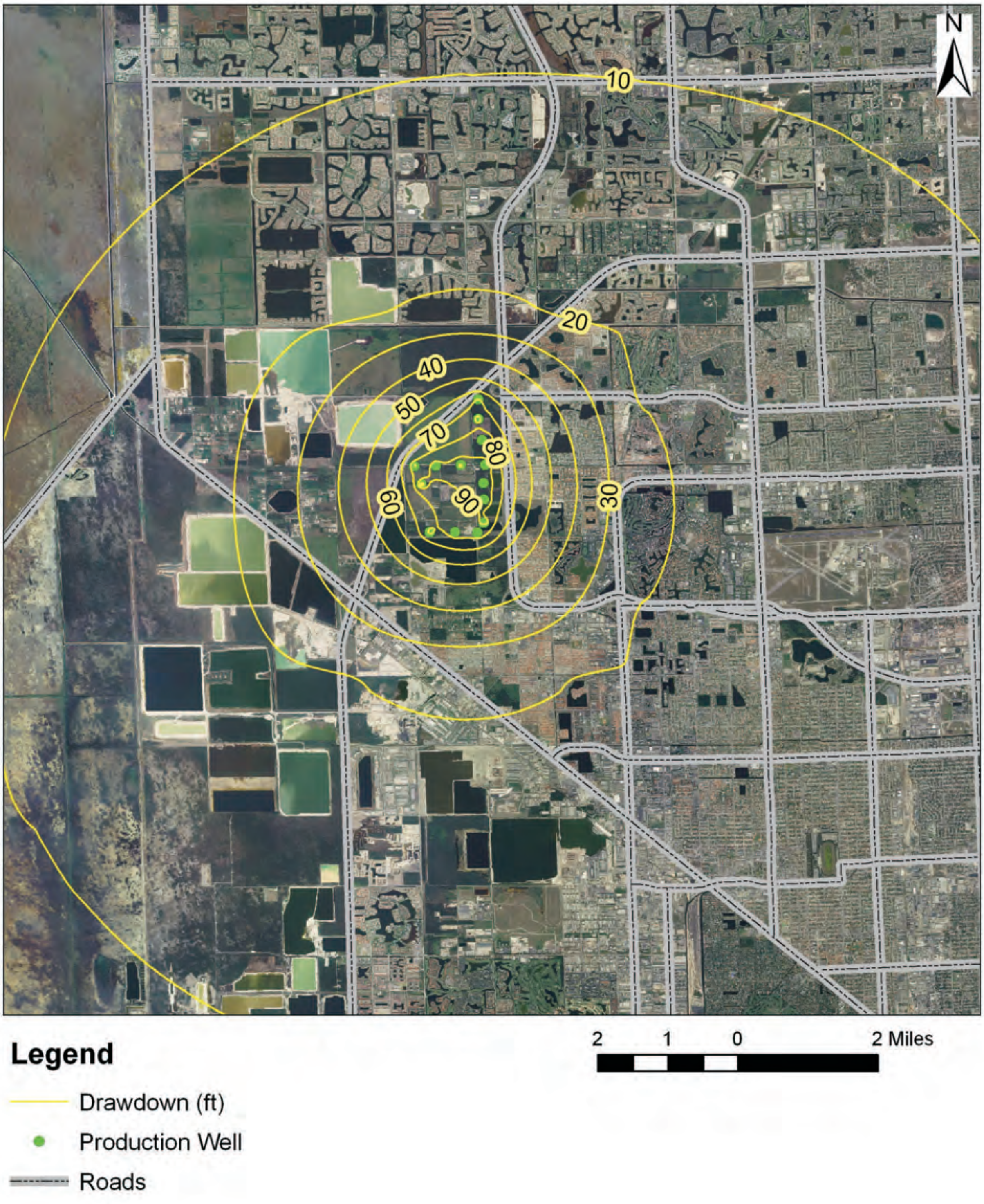

Figure 5-14: Simulated Drawdown (ft) in the Proposed Production Zone after 30 Years with Vertical Hydraulic Conductivity in Layer 6 Set at 0.005 ft/d(Run 7C)

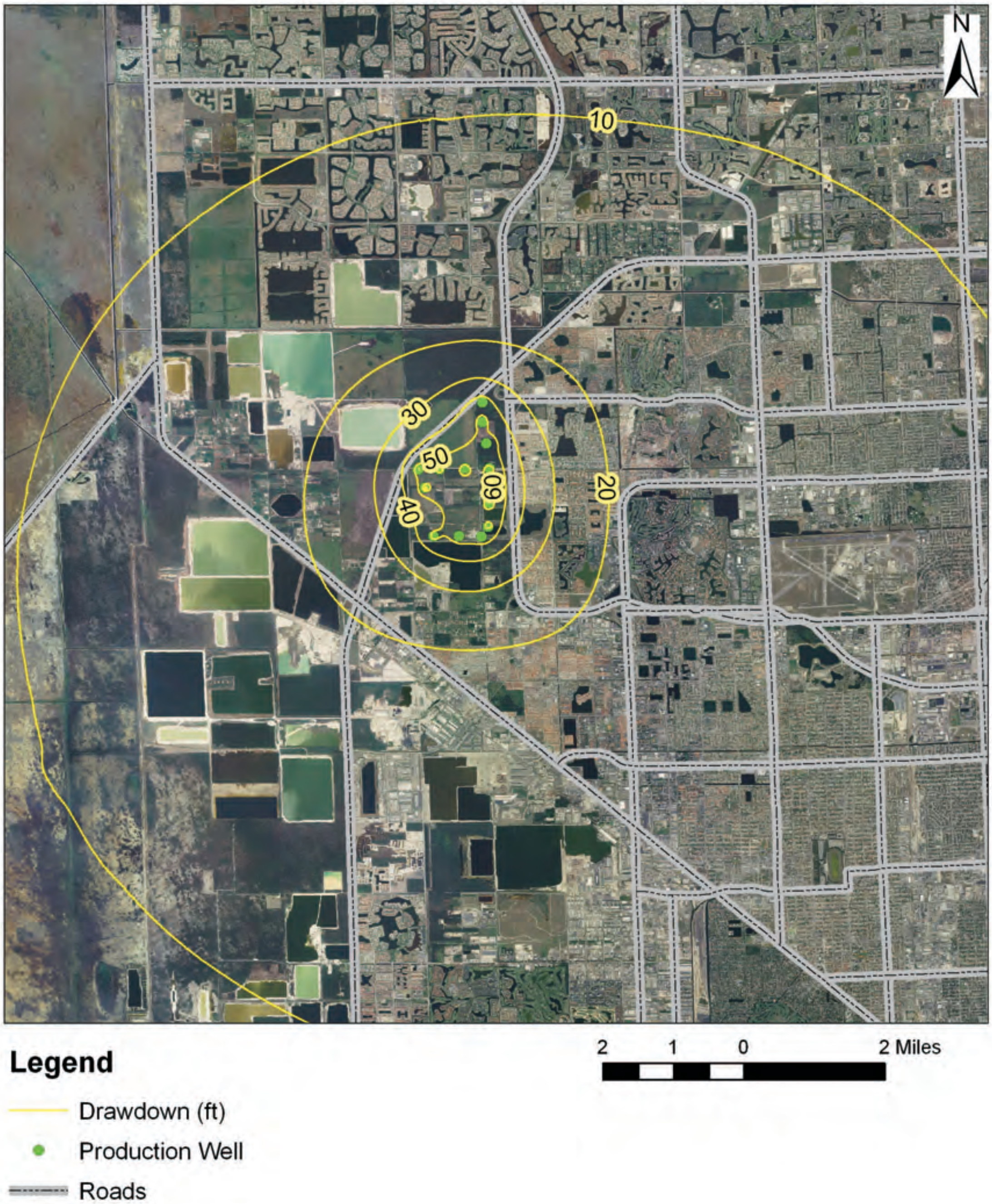

Figure 5-15: Simulated Drawdown (ft) in the Proposed Production Zone after 30 Years with Vertical Hydraulic Conductivity in Layer 6 Set at 0.05 ft/d (Run 7D)

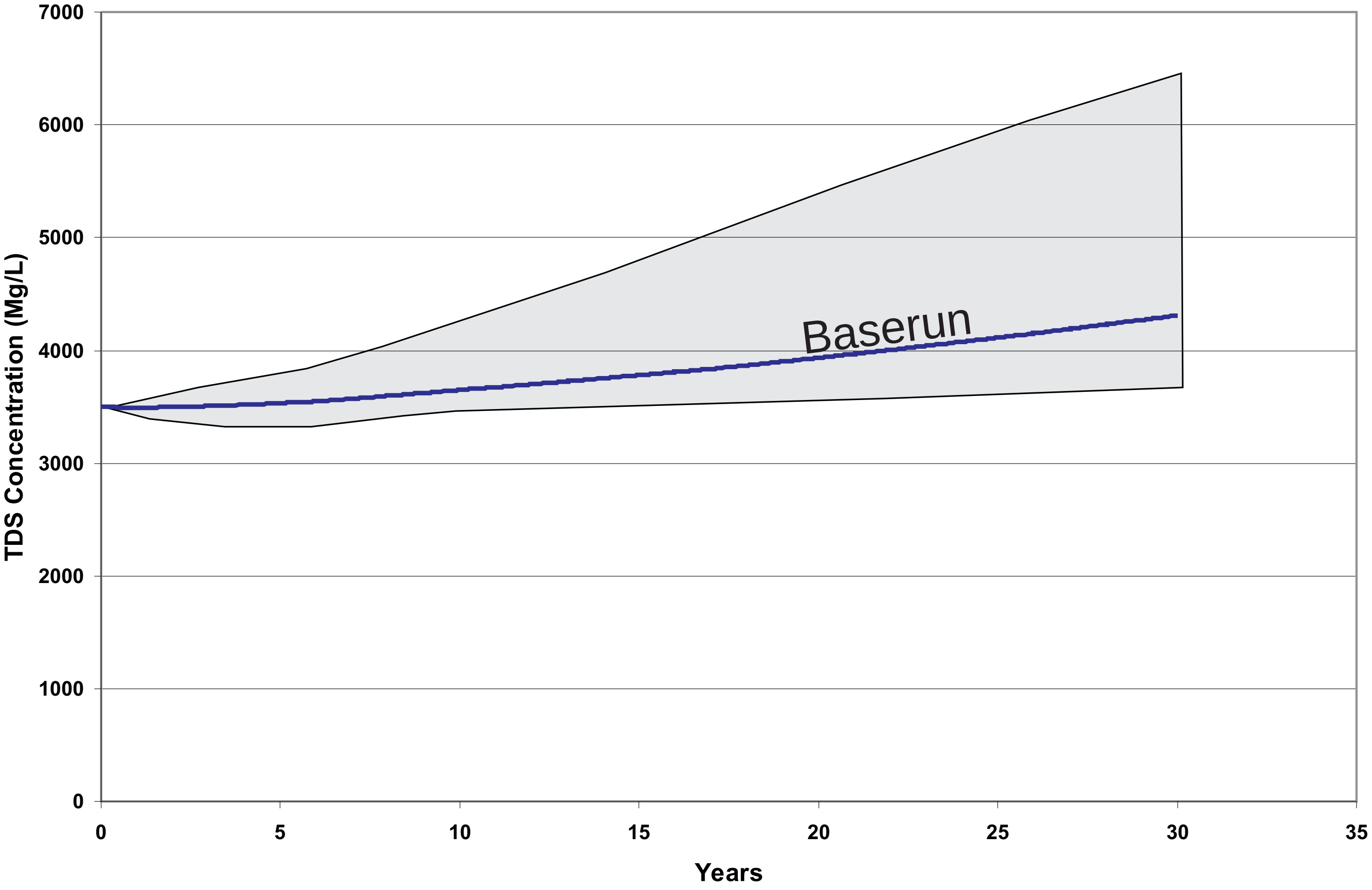

Figure 5-16:Simulated Ranges of TDS Concentration (Mg/L) vs. Time (Years)

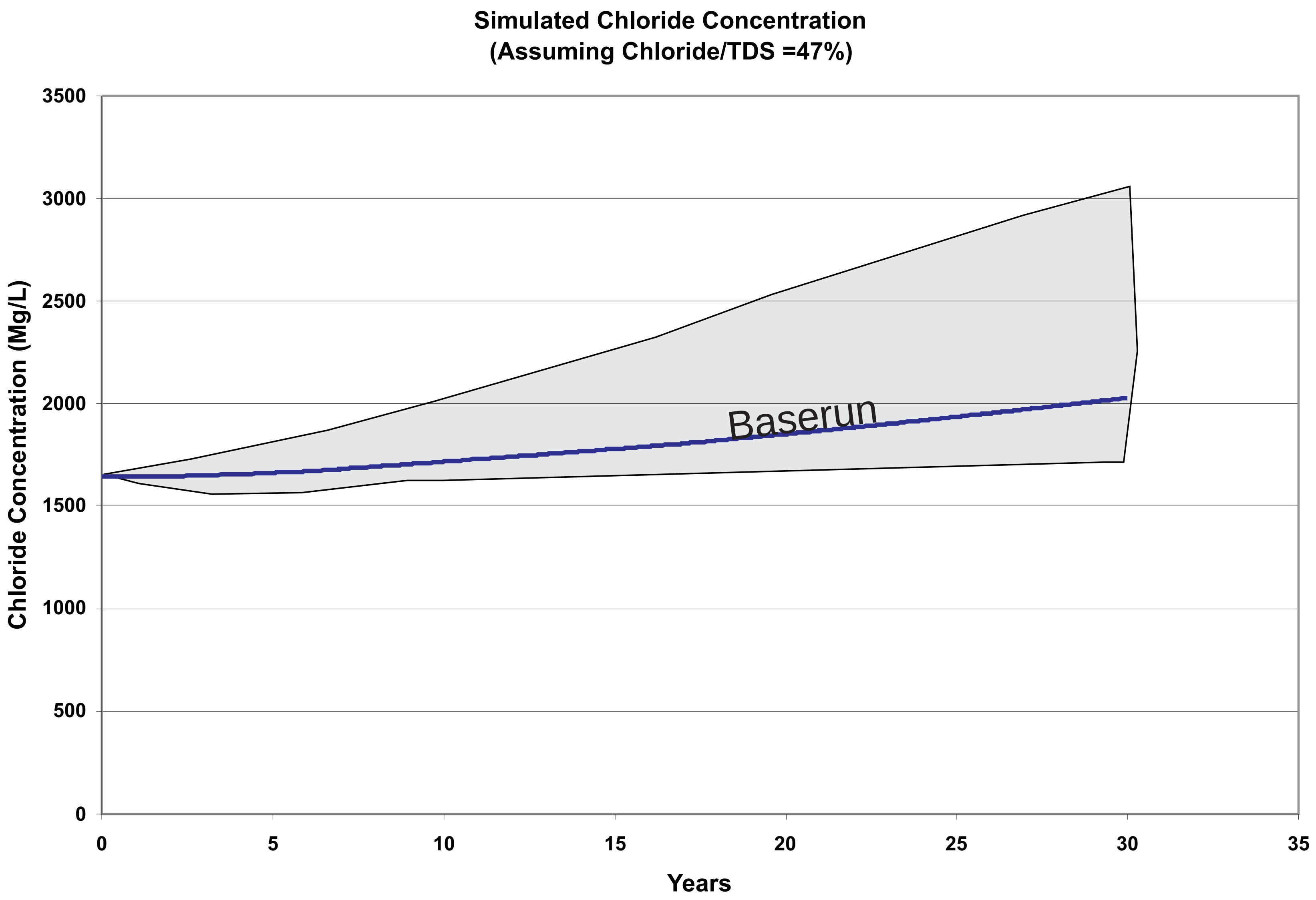

Figure 5-17:Simulated Ranges of Chloride Concentration (Mg/L) vs. Time (Years)

chloride/TDS ratio is 47%, which was determined from the field data collected during field investigation at this site.

It should be noted that the groundwater modeling is an iterative process (Anderson and Woessner, 1992). The prediction results presented here were based on the best available data and understanding of the geology and hydrogeology of the project site. This model should be updated and recalibrated when new data become available. It is recommended that the model prediction be checked against the actual water quality changes approximately two years after the proposed RO plant is in operation.

Section 6
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Appendix A

Geologic Log of Test-Production Well TP-1

TABLE A-1. Geological Log Well TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Location: SE ¼, NW ¼, Sec. 17, Township 52 South, Range 40 East
Miami-Dade County, Florida
Lat. 25º 55.451', Long. 80º 22.196'

Depth (ft bls)	Lithology
0 – 3	SAND, quartz, pale yellowish brown (10YR 8/2), fine, some silt, moderately well sorted, abundant debris-Styrofoam, roof tiles, pieces of wood, medium hydraulic conductivity.
3 – 10	LIMESTONE, yellowish gray (5Y 7/1 to 5Y 8/1), wackestone to slightly sandy wackestone (with 10-15% quartz sand), moderately hard, some gastropod molds, medium to low moldic macroporosity; some wackestone/mudstone, hard, with low macroporosity.
10 – 20	LIMESTONE, very pale orange to pale yellowish brown (10YR 7/2 to 10YR 8/2), sandy wackestone to wackestone, variable quartz content – up to 30%, hard to very hard, low moldic and intergranular macroporosity.
20 – 30	LIMESTONE, yellowish gray to light olive gray (5Y 7/1 to 5Y 8/1), fossiliferous wackestone/packstone, very hard, abundant rig chatter, abundant bivalve and gastropod molds, high to medium moldic macroporosity, some intraclasts, becoming slightly sandy and softer with depth.
30 – 39	LIMESTONE, yellowish gray (5Y 8/1), sandy, fossiliferous wackestone, hard, external bivalve molds, low to medium moldic macroporosity, noticeably harder 32 feet bls.
39 – 60	LIMESTONE/CALCAREOUS SANDSTONE, very pale yellowish brown (10YR 7/2), very sandy wackestone, bordering on calcareous sandstone, moderately hard –getting softer with depth, trace bivalve shell fragments, low intergranular macroporosity, drilling rate increasing through interval.
60 – 90	LIMESTONE, very pale yellowish brown (10YR 7/2), very sandy wackestone, as above, except more bivalve shell fragments- 5-10%, barnacles quick rate of penetration, harder limestone from 63 – 66 feet bls.
90 – 97	LIMESTONE, very pale yellowish brown (10YR 7/2), sandy fossiliferous wackestone, hard, less sandy than above, bivalve/gastropod molds, medium moldic macroporosity.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	Lithology
97 – 100	LIMESTONE, very pale yellowish brown (10YR 7/2), sandy wackestone/packstone, moderately hard, 15-20% shell fragments, other fossils include bryozoans, barnacles, high to medium moldic macroporosity.
100 – 110	LIMESTONE, very light gray to light gray (N7 to N8), sandy fossiliferous packstone, moderately hard to soft, abundant aragonitic shell fragments and molds, medium to high moldic macroporosity.
110 – 130	LIMESTONE, medium gray to medium light gray (N5 to N6) and yellowish gray (5Y 8/1), sandy, fossiliferous packstone, hard, fossils include bryozoans, bivalves, medium moldic and intergranular macroporosity.
130 – 140	LIMESTONE, yellowish gray to light gray (5Y 7/1), wackestone/packstone, moderately hard to soft, bivalve fragments, low to medium macroporosity.
140 – 174	LIMESTONE to CALCAREOUS SANDSTONE, light olive gray (5Y 6/1), very sandy wackestone to calcareous sandstone, moderately hard to soft, 10-15% bivalve fragments, trace (<5%) very fine sand-size phosphate grains, low to medium moldic macroporosity.
174 – 181	LIMESTONE to CALCAREOUS SANDSTONE (50%), as above. CLAYEY SILT/CLAYEY, SILTY SAND (50%), light olive gray (5Y 6/1), very fine quartz sand, well sorted, slightly sticky, abundant bivalve fragments, very fine sand-size phosphate grains.
181 – 201	SILT CLAY/CLAYEY SILT, pale olive (10Y 5/2), slightly sticky to stiff, well sorted, less abundant bivalve shell fragments than above, low permeability.
201 – 212	CLAYEY SILT, pale olive (10Y 5/2), sandy –very fine quartz sand, well sorted, abundant silt-size phosphate grains, low permeability.
212 – 225	CLAYEY, SANDY, PHOSPHORITIC SILT (60-70%), pale olive (10YR 5/2), very sticky, cohesive (sticking to shaker screen), very fine to fine quartz sand, trace shell fragments (getting more numerous with depth), abundant very fine grained phosphate. LIMESTONE (30-40%), interbedded with clayey silt, yellowish gray (5Y 8/1), fossiliferous wackestone, hard, external bivalve molds, medium to low moldic macroporosity.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	Lithology
225 – 230	SAME AS ABOVE? Lots of cement returns from drilling through cement plug at bottom of casing, drilling mud is extremely thick due to cement – taking a very long time to come up hole.
230 – 240	SILTY CLAY, light olive gray (5Y 5/2), well sorted, some very fine grained quartz sand, few returns, mud extremely thick due to drilling through cement plug, will empty mud tank at kelly down (244 ft bls).
240 – 250	SILTY SAND, light olive gray (5Y 5/2), minor clay, sticky, contains very fine grained quartz sand, moderately well sorted, 5-10% very fine to silt-size phosphate, trace lithified siliceous mudstone, some coarse-sand size grains.
250 – 260	SILTY SAND, as above, except slightly more phosphatic – 10-15%, also trace bivalve fragments and bone fragments.
260 – 280	SILTY SAND, light olive gray (5Y 5/2), minor clay, phosphatic – similar to above, except no shell or fossil fragments; abundant cement returns in sample (from above).
280 – 290	SILTY SAND, light olive gray (5Y 5/2), minor clay, very soft, plastic, 10% silt-size phosphate, mostly very fine grained quartz sand and silt.
290 – 300	SILTY/CLAYEY SAND, light olive gray (5Y 5/2), stiffer than above, but still relatively soft, 10% silt-size phosphate grains, trace of mudstone/siltstone – soft, low macroporosity.
300 – 310	SILTY/CLAYEY SAND, as above, except slightly more phosphatic (10-15%).
310 – 320	CLAYEY SILT, light olive gray (5Y 5/2), sticky – but pliable, cohesive, abundant fine sand, some siliceous mudstone/siltstone – moderately hard to soft, however, majority is unlithified sediments.
320 – 330	SILTY SAND, light olive gray (5Y 5/2), less clay than above, less cohesive, very wet, phosphatic, minor siliceous mudstone/siltstone.
330 – 340	CLAYEY, SILTY SAND, light olive gray (5Y 5/2), very fine quartz sand, phosphatic, 5% silty sandstone- coarse sand-size fragments - same composition as unlithified portion of sample, trace of bone fragments.
340 – 350	CLAYEY, SILTY SAND, light olive gray (5Y 5/2), very fine grained quartz sand, 15-20% silt-size phosphate, well sorted.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	Lithology
350 – 360	SANDY, CLAYEY SILT, light olive gray (5Y 5/2), more silt/clay than above, variable (5-15%) silt-size phosphate grains, <10% siliceous mudstone/siltstone, moderately hard.
360 – 380	CLAYEY, SANDY SILT, light olive gray (5Y 5/2), slightly stiff, cohesive, 5-10% silt-size phosphate, stiffer clay unit from 361-361.5, low permeability.
380 – 390	CLAYEY, SANDY SILT, similar to above, except slightly stiffer and more cohesive than above.
390 – 410	SILTY, SANDY CLAY, grayish olive (10Y 4/2), stiffer than above, more clay and less very fine quartz sand than above, 5% silt-size phosphate, low permeability.
410 – 433	SANDY, SILTY CLAY, grayish olive (10Y 4/2), slightly more phosphatic than above (15% silt-size phosphate), also some more silty, sandy lenses, overall low permeability.
433 – 446	SANDY, SILTY CLAY and LIMESTONE. Sandy, silty clay, as above, interbedded with yellowish gray (5Y 8/1), sandy, fossiliferous wackestone, hard, medium moldic macroporosity.
446 – 460	LIMESTONE (60-70%), similar to above, except slightly darker in color (pale light olive gray (5Y 7/1). MARL (30-40%), pale grayish olive (10Y 6/2), phosphatic, silty and samdy, trace of white bivalve shell fragments, some poorly lithified mudstone, friable to moderately hard – same composition as marl, low intergranular macroporosity.
460 – 469	CALCAREOUS SILTSTONE/SILTY LIMESTONE, light olive gray (5Y 7/1), wackestone, phosphatic, moderately hard to soft, some hard – mostly associated with bivalve fragments, small pebble-size phosphate grains, medium moldic macroporosity.
469 – 480	SILTY LIMESTONE/CALCAREOUS SILTSTONE, light olive gray (5Y 7/1) to olive gray (5Y 6/1), silty wackestone, hard to very hard, bivalve shell fragments, low moldic macroporosity.
480 – 490	CALCAREOUS SANDSTONE/SANDY LIMESTONE, light olive gray (5Y 7/1), sandy wackestone, moderately hard to soft, very similar to

Depth (ft bls)	**Lithology**
	above, except higher moldic macroporosity, Also some medium dark gray (N4), limestone, very hard, low macroporosity.
490 – 500	LIMESTONE, light olive gray (5Y 7/1), sandy wackestone, phosphatic, moderately hard to soft, medium moldic macroporosity.
500 – 520	LIMESTONE, light olive gray (5Y 7/1), sandy wackestone, hard to moderately hard, phosphatic, few very hard layers, abundant bivalve fragments and molds (internal and external), medium moldic macroporosity. Some light olive gray (5Y 6/1) siltstone/sandstone – moderately hard to soft, from above?
520 – 540	LIMESTONE, light olive gray (5Y 7/1), fossiliferous wackestone/packstone, moderately hard, abundant bivalve molds - internal/external, casts, foraminifera, medium macroporosity.
540 – 550	LIMESTONE, light olive gray (5Y 7/1), fossiliferous, sandy wackestone, moderately hard (softer than above), phosphatic, bivalve fragments, echinoderm fragments (urchin spine), medium moldic macroporosity.
550 – 582	LIMESTONE, yellowish gray (5Y 8/1), sandy fossiliferous wackestone, mostly moderately hard, some hard, abundant external bivalve molds, less shell fragments than above, medium moldic macroporosity, trace of sandy marl, yellowish gray (5Y 8/1).
582 – 593	LIMESTONE, yellowish gray (5Y 8/1), sandy fossiliferous wackestone, moderately hard to soft, rate of penetration has increased from previous interval, 5-10% silty to very fine sand-size phosphate, trace shell fragments, some internal/external bivalve molds, medium moldic and intergranular macroporosity.
593 – 606	LIMESTONE, as above, however, faster rate of penetration.
606 – 620	LIMESTONE, as above (582 – 593); Trace of sandy marl, light olive gray (5Y 7/1), soft, more prevalent below 615 ft bls.
620 – 633	LIMESTONE, yellowish gray to light olive gray (5Y 7/1), silty phosphatic wackestone, moderately hard to soft, low to medium moldic macroporosity; trace marl, as above.
633 – 640	LIMESTONE (60%), as above. MARL, (40%), yellowish gray to light olive gray (5Y 7/1), sandy, 10-20% very fine sand to silt-size phosphate, slightly sticky.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	**Lithology**
640 – 650	MARL (60%), as above. LIMESTONE (40%), as above.
650 – 660	LIMESTONE and MARL, interbedded, yellowish gray to light olive gray (5Y 7/1), limestone- wackestone, moderately hard to soft, as above; marl-sandy, phosphatic, more stiff than above.
660 – 670	LIMESTONE with MARL, yellowish gray to light olive gray (5Y 7/1), interbedded; Limestone – silty wackestone, very fine grained, moderately hard to soft, phosphatic, low to medium moldic macroporosity. Marl – silty, 5% very fine grained phosphate, sticky, cohesive, low permeability.
670 – 690	MARL with LIMESTONE, interbedded. Marl, yellowish gray to light olive gray (5Y 7/1), stiff to sticky, 5% very fine sand-size phosphate, low permeability. Limestone, yellowish gray (5Y 8/2) and lighter, very fine-grained wackestone, silty, 5-10% very fine sand-size phosphate, moderately hard to soft, low to medium moldic macroporosity.
690 – 700	MARL with LIMESTONE, interbedded, yellowish gray (5Y 7/2); marl – sticky, 5-10% phosphate; Limestone, as above.
700 – 720	LIMESTONE with MARL, yellowish gray (5Y 7/2), limestone-wackestone, sandy, <5% shell fragments, medium moldic macroporosity, <5% phosphate grains. Marl, as above.
720 – 740	LIMESTONE with MARL, similar to above, except more limestone and less marl. Also trace of sandy, fossiliferous packestone with a medium moldic macroporosity.
740 – 750	LIMESTONE, yellowish gray (5Y 7/2), sandy wackestone/packstone, moderately hard, medium moldic macroporosity; trace marl – from above?
750 – 760	LIMESTONE, yellowish gray (5Y 7/2), sandy wackestone to packed wackestone, similar to above, except harder—moderately hard to hard, trace of marl – from above?
760 – 770	LIMESTONE with MARL; Limestone – sandy wackestone to packed wackestone, as above, except slightly softer – moderately hard, also trace of shell fragments; Marl – yellowish gray (5Y 7/2), sticky, 5-10% phosphate grains.

Depth (ft bls)	**Lithology**
770 – 785	MARL with minor LIMESTONE, yellowish gray (5Y 7/2), sticky, as above, slow drilling; limestone, as above.
785 – 810	MARL (80%), yellowish gray (5Y 7/2), as above. LIMESTONE (20%), sandy wackestone, very fine grained allochems, moderately hard to hard, slightly phosphatic, low to medium moldic macroporosity.
810 – 824	MARL (75-80%), yellowish gray (5Y 7/2), as above, sandy, sticky, phosphatic. LIMESTONE (15-20%), as above.
824 – 837	LIMESTONE with MARL, limestone- yellowish gray (5Y 7/2), sandy, fossiliferous wackestone, slightly phosphatic, medium moldic macroporosity; marl – as above.
837 – 889	LIMESTONE, yellowish gray (5Y 8/1), wackestone, moderately hard to hard, <5% shell fragments, minor bivalve and gastropod molds/casts, medium to low moldic macroporosity, trace of clay/marl (YG 5Y 7/1).
889 – 896	MARL, yellowish gray to light olive gray (5Y 7/1), sticky, low permeability.
896 – 899	LIMESTONE, yellowish gray (5Y 8/1), wackestone, moderately hard to hard, <5% shell fragments, minor bivalve and gastropod molds/casts, medium to low moldic macroporosity, trace of clay/marl (YG 5Y 7/1).
899 – 915	MARL (>95%), yellowish gray (5Y 7/2), slightly sandy (5%) quartz sand, <5% silt-size phosphate grains, sticky, but getting stiffer and more cohesive with depth. Limestone (<5%), as above.
915 – 919	LIMESTONE, white to light gray (N8 to N9), fossiliferous wackestone, very hard, medium moldic macroporosity.
919 – 940	MARL/CLAY and LIMESTONE, roughly equal percentages. Limestone, as above. Clay/marl, yellowish gray (5Y 7/2), slightly sandy, trace of bivalve shell fragments, sticky, cohesive.
940 – 950	LIMESTONE (70%), white to light gray (N7 to N9), wackestone, moderately hard to hard, abundant bivalve molds and shell fragments. Clay (30%), marly, as above.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	**Lithology**
950 – 960	LIMESTONE, as above. Also some yellowish gray (5Y 7/2) fossiliferous wackestone, hard to moderately hard, with a trace of phosphate silt (<3%), low moldic macroporosity. Trace of clay, as above, 15-25% bivalve shell fragments.
960 – 970	CLAY (80-90%), yellowish gray (5Y 7/2) and (5Y 5/2), sticky, 5-10% silt-size phosphate, shell fragments. LIMESTONE (10-20%), as above.
970 – 980	CLAY (80%), yellowish gray to light olive gray (5Y 6/2), 10-15% silt-size phosphate, sticky to stiff. Limestone (20%), yellowish gray (5Y 8/1) and light gray (N8), fossiliferous wackestone/packstone, moderately hard, medium moldic macroporosity.
980 – 990	CLAY (90-95%), yellowish gray (5Y 7/2) and light olive gray (5Y 5/2), stiff, very plastic, contains shell fragments, silt-size phosphate. Clay is becoming more yellowish gray with depth (5Y 7/2) and not quite as stiff (still pretty stiff though). LIMESTONE (5-10%), as above.
990 – 1000	CLAY (>95%), light olive gray (5Y 5/2) and yellowish gray (5Y 7/2), as above. LIMESTONE (<5%), as above.
1000 – 1020	CLAY, light olive gray (5Y 6/2), very sticky. Trace of limestone (1-2%), yellowish gray (5Y 7/2), slightly sandy fossiliferous wackestone, medium moldic macroporosity.
1020 – 1044	CLAY, as above, but <1% limestone (>99% clay).
1044 – 1050	LIMESTONE with SHELL BED (?), white (N9) to yellowish gray (5Y 8/1), fossiliferous wackestone to sandy molluscan wackestone. Very hard to hard, yellowish gray limestone is shelly, medium moldic macroporosity; interval contains 30 – 40% loose shell fragments.
1050 – 1060	LIMESTONE with SHELL, as above.
1060 – 1070	CLAY (60%), yellowish gray (5Y 7/2 to 5Y 6/2), stiff, locking up bit teeth. LIMESTONE (40%), white to light gray (N9 to N8), fossiliferous wackestone, moderately hard, medium moldic macroporosity.
1070 – 1080	CLAY (75%), pale greenish gray to pale olive (10Y 7/2), stiff, abundant shell fragments. LIMESTONE (25%), as above.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	Lithology
1080 – 1085	LIMESTONE (60%), as above. CLAY (40%), as above.
1085 – 1095	LIMESTONE, light gray (N7 and yellowish gray (5Y 8/1), moderately hard, medium to high macroporosity, 5% fine phosphate grains.
1095 – 1100	LIMESTONE, very pale orange (10YR 8/2), soft, medium macroporosity, 5% phosphate fine grains.
1100 – 1105	LIMESTONE, yellowish gray (5Y 8/1), hard, high macroporosity.
1105 – 1110	LIMESTONE, very pale orange, soft, medium macroporosity.
1110 – 1115	LIMESTONE, pale yellowish brown (10YR 6/2), hard, high macroporosity.
1115 – 1122	LIMESTONE, very pale orange to pale yellowish brown (10YR 7/2), hard at top, soft in middle, moderately hard at bottom, high macroporosity, gastropod molds.
1122 – 1130	LIMESTONE, yellowish gray and light gray at top (5Y 8/1), grayish orange in middle (10YR 7/4), very pale orange at bottom (10YR 8/2), moderately hard to hard, high macroporosity, 3% phosphate fine grains.
1130 – 1143	LIMESTONE, dark greenish gray to 1135 (5GY 4/1), pale yellowish brown (10YR 6/2) to 1143, dolomitic.
1143 – 1148	LIMESTONE, matrix is medium light gray (N6) and grains are yellowish gray (5Y 8/10), hard, medium macroporosity, gastropod molds.
1148 – 1176	LIMESTONE, very pale orange (10YR 8/2), moderately hard, medium vuggy macroporosity, gastropod molds, crystalline bryzoan stems.
1176 – 1177	LIMESTONE, very pale orange (10YR 8/2), moderately hard, medium vuggy macroporosity, gastropod molds, crystalline bryzoan stems, abundant echinoids.
1177 – 1192	LIMESTONE, very pale orange (10YR 8/2), moderately hard, medium macroporosity, echinoids, foraminifera, bryzoan stems.
1192 – 1208	LIMESTONE, matrix is light gray (N7) and grains are yellowish gray (5Y8/1), moderately hard, medium macroporosity, echinoids and bryzoan stems.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	Lithology
1208 – 1259	LIMESTONE, yellowish gray (5y 8/1), moderately hard to hard, medium to high macroporosity, echinoids, foraminifera.
1259 – 1270	LIMESTONE yellowish gray (5Y 8/1), soft to moderately hard, medium macroporosity, echinoids.
1270 – 1290	LIMESTONE (50%), grayish orange (10YR 7/4), soft, medium macroporosity, echinoids, foraminifera. LIMESTONE (50%), very pale orange (10YR 8/2), soft, medium macroporosity, foraminifera.
1290 – 1300	LIMESTONE (60%), grayish orange, as above. LIMESTONE (40%), very pale orange, as above.
1300 – 1306	LIMESTONE, yellowish gray (5Y 8/1) and grayish orange (10YR 7/4), moderately hard, hard lense at 1306, medium macroporosity, low macroporosity at lense.
1306 – 1331	LIMESTONE, grayish orange (10YR 7/4), soft to moderately hard, medium macroporosity, echinoids, foraminifera, coral.
1331 – 1336	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity, echinoids, foraminifera.
1336 – 1337	LIMESTONE, grayish orange (10YR 7/4) and yellowish gray (5Y 8/1), moderately hard to hard, medium macroporosity, foraminifera.
1337 – 1362	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity, echinoids, foraminifera.
1362 – 1377	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity.
1377 – 1382	LIMESTONE, moderate orange pink (5YR 8/4), hard, high moldic macroporosity.
1382 – 1393	LIMESTONE, grayish orange (10YR 7/4) and moderate orange pink (5YR 8/4), hard, high moldic macroporosity.
1393 – 1422	LIMESTONE, grayish orange (10YR 7/4), soft with hard lense at 1403, medium macroporosity, echinoids, mollusks molds.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	**Lithology**
1422 – 1453	LIMESTONE, grayish orange (10YR 7/4), soft with hard lense at 1439, medium macroporosity, echinoids, mollusks molds.
1453 – 1482	LIMESTONE, grayish orange (10YR 7/4), soft and friable, medium macroporosity, foraminifera, coral.
1482 – 1484	LIMESTONE, very pale orange (10YR 8/2), moderately hard to hard, medium macroporosity.
1484 – 1485	LIMESTONE, very pale orange (10YR 8/2), moderately hard, medium macroporosity.
1485 – 1486	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity.
1486 – 1510	LIMESTONE, very pale orange (10Y 8/2), hard, high vuggy macroporosity, appears to be a substantial water source.
1510 – 1515	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity.
1515 – 1547	LIMESTONE, very pale orange (10YR 8/2) and grayish orange (10YR 7/4), soft, moderately high macroporosity, foraminifera.
1547 – 1562	LIMESTONE, grayish orange (10YR7/4), soft, medium macroporosity, foraminifera.
1562 – 1578	LIMESTONE, very pale orange (10YR 8/2), soft and hard, medium macroporosity.
1578 – 1603	LIMESTONE, very pale orange (10YR 8/2) and grayish orange (10YR 7/4), soft with hard lense at 1592, medium macroporosity.
1603 – 1608	LIMESTONE, very pale orange (10YR 8/2) and medium light gray (N6), moderately hard to hard, medium macroporosity.
1608 – 1626	LIMESTONE, grayish orange (10YR 7/4), soft to moderately hard, medium macroporosity.
1626 – 1635	LIMESTONE, very pale orange (10YR 8/2) and grayish orange (10YR 7/4), hard, low macroporosity.
1635 – 1640	Dolomitic LIMESTONE, dark gray (N3) and grayish orange (10YR 7/4), hard, medium macroporosity.

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth (ft bls)	**Lithology**
1640 – 1652	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity.
1652 – 1657	LIMESTONE, gray black (N2) to med dark gray (N4), moderately hard, medium macroporosity, banded phosphate.
1657 – 1666	LIMESTONE, light olive gray (5Y 5/2) and yellowish gray (5Y 7/2), soft, medium macroporosity.
1666 – 1671	LIMESTONE, very pale orange (10YR 8/2) and dusky yellowish gray (5Y 6/4), hard, low to medium macroporosity.
1671 – 1673	LIMESTONE, very pale orange (10YR 8/2) and grayish orange (10YR 7/4), moderately hard, medium macroporosity.
1673 – 1676	LIMESTONE, very pale orange (10YR 8/2), yellowish gray (5Y 8/1), and medium light gray (N6), hard, high vuggy macroporosity.
1676 – 1680	LIMESTONE, grayish orange (10YR 7/4), soft, medium macroporosity.
1680 – 1681	LIMESTONE, pale yellowish brown (10YR 6/2), hard, low macroporosity.
1681 – 1684	LIMESTONE with interbedded CLAY LIMESTONE (70%), light brownish gray (5YR 6/1), soft, medium macroporosity CLAY (30%), light brownish gray (5YR 6/1) to yellowish gray (5Y 7/2), stiff, banded.
1684 – 1688	LIMESTONE, grayish orange (10YR 7/4), soft, low to medium macroporosity.
1688 – 1693	Dolomitic LIMESTONE, dark gray (N3) to light gray (N7), hard, medium macroporosity.
1693 – 1700	LIMESTONE, grayish orange (10YR 7/4), soft, moderately high macroporosity.
1700 – 1701	Dolomitic LIMESTONE, dark gray (N3) to light gray (N7), hard, moderately high macroporosity.
1701 – 1710	LIMESTONE, very pale orange (10YR 8/2), pale yellowish brown (10YR 6/2), and medium light gray (N6), soft to hard, medium macroporosity

Geological Log TP-1
City of Hialeah Hydrogeologic Testing and Analyses

Depth **Lithology**
(ft bls)

1710 – 1711 LIMESTONE, medium gray (N5) and yellowish gray (5Y 8/1), hard, cherty low vuggy macroporosity.

1711 – 1715 LIMESTONE, very pale orange (10YR 8/2) to white (N9), hard, moderately high to high moldic and vuggy macroporosity, high yield water bearing source.

1715 – 1718 LIMESTONE, very pale orange (10YR 8/2), hard, medium macroporosity.

1718 – 1730 LIMESTONE, grayish orange (10YR 7/4) and medium gray (N5), hard, medium macroporosity.

1730 – 1733 LIMESTONE, very pale orange (10YR 8/2) and grayish orange (10YR 7/4), soft to moderately hard, medium macroporosity.

Note: pilot hole was back filled with neat cement to 1489 ft bls before being reamed with a 15 inch bit to 1490

Appendix B

Water Quality Laboratory Reports

Analytical Report 337158

for

Schlumberger Water Services

Project Manager: Scott Manahan

City of Hialeah

17-JUL-09

10200 USA Today Way, Miramar, FL 33025
Ph:(305) 823-8500 Fax:(305) 823-8555

Xenco-Houston (EPA Lab code: TX00122):
Texas (T104704215-08-TX), Arizona (AZ0738), Arkansas (08-039-0), Connecticut (PH-0102), Florida (E871002)
Illinois (002082), Indiana (C-TX-02), Iowa (392), Kansas (E-10380), Kentucky (45), Louisiana (03054)
New Hampshire (297408), New Jersey (TX007), New York (11763), Oklahoma (9218), Pennsylvania (68-03610)
Rhode Island (LAO00308), USDA (S-44102)

Xenco-Atlanta (EPA Lab Code: GA00046):
Florida (E87428), North Carolina (483), South Carolina (98015), Utah (AALI1), West Virginia (362), Kentucky (85)
Louisiana (04176), USDA (P330-07-00105)

Xenco-Miami (EPA Lab code: FL01152): Florida (E86678), Maryland (330)

Xenco-Miramar (EPA Lab code: FL01246): Florida (E86349)

Xenco-Tampa Mobile (EPA Lab code: FL01212): Florida (E84900)

Xenco-Odessa (EPA Lab code: TX00158): Texas (T104704400-08-TX)

Xenco-Dallas (EPA Lab code: TX01468): Texas (T104704295-08-TX)

Xenco-Corpus Christi (EPA Lab code: TX02613): Texas (T104704370-08-TX)

Houston - Dallas - San Antonio - Tampa - Miami - Midland - Corpus Christi - Atlanta - Latin America

XENCO Laboratories

17-JUL-09

Project Manager: **Scott Manahan**
Schlumberger Water Services
1567 Hayler Lane, Suite 202
Fort Myers, FL 33907

Reference: XENCO Report No: **337158**
City of Hialeah
Project Address:

Scott Manahan:

We are reporting to you the results of the analyses performed on the samples received under the project name referenced above and identified with the XENCO Report Number 337158. All results being reported under this Report Number apply to the samples analyzed and properly identified with a Laboratory ID number. Subcontracted analyses are identified in this report with either the NELAC certification number of the subcontract lab in the analyst ID field, or the complete subcontracted report attached to this report.

Unless otherwise noted in a Case Narrative, all data reported in this Analytical Report are in compliance with NELAC standards. Estimation of data uncertainty for this report is found in the quality control section of this report unless otherwise noted. Should insufficient sample be provided to the laboratory to meet the method and NELAC Matrix Duplicate and Matrix Spike requirements, then the data will be analyzed, evaluated and reported using all other available quality control measures.

The validity and integrity of this report will remain intact as long as it is accompanied by this letter and reproduced in full, unless written approval is granted by XENCO Laboratories. This report will be filed for at least 5 years in our archives after which time it will be destroyed without further notice, unless otherwise arranged with you. The samples received, and described as recorded in Report No. 337158 will be filed for 60 days, and after that time they will be properly disposed without further notice, unless otherwise arranged with you. We reserve the right to return to you any unused samples, extracts or solutions related to them if we consider so necessary (e.g., samples identified as hazardous waste, sample sizes exceeding analytical standard practices, controlled substances under regulated protocols, etc).

We thank you for selecting XENCO Laboratories to serve your analytical needs. If you have any questions concerning this report, please feel free to contact us at any time.

Respectfully,

Tom Helton
Technical Director

Recipient of the Prestigious Small Business Administration Award of Excellence in 1994.
Certified and approved by numerous States and Agencies.
A Small Business and Minority Status Company that delivers SERVICE and QUALITY

Houston - Dallas - San Antonio - Austin - Tampa - Miami - Atlanta - Corpus Christi - Latin America

Sample Cross Reference 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id	Matrix	Date Collected	Sample Depth	Lab Sample Id
TP-1 23 hrs	W	Jul-01-09 19:00		337158-001
TP-1 42 hrs	W	Jul-02-09 14:00		337158-002
TP-1	W	Jul-03-09 13:45		337158-003
TP-1	W	Jul-04-09 11:45		337158-004
TP-1 Z	W	Jul-05-09 14:00		337158-005
TP-1 Z	W	Jul-05-09 14:00		337158-006

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1 23 hrs**
Lab Sample Id: **337158-001**
Matrix: **WATER**
Date Collected: **Jul-01-09 19:00**
Date Received: **Jul-06-09 11:15**
% Moisture:

Analytical Method: Hardness, Total by SM2340B
Prep Method:
Date Analyzed: Jul-09-09 10:46
Analyst: ARP
Seq Number: 764893
Date Prep:
Tech: ARP

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Hardness (CaCO3)	471-34-1	1010	0.500	0.500	mg/L		1

Analytical Method: Inorganic Anions by EPA 300
Prep Method:
Date Analyzed: Jul-07-09 13:38
Analyst: NIB
Seq Number: 764833
Date Prep:
Tech: NIB

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Chloride	16887-00-6	2410	10.5	2.58	mg/L		25

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1 42 hrs**
Lab Sample Id: **337158-002**
Matrix: **WATER**
Date Collected: **Jul-02-09 14:00**
Date Received: **Jul-06-09 11:15**
% Moisture:

Analytical Method: Hardness, Total by SM2340B
Prep Method:
Date Analyzed: Jul-09-09 10:46
Analyst: ARP
Seq Number: 764893
Date Prep:
Tech: ARP

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Hardness (CaCO3)	471-34-1	992	0.500	0.500	mg/L		1

Analytical Method: Inorganic Anions by EPA 300
Prep Method:
Date Analyzed: Jul-07-09 13:38
Analyst: NIB
Seq Number: 764833
Date Prep:
Tech: NIB

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Chloride	16887-00-6	2390	10.5	2.58	mg/L		25

Project: Florida Standard List of Methods

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1**	Matrix: **WATER**	% Moisture:	
Lab Sample Id: **337158-003**	Date Collected: **Jul-03-09 13:45**		
	Date Received: **Jul-06-09 11:15**		

Analytical Method: Hardness, Total by SM2340B Prep Method:

Date Analyzed: Jul-09-09 10:46 Analyst: ARP Date Prep: Tech: ARP

Seq Number: 764893

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Hardness (CaCO3)	471-34-1	946	0.500	0.500	mg/L		1

Analytical Method: Inorganic Anions by EPA 300 Prep Method:

Date Analyzed: Jul-07-09 13:38 Analyst: NIB Date Prep: Tech: NIB

Seq Number: 764833

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Chloride	16887-00-6	2390	10.5	2.58	mg/L		25

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1**
Lab Sample Id: **337158-004**
Matrix: **WATER**
Date Collected: **Jul-04-09 11:45**
Date Received: **Jul-06-09 11:15**
% Moisture:

Analytical Method: Hardness, Total by SM2340B
Prep Method:
Date Analyzed: Jul-09-09 10:46
Analyst: ARP
Seq Number: 764893
Date Prep:
Tech: ARP

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Hardness (CaCO3)	471-34-1	884	0.500	0.500	mg/L		1

Analytical Method: Inorganic Anions by EPA 300
Prep Method:
Date Analyzed: Jul-07-09 13:38
Analyst: NIB
Seq Number: 764833
Date Prep:
Tech: NIB

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Chloride	16887-00-6	2300	10.5	2.58	mg/L		25

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id:	**TP-1 Z**	Matrix:	**WATER**	% Moisture:
Lab Sample Id:	**337158-005**	Date Collected:	**Jul-05-09 14:00**	
		Date Received:	**Jul-06-09 11:15**	

Analytical Method: **Hardness, Total by SM2340B** Prep Method:

Date Analyzed: Jul-09-09 10:46 Analyst: ARP Date Prep: Tech: ARP
Seq Number: 764893

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Hardness (CaCO3)	471-34-1	980	0.500	0.500	mg/L		1

Analytical Method: **Inorganic Anions by EPA 300** Prep Method:

Date Analyzed: Jul-07-09 13:38 Analyst: NIB Date Prep: Tech: NIB
Seq Number: 764833

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Chloride	16887-00-6	2410	10.5	2.58	mg/L		25

Project: Florida Standard List of Methods

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id:	**TP-1 Z**	Matrix:	**WATER**	% Moisture:
Lab Sample Id:	**337158-006**	Date Collected:	**Jul-05-09 14:00**	
		Date Received:	**Jul-06-09 11:15**	

Analytical Method: Alkalinity by SM2320B Prep Method:

Date Analyzed: Jul-07-09 11:00 Analyst: OLA Date Prep: Tech: OLA

Seq Number: 764635

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Alkalinity, Total (as CaCO3)		132	8.68	2.17	mg/L		1

Analytical Method: Color by SM2120B Prep Method:

Date Analyzed: Jul-06-09 14:55 Analyst: MSH Date Prep: Tech: MSH

Seq Number: 764534

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Color		10	1.0	0.50	CU		1

Analytical Method: DOC by SM5310 Prep Method:

Date Analyzed: Jul-09-09 01:28 Analyst: MAB Date Prep: Tech: MAB

Seq Number: 764878

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Dissolved Organic Carbon	7440-44-0	2.47	0.500	0.548	mg/L		1

Analytical Method: Hardness, Total by SM2340B Prep Method:

Date Analyzed: Jul-09-09 10:46 Analyst: ARP Date Prep: Tech: ARP

Seq Number: 764893

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Hardness (CaCO3)	471-34-1	937	0.500	0.500	mg/L		1

Analytical Method: Inorganic Anions by EPA 300 Prep Method:

Date Analyzed: Jul-07-09 13:38 Analyst: NIB Date Prep: Tech: NIB

Seq Number: 764833

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Fluoride	16984-48-8	0.744	0.740	0.183	mg/L		2
Chloride	16887-00-6	2310	21.0	5.15	mg/L		50
Nitrite as N	7727-37-9	U	0.800	0.197	mg/L	U	2
Nitrate as N	7727-37-9	U	0.540	0.132	mg/L	U	2
Ortho-Phosphate	7723-14-0	U	0.200	0.050	mg/L	U	2
Sulfate	14808-79-8	260	1.15	0.277	mg/L		5

Project: Florida Standard List of Methods

Version: 1.032

XENCO Laboratories

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1 Z**
Lab Sample Id: **337158-006**
Matrix: **WATER**
Date Collected: **Jul-05-09 14:00**
Date Received: **Jul-06-09 11:15**
% Moisture:

Analytical Method: Metals per ICP-MS by SW 6020A Prep Method: SW3010A
Date Analyzed: Jul-08-09 03:42 Analyst: ARP Date Prep: Jul-07-09 09:00 Tech: RWA
Seq Number: 764731

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Barium	7440-39-3	0.017	0.010	0.002	mg/L		1
Calcium	7440-70-2	128	10.0	2.50	mg/L	D	50
Potassium	7440-09-7	37.1	0.500	0.170	mg/L		1
Sodium	7440-23-5	1010	25.0	12.5	mg/L	D	50
Strontium	7440-24-6	12.4	0.005	0.001	mg/L		1

Analytical Method: Metals, Total by SW846 6010B Prep Method: SW3010A
Date Analyzed: Jul-08-09 12:39 Analyst: 4150 Date Prep: Jul-07-09 12:32 Tech: 4150
Seq Number: 764783

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Iron	7439-89-6	U	0.100	0.021	mg/L	U	1
Manganese	7439-96-5	U	0.050	0.001	mg/L	U	1

Analytical Method: Nitrogen Ammonia by EPA 350.1 Prep Method:
Date Analyzed: Jul-07-09 10:35 Analyst: SHH Date Prep: Tech: YAD
Seq Number: 764669

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Nitrogen, Ammonia (as N)	7664-41-7	0.172	0.100	0.020	mg/L		1

Analytical Method: Phosphorus, Total (Automated) by EPA 365.4 Prep Method:
Date Analyzed: Jul-08-09 11:40 Analyst: MSH Date Prep: Tech: MSH
Seq Number: 764826

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Total Phosphorus (as P)	7723-14-0	U	0.100	0.037	mg/L	U	1

Analytical Method: Silica by SM4500-SiO2 Prep Method:
Date Analyzed: Jul-09-09 11:58 Analyst: 9999 Date Prep: Tech: 9999
Seq Number: 765498

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Silica	7631-86-9	10.9	0.660	0.010	mg/L		1

Project: Florida Standard List of Methods

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1 Z**
Lab Sample Id: **337158-006**
Matrix: **WATER**
Date Collected: **Jul-05-09 14:00**
Date Received: **Jul-06-09 11:15**
% Moisture:

Analytical Method: Specific Conductance by EPA 120.1
Prep Method:
Date Analyzed: Jul-07-09 09:25
Analyst: MSH
Seq Number: 764582
Date Prep:
Tech: MSH

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Conductivity		5670	50.0	10.0	uS/cm		1

Analytical Method: Sulfide by SM4500-S-F
Prep Method:
Date Analyzed: Jul-07-09 11:30
Analyst: OLA
Seq Number: 764640
Date Prep:
Tech: OLA

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Sulfide, total	105-05-2	2.40	5.00	1.00	mg/L	I	1

Analytical Method: TDS by SM2540C
Prep Method:
Date Analyzed: Jul-07-09 13:00
Analyst: YAD
Seq Number: 764766
Date Prep:
Tech: YAD

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Total dissolved solids	TDS	4850	5.00	5.00	mg/L		1

Analytical Method: TOC by SM 5310C
Prep Method:
Date Analyzed: Jul-08-09 22:06
Analyst: MAB
Seq Number: 764872
Date Prep:
Tech: MAB

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Total Organic Carbon	7440-44-0	1.31	0.500	0.210	mg/L		1

Analytical Method: Temperature by EPA 170.1
Prep Method:
Date Analyzed: Jul-06-09 14:30
Analyst: MSH
Seq Number: 764535
Date Prep:
Tech: MSH

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Temperature		25.0	5.00	1.00	Deg C		1

Analytical Method: Turbidity by EPA 180.1
Prep Method:
Date Analyzed: Jul-06-09 14:30
Analyst: MSH
Seq Number: 764535
Date Prep:
Tech: MSH

Parameter	**Cas Number**	**Result**	**PQL**	**MDL**	**Units**	**Flag**	**Dil**
Turbidity		1.21	1.00	0.100	NTU		1

Project: Florida Standard List of Methods

Version: 1.032

Certificate of Analytical Results 337158

Schlumberger Water Services, Fort Myers, FL

City of Hialeah

Sample Id: **TP-1 Z**
Lab Sample Id: **337158-006**
Matrix: **WATER**
Date Collected: **Jul-05-09 14:00**
Date Received: **Jul-06-09 11:15**
% Moisture:

Analytical Method: UV254 by SM20 5910B
Prep Method:
Date Analyzed: Jul-09-09 14:00
Analyst: 9999
Seq Number: 765497
Date Prep:
Tech: 9999

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
Absorbance		0.030	0.001	0.001	/cm		1

Analytical Method: pH by SM4500-H
Prep Method:
Date Analyzed: Jul-06-09 13:30
Analyst: MSH
Seq Number: 764568
Date Prep:
Tech: MSH

Parameter	Cas Number	Result	PQL	MDL	Units	Flag	Dil
pH	PH	7.61		1.00	SU		1

Project: Florida Standard List of Methods

FLORIDA Flagging Criteria

A Value reported is the mean (average) of two or more determinations. This code shall be used if the reported value is the average of results for two or more discrete and separate samples. These samples shall have been processed and analyzed independently. Do not use this code if the data are the result of replicate analysis on the same sample aliquot, extract or digestate.

B Results based upon colony counts outside the acceptable range. This code applies to microbiological tests and specifically to membrane filter colony counts. The code is to be used if the colony count is generated from a plate in which the total number of coliform colonies is outside the method indicated ideal range. This code is not to be used if a 100 mL sample has been filtered and the colony count is less than the lower value of the ideal range.

F When reporting species: F indicates the female sex. Otherwise it indicates RPD value is outside the acceptable range.

H Value based on field kit determination; results may not be accurate. This code shall be used if a field screening test (i.e., field gas chromatograph data, immunoassay, vendor-supplied field kit, etc.) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

J Estimated value. A "J" value shall be accompanied by a narrative justification for its use. Where possible, the organization shall report whether the actual value is less than or greater than the reported value. A "J" value shall not be used as a substitute for K, L, M, T, V, or Y, however, if additional reasons exist for identifying the value as estimate (e.g., matrix spiked failed to meet acceptance criteria), the "J" code may be added to a K, L, M, T, V, or Y. The following are some examples of narrative descriptions that may accompany a "J" code: .

J1: No known quality control criteria exist for the component;

J2: The reported value failed to meet the established quality control criteria for either precision or accuracy (the specific failure must be identified);

J3: The sample matrix interfered with the ability to make any accurate determination;

J4: The data are questionable because of improper laboratory or field protocols (e.g., composite sample was collected instead of a grab sample).

J5: The field calibration verification did not meet calibration acceptance criteria.

J6: QC protocol not followed.

J7: B/A results for Chlorophyll does not meet 1 - 1.7 ratio.

K Off-scale low. Actual value is known to be less than the value given. This code shall be used if:

1. The value is less than the lowest calibration standard and the calibration curve is known to be non-linear; or

2. The value is known to be less than the reported value based on sample size, dilution. This code shall not be used to report values that are less than the laboratory practical quantitation limit or laboratory method detection limit.

L Off-scale high. Actual value is known to be greater than value given. To be used when the concentration of the analyte is above the acceptable level for quantitation (exceeds the linear range or highest calibration standard) and the calibration curve is known to exhibit a negative deflection.

M When reporting chemical analyses: presence of material is verified but not quantified; the actual value is less than the value given. The reported value shall be the laboratory practical quantitation limit. This code shall be used if the level is too low to permit accurate quantification, but the estimated concentration is greater than the method detection limit. If the value is less than the method detection limit use "T" below.

N Presumptive evidence of presence of material. This qualifier shall be used if:

1. The component has been tentatively identified based on mass spectral library search; or

2. There is an indication that the analyte is present, but quality control requirements for confirmation were not met (i.e., presence of analyte was not confirmed by alternative procedures).

O Sampled, but analysis lost or not performed.

Q Sample held beyond the accepted holding time. This code shall be used if the value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.

T Value reported is less than the laboratory method detection limit. The value is reported for informational purposes, only and shall not be used in statistical analysis.

U Indicates that the compound was analyzed for but not detected. This symbolshall be used to indicate that the specified component was not detected. The value associated with the qualifier shall be the laboratory method detection limit. Unless requested by the client, less than the method detection limit values shall not be reported (see "T" above).

V Indicates that the analyte was detected in both the sample and the associated method blank. Note: the value in the blank shall not be subtracted from associated samples.

Flagging Criteria

Y The laboratory analysis was from an unpreserved or improperly preserved sample. The data may not be accurate.

Z Too many colonies were present (TNTC); the numeric value represents the filtration volume.

? Data are rejected and should not be used. Some or all of the quality control data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data.

* Not reported due to interference.

.

The following codes deal with certain aspects of field activities. The codes shall be used if the laboratory has knowledge of the specific sampling event. The codes shall be added by the organization collecting samples if they apply:

D The sample result was reported from a dilution.

E Indicates that extra samples were taken at composite stations.

R Significant rain in the past 48 hours. (Significant rain typically involves rain in excess of 1/2 inch within the past 48 hours.) This code shall be used when the rainfall might contribute to a lower than normal value.

! Data deviate from historically established concentration ranges.

Blank Spike Recovery

Project Name: City of Hialeah

Work Order #: 337158

Project ID:

Lab Batch #: 764534
Sample: 764534-1-BKS
Matrix: Water
Date Analyzed: 07/06/2009
Date Prepared: 07/06/2009
Analyst: MSH
Reporting Units: CU
Batch #: 1

BLANK /BLANK SPIKE RECOVERY STUDY

Color by SM2120B Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Color	<0.50	36	35	97	80-120	

Lab Batch #: 764878
Sample: 764878-1-BKS
Matrix: Water
Date Analyzed: 07/09/2009
Date Prepared: 07/09/2009
Analyst: MAB
Reporting Units: mg/L
Batch #: 1

BLANK /BLANK SPIKE RECOVERY STUDY

DOC by SM5310 Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Dissolved Organic Carbon	<0.548	10.0	9.84	98	80-120	

Lab Batch #: 764826
Sample: 764826-1-BKS
Matrix: Water
Date Analyzed: 07/08/2009
Date Prepared: 07/08/2009
Analyst: MSH
Reporting Units: mg/L
Batch #: 1

BLANK /BLANK SPIKE RECOVERY STUDY

Phosphorus, Total (Automated) by EPA 365.4 Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Total Phosphorus (as P)	<0.037	6.82	7.00	103	80-120	

Lab Batch #: 764582
Sample: 764582-1-BKS
Matrix: Water
Date Analyzed: 07/07/2009
Date Prepared: 07/07/2009
Analyst: MSH
Reporting Units: uS/cm
Batch #: 1

BLANK /BLANK SPIKE RECOVERY STUDY

Specific Conductance by EPA 120.1 Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Conductivity	<10.0	101	102	101	80-120	

Lab Batch #: 764766
Sample: 764766-1-BKS
Matrix: Water
Date Analyzed: 07/07/2009
Date Prepared: 07/07/2009
Analyst: YAD
Reporting Units: mg/L
Batch #: 1

BLANK /BLANK SPIKE RECOVERY STUDY

TDS by SM2540C Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Total dissolved solids	<5.00	1000	1010	101	80-120	

Blank Spike Recovery [D] = 100*[C]/[B]
All results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

Blank Spike Recovery

Project Name: City of Hialeah

Work Order #: 337158

Project ID:

Lab Batch #: 764872
Sample: 764872-1-BKS
Matrix: Water

Date Analyzed: 07/08/2009
Date Prepared: 07/08/2009
Analyst: MAB

Reporting Units: mg/L
Batch #: 1

BLANK /BLANK SPIKE RECOVERY STUDY

TOC by SM 5310C Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Total Organic Carbon	<0.242	10.0	9.84	98	90-110	

Blank Spike Recovery [D] = 100*[C]/[B]
All results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

BS / BSD Recoveries

Project Name: City of Hialeah

Work Order #: 337158
Project ID:

Analyst: OLA
Date Prepared: 07/07/2009
Date Analyzed: 07/07/2009
Lab Batch ID: 764635
Sample: 764635-1-BKS
Batch #: 1
Matrix: Water
Units: mg/L

BLANK /BLANK SPIKE / BLANK SPIKE DUPLICATE RECOVERY STUDY

Alkalinity by SM2320B Analytes	Blank Sample Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Spike Added [E]	Blank Spike Duplicate Result [F]	Blk. Spk Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Alkalinity, Total (as CaCO3)	<2.17	100	100	100	100	98.0	98	2	89-106	20	
Alkalinity, Bicarbonate (as CaCO3)	<2.17	250	<8.68	0	250	<8.68	0	NC	80-117	20	J
Alkalinity, Carbonate (as CaCO3)	<2.17	250	<8.68	0	250	<8.68	0	NC	80-120	20	J

Analyst: NIB
Date Prepared: 07/07/2009
Date Analyzed: 07/07/2009
Lab Batch ID: 764833
Sample: 764833-1-BKS
Batch #: 1
Matrix: Water
Units: mg/L

BLANK /BLANK SPIKE / BLANK SPIKE DUPLICATE RECOVERY STUDY

Inorganic Anions by EPA 300 Analytes	Blank Sample Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Spike Added [E]	Blank Spike Duplicate Result [F]	Blk. Spk Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Fluoride	<0.092	5.00	4.78	96	5	4.66	93	3	90-110	20	
Chloride	<0.103	10.0	9.56	96	10	9.33	93	2	90-110	20	
Nitrite as N	<0.099	10.0	9.38	94	10	9.34	93	0	90-110	20	
Nitrate as N	<0.066	4.52	4.71	104	4.52	4.72	104	0	90-110	20	
Ortho-Phosphate	<0.025	9.79	9.18	94	9.79	9.22	94	0	90-110	20	
Sulfate	<0.055	20.0	19.0	95	20	19.1	96	1	90-110	20	

Relative Percent Difference RPD = 200*|(C-F)/(C+F)|
Blank Spike Recovery [D] = 100*(C)/[B]
Blank Spike Duplicate Recovery [G] = 100*(F)/[E]
All results are based on MDL and Validated for QC Purposes

BS / BSD Recoveries

Project Name: City of Hialeah

Work Order #: 337158

Project ID:

Analyst: ARP
Date Prepared: 07/07/2009
Date Analyzed: 07/08/2009
Lab Batch ID: 764731
Sample: 533175-1-BKS
Batch #: 1
Matrix: Water
Units: mg/L

BLANK /BLANK SPIKE / BLANK SPIKE DUPLICATE RECOVERY STUDY

Metals per ICP-MS by SW 6020A Analytes	Blank Sample Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Spike Added [E]	Blank Spike Duplicate Result [F]	Blk. Spk Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Barium	<0.002	0.100	0.108	108	0.1	0.107	107	1	75-125	25	
Calcium	<0.050	5.00	5.60	112	5	5.43	109	3	75-125	25	
Potassium	<0.170	5.00	5.23	105	5	5.08	102	3	75-125	25	
Sodium	<0.250	5.00	5.45	109	5	5.20	104	5	75-125	25	
Strontium	<0.001	0.100	0.103	103	0.1	0.105	105	2	75-125	25	

Analyst: 4150
Date Prepared: 07/07/2009
Date Analyzed: 07/08/2009
Lab Batch ID: 764783
Sample: 533209-1-BKS
Batch #: 1
Matrix: Water
Units: mg/L

BLANK /BLANK SPIKE / BLANK SPIKE DUPLICATE RECOVERY STUDY

Metals, Total by SW846 6010B Analytes	Blank Sample Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Spike Added [E]	Blank Spike Duplicate Result [F]	Blk. Spk Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Iron	<0.021	9.00	9.50	106	9	9.26	103	3	75-125	20	
Manganese	<0.001	1.00	1.02	102	1	0.994	99	3	75-125	20	

Relative Percent Difference RPD = 200*|(C-F)/(C+F)|
Blank Spike Recovery [D] = 100*(C)/[B]
Blank Spike Duplicate Recovery [G] = 100*(F)/[E]
All results are based on MDL and Validated for QC Purposes

BS / BSD Recoveries

Project Name: City of Hialeah

Work Order #: 337158

Project ID:

Analyst: SHH **Date Prepared:** 07/07/2009 **Date Analyzed:** 07/07/2009

Lab Batch ID: 764669 **Sample:** 764669-1-BKS **Batch #:** 1 **Matrix:** Water

Units: mg/L

BLANK /BLANK SPIKE / BLANK SPIKE DUPLICATE RECOVERY STUDY

Nitrogen Ammonia by EPA 350.1 **Analytes**	**Blank Sample Result [A]**	**Spike Added [B]**	**Blank Spike Result [C]**	**Blank Spike %R [D]**	**Spike Added [E]**	**Blank Spike Duplicate Result [F]**	**Blk. Spk Dup. %R [G]**	**RPD %**	**Control Limits %R**	**Control Limits %RPD**	**Flag**
Nitrogen, Ammonia (as N)	<0.020	2.00	1.84	92	2	1.92	96	4	90-110	20	

Analyst: OLA **Date Prepared:** 07/07/2009 **Date Analyzed:** 07/07/2009

Lab Batch ID: 764640 **Sample:** 764640-1-BKS **Batch #:** 1 **Matrix:** Water

Units: mg/L

BLANK /BLANK SPIKE / BLANK SPIKE DUPLICATE RECOVERY STUDY

Sulfide by SM4500-S-F **Analytes**	**Blank Sample Result [A]**	**Spike Added [B]**	**Blank Spike Result [C]**	**Blank Spike %R [D]**	**Spike Added [E]**	**Blank Spike Duplicate Result [F]**	**Blk. Spk Dup. %R [G]**	**RPD %**	**Control Limits %R**	**Control Limits %RPD**	**Flag**
Sulfide, total	<1.00	10.0	10.0	100	10	10.0	100	0	75-120	20	

Relative Percent Difference RPD = 200*|(C-F)/(C+F)|
Blank Spike Recovery [D] = 100*(C)/[B]
Blank Spike Duplicate Recovery [G] = 100*(F)/[E]
All results are based on MDL and Validated for QC Purposes

Form 3 - MS Recoveries

Project Name: City of Hialeah

Work Order #: 337158

Project ID:

Lab Batch #: 764635

Date Analyzed: 07/07/2009 **Date Prepared:** 07/07/2009 **Analyst:** OLA

QC- Sample ID: 337158-006 S **Batch #:** 1 **Matrix:** Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Alkalinity by SM2320B Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Alkalinity, Bicarbonate (as CaCO3)	<8.68	20.0	<8.68	0	80-120	J
Alkalinity, Carbonate (as CaCO3)	<8.68	20.0	<8.68	0	80-120	J
Alkalinity, Total (as CaCO3)	132	50.0	180	96	80-120	

Lab Batch #: 764833

Date Analyzed: 07/07/2009 **Date Prepared:** 07/07/2009 **Analyst:** NIB

QC- Sample ID: 337134-001 S **Batch #:** 1 **Matrix:** Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Inorganic Anions by EPA 300 Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Fluoride	<1.85	20.0	18.0	90	90-110	
Chloride	171	100	261	90	90-110	
Nitrite as N	<2.00	100	91.3	91	90-110	
Nitrate as N	<1.35	40.0	43.3	108	90-110	
Ortho-Phosphate	<0.500	100	102	102	90-110	
Sulfate	292	100	387	95	90-110	

Lab Batch #: 764731

Date Analyzed: 07/08/2009 **Date Prepared:** 07/07/2009 **Analyst:** ARP

QC- Sample ID: 337158-006 S **Batch #:** 1 **Matrix:** Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Metals per ICP-MS by SW 6020A Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Barium	0.017	0.100	0.143	126	75-125	J
Calcium	141	5.00	140	0	75-125	J
Potassium	37.1	5.00	41.0	78	75-125	
Sodium	964	5.00	927	0	75-125	J
Strontium	12.4	0.100	11.8	0	75-125	J

Matrix Spike Percent Recovery [D] = 100*(C-A)/B
Relative Percent Difference [E] = 200*(C-A)/(C+B)
All Results are based on MDL and Validated for QC Purposes

BRL - Below Reporting Limit

Form 3 - MS Recoveries

Project Name: City of Hialeah

Work Order #: 337158

Lab Batch #: 764731

Project ID:

Date Analyzed: 07/08/2009

Date Prepared: 07/07/2009

Analyst: ARP

QC- Sample ID: 337191-001 S

Batch #: 1

Matrix: Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Metals per ICP-MS by SW 6020A Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Barium	0.229	0.100	0.339	110	75-125	
Calcium	38.5	5.00	42.4	78	75-125	
Potassium	4.85	5.00	9.80	99	75-125	
Sodium	65.2	5.00	67.3	42	75-125	J
Strontium	0.322	0.100	0.420	98	75-125	

Lab Batch #: 764669

Date Analyzed: 07/07/2009

Date Prepared: 07/07/2009

Analyst: SHH

QC- Sample ID: 337107-001 S

Batch #: 1

Matrix: Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Nitrogen Ammonia by EPA 350.1 Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Nitrogen, Ammonia (as N)	0.828	2.50	2.65	73	90-110	J

Lab Batch #: 764826

Date Analyzed: 07/08/2009

Date Prepared: 07/08/2009

Analyst: MSH

QC- Sample ID: 337158-006 S

Batch #: 1

Matrix: Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Phosphorus, Total (Automated) by EPA 365.4 Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Total Phosphorus (as P)	<0.100	1.60	1.61	101	80-120	

Lab Batch #: 764640

Date Analyzed: 07/07/2009

Date Prepared: 07/07/2009

Analyst: OLA

QC- Sample ID: 337158-006 S

Batch #: 1

Matrix: Water

Reporting Units: mg/L

MATRIX / MATRIX SPIKE RECOVERY STUDY

Sulfide by SM4500-S-F Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	%R [D]	Control Limits %R	Flag
Sulfide, total	2.40	5.00	6.41	80	75-120	

Matrix Spike Percent Recovery [D] = 100*(C-A)/B
Relative Percent Difference [E] = 200*(C-A)/(C+B)
All Results are based on MDL and Validated for QC Purposes

BRL - Below Reporting Limit

Form 3 - MS / MSD Recoveries

Project Name: City of Hialeah

Work Order # : 337158 **Project ID:**

Lab Batch ID: 764878 **QC- Sample ID:** 337158-006 S **Batch #:** 1 **Matrix:** Water
Date Analyzed: 07/09/2009 **Date Prepared:** 07/09/2009 **Analyst:** MAB
Reporting Units: mg/L

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY STUDY

DOC by SM5310 Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	Spiked Sample %R [D]	Spike Added [E]	Duplicate Spiked Sample Result [F]	Spiked Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Dissolved Organic Carbon	2.47	5.00	6.55	82	5.00	6.74	85	3	80-120	20	

Lab Batch ID: 764783 **QC- Sample ID:** 336994-001 S **Batch #:** 1 **Matrix:** Water
Date Analyzed: 07/08/2009 **Date Prepared:** 07/07/2009 **Analyst:** 4150
Reporting Units: mg/L

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY STUDY

Metals, Total by SW846 6010B Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	Spiked Sample %R [D]	Spike Added [E]	Duplicate Spiked Sample Result [F]	Spiked Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Iron	0.223	9.00	9.49	103	9.00	9.44	102	1	75-125	20	
Manganese	0.006	1.00	1.00	99	1.00	0.997	99	0	75-125	20	

Lab Batch ID: 764872 **QC- Sample ID:** 336507-025 S **Batch #:** 1 **Matrix:** Water
Date Analyzed: 07/08/2009 **Date Prepared:** 07/08/2009 **Analyst:** MAB
Reporting Units: mg/L

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY STUDY

TOC by SM 5310C Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	Spiked Sample %R [D]	Spike Added [E]	Duplicate Spiked Sample Result [F]	Spiked Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Total Organic Carbon	8.14	5.00	13.2	101	5.00	12.7	91	4	90-110	20	

Matrix Spike Percent Recovery [D] = 100*(C-A)/B Matrix Spike Duplicate Percent Recovery [G] = 100*(F-A)/E
Relative Percent Difference RPD = 200*|(C-F)/(C+F)|

ND = Not Detected, J = Present Below Reporting Limit, B = Present in Blank, NR = Not Requested, I = Interference, NA = Not ApplicableN = See Narrative, EQL = Estimated Quantitation Limit

Sample Duplicate Recovery

Project Name: City of Hialeah

Work Order #: 337158

Lab Batch #: 764635 **Project ID:**
Date Analyzed: 07/07/2009 **Date Prepared:** 07/07/2009 **Analyst:** OLA
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

SAMPLE / SAMPLE DUPLICATE RECOVERY

Alkalinity by SM2320B Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Alkalinity, Total (as CaCO3)	132	132	0	20	

Lab Batch #: 764534
Date Analyzed: 07/06/2009 **Date Prepared:** 07/06/2009 **Analyst:** MSH
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: CU

SAMPLE / SAMPLE DUPLICATE RECOVERY

Color by SM2120B Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Color	10	10	0	20	

Lab Batch #: 764878
Date Analyzed: 07/09/2009 **Date Prepared:** 07/09/2009 **Analyst:** MAB
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

SAMPLE / SAMPLE DUPLICATE RECOVERY

DOC by SM5310 Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Dissolved Organic Carbon	2.47	2.27	8	20	

Lab Batch #: 764731
Date Analyzed: 07/08/2009 **Date Prepared:** 07/07/2009 **Analyst:** ARP
QC- Sample ID: 337191-001 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

SAMPLE / SAMPLE DUPLICATE RECOVERY

Metals per ICP-MS by SW 6020A Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Barium	0.229	0.226	1	25	
Calcium	38.5	37.4	3	25	
Potassium	4.85	4.78	1	25	
Sodium	65.2	63.3	3	25	
Strontium	0.322	0.316	2	25	

Spike Relative Difference RPD 200 * | (B-A)/(B+A) |
All Results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

Sample Duplicate Recovery

Project Name: City of Hialeah

Work Order #: 337158

Lab Batch #: 764783
Project ID:
Date Analyzed: 07/08/2009 **Date Prepared:** 07/07/2009 **Analyst:** 4150
QC- Sample ID: 336994-001 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Metals, Total by SW846 6010B **Analyte**	**Parent Sample Result [A]**	**Sample Duplicate Result [B]**	**RPD**	**Control Limits %RPD**	**Flag**
Iron	0.223	0.227	2	20	
Manganese	0.006	0.006	0	20	

Lab Batch #: 764582
Date Analyzed: 07/07/2009 **Date Prepared:** 07/07/2009 **Analyst:** MSH
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: uS/cm

	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Specific Conductance by EPA 120.1 **Analyte**	**Parent Sample Result [A]**	**Sample Duplicate Result [B]**	**RPD**	**Control Limits %RPD**	**Flag**
Conductivity	5670	5690	0	20	

Lab Batch #: 764640
Date Analyzed: 07/07/2009 **Date Prepared:** 07/07/2009 **Analyst:** OLA
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Sulfide by SM4500-S-F **Analyte**	**Parent Sample Result [A]**	**Sample Duplicate Result [B]**	**RPD**	**Control Limits %RPD**	**Flag**
Sulfide, total	2.40	2.40	0	20	

Lab Batch #: 764766
Date Analyzed: 07/07/2009 **Date Prepared:** 07/07/2009 **Analyst:** YAD
QC- Sample ID: 337134-010 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

	SAMPLE / SAMPLE DUPLICATE RECOVERY				
TDS by SM2540C **Analyte**	**Parent Sample Result [A]**	**Sample Duplicate Result [B]**	**RPD**	**Control Limits %RPD**	**Flag**
Total dissolved solids	384	408	6	30	

Spike Relative Difference RPD 200 * | (B-A)/(B+A) |
All Results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

Sample Duplicate Recovery

Project Name: City of Hialeah

Work Order #: 337158

Lab Batch #: 764872 **Project ID:**
Date Analyzed: 07/08/2009 **Date Prepared:** 07/08/2009 **Analyst:** MAB
QC- Sample ID: 336507-025 D **Batch #:** 1 **Matrix:** Water
Reporting Units: mg/L

TOC by SM 5310C Analyte	SAMPLE / SAMPLE DUPLICATE RECOVERY				
	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Total Organic Carbon	8.14	8.33	2	20	

Lab Batch #: 764535
Date Analyzed: 07/06/2009 **Date Prepared:** 07/06/2009 **Analyst:** MSH
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: NTU

Turbidity by EPA 180.1 Analyte	SAMPLE / SAMPLE DUPLICATE RECOVERY				
	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Turbidity	1.21	1.25	3	20	

Lab Batch #: 764568
Date Analyzed: 07/06/2009 **Date Prepared:** 07/06/2009 **Analyst:** MSH
QC- Sample ID: 337158-006 D **Batch #:** 1 **Matrix:** Water
Reporting Units: SU

pH by SM4500-H Analyte	SAMPLE / SAMPLE DUPLICATE RECOVERY				
	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
pH	7.61	7.65	1	20	

Spike Relative Difference RPD 200 * | (B-A)/(B+A) |
All Results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

XENCO
Florida Testing Services LLC

☑ 10200 USA Today Way, Miramar, FL 33025 954-431-4550
☐ 2505 Falkenburg Rd, Tampa, Fl 33569 813-620-2000
☐ 6017 Financial Drive, Norcross, Georgia 30071 770-449-8800
☐ Philadelphia/New Jersey 610-955-5649
☐ South Carolina 803-543-8099 ☐ Other

ANALYSIS REQUEST & CHAIN OF CUSTODY RECORD

Serial #: 251825 Page 1 of 3

Company-City Schlumberger (Ft. Myers) **Phone** 239-206-0814

Lab Only: 337158

Proj Name-Location ☐ Previously done at XENCO **Project ID**
City of Hialeah

TAT: ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d Standard TAT is project specific.
It is typically 5-7 Working Days for level II and 10+ Working days for level III and IV data.

Proj State: AL, [✓ FL], GA, LA, MS, NC, NJ, PA, SC, TN, TX, UT Other

Proj. Manager (PM) Scott Manahan

e-Mail Results to ☑ PM or **Fax No:**
SMANAHAN@SLB.COM

Invoice to ☐ Accounting ☐ Inc. Invoice with Final Report ☐ Invoice must have a P.O
Bill to:

Quote/Pricing: **P.O No:** ☐ Call for P.O.

Reg Program: UST DRY-CLEAN Land-Fill Waste-Disp NPDES DW GA HSRA
QAPP Per-Contract CLP AFCEE NAVY DOE DOD USACE OTHER:

Special DLs (GW DW QAPP MDLs RLs See Lab PM Included Call PM)

Sampler Name Signature

	Sample ID	Sampling Date	Time	Depth ft' In" m	Matrix	Composite	Grab	# Containers	Container Size	Container Type	Preservatives	VOCs Full-List BTEX-MTBE EtOH Oxyg VOHs VOAs	VOCs PP TCL DW Appdx-1 Appdx-2 CALL Other:	PAHs	FL PRO DRO GRO MA EPH MA VPH	SVOCs: Full-List DW BN&AE TCL PP Appdx-2 CALL	OC Pesticides PCBs Herbicides OP Pesticides	Metals: RCRA-8 RCRA-4 Pb 13PP 23TAL Appdx 1 Appdx 2	SPLP - TCLP (Metals VOCs SVOCs Pest. Herb. PCBs)	EDB / DBCP	Chlorides	Hardness	
1	TP-1 23hrs	07/01	1900		W		✓	1	V	P	ice										1		1
2	TP-1 23hrs	07/01	1900		W		✓	1	V	P	HNO3											1	2
3	TP-1 42hrs	07/02	1400		W		✓	1	V	P	ice										1		3
4	TP-1 42hrs	07/02	1400		W		✓	1	V	P	HNO3											1	4
WM 5	TP-1	07/03/09	1:45pm		W		✓	1	V	P	ice										1		5
6	TP-1	07/03/09	1:45pm		W		✓	1	V	P	HNO3											1	6
WM 7	TP-1	07/04/09	11:45Am		W		✓	1	✓	P	ice										1		7
8	TP-1	07/04/09	11:45Am		W		✓	1	✓	P	HNO3											1	8
9	TP-1Z	07/05	1400		W		✓	1	V	P	ice										1		9
10	PP-1Z	07/05	1400		W		✓	1	V	P	HNO3											1	10

Remarks

TAT ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d
Addn: PAH above mg/L W, mg/Kg S Highest Hit
Hold Samples (Surcharges will apply and are pre-approved)
Sample Clean-ups are pre-approved as needed
Addn: Date Rcv by: From:

	Relinquished by (Initials and Sign)	Date & Time		Relinquished to (Initials and Sign)	Date & Time
1	1)	07/06 1115	2)		7/6/09 1115
2	3)		4)		
3	5)		6)		

Total Containers per COC: Cooler Temp:

Upon signings this COC you accept XENCO terms and Conditions unless otherwise agreed on writing. Reports are the Intellectual Property of XENCO until paid. Samples will be held 30 days after final report is e-mailed unless hereby requested. Rush Charges and Collection Fees are pre-approved.

Preservatives: Various (**V**), HCl pH<2 (**H**), H2SO4 pH<2 (**S**), HNO3 pH<2 (**N**), Asbc Acid&NaOH (**A**), ZnAc&NaOH (**Z**), (Cool,<4C) (**C**), None (**NA**), See Label (**L**), Other (**O**)

Cont. Size: 4oz (**4**), 8oz (**8**), 32oz (**32**), 40ml VOA (**40**), 1L (**1**), 500ml (**5**), Tedlar Bag (**B**), Various (V), Other 250 **Cont. Type:** Glass Amb (**A**), Glass Clear (**C**), Plastic (**P**), Various (**V**)

Matrix: Air (**A**), Product (**P**), Solid(**S**), Water (**W**), Liquid (**L**)

Committed to Excellence in Service and Quality *www.xenco.com*

Notice: Signature of this document and relinquishment of these samples constitutes a valid purchase order from client company to Xenco Laboratories and its affiliates, subcontractors and assigns under Xenco's standard terms and conditions of service unless previoiusly negotiated under a fully executed client contract.

XENCO
Florida Testing Services, LLC

☑ 10200 USA Today Way, Miramar, FL 33025 954-431-4550
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☐ 6017 Financial Drive, Norcross, Georgia 30071 770-449-8800
☐ Philadelphia/New Jersey 610-955-5649
☐ South Carolina 803-543-8099 ☐ Other

ANALYSIS REQUEST & CHAIN OF CUSTODY RECORD

Serial #: 251826 Page 2 of 3

Company-City Schlumberger (Ft. Myers) **Phone** 239-206-0814

Lab Only: 337158

Proj Name-Location ☐ Previously done at XENCO **Project ID**
City of Aaleen

TAT: ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d Standard TAT is project specific.
It is typically 5-7 Working Days for level II and 10+ Working days for level III and IV data.

Proj State: AL, [✓ FL], GA, LA, MS, NC, NJ, PA, SC, TN, TX, UT Other

Proj. Manager (PM) Scott Manahan

e-Mail Results to ☑ PM or **Fax No:**
smanahan@slb.com

Invoice to ☐ Accounting ☐ Inc. Invoice with Final Report ☐ Invoice must have a P.O
Bill to:

Quote/Pricing: **P.O No:** ☐ Call for P.O.

Reg Program: UST DRY-CLEAN Land-Fill Waste-Disp NPDES DW GA HSRA
QAPP Per-Contract CLP AFCEE NAVY DOE DOD USACE OTHER:

Special DLs (GW DW QAPP MDLs RLs See Lab PM Included Call PM)

Sampler Name Signature

	Sample ID	Sampling Date	Time	Depth ft' In" m	Matrix	Composite	Grab	# Containers	Container Size	Container Type	Preservatives	VOCs Full-List BTEX-MTBE EtOH Oxyg VOHs VOAs	VOCs PP TCL DW Appdx-1 Appdx-2 CALL Other:	PAHs	FL PRO DRO GRO MA EPH MA VPH	SVOCs: Full-List DW BN&AE TCL PP Appdx-2 CALL	OC Pesticides PCBs Herbicides OP Pesticides	Metals: RCRA-8 RCRA-4 Pb 13PP 23TAL Appdx 1 Appdx 2	SPLP - TCLP (Metals VOCs SVOCs Pest. Herb. PCBs)	EDB / DBCP	Sulfide	Hardness	Ammonia, TP	Chloride, Color, DOC, Fe, H2S, Turdity, SO4, TDS	Manganese	Fe			?
1	TP-1Z	07/05	1400		W		X	1	250	P	Na OH										1								
2	TP-1Z	07/05	1400		W		X	1	250	P	HNO3											1							
3	TP-1Z	07/05	1400		W		X	1	250	P	H2 SO4												1						
4	TP-1Z	07/05	1400		W		X	1	1	P	None													1					
5	TP-1Z	07/05	1400		W		X	1	1	P	HNO3																		1
6	TP-1Z	07/05	1400		W		X	1	V	P	HNO3																		1
7	TP-1Z	07/05	1400		W		X	1	V	P	HNO3														1				
8	TP-1Z	07/05	1400		W		X	1	V	P	HNO3															1			
9																													
10																													

TAT ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d
Addn: PAH above mg/L W, mg/Kg S Highest Hit
Hold Samples (Surcharges will apply and are pre-approved)
Sample Clean-ups are pre-approved as needed

Remarks

Addn: Date Rcv by: From:

Relinquished by (Initials and Sign)	Date & Time	Relinquished to (Initials and Sign)	Date & Time
1)	07/06 1115	2)	7/6/09 1115
3)		4)	
5)		6)	

Total Containers per COC: Cooler Temp:

Upon signings this COC you accept XENCO terms and Conditions unless otherwise agreed on writing. Reports are the Intellectual Property of XENCO until paid. Samples will be held 30 days after final report is e-mailed unless hereby requested. Rush Charges and Collection Fees are pre-approved.

Preservatives: Various (**V**), HCl pH<2 (**H**), H2SO4 pH<2 (**S**), HNO3 pH<2 (**N**), Asbc Acid&NaOH (**A**), ZnAc&NaOH (**Z**), (Cool,<4C) (**C**), None (**NA**), See Label (**L**), Other (**O**) ________

Cont. Size: 4oz (**4**), 8oz (**8**), 32oz (**32**), 40ml VOA (**40**), 1L (**1**), 500ml (**5**), Tedlar Bag (**B**), Various (V), Other ________ **Cont. Type**: Glass Amb (**A**), Glass Clear (**C**), Plastic (**P**), Various (**V**)

Matrix: Air (**A**), Product (**P**), Solid(**S**), Water (**W**), Liquid (**L**)

Committed to Excellence in Service and Quality *www.xenco.com*

Notice: Signature of this document and relinquishment of these samples constitutes a valid purchase order from client company to Xenco Laboratories and its affiliates, subcontractors and assigns under Xenco's standard terms and conditions of service unless previoiusly negotiated under a fully executed client contract.

XENCO
Florida Testing Services, LLC

☑ 10200 USA Today Way, Miramar, FL 33025 954-431-4550
☐ 2505 Falkenburg Rd, Tampa, Fl 33569 813-620-2000
☐ 6017 Financial Drive, Norcross, Georgia 30071 770-449-8800
☐ Philadephia/New Jersey 610-955-5649
☐ South Carolina 803-543-8099 ☐ Other

ANALYSIS REQUEST & CHAIN OF CUSTODY RECORD

Serial #: 251827 Page 3 of 3

Company-City Schlumberger (Ft. Myers) **Phone** 239-206-0814

Lab Only: 337158

Proj Name-Location ☐ Previously done at XENCO **Project ID**
City of Hialeah

TAT: ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d Standard TAT is project specific. It is typically 5-7 Working Days for level II and 10+ Working days for level III and IV data.

Proj State: AL, [✓ FL], GA, LA, MS, NC, NJ, PA, SC, TN, TX, UT Other

Proj. Manager (PM) Scott Manahan

e-Mail Results to ☑ PM or
sManahan@slb.com **Fax No:**

Invoice to ☐ Accounting ☐ Inc. Invoice with Final Report ☐ Invoice must have a P.O
Bill to:

Quote/Pricing: **P.O No:** ☐ Call for P.O.

Reg Program: UST DRY-CLEAN Land-Fill Waste-Disp NPDES DW GA HSRA

QAPP Per-Contract CLP AFCEE NAVY DOE DOD USACE OTHER:

Special DLs (GW DW QAPP MDLs RLs See Lab PM Included Call PM)

Sampler Name Signature

	Sample ID	Sampling Date	Time	Depth ft' In" m	Matrix	Composite	Grab	# Containers	Container Size	Container Type	Preservatives	**VOCs** Full-List BTEX-MTBE EtOH Oxyg VOHs VOAs	VOCs PP TCL DW Appdx-1 Appdx-2 CALL Other:	PAHs	FL PRO DRO GRO MA EPH MA VPH	SVOCs: Full-List DW BN&AE TCL PP Appdx-2 CALL	OC Pesticides PCBs Herbicides OP Pesticides	Metals: RCRA-8 RCRA-4 Pb 13PP 23TAL Appdx 1 Appdx 2	SPLP - TCLP (Metals VOCs SVOCs Pest. Herb. PCBs)	EDB / DBCP	N	Nitrate, Nitrite, OP, Alkalinity, Bicarbonate, Carbonate	TOC	
1	TP-12	07/05	1400		W		x	1	1	P	None										1			1
2	TP-12	07/05	1400		W		x	1	1	P	None											1		2
3	TP-12	07/05	1400		W		x	1	125	P	H2SO4												1	3
4	TP-12	07/05	1400		W		x	1	125	P	None													4
5																								5
6																								6
7																								7
8																								8
9																								9
10																								10

TAT ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d
Addn: PAH above mg/L W, mg/Kg S Highest Hit
Hold Samples (Surcharges will apply and are pre-approved)
Sample Clean-ups are pre-approved as needed

Remarks

Addn: Date Rcv by: From:

	Relinquished by (Initials and Sign)	Date & Time	Relinquished to (Initials and Sign)	Date & Time
1	1)	07/06 1115	2)	7/6/09 1115
2	3)		4)	
3	5)		6)	

Total Containers per COC: Cooler Temp:

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Cont. Size: 4oz (**4**), 8oz (**8**), 32oz (**32**), 40ml VOA (**40**), 1L (**1**), 500ml (**5**), Tedlar Bag (**B**), Various (V), Other ____________ **Cont. Type:** Glass Amb (**A**), Glass Clear (**C**), Plastic (**P**), Various (**V**)

Matrix: Air (**A**), Product (**P**), Solid(**S**), Water (**W**), Liquid (**L**)

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Prelogin / Nonconformance Report
Sample Log-In

Client: Schlumberger

Date / Time: 7.6.9 11:15

Lab ID#: 337158

Initials: UWE

Sample Receipt Checklist

#1 Temperature of cooler?				4.0 °C
#2 Shipping container in good condition?	[✓ Yes]	No	None	
#3 Samples received on ice?	[✓ Yes]	No	N/A	Blue/Water
#4 Custody Seals intact on sample container/cooler?	Yes	[✓ No]	N/A	
#5 Custody Seasls intact on sample bottles/containers	Yes	[✓ No]	N/A	
#6 Chain of Custody present?	[✓ Yes]	No		
#7 Sample instructions complete of Chain of Custody?	[✓ Yes]	No		
#8 Any missing/extra samples?	Yes	[✓ No]		
#9 Chain of custody signed when relinquished/ received?	[✓ Yes]	No		
#10 Chain of Cusody agrees with sample label(s)?	[✓ Yes]	No		
#11 Container label(s) legible and intact?	[✓ Yes]	No		
#12 Sample matrix/ properties agree with Chain of Cusotdy?	[✓ Yes]	No		
#13 Sample in proper conatiner/bottle?	[✓ Yes]	No		
#14 Samples properly preserved?	[✓ Yes]	No	N/A	
#15 Sample container(s) intact?	[✓ Yes]	No		
#16 Sufficient sample amount for indicated test (s)?	[✓ Yes]	No		
#17 All samples received within sufficient hold time?	[✓ Yes]	No		
#18 Subcontract of sample(s)?	Yes	[✓ No]		
#19 VOC samples have zero headspace?	Yes	[✓ No]	N/A	

Nonconformance Documentation

Contact: ______ Contacted by: ______ Date/Time: ______

Regarding:

Corrective Action Taken:

Check all that Apply: ☐ Client understands and would like to proceed with analysis

☐ Cooling process had begun shortly after sampling event

XENCO LABORATORIES
Container Receipt Verification Form

Work Order Number: 337158

Chain of Custody Number(s): 1

Container Type/ Pres.	Tests	1	2	3	4	5	6	7	8	9	10
gal amb/											
32 amb/											
32 amb/											
32 amb/											
32 WM amb/											
40mL/											
40mL/											
40mL/											
40ml/											
250mL/ UP	chloride	1	1	1	1	1					
4 PE/ UP	silica						1				
8 PE/ HNO3	metals						3				
8 PE/ HNO3	Hardness	1	1	1	1	1	1				
16 PE/											
16 PE/ HNO3	UU-254						1				
16 PE/ UP							2				
32 PE/											
32 PE/											
8 WM/											
8 WM/											
8 WM/											
4 WM/											
4 WM/											
2 WM/											
2 WM/											
Tedlar Bag											
Ampules/											
Other/											

Comments

Abbreviations:

Gal amb = One gallon amber
32 amb = 32 oz Amber
40mL = 40mL vials
32 WM amb = Wide Mouth Amber

32 PE = 32oz Plastic Bottle
16 PE = 16 oz Plastic Bottle
8 PE = 8oz Plastic Bottle

8 WM = 8oz Wide Mouth Jar
4 WM = 4oz Wide Mouth Jar
2 WM = 2oz Wide Mouth Jar

100mL = 100mL Sterile Container
Zip = Ziplock Bag
4 PE = 4oz Plastic Bottle

HCl = Hydrochloric Acid
H2SO4 = Sulfuric Acid
NaOH = Sodium Hydroxide
MeOH = Methanol
HNO3 = Nitric Acid
ZnAC = Zinc Acetate
Na2S2O3 = Sodium Thiosulfate

NH4Cl2 = Ammonium Chloride
DI H2O = DI Water
MCAA = Monochloroacetic Acid

Reviewed By: ______________

Reverse Osmosis Parameters						
Analyte	**Analytical Method**	**Analytical Equipment**	**Container**	**Volume (mL)**	**Preservative**	**Maximum Holding Time**
Ammonia	350.1	Contract Laboratory	P	250	Ice/H_2SO_4	28 d
Barium	200.7/200.8/6010/6020	Contract Laboratory	P	250	Ice/HNO_3	180 d
Bicarbonate	310	Contract Laboratory	P	250	Ice	7 d
Calcium		Contract Laboratory				
Carbonate	310	Contract Laboratory	P	250	Ice	7 d
Chloride	300	Contract Laboratory	P	250	Ice	28 d
Color	110.2	Contract Laboratory	P	250	Ice	48 hrs
Dissolved Organic Carbon HOU		Contract Laboratory				
Field Conductivity	120.1	Contract Laboratory	P	250	Ice	7 d
Field pH } Lab	150.2	Contract Laboratory	P	250	Ice	Immediate
Field Temperature		Contract Laboratory				
Fluoride	300	Contract Laboratory	P	250	Ice	28 d
Hydrogen Sulfide		Contract Laboratory				
Iron > ATC	200.7/200.8/6010/6020	Contract Laboratory	P	250	Ice/HNO_3	180 d
Manganese	200.7/200.8/6010/6020	Contract Laboratory	P	250	Ice/HNO_3	180 d
Nitrate/Nitrite	300	Contract Laboratory	P	250	Ice	48 hrs
Orthophosphate	300	Contract Laboratory	P	250	Ice/H_2SO_4	48 hrs
Potassium	200.7/200.8/6010/6020	Contract Laboratory	P	250	Ice/HNO_3	180 d
Silica FGS		Contract Laboratory				
Sodium	200.7/200.8/6010/6020	Contract Laboratory	P	250	Ice/HNO_3	180 d
Strontium	200.7/200.8/6010/6020	Contract Laboratory	P	250	Ice/HNO_3	180 d
Sulfate	300	Contract Laboratory	P	250	Ice	28 d
Total Alkalinity		Contract Laboratory				
Total Dissolved Solids	160.1	Contract Laboratory	P	500	Ice	7 d
Total Hardness	130.2	Contract Laboratory	P	250	Ice	180 d
Total Organic Carbon HOU	415.1/9060	Contract Laboratory	GA	500	Ice/H_2SO_4	28 d
Total Phosphate		Contract Laboratory				
Total Sulphides						
Turbidity	180.1	Contract Laboratory	P	500	Ice	Immediate
UV-254 Microbac		Contract Laboratory				

Florida Spectrum
Environmental Services, Inc.

Report To:
Andrea Jennings
Diversified Drilling-Lehigh
5620 Lee Street
Lehigh Acres, FL 33971

Page 1 of 8
Report Printed: 07/23/09
Submission # 907000097
Order # 116139

Project: Primary & Secondary Testing
Site Location: Hialeah, FL
Matrix: Drinking Water

Sample I.D.: S/P
Collected: 07/05/09 13:00
Received: 07/05/09 14:30
Collected by: A.P./ L.G

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Coliform-Total (E-Coli)	A		--------			9223B	07/06 10:50	07/07 10:50	AMC
Specific Conductance (Field)(grab)	5560		uS/cm	0.2	0.6	120.1	07/05 13:00	07/05 13:00	AP/LG
pH (field)	6.70		units	0.1	0.3	150.1	07/05 13:00	07/05 13:00	AP/LG
Temperature (Field)	22.1		Degree C	1	3	170.1	07/05 13:00	07/05 13:00	AP/LG
Turbidity (field)	1.4		NTU	0.1	0.3	180.1	07/05 13:00	07/05 13:00	AP/LG
Oxygen, Dissolved (Field)	7.9		mg/L	0.01	0.03	360.1	07/05 13:00	07/05 13:00	AP/LG
531.1 Carbamate Pesticides: 62-550.310(4)(b)				**Dilution Factor =1**					
Carbofuran	U	U	ug/L	0.45	1.35	531.1	07/13 18:28	07/13 18:28	RPV
Oxamyl (Vydate)	U	U	ug/L	0.41	1.23	531.1	07/13 18:28	07/13 18:28	RPV
Glyphosate	U	U	ug/L	3.55	10.65	547	07/07 13:56	07/07 13:56	RPV
549.2 Diquat: 62-550.310(4)(b)				**Dilution Factor =1**					
Diquat	U	U	ug/L	0.4	1.2	549.2	07/08 10:30	07/08 12:26	RPV
Total Dissolved Solids (TDS)	3416		mg/L	1.00	3.00	EPA 160.1	07/06 16:06	07/07 16:06	LYR
Chloride	1430		mg/L	15.50	46.50	300.0	07/06 16:32	07/06 16:32	IMA
Fluoride	1.11		mg/L	0.080	0.240	300.0	07/06 16:32	07/06 16:32	IMA
Nitrate (as N)	U	U	mg/L	0.010	0.030	300.0	07/06 16:32	07/06 16:32	IMA
Nitrate+Nitrite (as N)	U	U	mg/L	0.012	0.036	300.0	07/06 16:32	07/06 16:32	IMA
Nitrite (as N)	U	U	mg/L	0.012	0.036	300.0	07/06 16:32	07/06 16:32	IMA

Report To:
Andrea Jennings
Diversified Drilling-Lehigh
5620 Lee Street
Lehigh Acres, FL 33971

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Site Location: Hialeah, FL
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LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Ortho-Phosphate (as P)	0.42		mg/L	0.080	0.240	300.0	07/06 16:32	07/06 16:32	IMA
Sulfate	460		mg/L	2.00	6.00	300.0	07/06 16:32	07/06 16:32	IMA
Alkalinity, Total (CaCO3) Endpoint 4.3	122		mg/L	0.1	0.3	310.1	07/08 10:38	07/08 10:38	DGK
Bicarbonate	122		mg/L	0.01	0.03	310.1	07/08 10:38	07/08 10:38	DGK
Carbonate	0.16		mg/L	0.01	0.03	310.1	07/08 10:38	07/08 10:38	DGK
Nitrogen (Ammonium, NH4+)	0.41		mg/L	0.02	0.06	350.CALC	07/15 14:41	07/15 14:41	RPV
Sulfide	3.61		mg/L	0.050	0.150	376.2	07/07 15:47	07/07 15:47	IMA
Color/pH (Lab)	U	U	Pt-Co	1.0	3.0	SM2120B	07/06 12:52	07/06 12:52	IMA
Odor (Lab) at 40 Degrees C	8		TON	1.0	3.0	SM2150B	07/06 12:53	07/06 12:53	IMA
Cyanide, Total	0.0043	I	mg/L	0.002	0.006	SM4500CN-E	07/07 09:40	07/07 12:31	MSG
Silica	10.8		mg/L	0.22	0.66	SM4500-SiO2	07/09 11:55	07/09 11:55	LYR
Organic Carbon, Dissolved	1.5		mg/L	0.302	0.906	SM5310C	07/09 10:02	07/09 10:02	MSG
Organic Carbon, Total	2.0		mg/L	0.302	0.906	SM5310C	07/09 10:02	07/09 10:02	MSG
MBAS Surfactants	0.12		mg/L	0.033	0.099	SM5540C	07/07 09:00	07/07 09:00	LR
Hardness, Total	792		mg/L	0.50	1.50	200.7	07/06	07/06 16:04	IMN
Aluminum	0.021		mg/L	0.0069	0.0207	200.7	07/06	07/06 14:19	IMN
Calcium	94.4		mg/L	0.0091	0.0273	200.7	07/06	07/06 14:18	IMN
Copper	U	U	mg/L	0.0001	0.0003	200.7	07/06	07/06 14:18	IMN

Report To:
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5620 Lee Street
Lehigh Acres, FL 33971

Report Printed: 07/23/09
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Order # 116139

Sample I.D.: S/P
Collected: 07/05/09 13:00
Received: 07/05/09 14:30
Collected by: A.P./ L.G

Project: Primary & Secondary Testing
Site Location: Hialeah, FL
Matrix: Drinking Water

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Iron	0.023		mg/L	0.0007	0.0021	200.7	07/06	07/06 14:18	IMN
Magnesium	135		mg/L	0.3100	0.9300	200.7	07/06	07/06 16:04	IMN
Manganese	U	U	mg/L	0.00006	0.00018	200.7	07/06	07/06 14:18	IMN
Potassium	59.5		mg/L	0.0012	0.0036	200.7	07/06	07/06 14:18	IMN
Silver	U	U	mg/L	0.0001	0.0003	200.7	07/06	07/06 14:18	IMN
Sodium	958		mg/L	0.110	0.330	200.7	07/06	07/06 16:00	IMN
Strontium	11.3		mg/L	0.00030	0.00090	200.7	07/06	07/06 14:18	IMN
Zinc	0.002	I	mg/L	0.00099	0.00297	200.7	07/06	07/06 14:18	IMN
200.8 DW-10 Metals in Drinking Water 62-550.310				**Dilution Factor =1**					
Arsenic	0.0015		mg/L	0.0002	0.0006	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Barium	0.0100		mg/L	0.00004	0.00012	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Cadmium	U	U	mg/L	0.00008	0.00024	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Chromium	0.0021		mg/L	0.0001	0.0003	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Lead	U	U	mg/L	0.00006	0.00018	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Nickel	U	U	mg/L	0.0002	0.0006	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Selenium	U	U	mg/L	0.0009	0.0027	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Antimony	U	U	mg/L	0.0002	0.0006	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Beryllium	U	U	mg/L	0.00003	0.00009	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN

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Collected by: A.P./ L.G

LABORATORY ANALYSIS REPORT

PARAMETER	**RESULT**	**QC**	**UNITS**	**MDL**	**PQL**	**METHOD**	**DATE EXT.**	**DATE ANALY.**	**ANALYST**
Thallium	U	U	mg/L	0.00000	0.00001	4.1.3/200.8	07/06 09:00	07/06 15:37	IMN
Mercury	U	U	mg/L	0.0001	0.0003	245.1	07/10	07/10 12:02	EN
Ultraviolet Absorption Method	0.070		1/cm	0.009	0.027	5910.B	07/06	07/06 11:45	EN
504.1 EDB, DBCP: 62-550.310(4)(b)				**Dilution Factor =1**					
1,2-Dibromo-3-Chloropropane (DBCP)	U	U	ug/L	0.004	0.012	EPA 504.1 ECD	07/0910:52	07/09 19:14	DS
Ethylene Dibromide (EDB)	U	U	ug/L	0.007	0.021	EPA 504.1 ECD	07/0910:52	07/09 19:14	DS
508 Pesticides & PCBs: 62-550.310(4)(b)				**Dilution Factor =1**					
Hexachlorocyclopentadiene	U	U	ug/L	0.015	0.045	508	07/07 15:42	07/09 03:15	DS
Hexachlorobenzene	U	U	ug/L	0.006	0.018	508	07/07 15:42	07/09 03:15	DS
v-BHC (Lindane)	U	U	ug/L	0.005	0.015	508	07/07 15:42	07/09 03:15	DS
Heptachlor	U	U	ug/L	0.002	0.006	508	07/07 15:42	07/09 03:15	DS
Heptachlor Epoxide	U	U	ug/L	0.002	0.006	508	07/07 15:42	07/09 03:15	DS
Endrin	U	U	ug/L	0.005	0.015	508	07/07 15:42	07/09 03:15	DS
Methoxychlor	U	U	ug/L	0.005	0.015	508	07/07 15:42	07/09 03:15	DS
Arochlor 1016	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS
Arochlor 1221	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS
Arochlor 1232	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS
Arochlor 1242	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS

Report To:
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5620 Lee Street
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Report Printed: 07/23/09
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Site Location: Hialeah, FL
Matrix: Drinking Water

Sample I.D.: S/P
Collected: 07/05/09 13:00
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Collected by: A.P./ L.G

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Arochlor 1248	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS
Arochlor 1254	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS
Arochlor 1260	U	U	ug/L	0.1	0.3	508	07/07 15:42	07/09 03:15	DS
Toxaphene	U	U	ug/L	0.21	0.63	508	07/07 15:42	07/09 03:15	DS
Chlordane	U	U	ug/L	0.03	0.09	508	07/07 15:42	07/09 03:15	DS
515.3 Chlorophenoxy Herbicides 62-550 (Reg)				**Dilution Factor =1**					
Dalapon	U	U	ug/L	0.50	1.50	515.3	07/11 11:53	07/15 11:53	AC
2,4-D	U	U	ug/L	0.09	0.27	515.3	07/11 11:53	07/15 11:53	AC
Pentachlorophenol	U	U	ug/L	0.020	0.060	515.3	07/11 11:53	07/15 11:53	AC
2,4,5-TP (silvex)	U	U	ug/L	0.14	0.42	515.3	07/11 11:53	07/15 11:53	AC
Dinoseb	U	U	ug/L	0.2	0.6	515.3	07/11 11:53	07/15 11:53	AC
Picloram	U	U	ug/L	0.09	0.27	515.3	07/11 11:53	07/15 11:53	AC
524.2 Trihalomethanes: 62-550.310(3) THMs				**Dilution Factor =1**					
Bromodichloromethane	U	U	ug/L	0.08	0.24	524.2	07/06 22:48	07/06 22:48	MMD
Dibromochloromethane	U	U	ug/L	0.06	0.18	524.2	07/06 22:48	07/06 22:48	MMD
Tribromomethane (Bromoform)	U	U	ug/L	0.08	0.24	524.2	07/06 22:48	07/06 22:48	MMD
Trichloromethane (Chloroform)	U	U	ug/L	0.07	0.21	524.2	07/06 22:48	07/06 22:48	MMD
TOTAL Trihalomethanes	U		ug/L			524.2	07/06 22:48	07/06 22:48	MMD

Report To:
Andrea Jennings
Diversified Drilling-Lehigh
5620 Lee Street
Lehigh Acres, FL 33971

Report Printed: 07/23/09
Submission # 907000097
Order # 116139

Project: Primary & Secondary Testing
Site Location: Hialeah, FL
Matrix: Drinking Water

Sample I.D.: S/P
Collected: 07/05/09 13:00
Received: 07/05/09 14:30
Collected by: A.P./ L.G

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
524.2 Volatile Organics: 62-550.310(4)(a)				**Dilution Factor =1**					
Vinyl Chloride	U	U	ug/L	0.08	0.24	524.2	07/06 22:48	07/06 22:48	MMD
1,1-Dichloroethylene	U	U	ug/L	0.06	0.18	524.2	07/06 22:48	07/06 22:48	MMD
Dichloromethane (Methylene Chloride)	U	U	ug/L	0.14	0.42	524.2	07/06 22:48	07/06 22:48	MMD
Trans-1,2-Dichloroethylene	U	U	ug/L	0.09	0.27	524.2	07/06 22:48	07/06 22:48	MMD
Cis-1,2-Dichloroethylene	U	U	ug/L	0.12	0.36	524.2	07/06 22:48	07/06 22:48	MMD
1,1,1-Trichloroethane	U	U	ug/L	0.10	0.30	524.2	07/06 22:48	07/06 22:48	MMD
Carbon Tetrachloride	U	U	ug/L	0.10	0.30	524.2	07/06 22:48	07/06 22:48	MMD
Benzene	U	U	ug/L	0.06	0.18	524.2	07/06 22:48	07/06 22:48	MMD
1,2-Dichloroethane	U	U	ug/L	0.12	0.36	524.2	07/06 22:48	07/06 22:48	MMD
Trichloroethylene	U	U	ug/L	0.18	0.54	524.2	07/06 22:48	07/06 22:48	MMD
1,2-Dichloropropane	U	U	ug/L	0.06	0.18	524.2	07/06 22:48	07/06 22:48	MMD
Toluene	U	U	ug/L	0.06	0.18	524.2	07/06 22:48	07/06 22:48	MMD
1,1,2-Trichloroethane	U	U	ug/L	0.13	0.39	524.2	07/06 22:48	07/06 22:48	MMD
Tetrachloroethylene	U	U	ug/L	0.14	0.42	524.2	07/06 22:48	07/06 22:48	MMD
Chlorobenzene	U	U	ug/L	0.06	0.18	524.2	07/06 22:48	07/06 22:48	MMD
Ethylbenzene	U	U	ug/L	0.07	0.21	524.2	07/06 22:48	07/06 22:48	MMD
Xylenes (Total)	U	U	ug/L	0.16	0.48	524.2	07/06 22:48	07/06 22:48	MMD

Report To:
Andrea Jennings
Diversified Drilling-Lehigh
5620 Lee Street
Lehigh Acres, FL 33971

Report Printed: 07/23/09
Submission # 907000097
Order # 116139

Project: Primary & Secondary Testing
Site Location: Hialeah, FL
Matrix: Drinking Water

Sample I.D.: S/P
Collected: 07/05/09 13:00
Received: 07/05/09 14:30
Collected by: A.P./ L.G

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Styrene	U	U	ug/L	0.08	0.24	524.2	07/06 22:48	07/06 22:48	MMD
1,4-Dichlorobenzene (para)	U	U	ug/L	0.09	0.27	524.2	07/06 22:48	07/06 22:48	MMD
1,2-Dichlorobenzene (ortho)	U	U	ug/L	0.07	0.21	524.2	07/06 22:48	07/06 22:48	MMD
1,2,4-Trichlorobenzene	U	U	ug/L	0.12	0.36	524.2	07/06 22:48	07/06 22:48	MMD
525.2 Semivolatile Organics: 62-550.310(4)(b)				**Dilution Factor =1**					
Di(2-Ethylhexyl)phthalate	U	U	ug/L	0.04	0.12	525.2	07/10 11:52	07/14 11:52	AC
Di(2-Ethylhexyl)adipate	U	U	ug/L	0.01	0.03	525.2	07/10 11:52	07/14 11:52	AC
Benzo(a)pyrene	U	U	ug/L	0.02	0.06	525.2	07/10 11:52	07/14 11:52	AC
Pentachlorophenol	U	U	ug/L	0.02	0.06	525.2	07/10 11:52	07/14 11:52	AC
Alachlor	U	U	ug/L	0.04	0.12	525.2	07/10 11:52	07/14 11:52	AC
Atrazine	U	U	ug/L	0.04	0.12	525.2	07/10 11:52	07/14 11:52	AC
Simazine	U	U	ug/L	0.06	0.18	525.2	07/10 11:52	07/14 11:52	AC
2,3,7,8-TCDD (Dioxin)	See Attch.					1613	07/09	07/14 22:12	E87611
Endothall	U	U	mg/L	0.0046	0.0138	548.1	07/10 17:30	07/20 18:31	E84809
Gross Alpha	21.8 ± 5.1		pCi/L	6.9	20.7	EPA 900.0	07/09 06:34	07/10 15:24	E83033
Radium-226	5.2 ± 0.6		pCi/L	0.1	0.3	EPA 903.1	07/10 09:50	07/17 15:30	E83033
Radium-228	0.8U ± 0.5		pCi/L	0.8	2.4	EPA Ra-05	07/10 09:50	07/16 13:34	E83033
TEM Asbestos in Water 17-550.310				**Dilution Factor =1**					

Report To:
Andrea Jennings
Diversified Drilling-Lehigh
5620 Lee Street
Lehigh Acres, FL 33971

Page 8 of 8
Report Printed: 07/23/09
Submission # 907000097
Order # 116139

Sample I.D.: S/P
Collected: 07/05/09 13:00
Received: 07/05/09 14:30
Collected by: A.P./ L.G

Project: Primary & Secondary Testing
Site Location: Hialeah, FL
Matrix: Drinking Water

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Asbestos (# of Fibers >10u Detected)	See Attch.					TEM	07/02 12:30	07/03 11:00	E86772
Asbestos (Conc. of fibers > 10u)	See Attch.					TEM	07/02 12:30	07/03 11:00	E86772

Unless indicated, soil results are reported based on actual (wet) weight basis.

Analytes not currently NELAC certified denoted by ˜.
Work performed by outside (subcontract) labs denoted by Cert.ID in Analyst Field.
Results relate only to this sample.
QC=Qualifier Codes as defined by DEP 62-160
U=Analyzed for but not detected.
Q=Sample held beyond accepted holding time.
I=Value is between MDL and PQL.
J=Estimated value.

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services,Inc.
Certification # E86006

Florida Radiochemistry Services, Inc.

Case Narrative

ORDER # 116139

NOTE: ** Gross Alpha:

Sample 0907050-01 had an elevated detection limit and/or counting error due to a low volume of sample used. The sample had high TDS (Total Dissolved Solids). The high TDS interferes with the sample counting efficiency. This is caused by the solids absorbing the sample activity (Sample self-absorption). The sample counting efficiency is decreased because of this. Therefore, the counting time was increased (the sample was counted over night or as long as possible) to help reduce the detection limit and counting error.

Columbia Analytical Services
19408 Park Row, Suite 320, Houston, TX 77084 | 713.266.1599 | www.caslab.com

July 21, 2009

Service Request No: E0900482

Marie Castellanos
Florida-Spectrum Environmental Services
1460 W. McNab Road
Fort Lauderdale, FL 33309

Laboratory Results for: TCDD by 1613B/Hickeh

Dear Marie:

Enclosed are the results of the sample(s) submitted to our laboratory on July 9, 2009. For your reference, these analyses have been assigned our service request number **E0900482**.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided.
All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report. In accordance to the NELAC 2003 Standard, a statement on the estimated uncertainty of measurement of any quantitative analysis will be supplied upon request.

Please contact me if you have any questions. My extension is 2960. You may also contact me via email at KVerschoor@caslab.com.

Respectfully submitted,

Columbia Analytical Services, Inc.

Karen Verschoor

Karen Verschoor
Project Manager

Page 1 of ___________

Columbia
Analytical Services^INC

Certificate of Analysis

19408 Park Row, Suite 320, Houston, TX 77084
Phone (713)266-1599 Fax (713)266-0130
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COLUMBIA ANALYTICAL SERVICES, INC

Client:	Florida-Spectrum Environmental Services	**Service Request No.:**	E0900482
Project:	Hickeh	**Date Received:**	7/9/09
Sample Matrix:	Drinking Water		

CASE NARRATIVE

All analyses were performed in adherence to the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for samples designated for Tier II. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

One drinking water sample was received for analysis at Columbia Analytical Services on 7/9/09.

The following discrepancies were noted upon initial sample inspection: no custody seals on cooler(s). The exceptions are also noted on the cooler receipt and preservation form included in this data package.

The sample was received at 0°C in good condition and is consistent with the accompanying chain of custody form. The sample was stored in a refrigerator at 4°C upon receipt at the laboratory.

Data Validation Notes and Discussion

MS/DMS

EQ0900256: Laboratory Control Spike/Duplicate Laboratory Control Spike (LCS/DLCS) samples were analyzed and reported in lieu of an MS/DMS for this extraction batch. The batch quality control criteria were met.

Y flags – Labeled Standards

Samples that had recoveries of labeled standards outside the acceptance limits are flagged with 'Y' flags. In all cases, the signal-to-noise ratios are greater than 10:1, making these data acceptable.

Detection Limits

Detection limits are calculated for each congener in each sample by measuring the height of the noise level for each quantitation ion for the associated labeled standard. The concentration equivalent to 2.5 times the height of the noise is then calculated using the appropriate response factor and the weight of the sample. The calculated concentration equals the detection limit.

Lan Le, Ph.D.
2009.07.22
10:40:29 -05'00'

For XL

Approved by________________________ Date 07/22/09

Xiangqiu Liang, Laboratory Director

Client: Florida-Spectrum Environmental Services

Project: TCDD by 1613B/Hickeh

Service Request: E0900482

SAMPLE CROSS-REFERENCE

SAMPLE #	CLIENT SAMPLE ID	DATE	TIME
E0900482-001	116139	7/5/09	13:00

Laboratory Certifications
2009-2010

STATE/PROGRAM	AGENCY	CERTIFICATION ID	EXP DATE
ARIZONA	AZ-DHS	AZ0725	05/26/10
ARKANSAS	ADEQ	08-056-0	06/16/09
CALIFORNIA	CA-ELAP	2452	02/28/11
FLORIDA/NELAP	FL-DOHS	E87611	06/30/10
HAWAII	HI-DOH	N/A	06/30/10
ILLINOIS/NELAP	IL-EPA	002122	10/06/09
LOUISIANA/NELAP	LELAP	03048	06/30/10
MAINE	ME-DOHS	2008031	06/05/10
MICHIGAN	MIDEQ	9971	06/30/10
MINNESOTA	MDH	048-999-427	03/25/10
NEVADA	NDEP	TX014112009A	07/31/09
NEW JERSEY	NJDEP	TX008	06/30/10
NEW MEXICO	NMED-DWB	N/A	06/30/10
NEW YORK/NELAP	NY-DOH	11707	03/31/10
NFESC/NAVY	NFESC	N/A	01/09/10
OKLAHOMA	OKDEQ	D9925, 9962	08/31/09
OREGON/NELAP	ORELAP	TX200002-006	03/24/10
TENNESSEE	TNDEC	04016	06/30/10
TEXAS/NELAP	TCEQ	T104704216-09-TX	06/30/10
UTAH/NELAP	UTELCP	COLU2	06/30/10
SOIL IMPORT PERMIT	USDA	P330-09-00067	03/27/12
WASHINGTON/NELAP	WA-Ecology	C1855	11/14/09
WEST VIRGINIA	WVDEP	347	06/30/10

Abbreviations, Acronyms & Definitions

Cal	Calibration
Conc	CONCentration
Dioxin(s)	Polychlorinated dibenzo-p-dioxin(s)
EDL	Estimated Detection Limit
EMPC	Estimated Maximum Possible Concentration
Flags	Data qualifiers
Furan(s)	Polychlorinated dibenzofuran(s)
g	Grams
ICAL	Initial CALibration
ID	IDentifier
Ions	Masses monitored for the analyte during data acquisition
L	Liter (s)
LCS	Laboratory Control Sample
DLCS	Duplicate Laboratory Control Sample
MB	Method Blank
MCL	Method Calibration Limit
MDL	Method Detection Limit
MRL	Method Reporting Limit
mL	Milliliters
MS	Matrix Spiked sample
DMS	Duplicate Matrix Spiked sample
NO	Number of peaks meeting all identification criteria
PCDD(s)	Polychlorinated dibenzo-p-dioxin(s)
PCDF(s)	Polychlorinated dibenzofuran(s)
ppb	Parts per billion
ppm	Parts per million
ppq	Parts per quadrillion
ppt	Parts per trillion
QA	Quality Assurance
QC	Quality Control
Ratio	Ratio of areas from monitored ions for an analyte
% Rec.	Percent Recovery
RPD	Relative Percent Difference
RRF	Relative Response Factor
RT	Retention Time
RRT	Relative Retention Time
SDG	Sample Delivery Group
S/N	Signal-to-Noise ratio
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalence Quotient

Data Qualifier Flags – Dioxin/Furans

- **B** Indicates the associated analyte is found in the method blank, as well as in the sample.
- **C** Confirmation of the TCDF compound: When 2378-TCDF is detected on the DB-5 column, confirmation analyses are performed on a second column (DB-225). The results from both the DB-5 column and the DB-225 column are included in this data package. The results from the DB-225 analyses should be used to evaluate the 2378-TCDF in the samples. The confirmed result should be used in determining the TEQ value for TCDF.
- **E** Indicates an estimated value – used when the analyte concentration exceeds the upper end of the linear calibration range.
- **J** Indicates an estimated value – used when the analyte concentration is below the method reporting limit (MRL) and above the estimated detection limit (EDL).
- **K** EMPC - When the ion abundance ratios associated with a particular compound are outside the QC limits, samples are flagged with a 'K' flag. A 'K' flag indicates an estimated maximum possible concentration for the associated compound.
- **U** Indicates the compound was analyzed and not detected.
- **Y** Samples that had recoveries of labeled standards outside the acceptance limits are flagged with 'Y'. In all cases, the signal-to-noise ratios are greater than 10:1, making these data acceptable.
- **ND** Indicates concentration is reported as 'Not Detected.'
- **S** Peak is saturated; data not reportable.
- **P** Indicates chlorodiphenyl ether interference present at the retention time of the target compound.
- **Q** Lock-mass interference by chlorodiphenyl ether compounds.

CAS/HOU - Form Production, Peer Review & Project Review Signatures

SR# Unique ID E0900482

First Level - Data Processing - to be filled by person generating the forms

Date	07/15/09	Person 1	JB (001)
Date		Person 2	

Second Level - Data Review – to be filled by person doing peer review

Date	07/15/09	Primary Data Reviewer	MC (001)
Date		Secondary Data Reviewer	

Project Level - Review - to be filled by person doing project compliance review

Date	7/22/09	Reviewer	QB

Columbia
Analytical Services^INC

Analytical Results

Client:	Florida-Spectrum Environmental Services	**Service Request:**	E0900482
Project:	TCDD by 1613B/Hickeh	**Date Collected:**	7/ 5/09 1300
Sample Matrix:	Drinking Water	**Date Received:**	7/ 9/09
Sample Name:	116139	**Units:**	pg/L
Lab Code:	E0900482-001	**Basis:**	NA

Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by HRGC/HRMS

Analytical Method:	1613B	**Date Analyzed:**	7/14/09 2212
Prep Method:	Method	**Date Extracted:**	7/9/09
Sample Amount:	1060mL	**Instrument Name:**	E-HRMS-01
		GC Column:	DB-5
Data File Name:	U132157	**Blank File Name:**	U132137
ICAL Date:	05/02/08	**Cal Ver. File Name:**	U132151

Analyte Name	Result	Q	EDL	MRL	Ion Ratio	RRT	Dilution Factor
2,3,7,8-TCDD	ND	U	0.786	9.43			1

Labeled Compounds	Spike Conc.(pg)	Conc. Found (pg)	%Rec	Q	Control Limits	Ion Ratio	RRT
13C-2,3,7,8-TCDD	2000	1329.467	66		25-164	0.79	1.008
37Cl-2,3,7,8-TCDD	800	650.121	81		35-197	NA	1.009

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Florida-Spectrum Environmental Services
Project: TCDD by 1613B/Hickeh
Sample Matrix: Drinking Water

Sample Name: Method Blank
Lab Code: EQ0900256-01

Service Request: E0900482
Date Collected: NA
Date Received: NA

Units: pg/L
Basis: NA

Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by HRGC/HRMS

Analytical Method: 1613B
Prep Method: Method
Sample Amount: 1000mL

Data File Name: U132137
ICAL Date: 05/02/08

Date Analyzed: 7/13/09 1930
Date Extracted: 7/9/09
Instrument Name: E-HRMS-01
GC Column: DB-5
Blank File Name: U132137
Cal Ver. File Name: U132135

Analyte Name	Result	Q	EDL	MRL	Ion Ratio	RRT	Dilution Factor
2,3,7,8-TCDD	ND	U	1.13	10.0			1

Labeled Compounds	Spike Conc.(pg)	Conc. Found (pg)	%Rec	Q	Control Limits	Ion Ratio	RRT
13C-2,3,7,8-TCDD	2000	557.524	28		25-164	0.79	1.008
37Cl-2,3,7,8-TCDD	800	257.087	32	Y	35-197	NA	1.009

Comments:

Columbia Analytical Services INC

Accuracy and Precision

Client:	Florida-Spectrum Environmental Services	**Service Request:**	E0900482
Project:	TCDD by 1613B/Hickeh	**Date Analyzed:**	7/13/09 - 7/14/09
Sample Matrix:	Drinking Water		

Lab Control Sample Summary
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by HRGC/HRMS

Analytical Method:	1613B	**Units:**	pg/L
Prep Method:	Method	**Basis:**	NA
		Extraction Lot:	90735

	Lab Control Sample EQ0900256-02			**Duplicate Lab Control Sample** EQ0900256-03					
Analyte Name	**Result**	**Expected**	**% Rec**	**Result**	**Expected**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
2,3,7,8-TCDD	233	200	117	240	200	120	67 - 158	3	50

Comments:

Client:	Florida-Spectrum Environmental Services	**Service Request:**	E0900482
Project:	TCDD by 1613B/Hickeh	**Date Collected:**	NA
Sample Matrix:	Drinking Water	**Date Received:**	NA
Sample Name:	Lab Control Sample	**Units:**	pg/L
Lab Code:	EQ0900256-02	**Basis:**	NA

Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by HRGC/HRMS

Analytical Method:	1613B	**Date Analyzed:**	7/13/09 2328
Prep Method:	Method	**Date Extracted:**	7/9/09
Sample Amount:	1000mL	**Instrument Name:**	E-HRMS-01
		GC Column:	DB-5
Data File Name:	U132142	**Blank File Name:**	U132137
ICAL Date:	05/02/08	**Cal Ver. File Name:**	U132135

Analyte Name	Result	Q	EDL	MRL	Ion Ratio	RRT	Dilution Factor
2,3,7,8-TCDD	**233**		0.439	10.0	0.77	1.001	1

Labeled Compounds	Spike Conc.(pg)	Conc. Found (pg)	%Rec	Q	Control Limits	Ion Ratio	RRT
13C-2,3,7,8-TCDD	2000	1525.245	76		25-164	0.78	1.008
37Cl-2,3,7,8-TCDD	800	739.000	92		35-197	NA	1.009

Comments:

Client:	Florida-Spectrum Environmental Services	**Service Request:**	E0900482
Project:	TCDD by 1613B/Hickeh	**Date Collected:**	NA
Sample Matrix:	Drinking Water	**Date Received:**	NA
Sample Name:	Lab Control Sample Dup	**Units:**	pg/L
Lab Code:	EQ0900256-03	**Basis:**	NA

Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans by HRGC/HRMS

Analytical Method:	1613B	**Date Analyzed:**	7/14/09 2347
Prep Method:	Method	**Date Extracted:**	7/9/09
Sample Amount:	1000mL	**Instrument Name:**	E-HRMS-01
		GC Column:	DB-5
Data File Name:	U132159	**Blank File Name:**	U132137
ICAL Date:	05/02/08	**Cal Ver. File Name:**	U132151

Analyte Name	Result	Q	EDL	MRL	Ion Ratio	RRT	Dilution Factor
2,3,7,8-TCDD	240		0.564	10.0	0.78	1.001	1

Labeled Compounds	Spike Conc.(pg)	Conc. Found (pg)	%Rec	Q	Control Limits	Ion Ratio	RRT
13C-2,3,7,8-TCDD	2000	1207.611	60		25-164	0.77	1.008
37Cl-2,3,7,8-TCDD	800	602.869	75		35-197	NA	1.009

Comments:

Columbia Analytical Services

Chain of Custody

19408 Park Row, Suite 320, Houston, TX 77084
Phone (713)266-1599 Fax (713)266-0130
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SUBMISSION # ______

Logged in LIMS by ______
CSM assigned ______

To: CAS-Huston

CHAIN OF CUSTODY RECORD

Florida Environmental

☑ 1460 W. McNab Road Ft Laud. FL 33309 Tel: (954) 978-6400 Fax: (954) 978-2233
☐ 630 Indian Street Savannah, GA 31401 Tel: (912) 238-5050 Fax: (912) 234-4815
☐ 528 Gooch Road Fort Meade, FL 33841 Tel: (863) 285-8145 Fax: (863) 285-7030
☐ 1112 NW Park St., Okeechobee, FL 34972 Tel: (863) 763-3336 Fax: (863) 763-1544

Original-Return w/report Yellow- Lab File Copy Pink- Sampler Copy

DUE DATE Requested

RUSH RESERVATION #

Rush Surcharges apply

Report to: (company name) FSES
Report to Address:
Invoice to: (company name)
Purchase Order #
Invoice to Address:
Project Name and/or Number 907-09.7
Site Location: Hickech
Project Contact: Marc Castellanos
Phone:
Fax:
Email:
Sampler Name: (printed)
Sampler Signature

ORDER # *Lab Control Number* *Shaded Areas For Laboratory Use Only*	Sample ID	Date Sampled	Time Sampled	Matrix DW SW GW WW S SED HW BIO SEA OIL X AIR	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes #	A-?	Analysis Required: Dioxin 1613							Field Tests: TEMP °C	PH	COND	CHLOR
1	11L139	7/5/09	1300	DW		1		O										
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Special Comments:
"I waive NELAC protocol" (sign here) >
Total
Deliverables: QA/QC Report Needed? Yes No (additional charge)

	SAMPLE CUSTODY AND TRANSFER SIGNATURES	DATE / TIME
1	Relinquished by:	7/8/09
1	Received by:	
2	Relinquished by:	
2	Received by:	
3	Relinquished by:	
3	Received by: Nicole Brown CAS	7/9/09 1030

Sample Custody & Field Comments
Temp as received ______ C
Custody Seals? Y N
FIELD TIME:
Sampling ______ hrs
Pick-Up ______ hrs
Misc. Charges ______

Bottle Type
A-liter amber
B-Bacteria bag/bottle
F-500 ml O-125 ml
L-liter bottle
S4- 4 oz soil jar / S8- 8 oz soil jar
T-250 ml
V-40 ml vial
W-wide mouth
X-other TED=Tedlar Air Bag

Preservatives
A-ascorbic acid P-H3PO4
C-HCL S-H2SO4
Cu-CuSO4 T-Na2S2O3-H2O
H-HNO3 U-Unpreserved
M-MCAB N-NaOH
Z-zinc acetate NH4-NH4CL

www.flenviro.com 0°C COC Page ______ of ______

Reorder From NEBS CUSTOM printing service

Page 17 of 22
SAMPLER COPY

Wet ice, bubble Wrap
no custody seals

FedEx
7977 4548 8164

Reset Form

Print Form

Columbia Analytical Services, Inc.
Cooler Receipt Form

Client/Project: Florida Environmental Service Request: E0900482

Received: 07/09/09 Opened (Date/Time): 07/09/09 1030 By: NAB

1. Samples were received via? ☐ *US Mail* ☑ *Fedex* ☐ *UPS* ☐ *DHL* ☐ *Courier* ☐ *Hand Delivered*
2. Samples were received in: (circle) ☑ *Cooler* ☐ *Box* ☐ *Other* ☐ *NA*
3. Were <u>custody seals</u> present on coolers? ☐ Y ☑ N If yes, how many and where?

   If present, were custody seals intact? ☐ Y ☐ N If present, were they signed and dated? ☐ Y ☐ N
4. Is shipper's air-bill filed? ☐ NA ☐ Y ☑ N If not, record air bill number: 797745488164
5. Temperature of cooler(s) upon receipt (°C): 0
6. If applicable, list Chain of Custody numbers:
7. Were custody papers properly filled our (ink, signed, etc.)? ☐ NA ☑ Y ☐ N
8. Packing material used: ☐ *Inserts* ☑ *Bubble Wrap* ☐ *Blue Ice* ☑ *Wet Ice* ☐ *Sleeves* ☐ *Other*
9. Were the correct types of bottles used for the tests indicated? ☑ Y ☐ N

   Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* ☑ Y ☐ N

Sample ID	Bottle Count	Bottle Type	Out of Temp	Broken	Initials
			☐	☐	
			☐	☐	
			☐	☐	
			☐	☐	
			☐	☐	
			☐	☐	
			☐	☐	

10. Were all bottle labels complete (i.e. analysis, ID, etc.)? ☑ Y ☐ N

    Did all bottle labels and tags agree with custody papers? *Indicate in the table below.* ☑ Y ☐ N

Sample ID on Bottle	Sample ID on COC		Sample ID on Bottle	Sample ID on COC

11. Additional notes, discrepancies, and resolutions:

<u>Page 1 of:</u> ☑ 1 ☐ 2

Sample Acceptance Policy

Custody Seals (desirable, mandatory if specified in SAP):

- ✓ On outside of cooler
- ✓ Seals intact, signed and dated

Chain-of-Custody documentation (mandatory):

- ✓ Properly filled out in ink & signed by the client
- ✓ Sign and date the coc for CAS/HOU upon cooler receipt
- ✓ Coc must list method number
- ✓ If no coc was submitted with the samples, complete a CAS/HOU coc for the client

Sample Integrity (mandatory):

- ✓ Sample containers must arrive in good condition (not broken or leaking)
- ✓ Sample IDs on the bottles must match the sample IDs on the coc
- ✓ The correct type of sample bottle must be used for the method requested
- ✓ The correct number of sample containers received must agree with the documentation on the coc
- ✓ The correct sample matrix must appear on the coc
- ✓ An appropriate sample volume or weight must be received

Temperature Preservatives (varies by sample matrix):

- ✓ Aqueous and Non-aqueous samples must be shipped and stored cold, at 0 to 6°C
- ✓ Tissue samples must be shipped and stored frozen, at -20 to -10°C
- ✓ Air samples can be shipped and stored at ambient temperature, ~23°C
- ✓ The sample temperature must be recorded on the coc
- ✓ Notify a Project Chemist if any samples are outside the acceptance temperature or have compromised sample integrity – the client must decide re: replacement sample submittal or continue with the analysis

Cooler Receipt Form, CRF (mandatory):

- ✓ Cooler receipt forms must be completed for each coc & SR#
- ✓ Sample integrity issues must be documented on the CRF
- ✓ A scan of the carrier and the airbill number must be recorded in CAS LIMS

Sample Integrity Issues/Resolutions (mandatory):

- ✓ Sample integrity issues are documented on the CRF and given to the Project Chemist for resolution with the client
- ✓ Client resolution is documented in writing (typically email or on the CRF) and filed in the project folder(s)

Service Request Summary

Folder #: **E0900482**
Client Name: Florida-Spectrum Environmental Services
Project Name: TCDD by 1613B
Project Number: Hickeh

Report To: Marie Castellanos
Florida-Spectrum Environmental Services
1460 W. McNab Road
Fort Lauderdale, FL 33309

Phone Number: 954-978-6400
Cell Number:
Fax Number:
E-mail: mcastellanos@flenviro.com

Project Chemist: Karen Verschoor
Originating Lab: HOUSTON
Logged By: NBROWN
Date Received: 7/ 9/09
Internal Due Date: 7/23/09
QAP: LAB QAP
Qualifier Set: CAS Standard
Formset: CAS Standard
Merged?: N
Report to MDL?: Y
P.O. Number:
EDD: No EDD Specified

1 - 1000 ml-Glass Bottle NM AMBER Teflon Liner Unpreserved

Location: E-WIC01

				SVM
CAS Samp No	**Client Samp No.**	**Matrix**	**Collected**	1613B/ Dioxins Furans
E0900482-001	116139	DW	7/5/09 1300	**II**

Preparation Information Benchsheet

Prep Run#: 90735
Team: Semivoa GCMS/AKODUR

Prep WorkFlow: OrgExtAq(365)
Prep Method: Method

Status: Prepped
Prep Date/Time: 7/9/09 01:00 PM

#	Lab Code	Client ID	B#	Method /Test	pH	Matrix	Amt. Ext.	Sample Description
1	E0900466-001	L09070007-01N	.02	1613B/Dioxins Furans	14	Water	1080mL	clear colorless liquid
2	E0900476-001	9750	.01	1613B/Dioxins Furans	7	Water	1050mL	clear colorless liquid
3	E0900480-001	19G0259-01	.01	1613B/Dioxins Furans	5	Water	1060mL	clear colorless liquid
4	E0900481-001	OUTFALL 004	.01	1613B/Dioxins Furans	4	Wastewater	1010mL	light orange cloudy liquid
5	E0900481-002	OUTFALL 005	.01	1613B/Dioxins Furans	8	Wastewater	1020mL	dark orange cloudy liquid
6	E0900482-001	116139	.01	1613B/Dioxins Furans	8	Drinking Water	1060mL	clear colorless liquid
7	E0900483-001	001	.01	1613B/Dioxins Furans	7	Water	1040mL	clear colorless liquid
8	EQ0900256-01	MB		1613B/Dioxins Furans		Liquid	1000mL	
9	EQ0900256-02	LCS		1613B/Dioxins Furans		Liquid	1000mL	
10	EQ0900256-03	DLCS		1613B/Dioxins Furans		Liquid	1000mL	
11	EQ0900256-04	MB		1613B/Dioxins Furans		Liquid	1000mL	
12	EQ0900256-05	LCS		1613B/Dioxins Furans		Liquid	1000mL	
13	EQ0900256-06	DLCS		1613B/Dioxins Furans		Liquid	1000mL	

Spiking Solutions

Name: 1613B Matrix Working Standard | Inventory ID 10213 | Logbook Ref: D10-43-5B | Expires On: 05/28/2019

EQ0900256-02	100.00µL	EQ0900256-03	100.00µL	EQ0900256-05	100.00µL	EQ0900256-06	100.00µL

Name: 8290/1613B Cleanup Working Standard | Inventory ID 10768 | Logbook Ref: D10-51-3A/B | Expires On: 07/01/2014

E0900466-001	100.00µL	EQ0900256-01	100.00µL	EQ0900256-02	100.00µL	EQ0900256-04	100.00µL	EQ0900256-05	100.00µL

Name: 1613B Labeled Working Standard | Inventory ID 10911 | Logbook Ref: D10-52-4B | Expires On: 07/09/2014

E0900466-001	1,000.00µL	E0900476-001	1,000.00µL	E0900480-001	1,000.00µL	E0900481-001	1,000.00µL	E0900481-002	1,000.00µL	E0900482-001	1,000.00µL
E0900483-001	1,000.00µL	EQ0900256-01	1,000.00µL	EQ0900256-02	1,000.00µL	EQ0900256-03	1,000.00µL	EQ0900256-04	1,000.00µL	EQ0900256-05	1,000.00µL
EQ0900256-06	1,000.00µL										

Name: 8290/1613B Cleanup Working Standard | Inventory ID 10913 | Logbook Ref: D10-52-5A/B | Expires On: 07/13/2014

E0900476-001	100.00µL	E0900480-001	100.00µL	E0900481-001	100.00µL	E0900481-002	100.00µL	E0900482-001	100.00µL	E0900483-001	100.00µL
EQ0900256-03	100.00µL	EQ0900256-06	100.00µL								

Preparation Information Benchsheet

Prep Run#: 90735
Team: Semivoa GCMS/AKODUR

Prep WorkFlow: OrgExtAq(365)
Prep Method: Method

Status: Prepped
Prep Date/Time: 7/9/09 01:00 PM

Preparation Materials

Acetone 99.5% Minimum	C2-16-007 (7199)	Carbon, High Purity	C2-23-004 (9452)	Ethyl Acetate 99.9% Minimum EtOAc	C2-23-006 (9462)
Glass Wool	C2-13-005 (7198)	Sulfuric Acid Reagent Grade H2SO4	C2-24-003 (9461)	Dichloromethane (Methylene Chloride) 99.9% MeCl2	C2-25-001 (9449)
Methanol HR-GC Grade MeOH	C2-18-004 (7220)	Sodium Chloride Reagent Grade NaCl	C1-104-2 (3306)	Sodium Hydroxide Reagent Grade NaOH	C2-24-002 (9463)
Sodium Sulfate Anhydrous Reagent Grade Na2SO4	C2-19-006 (7201)	Tridecane (n-Tridecane)	C2-24-001 (9460)	Hexane (n-Hexane) 98.5% Minimum	C2-25-004 (9441)
Nonane (n-Nonane) 99%	C2-21-004 (9457)	pH Paper 0-14	(1008)	Silica Gel Reagent Grade	C2-27-007 (9456)
Toluene 99.9% Minimum	C2-25-003 (9446)				

Preparation Steps

Step:	Extraction	Step:	Acid Clean	Step:	Silica Gel Clean	Step:	Final Volume
Started:	7/9/09 13:00	Started:	7/10/09 08:00	Started:	7/10/09 13:00	Started:	7/13/09 07:30
Finished:	7/9/09 18:00	Finished:	7/10/09 08:00	Finished:	7/10/09 17:30	Finished:	7/13/09 14:00
By:	NBROWN	By:	NBROWN	By:	NBROWN	By:	NBROWN

Comments: ______

Reviewed By: ______ Date: ______

Chain of Custody

Relinquished By: ______ Date: ______

Received By: Nicole Brown Date: 04/16/09

Extracts Examined
Yes No

SUBMISSION # 907-097

Logged into LIMS by:

Florida Environmental

CHAIN OF CUSTODY RECORD

1460 W McNab Road Ft Lauderdale FL 33309 Tel: (954) 978-6400 Fax: (954) 978-2233
940 Alt. 27 South Babson Park, FL 33827 Tel: (863) 638-3255 Fax: (863) 638-3637
630 Indian Street Savannah, GA 31401 Tel: (912) 238-5050 Fax (912) 234-4815
528 Gooch Road Fort Meade FL 33841 Tel: (863) 285-8145 Fax (863) 285-7030

Original-Return w/report Yellow- Lab File Copy Pink- Sampler Copy

~~DUE DATE Requested~~

RUSH RESERVATION #

Rush Surcharges apply

Report to: **Diversified Drilling -Lehigh**

Report to Address: 5620 Lee St, Lehigh, FL 33971

Invoice to: **Diversified Drilling -Lehigh**

Purchase Order #

Invoice to Address: 5620 Lee St, Lehigh, FL 33971

Project Name and/or Number : Primary & Secondary Tesing

Site Location: Hialeah , FL

Project Mgr: **Andrea Jennings**

Phone: 239-368-6404

Fax: 239-368-6716

Email:

Sampler Name: (printed) Argelio Pifferrer / Lio Gamero

Sampler Signature

ORDER # *Lab Control Number* *Shaded Areas For Laboratory Use Only*	Sample ID	Date Sampled	Time Sampled	Matrix DW SW GW SED S EFF HW BIO SA OIL X	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes #	A-?	See Attached	Primary	Secondary			DO	TURBID	PH	TEMP -C	~~Cond~~ COND	TOTAL Cl
1 11639	S/P	07-05-09	13:00	DW		32		X	X	X			7.9	1.4	6.70	22.1	5560	
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
						Total												

Special Comments:
"I waive NELAC protocol" (sign here) >

Deliverables: QA/QC Report Needed? Yes No (additional charge)

SAMPLE CUSTODY AND TRANSFER SIGNATURES

			DATE / TIME
1	Relinquished by:	Argelio Pifferrer	07-05-09 14:30
1	Received by:		7/5/09 1430
2	Relinquished by:		
2	Received by:		
3	Relinquished by:		
3	Received by:		

Sample Custody & Field Comments

Temp as received 4 C

Custody Seals? Y N

Billable Field Time 3 hrs

Misc. Charges -Weekend Charge

Bottle Type
- A-liter amber
- B-Bacteria bag/bottle
- F-500 ml
- L-liter bottle
- S-soil jar
- T-250 ml
- V-40 ml vial
- W-wide mouth
- X-other

Preservatives
- A-ascorbic acid
- C-HCL
- Cu-CuSO$_4$
- H-HNO$_3$
- M-MCAB
- N-NaOH
- NH$_4$-NH$_4$CL
- P-H$_3$PO$_4$
- S-H$_2$SO$_4$
- T-Na$_2$S$_2$O$_3$-H$_2$O
- U-Unpreserved
- P-H$_3$PO$_4$
- Z-zinc acetate

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COC Page of

EM ANALYTICAL INC

July 15, 2009

Accounts Payable
Florida Spectrum Environmental Services, Inc.
1460 West McNab Road
Ft. Lauderdale, FL 33309

Re: **#907-030, Miami Beach**
#907-097, Hialeah

Dear Sir or Madam:

Enclosed are the data reports for Transmission Electron Microscope (TEM) analyses for asbestos in water samples. A known volume of water was filtered and dried. Each filter was coated with a thin film of carbon by evaporative deposition under vacuum. The samples were then cleared in acetone leaving the particles attached to the carbon film.

The samples were examined in the TEM at magnifications of 15,000-20,000X. A variable number of grid openings from each prepared grid were examined in the TEM for mineral identification and structure counts. The analytical instrument used was a Philips 300 with electron diffraction capability. Elemental analysis was performed with a Link Analytical QX200 Energy Dispersive Spectrometer (EDS)/ AN10000 Multi-Channel Analyzer.

These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc.

Sincerely,

Pat Blackwelder

Pat Blackwelder, Ph.D.
President

PB/at
Enclosures

E.M. Analytical, Inc.
8000 North Ocean Drive, Dania, FL 33004
Billing: P.O. Box 488, Dania, FL 33004-0488
Office: (305) 751-1184 Fax: (954) 921-6747

EM ANALYTICAL INC

Asbestos in Water Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-1
Sample ID: 115804
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@0915
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: <1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (µm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10µ Detected: 0
Concentration of Asbestos Fibers >10µ: <0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-2
Sample ID: 115805
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@0930
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: <1 %
Non-Asbestos Structures: organics, fiberglass

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (μm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10μ Detected:	0
Concentration of Asbestos Fibers >10μ:	<0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-3
Sample ID: 115806
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@0950
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: 1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (µm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10µ Detected: 0
Concentration of Asbestos Fibers >10µ: <0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-4
Sample ID: 115807
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@1005
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: 1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (μm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10μ Detected: 0
Concentration of Asbestos Fibers >10μ: <0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-5
Sample ID: 115808
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@1015
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: 1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (µm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10µ Detected: 0
Concentration of Asbestos Fibers >10µ: <0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-6
Sample ID: 115809
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@1030
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: 1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (μm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10μ Detected:	0
Concentration of Asbestos Fibers >10μ:	<0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-7
Sample ID: 115810
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@1045
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: 1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (μm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10μ Detected: 0
Concentration of Asbestos Fibers >10μ: <0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature: ____________________

E.M. Analytical, Inc. * P.O. Box 488 Dania, FL 33004 * 8000 N. Ocean Dr. Dania, FL 33004 * (305) 751-1184
An HRS Accredited TEM Lab (HRS #E86772)

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client: Florida Spectrum Environmental Services, Inc.
1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location: #907-030, Miami Beach
E.M. Number: 09EF-8
Sample ID: 115811
Sampled By: Not Provided
Preservation Type: Plain
Date Collected: 07/01/09@1100
Date Issued: 07/06/09

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: 07/02/09@1230
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: 1 %
Non-Asbestos Structures: organics

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (μm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10μ Detected: 0
Concentration of Asbestos Fibers >10μ: <0.18 MFL

MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was < than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature:

EM ANALYTICAL INC

Asbestos in Water
Report/Count Sheet

Client:	Florida Spectrum Environmental Services, Inc. 1460 W McNab Rd., Ft. Lauderdale, FL, 33309
Project/Location:	Asbestos in Water
E.M. Number:	09EF-WB
Sample ID:	N/A
Sampled By:	N/A
Date Collected:	N/A@
Date Issued:	07/06/09

Preservation Type: N/A

FILTER

Type: Mixed Cellulose Ester
Filter Size: 47 mm
Effective Filter Area: 1320 mm^2
Total Area of Filter Analyzed: 0.153 mm^2

INSTRUMENT

TEM: Philips EM 300
Magnification: 17,000 X
Accelerating Voltage: 100 kV
EDS: Link Analytical QX 200
Multi-Channel Analyzer: AN10000

Date Received: N/A@
Date Filtered: 07/02/09@1230
Date Analyzed: 07/03/09@1100
Volume Filtered: 50 ml
Particulate Loading: <1 %
Non-Asbestos Structures: none identified

Analyst: PB
Grid Opening Area: 0.0102 mm^2
Grid Openings Counted: 15
Analytical Sensitivity: 0.18 MFL
Analysis Method: EPA-100.2

Grid Opening	Fiber #	Fiber Length (μm)	SAED ID	EDS ID	Asbestos Type	Negative #	Spectrum #
1-15	NFD						

NFD: No Fibers Detected
SAED: Select Area Electron Diffraction; EDS: Elemental Dispersive Spectroscopy.
Upper and lower limits of the Poissonian 95% confidence interval of the asbestos structure concentration: N/A - 0.5382.

Total Number of Asbestos Fibers Detected: 0; Total Asbestos Fiber Concentration: <0.18 MFL.

RESULTS

Number of Asbestos Fibers >10μ Detected:	0
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MCL = 7 Millions (MFL) longer than 10 microns. Target Analytical Sensitivity = 0.20 MFL; MFL: Millions of Fibers per Liter; MCL: Maximum Contaminant Level. Preparation and analyses utilized guidelines from Federal Register 40 CFR Parts 114, 142, 143, National Primary Drinking Water Regulations; Final Rule. Additional procedures are from "Transmission Electron Microscopy by EPA, Method: Analytical Method for Determination of Asbestos Fibers in Water", EPA-600/4-83-043. These results reflect only the concentration of particles extracted from the provided water and observed in the sample preparation. These results relate only to those items or parts tested. The samples were collected by the client and therefore we have no knowledge as to the manner in which they were obtained. Data interpretation is provided by the consultant who obtained the samples. The total number of pages in this report (including this page) is14. This report shall not be reproduced except in full, and with the written approval of E. M. Analytical, Inc. This report meets the requirements of the NELAC Standard and EPA Method 100.2. Submitted sample volume was N/A than that recommended by EPA Method 100.2.. If there are any questions contact the signatee at the phone number below.

Lab Director's Signature: ______________

Appendix C

Geophysical Logs

GEOFRAME
PROCESSED
INTERPRETATION

Integrated Wireline Log Well Composite

Processed Advanced Borehole Geophysical Logs

*A Mark of Schlumberger

Using the following logs:

AIT*, MCFL*, FMI*
CNT*, TLD*, DSI*
HNGS*, ECS*, PSP*
FMI
CMR

COMPANY: CITY OF HIALEAH
WELL: HIALEAH UPPER FLORIDAN TEST WELL
FIELD: HIALEAH
STATE: FLORIDA
COUNTRY:
Date Logged: 8–JUNE–2009 Date Processed: Sept–2009
Well Location: LAT: 25* 55.447’
LONG: 80* 22.195’
Elevations: K.B. 5 ft D.F. 5 ft G.L. 5 ft
API Number: Job Number:

FOLD HERE The well name, location and borehole reference data were furnished by the customer

Ser. Oder # B2EO00014 OP Vers.: 16C0−147 Process Date: Sept−2009 Center: SWS Tucson Baseline: GF4.2 Log Analyst: N. Cla

Mud and Borehole Measurements:

Rm @ Measured Temperature: 1.6 ohm.m @ 85 d	BHT: 78 degF	Bitsize: 15 in
Rmf @ Measured Temperature: 1.6 ohm.m @ 85 d	Type Fluid in Hole:	FGM:
Rmc @ Measured Temperature: 1.6 ohm.m @ 85	Mud density: 8.34 lbm/gal	FGM:

Remarks:

Depth reference is drill floor (5 ft above ground surface).
Severe washout (cavity) at 1160−1260 ft compromising log quality.
Certain log measurements are unattainable in PVC casing (above 1088 ft).

Appendix D

APT Data (Attached Digitally)