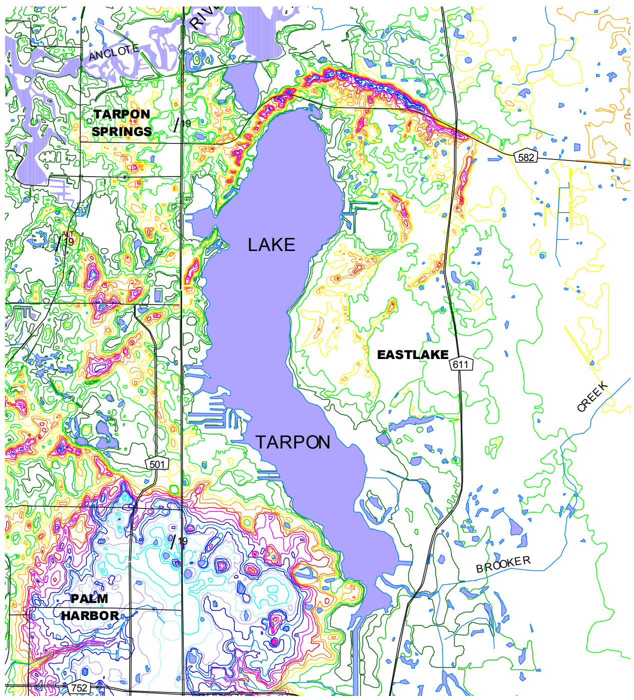
LAKE TARPON
GROUND-WATER NUTRIENT STUDY

TASK 4: FINAL REPORT

PROJECT NUMBER 922938

OCTOBER 2004



Prepared For

PINELLAS COUNTY DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
AND
THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Prepared by

Leggette, Brashears & Graham, Inc.

With Assistance from

SDI Environmental Inc.

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EXECUTIVE SUMMARY

Pinellas County (The County) and the Southwest Florida Water Management District (District) entered into a cooperative funding agreement for the purpose of collecting ground-water data to assess nutrient loading to Lake Tarpon by ground-water flow into the lake. The objectives of the project included the following:

- Establish a shallow ground-water monitoring network around the lake capable of providing long-term monitoring of surficial aquifer nutrient flux to the lake.
- Develop a ground-water flow net and nutrient flux model to provide updated nutrient flux estimates to the lake.
- Assess the nutrient load from existing septic tanks and evaluate the potential nutrient load reduction to the lake by replacing those septic tanks with a central sewer system.
- Evaluate surficial aquifer water quality in the following geographic areas: 1) Highland Lakes Golf Club; 2) west and northwest regions of the lake; and 3) east and northeast regions of the lake. The installation of two monitoring wells planned for the Highlands Lakes Golf Course was cancelled when site access could not be obtained.

The project included installation of 24 monitoring wells, sampling of the 24 new and 7 existing wells, evaluation of ground-water quality data, and preparation of an analytical model to estimate nutrient loading into Lake Tarpon from discharge of ground water from the surficial aquifer. The 31 monitoring wells were sampled once during May 2002, and later during October 2002. Seventeen wells were also sampled for nitrogen isotope analysis. The water-quality data and hydraulic conductivity values were used as inputs in an analytical model to estimate the nutrient loading in ground water discharging from the surficial aquifer into Lake Tarpon.

Nutrient loading was evaluated based on analytical results for total nitrogen, nitrate+nitrite (nitrate), and ammonia concentrations. Of these parameters, only nitrate has a regulatory drinking water standard (10 milligrams per liter (mg/l)). For the purpose of this evaluation, total nitrogen concentrations greater than 2.0 mg/l were considered to be above background concentrations, and are referred to as “elevated” concentrations. Total nitrogen

ranged from 0.01 to 12.8 mg/l and was detected at elevated levels (>2.0 mg/l) in 19 of the 31 wells. Total nitrogen concentration is the sum of ammonia, nitrite+nitrate, and organic nitrogen concentrations. Nitrate concentrations ranged from 0.01 to 12.3 mg/l. Nitrate concentrations greater than 1.0 mg/l are above background levels and are referred to as "elevated" levels. Elevated levels were detected in 11 of the 31 wells. Ten of the 11 wells with elevated nitrate concentrations were located on the west side of Lake Tarpon, including six wells in the unsewered area on the northwest side of the lake. Ammonia concentrations ranged from 0.01 to 7.07 mg/l. Ammonia concentrations greater than 1.0 mg/l are above background levels, and are referred to as "elevated" levels. Elevated levels were detected in nine of the 31 wells. Six of the nine wells with elevated ammonia concentrations were located on the east side of Lake Tarpon, in a mix of sewered and unsewered areas. Organic nitrogen concentrations ranged from 0.0 to 2.5 mg/l. Organic nitrogen concentrations greater than 1.0 mg/l are above background levels, and are referred to as "elevated" levels. Elevated levels were detected in nine of the 31 wells. The nine wells with elevated organic nitrogen concentrations were located randomly around Lake Tarpon, in both sewered and unsewered areas.

Most of the wells with elevated total nitrogen concentrations also contained elevated TOC concentrations. A comparison of TOC and total nitrogen concentrations indicated four grouping of wells. Group 1 wells have low total nitrogen (<1.0 mg/l) and TOC concentrations (<10mg/l) and represent background conditions. Group 2 wells have elevated TOC concentrations (>10 mg/l) and slightly elevated total nitrogen (>1.0 mg/l and <2.0 mg/l). Four of the six Group 2 wells are located at the unsewered northwest side of the lake. Group 3 wells have TOC concentrations less than 20 mg/l and elevated total nitrogen concentrations (>2.0 mg/l). All of the Group 3 wells are located on the west side of the lake. Four are located in unsewered areas and three are in sewered areas, which suggest that septic tanks may not be the primary source of nutrients in these areas. Group 4 wells have TOC concentrations greater than 20 mg/l and elevated total nitrogen concentrations (>2.0 mg/l). Six out of the eight Group 4 wells are located on the east side of the lake in an area of mixed sewered/unsewered use.

The potential sources of elevated nutrients in the surficial aquifer are septic tanks, reclaimed water, and fertilizers. There are no consistent relationships between land use and the locations of elevated nutrients that clearly define the source. Nitrogen isotope analysis was used to attempt to identify the sources of nitrogen in the surficial aquifer. Comparison of isotopic compositions with nitrate or ammonia concentrations showed two trends. The first trend shows several samples with light isotopic compositions, and increasing nitrate concentrations (and therefore low NH_4 concentrations). These light isotopic ratios ($\delta^{15}N$) and higher NO_3 values suggest that fertilizer is the dominant source. The second trend shows enriched $\delta^{15}N$ values with increasing concentrations of either nitrate or ammonium. This trend suggests that animal/human waste is the dominant source. Three of the wells with isotope analyses indicated of waste sources are located in unsewered areas, and the other two are in sewered areas. One of these wells (LT-17) is located near a former reclaimed water sprayfield associated with the package plant that previously served the Lansbrook development. The previous package plant did not provide advance treatment, which may explain the higher nutrient concentrations. The William F. Dunn Water Reclamation Facility now provides advanced treatment reclaimed water to the development.

A nutrient loading model was developed to estimate nutrient loading to Lake Tarpon from discharge of ground water from the surficial aquifer to Lake Tarpon. Nutrient loading was calculated for a series of aquifer cross sections around the lake based on the volumetric flow of ground water through a specified cross section, and the nitrogen concentration from monitoring wells within each cross section. The analysis showed that the average loading of total nitrogen to Lake Tarpon ranged between 22 and 28 pounds per day. Based on the results of the loading analysis and the isotope analysis, which identified the source of nitrogen as either fertilizer or animal/human waste, approximately 79 percent of the total nitrogen load to the lake from the surficial aquifer is due to fertilizer. This percentage should be viewed as a gross estimate because many of the wells potentially have multiple sources. Only one of the three wells in areas irrigated with reclaimed water had elevated nitrogen concentrations, and the concentration in this well (WRAP-47) was most likely due to the nearby septic tank. Therefore, the assumption can be made that, due to the low total nitrogen concentrations in the reclaimed water (1.29 mg/l), it contributes a negligible load to the lake, and the remaining 21 percent of the nutrient load is due to septic tanks.

1.0 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Numerous studies of the relationship between the water quality of Lake Tarpon and flow patterns of the surficial and Upper Floridan aquifers have been conducted as far back as 1954 (Heath and Smith). In 1998 Environmental Resources Management (ERM) conducted a study funded by the Southwest Florida Water Management District (SWFWMD or District) to determine if Lake Tarpon's water quality was at risk from the nutrient flux within the surficial and Upper Floridan aquifers to the lake. ERM (1998) studied land use and water quality of the surficial and Upper Floridan aquifers within the Lake Tarpon/Brooker Creek drainage basins. The ERM report concluded that nutrient distributions within the study area reflected the relationship of nitrogen compounds to area land use. Furthermore, ground-water data indicated some existing and potential problems in the basin area and around the lake area. On April 24, 2002, Pinellas County contracted with Leggette, Brashears & Graham, Inc. (LBG) to perform a ground-water nutrient study around Lake Tarpon (Project Number 922398). LBG was assisted by SDI Environmental, Inc. with the nutrient flux model development for this study.

1.2 PROJECT BACKGROUND AND DESCRIPTION

Pinellas County (The County) and the Southwest Florida Water Management District entered into a cooperative funding agreement for the purpose of collecting ground-water data to assess nutrient loading to Lake Tarpon by ground-water flow into the lake. Previous and current land uses in the Lake Tarpon area with the potential to be sources of nutrients to ground water include: residential septic tanks, spray irrigation of treated wastewater, pasture lands, citrus groves, and golf courses. The project consists of monitoring well installation, sampling, and evaluation of ground-water conditions to determine the source and fate of nutrients in the surficial aquifer affecting the water quality of Lake Tarpon.

1.3 PROJECT NEEDS AND OBJECTIVES

The study is to establish a ground-water monitoring network around the lake using a combination of existing and new monitoring wells. The County identified seven existing monitoring wells for use in the study. These existing wells are augmented with 24 new permanent wells installed at locations selected by the County. The wells are located in close proximity to the lake with a sufficient distribution around the lake perimeter in order to form a segmented monitoring "fence" having adequate coverage for determining flux of water and nutrients to Lake Tarpon. Well densities are greatest where property development or other potential nutrient sources are known to exist. Specifically, the new well locations were selected to refine ground-water quality data in the vicinity of the Highland Golf Club and in areas served by septic tanks, more specifically as the area between Anderson Park and Keystone Road and along George Street.

The objectives of the project, as stated in the Agreement for Hydrogeologic Services for the Lake Tarpon Groundwater Nutrient Study (Agreement), Project 922398, include the following:

- Establish a shallow ground-water monitoring network around the lake capable of providing long-term monitoring of surficial aquifer nutrient flux to the lake.
- Develop a ground-water flow net and nutrient flux model to provide updated nutrient flux estimates to the lake.
- Assess the nutrient load from existing septic tanks and evaluate the potential nutrient load reduction to the lake by replacing those septic tanks with a central sewer system.
- Evaluate surficial aquifer water quality in the following geographic areas: 1) Highland Lakes Golf Club; 2) West and Northwest regions of the Lake; and 3) Northeast and East Regions of the lake. Installation of two monitoring wells planned for the Highlands Lakes Golf Course was cancelled when site access could not be obtained.

1.4 DESCRIPTION OF AREA GEOLOGY

The hydrogeologic units in the vicinity of the Lake Tarpon area consist of the surficial aquifer, the upper semi-confining unit, and the Upper Floridan aquifer. The surficial aquifer is contained within a unit of unconsolidated deposits of sand with interbedded layers of clayey-sand and clay and is not a source of drinking water, but is typically utilized for residential irrigation wells. These deposits vary in thickness from 30 to 50 feet and are underlain by a sandy-clay and clay unit. This sandy-clay layer is classified as part of the Hawthorn Group and functions as the upper semi-confining unit to the Upper Floridan aquifer. The thickness of the upper confining unit has been estimated to vary between 5 and 15 feet. The Upper Floridan aquifer is comprised predominantly of limestone and dolomite, and is the major water-producing unit in the region. The Upper Floridan aquifer consists of, in descending order, the Tampa Member, Suwannee Limestone, Ocala Limestone, and Avon Park Limestone. Ground-water flow in the surficial aquifer and Upper Floridan aquifer is generally to the west-southwest in the area of Lake Tarpon.

Aquifer characteristics for the surficial and Upper Floridan aquifers were obtained from the report, "Aquifer Characteristics Within the Southwest Florida Water Management District" (SWFWMD, 1987). Hydraulic conductivity and specific yield of the surficial aquifer were obtained from an aquifer test at the Eldridge-Wilde Well Field, and were 3 feet per day (ft/day) and 0.16, respectively. Transmissivity, storativity, and leakance for the Upper Floridan aquifer were obtained from aquifer tests at the Eldridge-Wilde Well Field, East Lake Well Field, and a well at Sunset Lake. Transmissivity from these tests ranged from 28,500 ft2/day to 40,000 ft2/day. Storativity ranged from 5 x 10-4 to 6 x 10-3. Leakance between the surficial and Upper Floridan aquifers ranged from 8 x 10-3 per day (d-1) to 8 x 10-4 d-1. Transmissivity values from tests at the Eldridge-Wilde and East Lake Well Fields were higher than that from the test at the Sunset Lake well. Wells at Eldridge-Wilde and East Lake Well Fields penetrate the Avon Park Limestone, while the Sunset Lake well produces water only from the Tampa and Suwannee Limestones.

2.0 TASK 1: MONITORING WELL INSTALLATION

2.1 INTRODUCTION

Task 1 (Monitoring Well Installation) activities included all onsite pre-construction meetings, notifications, utility mark-outs, permitting, and well construction and development. All work was conducted in accordance with the signed contract between Leggette, Brashears & Graham, Inc. (LBG) and the County for the Agreement for Hydrogeologic Services for the Lake Tarpon Groundwater Nutrient Study (Agreement), Project 922398.

Under this project, a total of 24 new shallow monitoring wells were installed at locations around the perimeter of Lake Tarpon. Monitoring well locations are shown on **Figure 1**. Wells were designated as LT-1 through LT-24. The letters "LT" signifies the project (Lake Tarpon) and the corresponding number signifies the location of the well. Two wells were installed at two of the referenced well locations (LT-19 and LT-21). Wells at each of these locations were further designated as "N" for north and "S" for south as follows: LT-19N (North), LT-19S (South), LT-21N (North), and LT-21S (South). The LT-19 wells were installed adjacent to a new and an old septic tank to evaluate water-quality impacts from an active versus inactive septic tank. The LT-21 wells were installed downgradient and away from a septic tank to attempt to identify specific septic tank water-quality impacts. A single monitoring well was installed at all of the remaining locations. Two monitoring wells (LT-13 and LT-14) planned for the Highlands Lakes Golf Course were cancelled when site access could not be obtained. Well locations were pre-determined and specified in the signed agreement. The rationale for each well location is provided in **Table 1**. Wells varied in total depth from 12 to 20 feet below land surface (bls). Diversified Drilling Corporation (Diversified), a Florida licensed water well contractor located in Tampa, Florida was subcontracted by LBG to install the monitoring wells. All wells were installed in accordance with 40D-3 Florida Administration Code (FAC) by Diversified under the direct supervision of LBG personnel.

2.2 PRE-CONSTRUCTION ACTIVITIES

Pre-well construction activities included pre-construction meetings, permitting, utility clearance, scheduling, and written or verbal notifications required under access agreements or utilization permits.

2.2.1 Pre-Construction Meetings

Prior to the installation of the monitoring wells, two onsite pre-construction meetings were held to confirm the locations of the monitoring wells and to familiarize all parties with actual site conditions, including, but not limited to: utility locations, site access, right of way (R.O.W.) boundaries, and any special restrictive site conditions. Representatives of LBG, Diversified, Pinellas County Utilities Engineering Department and the Pinellas County Department of Environmental Management were present at each of the pre-construction meetings.

2.2.2 Permits

A State of Florida well construction permit was obtained from the SWFWMD by Diversified prior to the initiation of well installation activities for each of the 24 shallow monitoring wells. Additionally, six of the wells (LT-10, LT-11, LT-12, LT-18, LT-20, and LT-22) required Pinellas County Highway Department Right of Way Utilization Permits, and five wells (LT-2, LT-3, LT-4, LT-5, and LT-6) required building permits in accordance with a License Agreement between the County and the City of Tarpon Springs Building Department. The County obtained the Right of Way Utilization Permits and City of Tarpon Springs building permits, and furnished copies to LBG before the start of well construction activities. Copies of all permits were kept onsite and available for inspection during the well construction activities.

2.2.3 Utility Clearance

A minimum of 48 hours prior to the initiation of monitoring well installation activities, the Sunshine State One Call of Florida, Inc. was contacted to request utility mark outs at each well location and to verify that no utility conflicts existed at any of the proposed well locations.

2.2.4 Notifications

On May 9, 2002, pursuant to the Pinellas County Right of Way Utilization Permit, LBG gave verbal notification of intent to proceed with construction activities to the Pinellas County Highway Department, a minimum of 48 hours prior to beginning installation of the monitoring wells LT-10, LT-11, LT-12, LT-18, LT-20, and LT-22.

On May 23, 2002, LBG provided advance verbal notification to the City of Tarpon Springs of intent to proceed with construction activities for monitor wells LT-2 through LT-6. Advanced verbal notification was also given to the Park Supervisor at Chestnut Park (LT-15), and to the private property owners for the locations of wells LT-7, LT-8, LT-16, LT-19, LT-21, LT-23, and LT-24.

2.3 WELL CONSTRUCTION ACTIVITIES

Well construction activities consisted of all field activities required to construct and develop the proposed wells including: mobilization of equipment and crews, well drilling and installation, development, and lithologic logs.

2.3.1 Mobilization

LBG mobilized to the project area to initiate well installation activities beginning on May 13, 2002. Well installation activities were completed on May 28, 2002. Well installation activities were staggered based on availability of drilling crews and occurred on the following dates: May 13, May 14, May 15, May 21, May 24, and May 28, 2002. Installation activities were initiated at monitor well LT-21, located at 216 South George Street on the northeast edge of Lake Tarpon and continued in a general clockwise rotation around Lake Tarpon.

2.3.2 Well Installation Methods

LBG supervised the installation of 24 shallow monitoring wells around the perimeter of Lake Tarpon in Pinellas County, Florida. Diversified Drilling installed all wells in accordance with Florida Department of Environmental Protection (FDEP) and the SWFWMD criteria by a State of Florida licensed drilling contractor. All down-hole equipment, including well screens and casings were decontaminated prior to use.

Monitoring wells LT-19N, LT-19S, LT-21N, LT-21S, LT-23, and LT-24 were installed using a hand auger due to the inaccessibility to the well site with a conventional drilling rig. The hand auger was equipped with a 6-inch inner-diameter auger bucket in order to provide a minimum 2-inch annular space for filter pack installation. Each of the hand-augered wells was installed to a total depth of 12 feet bls. Drilling mud was added to the formation water during installation to prevent the borehole from collapsing below the water table. Once installation was complete, each of the wells was continuously flushed with clean potable water to remove excess drilling mud from the well screen, filter pack, and sidewalls of the borehole.

All of the remaining wells (LT-1 through LT-12, LT-15 through LT-18, LT-20, and LT-22) were installed with a BK-51 truck-mounted drilling rig utilizing 4.25-inch inside diameter hollow stem augers (HSA). The HSA flights produced a nominal 8 to 9-inch diameter borehole. PVC well casings and screens were installed through the center of the auger negating the use of drilling mud. These wells were installed to total depths of 12 to 20 feet bls. Total depths for each well are listed in **Table 2**.

2.3.3 Well Construction Details

Wells were constructed of 2-inch inner diameter, flush-jointed Schedule 40 PVC, with 10 to 15-foot lengths of machine slotted well screen (0.010-inch openings) attached to 2-inch solid PVC casing. Fifteen (15)-foot screens were utilized in wells at locations anticipated to have slow recharge or at wells with total depths of 16 feet or greater. All wells were constructed such that the upper surface of the water table would intersect the screened interval of the well. The FDEP requires that permanent monitoring wells be constructed with a minimum 2-foot solid PVC riser to allow adequate space for placement of a proper well seal and filter pack. A 20/30-grade silica sand filter pack was placed within the annular space between the borehole and the well screen to approximately one-foot above the screen. A one-half to one-foot thick fine sand seal (30/65 grade silica) was placed on top of the 20/30-grade silica sand filter pack. Portland Type I cement grout was then placed on top of the fine sand seal to land surface to ensure that surface infiltration would not preferentially flow down the borehole. Wells were completed with a locking, expandable cap and enclosed within an 8-inch diameter flush mounted manhole or a standup 4-inch x 5-foot protective metal riser with a hinged top. The manholes or standup risers were installed in the center of a 4-inch thick concrete pad approximately 2 feet by 2 feet in dimension. Monitoring well construction details for total depth and screen lengths are listed in **Table 2**. The typical monitoring well construction is shown on **Figure 2**. Additional well construction details are listed in the geologic well logs attached as **Appendix A**.

Monitoring well LT-16 was the only well constructed with a protective metal riser; all other wells were completed with flush mounted manholes. A metal-riser construction was used for LT-16, located approximately 5 feet inside an un-maintained wooded area off Jasmine Avenue in order to provide protection from flooding and to aid in identifying and locating the well. The metal riser consists of a 4-inch by 4-inch by 5-foot rectangular aluminum "box" open at one end and having a hinged cover at the other. The well is completed such that the PVC well casing extends or sticks up approximately 3 feet above the concrete well pad. The open end of the aluminum box is placed over the PVC casing "stickup" and secured into the concrete well pad such that the top of the PVC stickup can be accessed when the hinged top is opened. The metal riser provides both protection and visibility for wells located in un-maintained areas.

Monitoring well LT-05 is located adjacent to a canal along the southern edge of Wegman Drive. Neighborhood residents frequently use the area around the well to park their boat trailers and there was some concern that access to the well could be restricted by one of the trailers being parked over the well. To prevent this from occurring, 4.5-inch diameter hollow metal bollards were placed at each corner of the 2 feet by 2 feet concrete pad. The bollards extend approximately 2 feet above land surface and 3 feet below land surface and are anchored in place with cement. The hollow centers of the bollards were filled with clean sand and completed with a cement cap.

2.3.4 Well Development

Upon completion, each well was developed using a submersible or rig-mounted centrifugal pump to ensure an adequate hydraulic connection between the filter pack and surrounding formation, and to remove fine sand and silt from the sand pack and well. A submersible pump was used when access to a well with the drill rig was not possible. Each well was alternately pumped and surged until the discharge water was free of sand and suspended sediment. Sustained pumping rates varied between 1.0 to 15.0 gallons per minute (gpm). Dry purge conditions were experienced at several wells with very low recharge rates. When these conditions occurred, the well was allowed to recharge and then pumped until dry. This process was repeated until the discharge was free of sand and suspended sediment.

2.3.5 Well Lithologic Conditions

The lithology of each well was logged in the field based on the examination of the well cuttings. Undisturbed sediments were characterized predominantly by fine to very fine-grained sands with variable amounts of silt, organics and clay. Lithologic details for the monitoring wells are contained in the Geologic Well Logs attached as **Appendix A**.

3.0 TASK 2: DATA COLLECTION

Task 2 (Data Collection) activities included the collection of ground-water samples and water-level data from a total of thirty-one (31) surficial aquifer monitoring wells and the collection of hydraulic conductivity data from twenty-one (21) surficial aquifer monitoring wells. All work was conducted in accordance with the signed contract between LBG and the County for the Agreement for Hydrogeologic Services for the Lake Tarpon Groundwater Nutrient Study (Agreement), Project 922398.

3.1 GROUND-WATER QUALITY SAMPLING

A total of twenty-four (24) new shallow monitoring wells and seven (7) pre-existing shallow monitoring wells were sampled for this project. The locations of all 31 monitoring wells are shown on **Figure 1**. Each well was sampled once during the May 2002 and once during October 2002 for those parameters determined by the County as listed in Section 2.3 C of Proposal No 012-33-P (DD) and shown below.

Cations:	**Anions:**	**Nutrients:**
Calcium (Ca)	Chloride (Cl)	Total nitrogen (TN)
Magnesium (Mg)	Sulfate (SO_4)	Ammonia nitrogen (NH_4)
Sodium (Na)	Bicarbonate and/or (HCO_3)	Nitrate nitrogen (NO_3)
Potassium (K)	Alkalinity (Alk)	Nitrite + nitrate nitrogen (NO_2+ NO_3)
Strontium (Sr)	Fluoride (Fl)	Total phosphorous (TP)
Iron (Fe)		Orthophosphate (OP)
Other Analytes:		
Total Dissolved Solids (TDS)	Total Organic Carbon (TOC)	pH (field measured)

Additionally, one set of samples were collected from all twenty-four (24) new shallow monitoring wells and the seven (7) pre-existing shallow monitoring wells for analysis of isotopic nitrogen ratios ($^{15}N/^{14}N$) during the October 2002 sampling event. Of the 31 wells sampled, samples from 17 wells were selected for analysis of isotopic nitrogen. The 31 samples were taken to the US Biosystems' laboratory facility in Tampa, Florida for storage until selection of the 17 samples was determined.

3.1.1 Sampling Methodology

All sampling activities were conducted in accordance with the FDEP New Ground-Water Sampling Standard Operating Procedures (SOPs), effective April 10, 2002. Prior to sample collection, each well was purged a minimum 3 well volumes or 1 well volume and 2 equipment volumes (for wells with very low recharge rates). All well purge and sampling activities were conducted with a peristaltic pump and dedicated tubing using low flow (less than one liter per minute) quiescent procedures.

Sample containers were provided to LBG by the SWFWMD laboratory along with bulk containers of nitric and sulfuric acid for sample preservation. Prior to sample collection, field-sampling personnel added the required aliquots of the acid preservatives to the proper sample containers [Nitric Acid for: Ca, Mg, Na, K, Sr, Fe and sulfuric acid for: NH_4, NO_3, TP, and TOC] in accordance with the instructions provided by the SWFWMD laboratory. Samples collected for all parameters except orthophosphate were unfiltered. Samples collected for analysis of orthophosphate were field filtered using a 1.0-micron in-line disposable filter. In accordance with the New FDEP SOPs for general aqueous sampling (DEP-SOP-001/01 FS 2000.1.37), effective April 10, 2002, a 0.45-micron filter should be used when filtering ground-water samples for all constituents other than metals. US Biosystems, Inc. indicated that a 1.0 micron filter was used to collect the dissolved (filtered) samples for analysis of orthophosphate. LBG research of filter use for the collection of orthophosphate samples indicates that the effect of using a 1.0-micron filter would be negligible with regard to the reported orthophosphate levels in the Lake Tarpon samples. According to Standard Methods for the Examination of Water and Wastewater (1997), filtration through a 0.45-micron membrane filter separates dissolved from suspended forms of phosphorus. No claim is made that filtration through 0.45 micron filters is a true separation of suspended and dissolved forms of phosphorus; it is merely a convenient and replicable analytical technique designed to make a gross separation." Use of a 1.0-micron membrane filter may result in slightly elevated orthophosphate concentrations. Review of the data suggests that this was not a significant factor in the orthophosphate results. The samples were placed on wet ice in insulated storage containers and transported the next day, under chain of custody, to the SWFWMD laboratory facility in Brooksville, Florida by LBG personnel.

3.1.2 <u>May 2002 Sampling Event</u>

Dry-season ground-water samples were collected from the twenty-four (24) new and seven (7) pre-existing shallow monitoring wells during the weeks of May 12, 2002, May 26, 2002 and June 2, 2002. Upon receipt of the samples collected on May 30, 2002, the SWFWMD reported sample temperatures that exceeded the acceptable upper limit (6 degrees Celsius) for proper preservation. Accordingly, those wells (LT-01, LT-02, LT-03, LT-04, LT-05 and WRAP-47) were re-sampled on June 4, 2002 and submitted to the SWFWMD for analysis. The sample dates for all wells, including Quality Assurance/Quality Control (QA/QC) samples, are listed in **Table 3**.

Both filtered and unfiltered samples for metals analysis were collected from monitoring well LT-03 during the sampling event (May/June 2002) due to high sample turbidity. The new FDEP sampling procedures (DEP-SOP-001/01), effective April 10, 2002, indicate that one of the conditions for purge completion is that sample turbidity should be no greater than 20 nephelometric turbidity units (NTUs). If turbidity levels are greater than 20 NTUs after a purge of five well volumes is complete, the new SOPs leave it to the discretion of the project leader whether to collect a sample or continue purging. After 5 purge volumes, well LT-03 exhibited a turbidity of 65.6 NTUs. Therefore, the project leader instructed the sampler to collect filtered and unfiltered samples for metals analysis only in order to evaluate whether the analytical results would be biased by the suspended sediments in the turbid samples. Samples for metals analysis only for LT-03, were filtered in the field using a 1.0-micron in-line disposable filter. The SWFWMD laboratory personnel were instructed to analyze both the filtered and unfiltered samples. Laboratory analysis did not indicate any significant difference between the filtered and unfiltered metals samples. Laboratory analytical results for these samples are summarized in **Table 4**.

3.1.3 October 2002 Sampling Event

Ground-water samples were collected from the twenty-four (24) new and seven (7) pre-existing shallow monitoring wells during the weeks of October 20, 2002, and October 27, 2002. Turbidity levels for all samples were within acceptable limits and did not necessitate the collection of additional filtered samples for metals. The sample dates for all wells, including QA/QC samples, are listed in **Table 3**. Laboratory analytical results for the wet-season samples are summarized in **Table 5**.

3.1.4 Isotopic Nitrogen Sample Collection

In accordance with the signed Agreement, ground-water samples for the analysis of isotopic nitrogen ratios were to be collected and analyzed from 17 of the 31 wells as recommended by the Consultant and approved by the County. The 17 wells were selected based on nitrogen concentration, land use, and any other factors made apparent from the evaluation of the basic chemical and hydraulic data. In order to facilitate this process, two unfiltered one-liter samples were collected from each well (total of 31 wells) for the analysis of isotopic nitrogen ratios concurrent with the October 2002 sampling event. The samples were collected in non-preserved (without acid) one-liter high density polyethylene (HDPE) containers, placed on wet ice in insulated storage containers and transported under chain-of-custody to the US Biosystems' laboratory facility in Tampa, Florida for proper storage. To ensure sample integrity, the stored samples were frozen and maintained at a constant temperature of less than negative 10 degrees Celsius. Once the selection was approved by the County, samples from the 17 selected wells were transported under chain-of-custody to Coastal Science Laboratories, Inc. in Austin, Texas for isotopic nitrogen ratio analysis.

3.2 WATER-LEVEL DATA COLLECTION

Water-level data was collected from each of the thirty-one (31) monitoring wells concurrent with the dry-season and wet-season sampling events. The depth to water level in each monitoring well was measured to the nearest 0.01 foot from the north side of the top of the wellhead casing to the water surface using an electronic water-level indicator. The ground-water elevation at each well was determined by subtracting the measured depth to water from the wellheads surveyed top of casing elevation (TOCE). A summary of depth to water and water-elevation data for the monitoring wells is provided in **Table 6**.

The Pinellas County Public Works Division of Survey and Mapping surveyed the TOCE of each newly installed monitoring well. The TOCE data for the 24 new wells was provided to LBG in the report "Specific Purpose Survey Report SFN 1238 - Lake Tarpon Monitor Wells," **Appendix B**. The TOCEs surveyed by the County are recorded in feet and are based on NGVD 1929 Vertical Datum. Additionally, the County provided LBG with TOCE datum for existing wells: NP-137, NP-141, NS-07, SM-43, TLV-157, and TLV-177. A TOCE for the SWFWMD monitoring well, WRAP-47, was not provided to LBG and therefore, a water-level elevation for that well could not be determined.

3.3 HYDRAULIC CONDUCTIVITY DATA COLLECTION

LBG conducted hydraulic conductivity tests on a total of twenty-one (21) monitoring wells on October 25, 2002 and during the week of January 19, 2003 to evaluate hydraulic conductivity of the surficial aquifer. In a memo dated August 20, 2002, LBG recommended ten primary and seven supplemental wells to the County for hydraulic conductivity testing. The supplemental selections were intended to establish a more complete database by providing less space between wells and to provide a greater level of assurance in the data by allowing a comparison of tests for several closely spaced or paired wells. In response to comments and recommendations contained in a September 4, 2002 email from the County, LBG issued a revised recommendation for ten primary and eleven supplemental wells to the County in a memo dated September 24, 2002. The County subsequently approved the ten primary wells (LT-01,

LT-04, LT-07, LT-10, LT-12, LT-15, SM-43, LT-19S, LT-21S and LT-22) and the eleven supplemental wells (LT-02, LT-03, LT-06, LT-08, LT-11, NP-141, WRAP-47, LT –16, LT-18 LT-20, and LT-24) recommended by LBG for hydraulic conductivity testing. The approximate locations of the wells selected for hydraulic conductivity testing are shown on **Figure 3**.

3.3.1 Slug Test Methodology

Slug tests were conducted on all of the tested wells, except well SM-43, using the "slug-out" method to evaluate the hydraulic conductivity of the surficial aquifer. The "slug-out" method consists of quickly lowering the water level in the well and measuring its rate of fall and subsequent recovery. The water level is lowered by inserting a solid section of PVC pipe, capped at both ends and filled with sand for added weight, into the well to a level where the top of the PVC pipe or "slug" is below the static water level in the well. The insertion of the slug causes a positive displacement of the water level in the well equal to the volume of the slug. A seven foot long, one-inch diameter PVC slug was utilized for the tests. The water level in the well with the slug inserted is allowed to equilibrate back to static level conditions and the slug is quickly removed which results in a negative displacement or lowering of the static water level. The change in water-level data, initiating with the removal of the slug and terminating with recovery to static level, was recorded using a Mini-Troll 9000 model In-Situ pressure transducer/data logger inserted into the well below the level of the slug and prior to insertion of the slug. Pressure readings are automatically converted to water-level heights above the pressure transducer and recorded electronically to a laptop computer.

LBG elected not to use the slug-out method to evaluate the hydraulic conductivity for well SM-43. This was deemed not to be the optimal method for well SM-43 due to the larger (six-inch) size diameter of the well casing. All other wells tested for this study were constructed with two-inch diameter well casings. Rather, the water level in well SM-43 was lowered approximately 5 to 6 feet using a submersible pump. As the water level returned to equilibrium or a static condition, the rate of change in the water level was monitored and recorded using the Mini-Troll 9000 In-Situ Troll pressure transducer/data logger.

3.3.2 Data Analysis

Upon completion of the tests, the data was reduced and used to calculate the hydraulic conductivity of the sediments in the upper portions of the surficial aquifer using the AquiferWin32 analytical software. The AquiferWin32 program utilized the Bouwer-Rice (Unconfined Aquifer Slug Test) analytical method. Hydraulic conductivity data and test dates for the twenty-one referenced wells are listed in **Table 7**. Reports for the AquiferWin32 program aquifer characterization and In-Situ data for each test are included in **Appendix C**. Hydraulic conductivity values for the 21 wells ranged from 2 ft/day to 33 ft/day, and averaged 11.3 ft/day. The site-specific horizontal hydraulic conductivity data obtained from this study were used in the nutrient flux model calculations as discussed in Section 4.4.

4.0 TASK 3: DATA ANALYSIS, MODELING, AND DOCUMENTATION

4.1 GROUND-WATER QUALITY ANALYSIS

4.1.1 General Water Chemistry

The chemical composition of ground water in the surficial aquifer at any location is defined by the sources of recharge to the aquifer, geochemical reactions that occur along the flow path, and influxes of water from other differing water quality, i.e. upward leakance from the Upper Floridan aquifer or the occurrence of a freshwater/saltwater interface. Composition of water in the surficial aquifer is defined by the major ions calcium (Ca^{2+}), potassium (K^{+}), sodium (Na^{+}), magnesium (Mg^{2+}), bicarbonate (HCO_3^{-}), chloride (Cl^{-}), sulfate (SO_4^{2-}), and total dissolved solids (TDS). The concentrations of these constituents for the samples collected in early June 2002 and October 2002 are shown in **Tables 4 and 5**, respectively. The composition of water in each well was characterized by plotting the major ion constituents from the October 2002 data on a Piper Diagram (**Figure 4**). The Piper Diagram provides a means to graphically illustrate the composition of water samples based on the percentages of the major ion species identified above. Review of the data in **Tables 4 and 5** and the Piper Diagram shows that the water chemistry is highly variable between the 31 wells sampled. Water-quality data from surficial aquifer monitoring wells at the former East Lake Well Field can be considered to represent background water quality in the surficial aquifer in the area. Data from SWFWMD (1990) indicates that water in the surficial aquifer is of the following general chemistry:

Calcium	2.7 to 24 mg/l
Sodium	4.9 to 20.5 mg/l
Magnesium	0.7 to 2.9 mg/l
Bicarbonate	0.1 to 23.9 mg/l
Chloride	10.3 to 55 mg/l
Sulfate	5.1 to 12.3 mg/l
TDS	84 to 170 mg/l

Ground-water quality can be defined in terms of hydrochemical facies. Freeze and Cherry (1979) describe a hydrochemical facies as "distinct zones that have cation and anion concentrations describable within defined composition categories". Four hydrochemical facies were identified for these wells: Ca–HCO_3, Na-Cl, Na-Cl-SO_4, and transitional. A Ca–HCO_3 facies was identified in five wells, all along the west side of Lake Tarpon. The locations of these wells are shown on **Figure 5**. The samples from four of these wells (LT-05, LT-08, LT-11, and NS-07) contained TDS concentrations ranging from 185 to 270 (mg/l) milligrams per liter, total alkalinity (bicarbonate) ranging from 99 to 167 mg/l, calcium ranging from 44 to 142 mg/l, and chloride ranging from 5 to 40 mg/l. This water quality may be indicative of areas irrigated with potable water from Pinellas County Utilities, as the quality is similar to that reported from Upper Floridan aquifer wells at the Eldridge-Wilde Well Field. The fifth well (LT-04) had a TDS concentration in excess of 650 mg/l, total alkalinity of 435 mg/l, calcium of 142 mg/l, and chloride of 92 mg/l. This water quality may be representative of an area irrigated with local Upper Floridan aquifer water, which is higher in chloride and TDS.

A Na-Cl facies was identified in two wells, one at the northeast end of Lake Tarpon (LT-01) and one along the southeast side of the lake (TLV-177). The locations of these wells are shown on **Figure 5**. The total alkalinity and calcium concentration concentrations for these wells shown in **Table 5** suggest that the water quality in these wells is representative of background surficial aquifer water. The elevated chloride and TDS concentrations at LT-01 are likely background for that area. The area around TLV-177 is irrigated with reclaimed water. The elevated chloride concentration of 152 mg/l in this well is similar to the concentrations of 159 to 194 mg/l reported for effluent from the William E. Dunn Water Reclamation Facility, and is indicative of the effect of reclaimed water on surficial aquifer water quality in the area.

A Na-Cl-SO_4 facies was identified in five wells, one at the north end of Lake Tarpon (LT-21N), three along the east side of the lake (LT-16, LT-20, and TLV-157) and one at the southwest end (WRAP-47). The locations of these wells are shown on **Figure 5**. Although each of these wells contained water quality in the same facies, the concentrations of the constituents were dissimilar, with TDS concentrations ranging from 65 to 648 mg/l, sulfate from 16 to 88 mg/l, and chloride from 13.7 to 255 mg/l. This variation is due to different sources of recharge to the surficial aquifer in each area.

The majority of the wells have water quality that is transitional from Ca–HCO_3 to Na-Cl. The water quality in these wells is highly variable, and defined by the source and quantity of water used for irrigation in each area. For example, water in well LT-10 contains high TDS, chloride, and calcium concentrations, which is indicative of irrigation with local Upper Floridan aquifer water. Well LT-9, located about 0.5 miles north of LT-10 has water quality that is within the ranges of background surficial aquifer water quality shown above, which suggests less influence of irrigation water.

4.1.2 Nutrient Constituents

Nutrient loading in the surficial aquifer was evaluated using the following constituents: nitrate+nitrite (nitrate); total nitrogen, total ammonia; organic nitrogen; orthophosphate; and total organic carbon (TOC). A summary of the results for each constituent follows.

4.1.2.1 Nitrate

The laboratory reported nitrate+nitrite concentration, and nitrite concentration only. Nitrite made up an average of less than one percent of the nitrate+nitrite concentration, therefore the nitrate+nitrite concentration is used as the nitrate concentration in this analysis. Nitrate concentration ranged from 0.01 to 12.3 mg/l in the samples collected in May 2002, and 0.01 to 8.18 in the October 2002 samples. A graph of nitrate concentrations for each well shown on **Figure 6** indicates that there was no consistent seasonal relationship in nitrate concentrations between sampling events at each well. Nitrate concentrations greater than 1.0 mg/l were detected in 11 of the 31 wells sampled. As shown on **Figure 7**, 10 of these 11 wells are located on the west side of the lake. Six of these 10 wells (LT-1, LT-3, LT-5, LT-7, NP-137, and LT-24) are located in unsewered areas. One well (WRAP-47) is located down gradient of a septic tank on a golf course irrigated with reclaimed water. The other three wells are located in sewered areas that do not use reclaimed water. Well LT-11 is located near a ditch that carries stormwater runoff to Lake Tarpon, and NS-07 is a background well for the reclaimed water system at the Innisbrook development. Well NP-141, located in a sewered subdivision had the highest nitrate concentrations detected in this study. The one well with elevated nitrate concentration located on the east side of the lake (TLV-157) is on the Lansbrook Golf Course, which is irrigated with water from an Upper Floridan aquifer well.

4.1.2.2 Ammonia

Ammonia concentration ranged from 0.01 to 7.07 mg/l in the samples collected in May 2002, and from 0.01 to 2.69 mg/l in the October 2002 samples. A graph of ammonia concentrations for each well shown on **Figure 8** indicates that most of the wells had higher ammonia concentrations detected in the May samples than in the October samples. Ammonia concentrations greater than 1.0 mg/l were detected in 9 of the 31 wells sampled. As shown on **Figure 9**, six of these wells are located on the east side of the lake. Wells LT-19N and LT-19S are located in an unsewered area. Wells LT-17 and LT-18 are located in sewered areas. TLV-157 is located on the Lansbrook Golf Course, which is irrigated with water from an Upper Floridan aquifer well. LT-15 is near a pond in an area irrigated with water from Lake Tarpon. Of the three wells located on the west side of the lake, LT-4 and LT-7 are located in unsewered areas, and LT-10 is in a sewered area near a nursery.

4.1.2.3 Total Nitrogen

Total nitrogen is the sum of nitrate+nitrite, ammonia, and organic nitrogen concentrations. Total nitrogen concentration ranged from 0.01 to 12.8 mg/l in the samples collected in May 2002, and from 0.01 to 10.2 mg/l in the October 2002 samples. A graph of total nitrogen concentrations for each well shown on **Figure 10** indicates that there was no consistent relationship in total nitrogen concentration between sampling events at each well. Total nitrogen concentrations greater than 2.0 mg/l were detected in 19 of the 31 wells sampled, as shown on **Figure 11**.

4.1.2.4 Organic Nitrogen

Organic nitrogen concentration for each sample was calculated by subtracting the sum of nitrate+nitrite and ammonia concentrations from the total nitrogen concentration. Organic nitrogen concentration ranged from 0.0 to 1.67 mg/l in the samples collected in May 2002, and from 0.0 to 2.48 mg/l in the October 2002 samples. A graph of organic nitrogen concentrations for each well shown on **Figure 12** indicates that most of the wells had higher concentrations detected in the October samples than in the May samples. Of particular interest are the higher concentrations in the October samples from the monitoring wells located at the unsewered northwest area of Lake Tarpon. The higher organic nitrogen concentrations suggest that denitrification is not as active in this area, which may be related to the seasonal variation in water table elevation. Organic nitrogen concentrations greater than 1.0 mg/l were detected in 9 of the 31 wells sampled. The locations of wells with organic nitrogen concentrations greater than 1.0 mg/l during the May and October sampling events are shown on **Figure 13**. Only three of these wells (LT-10, LT-17, and LT-23) had concentrations greater than 1.0 mg/l in both samples. LT-10 and LT-17 are located in sewered residential areas near wetlands, which suggests that the organic nitrogen may be due to decomposition of organic material in the wetlands. LT-23 is located downgradient of a septic tank drain field.

4.1.2.5 Orthophosphate

Orthophosphate concentration ranged from 0.01 to 0.47 mg/l in the samples collected in May 2002, and 0.01 to 1.4 mg/l in the October 2002 samples. Comparison of orthophosphate and total phosphorus concentrations indicated that orthophosphate made up 54 to 100 percent of the total phosphorus concentration in the October samples and 7 to 100 percent of the total phosphorus concentration in the May samples. A graph of orthophosphate concentrations for each well shown on **Figure 14** indicates that most of the wells had higher concentrations detected in the October samples than in the May samples. Orthophosphate concentrations greater than 0.5 mg/l were detected in three of the 31 wells sampled (LT-2, LT-4, and LT-7), all of which are located in the unsewered residential area along the northwest shore of Lake Tarpon. Orthophosphate is a common ingredient in fertilizers.

4.1.2.6 Total Organic Carbon

Total organic carbon (TOC) concentrations ranged from 0.4 to 49.1 mg/l in the samples collected in May 2002, and 0.8 to 60.6 mg/l in the October 2002 samples. A graph of TOC concentrations for each well shown on **Figure 15** indicates that there was no consistent relationship in total organic carbon concentration between sampling events at each well. The locations of the wells with TOC concentrations greater than 10 mg/l are shown on **Figure 16**.

4.1.3 Nitrogen Species and TOC Concentration

Comparison of **Figures 11** and **16** indicates that most of the wells with elevated total nitrogen concentrations also contain elevated TOC concentrations. This relationship was not observed with phosphorous and TOC. **Figure 17** shows a graph of total nitrogen concentration versus TOC concentration. Four groupings of wells are apparent on this graph. Group 1 wells have total nitrogen concentrations less than 1.0 mg/l and TOC concentration less than 10 mg/l. Group 2 wells have total nitrogen concentrations between 1.0 and 2.0 mg/l and TOC concentrations greater than 10 mg/l. Group 3 wells have total nitrogen concentrations greater than 2.0 mg/l and TOC concentrations less than 20 mg/l and, and Group 4 wells have total nitrogen concentration greater than 2.0 mg/l and TOC concentrations greater than 20 mg/l.

Group 1 wells represent water quality that is apparently unaffected by nutrient sources. Four of the wells (LT-20, LT-21S, LT-21N, and LT-22) are located on the northeast corner of the lake, which is an area of mixed sewered and unsewered residences (see **Figure 18**). Two of the wells (LT-9 and LT-12) are located in sewered areas. Well SM-43 is located in a debris disposal/tree farm for Chestnut Park, upgradient of a wetland area.

The six Group 2 wells have elevated TOC concentrations and slightly elevated total nitrogen concentrations. Four of these wells (LT-02, LT-03, LT-04, and LT-08) are located in the unsewered area on the northwest portion of the lake (see **Figure 18**). The other two wells are on the east side of the lake, one (LT-16) in a sewered area, and the other (TLV-177) in a sewered area irrigated with reclaimed water.

The Group 3 and 4 wells both have elevated total nitrogen concentrations. However, a distinct separation of wells is apparent at about 20 mg/l TOC concentration. Group 3 wells have TOC concentrations less than 20 mg/l, and Group 4 wells have TOC concentrations greater than 20 mg/l. In general, higher TOC concentrations tend to result in water that is low in dissolved oxygen, creating reducing conditions that favor nitrogen occurring as ammonia. Conversely, lower TOC concentrations result in higher dissolved oxygen concentrations, which causes the oxidation of ammonia to nitrate. Therefore, TOC concentrations were plotted against nitrate and ammonia concentrations to assess the relationship of TOC concentration in the form of nitrogen present in the ground water. The graph of nitrate concentration versus TOC concentration shown on **Figure 19** indicates that the Group 3 wells have elevated nitrate concentrations and TOC concentrations less than 20 mg/l, while **Figure 20** shows that Group 4 wells have elevated ammonia concentrations with TOC concentrations greater than 20 mg/l. As shown on **Figure 18**, all of the Group 3 wells (LT-1, LT-5, LT-6, LT-24, NP-137, NS-07, LT-11, NP-141, and WRAP-47) are located on the west side of Lake Tarpon. Five of the wells are located in the unsewered area on the northwest side of the lake, three are located in sewered residential areas, and one is near a septic tank on a golf course irrigated with reclaimed water. **Figure 18** also shows that six out of the eight Group 4 wells (LT-15, LT-17, LT-18, LT-19N, LT-19S and TLV-157 are located on the east side of Lake Tarpon, in areas of mixed sewered and unsewered residences, a golf course irrigated with Upper Floridan aquifer water, and an area near a former effluent sprayfield. One of the three wells on the west side of the lake (LT-10) is located in a sewered area and the others (LT-7 and LT-23) are located in an unsewered area.

As shown on **Figure 18**, elevated nitrate or ammonia levels occur in both sewered and unsewered areas, and in areas using reclaimed water. However, some wells located in these same areas did not contain elevated nutrients. These results are consistent with the findings in ERM (1998) that elevated nutrients concentrations are generally localized in the areas near the source. The potential sources of elevated nutrients in the surficial aquifer are septic tanks, reclaimed water, and fertilizers. There are no consistent relationships between the observed land use at each monitoring well location and the locations of elevated nutrients that clearly define the source.

4.2 ISOTOPIC NITROGEN ANALYSIS

Seventeen water samples were collected from the monitoring well network established for this study to measure the nitrogen isotope composition ($\delta^{15}N$) of either the dissolved nitrate (NO_3) or dissolved ammonium (NH_4). Nitrogen isotope analyses have previously been used to determine sources of nitrate in ground water and surface water. This approach has been used effectively to determine whether a nitrate source is from an animal waste source (e.g. septic tanks, sewage treatment plants, barnyards, and feedlots) or an agricultural source (either nitrogen from fertilizers or from other cultivation processes in agricultural areas). Nitrogen isotope analyses were used for this study to help identify nitrogen sources in the ground water around Lake Tarpon.

The nitrogen isotope ratio is a measure of the ratio of the naturally occurring isotopes of nitrogen, ^{14}N and ^{15}N. The more enriched a nitrogen sample (either as NO_3, NH_4 or as total nitrogen) is in the nitrogen -15 isotope (versus the nitrogen -14 isotope), the heavier (or greater) will be its $\delta^{15}N$ value. **Figure 21** shows the range of isotopic values that several researchers have observed for ground water nitrate. The heavier (or more enriched) in ^{15}N nitrate samples the higher the probability the nitrate originated from an animal waste source. This enrichment in ^{15}N results primarily from the volatilization of isotopically light ammonia during the decomposition of animal waste material. As isotopically light ammonia leaves as a gas, the remaining nitrogen becomes enriched in ^{15}N, the heavier isotope. NO_3, the end product of the decomposition of the organic waste then is also enriched in nitrogen-15.

Denitrification also causes an increase in the $\delta^{15}N$ of ground water nitrate. Nitrate concentrations, however, are typically very low, which makes the source of these values discernable from animal waste nitrates, which often have higher concentrations. Tihansky and

Sacks (1997) identified this reaction occurring in their study of the ground-water nitrate in the Central Lake District in Polk and Highlands Counties, Florida (see discussion below).

The source of ground-water nitrate with lighter (or depleted) $\delta^{15}N$ values is considered to be from natural sources (decay of organic material) or non-animal waste agricultural sources (soil cultivation and fertilizer). Fertilizer is produced from a high temperature reaction of natural gas with atmospheric nitrogen and has an isotopic composition similar to atmospheric nitrogen, which is significantly lighter than the animal waste nitrogen. Cultivation nitrogen is the oxidation of the organic nitrogen that naturally occurs in soils as well as the mixing of fertilizer nitrogen when applied to agricultural soils. This nitrate has an isotopic composition similar to fertilizer nitrogen or may be slightly heavier than fertilizer nitrogen alone. These two sources (fertilizer nitrogen and cultivation nitrogen) have isotopic compositions sufficiently similar that they often cannot be differentiated from each other. However, they often can be separated from nitrates that may originate from animal waste.

4.2.1 Previous Nitrogen Isotope Studies of Ground Water in Florida

There have been two previous studies of nitrogen isotopes of ground-water nitrogen in Florida. They are reports by Tihansky and Sacks (1997) in the Central Lake District in Polk and Highlands Counties, Florida, and ERM's (1998) of the Lake Tarpon drainage basin, which includes the current study area, but they collected very few samples specifically from the current study area.

4.2.1.1 Central Lake District, Polk and Highland Counties, Florida (1997)

Tihansky and Sacks (1997) analyzed the nitrogen isotopes of nitrate from 80 ground water samples collected in dry (June, 1996) and wet (October, 1996) seasons from several different land uses areas in the Central Lake District, Polk and Highland Counties, Florida. The different land uses included citrus, undeveloped, mixed, residential, and lake. **Figure 22** plots the $\delta^{15}N$ values versus the nitrate-nitrogen (NO_3-N) concentrations. Three important groupings are apparent from this figure. They are 1) the concentration and nitrogen isotope values for the citrus area, 2) the residential area and 3) the undeveloped area.

Many of the samples from citrus grove areas with high nitrate concentration waters (NO_3-N concentrations ranged from 12-57 mg/l) have isotopic compositions ($\delta^{15}N$ range of –1.8 to 5.3 o/oo) similar to fertilizer or cultivation nitrate and represent waters from the citrus land use category. Tihansky and Sacks (1997) considered the source of the nitrate in these ground waters to be from nitrate fertilizers.

The waters in the undeveloped area have very low nitrate concentrations (about 0.002 mg/l) with high $\delta^{15}N$ values ($\delta^{15}N$ values range from 9.7 to 16.6 o/oo). These low nitrate values may result from, a two-step process: (1) natural recharge of a low nitrate water and (2) subsequent denitrification. The ground water in the surficial aquifer contains significant concentrations of dissolved organic carbon (total organic carbon (TOC)). These high TOC values create a low dissolved oxygen geochemical environment, which is conducive for denitrification. Denitrification will cause an enrichment of ^{15}N in the remaining nitrate.

Nitrate concentrations in the ground waters where the overlying land use was "residential" had $\delta^{15}N$ values that ranged from -6.8 to 13.4 o/oo and NO_3-N concentrations that varied from about 0.0 up to 4.6 mg/l. The nitrate concentrations are much lower than observed in the citrus areas. The wide range of $\delta^{15}N$ values may result from a mix of nitrogen sources and geochemical reactions, such as lawn fertilizer nitrogen, septic tank effluent nitrogen and denitrification. The addition of dissolved organic carbon from septic tanks further adds to the dissolved organic carbon in the surficial aquifer and possibly causes the aquifer to be more reducing.

Tihansky and Sacks (1997) concluded that the use of nitrogen isotope analyses in conjunction with other hydrologic and geochemical data was effective in delineating sources of nitrate in the surficial aquifer for their study area. Three important conclusions from their isotopic analyses were: (1) the presence of high concentrations of fertilizer nitrate in citrus areas, (2) the presence of septic tank effluent in unsewered residential areas and (3) the impact of geochemically reducing ground water which may prevent the oxidation of effluent organics to nitrate, and the reduction of nitrate to very low concentrations in undeveloped areas that can result in heavy nitrogen isotope values. They did not observe significant changes in either the nitrate concentrations or the nitrogen isotope composition between the May sample and the October sample. They did not measure the isotopic composition of the NH_4 in the aquifer.

4.2.1.2 Lake Tarpon Ground Water Nutrient Study (1998)

ERM (1998) analyzed the hydrodynamics of ground water flow and the hydrochemistry of ground water in the surficial aquifer to determine the current and potential impact of land use changes and subsequent water chemistry changes that might be providing nutrients to the various surface water bodies in the Lake Tarpon drainage basin. They collected approximately 95 samples that were analyzed for general water chemistry. In addition thirteen samples were analyzed for the nitrogen isotopes of dissolved nitrate and ammonium in the ground water. They observed a widespread occurrence of low concentrations of ammonia and organic nitrogen in the ground water of the surficial aquifer throughout the drainage basin. Ammonia and organic nitrogen concentrations were high in the vicinity of Lake Tarpon. Nitrate concentrations were highly variable although several high values were found in the surficial aquifer around Lake Tarpon. They concluded that nitrate sources were related to septic tanks, animal wastes, golf courses, wastewater reuse facilities (spray irrigation of treated effluent), and suburban development. The nitrogen isotope analyses indicated several different sources, including inorganic fertilizers, treated wastewater, and fertilizer. **Figure 23** is a plot of total nitrogen concentration versus the nitrogen isotope composition of both the nitrate and the ammonium. The data show an increasing trend of enriched isotopic compositions for both the nitrate and the ammonium for higher nitrogen concentrations, which suggest the higher concentrations are dominated by an animal waste source (**Figure 23**). Conversely, there is not a grouping of high nitrate concentrations and low isotopic values as observed by Tihansky and Sacks (1997), indicating the impact of fertilizers from citrus groves in their earlier study. Large-scale contamination of the ground water by citrus groves does not appear to be occurring in the general drainage basin of Lake Tarpon at the time of ERM's sampling. They also estimated the flux of nitrate in the ground water and it was small in comparison to the flux of nutrients from surface water sources entering Lake Tarpon, but were concerned about the accuracy of their numbers because of the limited number of monitoring wells in close proximity to Lake Tarpon.

4.2.2 Results of Current Investigation

Seventeen samples were analyzed for either the nitrogen isotopic_composition of either the NO_3 or the NH_4 dissolved species in the ground-water samples collected in October 2002. Locations of the 17 wells sampled are shown on **Figure 24**. The method of analysis followed Kreitler (1975). Analyses were conducted by Coastal Science Laboratory, Austin, Texas. Kreitler (1975) was used for preparation and analysis because it permitted the analysis of the nitrogen isotope composition of NH_4 as well as for NO_3. Most nitrogen isotope studies of "nitrogen" ground-water contamination have depended on the evaluation of the NO_3 in the ground water. The geochemical conditions of the shallow surficial aquifer of Central Florida, however, differ from many aquifer settings around the United States, because of their high organic carbon concentrations and reducing environment. Septic tank effluent is reducing by nature; therefore, the nitrogenous species in the effluent will be either as organic nitrogen or as ammonium, and not as nitrate. The percolation of the effluent through the generally oxidizing drain fields causes the reduced nitrogen to be oxidized to the nitrate form. The elevated TOC concentrations and resulting reducing conditions detected at many locations indicate that oxidation may not occur, and the nitrogen may stay as either organic nitrogen or as ammonium. To evaluate the nitrogen isotopes for this setting requires analysis of either the nitrate or the ammonium, depending which has a concentration high enough for analysis. For this study, the lower practical limit for analysis was considered to be 1 mg/l nitrogen either as nitrate or as ammonium. Because of the inverse relationship between nitrate and ammonium, either one or the other was high enough (but not together) for analysis. **Table 8** shows the concentrations of the various nitrogen species and which was used for isotopic analysis. Nine nitrate samples were analyzed for nitrogen isotopes, and eight ammonium samples were analyzed for their nitrogen isotopes.

Figure 25 shows a plot of the isotopic composition of the nitrogen species analyzed and its nitrogen concentration either as nitrate or ammonium. The sample number is also given on the figure. Nitrate samples are identified as diamonds; ammonium samples are identified as squares. There are two general trends shown on **Figure 26**. The first trend shows several samples with light isotopic compositions, and increasing nitrate concentrations (and therefore low NH_4 concentrations). These light isotopic values and higher NO_3 values suggest that fertilizer is the dominant source. The samples are from both sewered and unsewered areas (**Figures 26 and 27**).

The second trend shows enriched $\delta^{15}N$ values with increasing concentrations of either nitrate or ammonium. Land use for most of these areas is either unsewered/ septic or where spray irrigation of treated effluent has been applied (**Figures 26 and 27**). These areas appear to be impacted by the disposal of organic waste effluent. It should be noted that the data for well TLV-157 was not included on **Figure 26** because the high $\delta^{15}N$ value for this sample did not fit along either trend, and adjusting the y-axis scale to show the value decreased the ability to discern the two visible trends. The $\delta^{15}N$ value of 36.5%, low nitrate concentration of 0.007 mg/L and high TOC concentration of 30 mg/L suggest that the mechanism of the high $\delta^{15}N$ value is denitrification of nitrate under reducing conditions, which causes an enrichment of $\delta^{15}N$ in the remaining nitrate (Tihansky and Saclc 1997).

The nitrogen isotope data from this study appear to differentiate nitrate and ammonium that have originated from animal waste sources (septic systems and spray irrigation of treated effluent) (Trend 2) from fertilizer sources (Trend 1). The data and data ranges are similar to the values observed by Tihansky and Sacks (1997) and ERM (1998). The extensive contamination from citrus groves in the U.S.G.S. investigation is not present in ground water investigated in either of the Lake Tarpon studies (ERM, 1998, and this study). This also suggests that the past fertilizing practice of citrus groves is not currently causing contamination in the area of investigation. Denitrification probably is an important geochemical reaction in the ground waters around Lake Tarpon. The high concentrations of organic carbon and the low dissolved oxygen suggest that any nitrate that is added to the aquifer either as septic tank effluent, fertilizer or spray irrigation of treated effluent would ultimately be reduced to nitrogen gas as the ground water flows toward Lake Tarpon. There may be, however, a buildup of ammonium and dissolved organic carbon in the ground water down gradient from the various effluent sources.

4.3 NUTRIENT FLUX MODEL

4.3.1 Flux Model Setup

An estimate of the nutrient load from ground water from the surficial aquifer into Lake Tarpon was made using an analytical model. Estimates of horizontal flow from the surficial aquifer into Lake Tarpon may be calculated Darcy's equation for flow within a porous media. The Dupuit equation states that for a unit width of aquifer

$$Q=KIA$$

Where:

Q= discharge (ft^3/day),
K= horizontal hydraulic conductivity (ft/day),
I = hydraulic gradient $\Delta h/d$ (ft/ft)
Δh = head at well – head at Lake Tarpon (ft)
d= distance from well to Lake Tarpon (ft)
$A = L \times b$
L = flow panel length (ft)
b = saturated aquifer thickness

The nutrient mass flux (lbs/day/foot) through the surficial aquifer for a given parameter can then be calculated from the product of the ground-water discharge (ft^3/day) calculated above from the Darcy equation and the ground-water concentration of the parameter (mg/L).

A previous study calculated nutrient fluxes into Lake Tarpon from the surficial aquifer and the Upper Floridan aquifer using existing networks of monitor wells, and regional estimates of hydraulic conductivity and aquifer gradients (ERM, 1998). The ERM study was limited by the use of existing networks of monitor wells and resulted in a coarse estimate of the surficial aquifer and Upper Floridan aquifer flow paths, aquifer discharges, and nutrient fluxes.

A similar analytical model concept is utilized within this study. The installation of additional dedicated surficial aquifer monitor wells provides a denser network of monitor wells in closer proximity to Lake Tarpon. These additional wells were combined with existing wells to construct a network of flow panels around Lake Tarpon to calculate ground-water discharge into the lake (**Figure 28**). Discharges for the flow panels associated with each monitor well were calculated using the form of the Darcy equation shown above.

Site-specific horizontal hydraulic conductivities (K) were obtained from slug tests performed on 20 of the 29 monitor wells used in the study. Hydraulic conductivities for those wells not tested were estimated from the average of the results for the two closest slug tests. Hydraulic conductivity values from these wells ranged from 2 ft/day to 33 ft/day. The value from each well was used in the discharge calculation for the flow panel defined by that well.

The hydraulic gradient ($\Delta h/d$) between the monitor well network and Lake Tarpon is based upon the water levels at the time of the ground-water sampling event and the water level in Lake Tarpon for the same day (Δh). The distance from the monitor wells to the lake (d) ranged from 16 feet to 7,660 feet. Daily stage data for Lake Tarpon, collected by the SWFWMD, is available online (www.swfwmd.org) and was used in this study. The average hydraulic gradient between the 29 monitor wells and Lake Tarpon was 0.005 in May 2002 and 0.007 in the October 2002.

The saturated thickness of the surficial aquifer (b) is calculated from surficial aquifer water-level elevation at each well during each sampling event and the elevation of the base of the surficial aquifer at each well. The base of the surficial aquifer at each well was estimated from contour maps of the elevation of the bottom of the surficial aquifer. The contour map of the bottom of the surficial aquifer (**Figure 29**) was constructed from well logs from existing wells in the Florida Geological Survey well database, wells constructed for the study, and bathymetric data for Lake Tarpon. In the vicinity of the monitor wells used in the nutrient study, the approximate bottom elevation of the surficial aquifer ranges from 0 to –20 feet NGVD. Elevations of land surface range from 4 to 38 feet NGVD.

The width of each flow panel (L) is calculated from the distance between the halfway points for the adjacent wells on either side of the monitor well (**Figure 30**). At the Lake Tarpon outfall canal, flow panels were divided at the middle of the outfall canal. The flow panel follows the general direction of the water-level contours of the surficial aquifer between each monitor well such that the flow path of ground water between wells is approximately perpendicular to the flow panel.

The discharge calculations were made using an Excel 97 spreadsheet. Flux models were constructed to calculate unit width discharges and flow panel discharges from the surficial aquifer for both May and October sampling events. The input parameters and results are shown in **Tables 9 and 10**. The discharges calculated for each flow panel were then input into a second Excel spreadsheet with the nutrient parameter concentrations from each monitoring well to calculate the nutrient flux for each flow panel. The results are shown in **Tables 11 and 12**.

4.3.2 Flux Model Results

Average surficial aquifer discharges through the 29 flow panels to Lake Tarpon were calculated to be 3,959 cubic feet per day (ft^3/day) in May 2002 and 4,463 ft^3/day in the October 2002. Nutrient fluxes for measured parameters are shown in **Tables 11 and 12** for the May and October sampling events, respectively.

The estimated total nitrogen discharge into Lake Tarpon during May 2002 was 27.47 pounds/day. The majority of loading occurred in the southwest quadrant of the lake (19.03 pounds/day) and the northeast quadrant of the lake (4.57 pounds/day).

The estimated total nitrogen discharge into Lake Tarpon during the October 2002 was 20.67 pounds per day. The majority of loading occured in the southwest quadrant (14.11 pounds/day) of the lake. Total nitrogen for monitor well LT-18 in the northeast quadrant during the October 2002 sampling event was unavailable due to a laboratory error, and as a result discharges for the northeast quadrant are incomplete.

Total phosphorous discharge into Lake Tarpon from May 2002 data was 1.4 pounds/day. The majority of loading occurred in the southeast quadrant (0.575 pounds/day) and southwest quadrant (0.523 pounds/day). Similarly, total phosphorous discharge into Lake Tarpon during

October 2002 was 1.59 pounds/day. The majority of loading occurred in the southwest (0.486 pounds/day) and southeast quadrants (0.481 pounds/day).

Unit width discharges allow for direct comparisons of nutrient fluxes for each monitor well irrespective of flow panel length. Nitrogen discharge, per unit width of aquifer for each monitor well during the May and October sampling events, are shown in **Figures 31 and 32**, respectively. Monitor wells NP-141 (3.4×10^{-3} pounds/day/foot), LT-18 (5.8×10^{-4} pounds/day /foot), and LT-1 (4.3×10^{-4} pounds/day/foot) account for 78% of the unit-width nitrogen discharges to the lake in May 2002. Monitor wells NP-141 (2.5×10^{-3} pounds/day/foot) and LT-1 (1.4×10^{-3} pounds/day/foot) account for 70% of the unit-width nitrogen discharges to the lake for the October 2002 sampling event. As mentioned above total nitrogen data are unavailable for LT-18 during the October 2002 sampling event.

Phosphorous discharge, per unit width of aquifer for each monitor well during the May and October sampling events, are shown in **Figures 33 and 34**, respectively. Monitor wells NP-141 (8.9×10^{-5} pounds/day/foot) and TLV-177 (1.1×10^{-4} pounds/day/foot) account for 59% of the unit-width phosphorous discharges to the lake in May 2002. Similarly, these two wells account for 53% of the unit-width phosphorous discharges for October 2002 sampling event. Both of these wells are in sewered residential areas. The isotope analysis for NP-141 indicates that fertilizer is the source of nitrogen. It is assumed that orthophosphate in this area is also from fertilizer.

5.0 SUMMARY AND CONCLUSIONS

Pinellas County (The County) and the Southwest Florida Water Management District (District) entered into a cooperative funding agreement for the purpose of collecting ground-water data to assess nutrient loading to Lake Tarpon by ground-water flow into the lake.

The project included installation of 24 monitoring wells, sampling of the 24 new and seven existing wells, evaluation of ground-water quality data, and preparation of an analytical model to estimate nutrient loading into Lake Tarpon from discharge of ground water from the surficial aquifer. Slug tests were performed in 21 wells to obtain data used to calculate hydraulic conductivity of the surficial aquifer. The 31 monitoring wells were sampled during the period of May 16, 2002 to June 4, 2002 to represent dry season conditions, and October 22, 2002 to October 28, 2002 to represent wet season conditions. Seventeen wells were sampled in October for nitrogen isotope analysis. The water-quality data and hydraulic conductivity values were used as inputs in an analytical model to estimate the nutrient loading in ground water discharging from the surficial aquifer into Lake Tarpon. Following is a summary of the results of this study.

1) The surficial sediments were characterized predominantly by fine to very fine-grained sands with variable amounts of silt, organics and clay.

2) Hydraulic conductivity of the surficial aquifer ranged from 2.5 to 33 feet/day, and averaged 11.3 feet/day.

3) The major ion concentrations in the surficial aquifer at each monitoring well was plotted on a Piper Diagram to define four hydrochemical facies for the surficial in the study area. Each hydrochemical facies appeared to be defined primarily by the chemistry of the source of recharge to the surficial aquifer (i.e. irrigation with local water from the Upper Floridan aquifer, reclaimed water, or public supply system water). The majority of the wells contained water quality that was transitional between the various facies.

4) Total nitrogen concentrations greater than 2.0 mg/l were considered to be above background concentrations, and are referred to as "elevated" concentrations. Total nitrogen ranged from 0.01 to 12.8 mg/l and was detected at elevated levels in 19 of the 31 wells.

5) Nitrate concentrations ranged from 0.01 to 12.3 mg/l. Nitrate concentrations greater than 1.0 mg/l were considered to be above background concentrations, and are referred to as "elevated" concentrations. Elevated nitrate concentrations were detected in 11 of the 31 wells. Ten of the 11 wells with elevated nitrate concentrations were located on the west side of Lake Tarpon, including six wells in the unsewered area on the northwest side of the lake.

6) Ammonia concentrations ranged from 0.01 to 7.07 mg/l. Ammonia concentrations greater than 1.0 mg/l were considered to be above background concentrations, and are referred to as "elevated" concentrations. Elevated ammonia concentrations were detected in nine of the 31 wells. Six of the nine wells with elevated ammonia concentrations were located on the east side of Lake Tarpon, in a mix of sewered and unsewered areas.

7) Organic nitrogen concentration for each sample was calculated by subtracting the sum of nitrate+nitrite and ammonia concentrations from the total nitrogen concentration. Organic nitrogen concentration ranged from 0.0 to 2.48 mg/l. Organic nitrogen concentrations greater than 1.0 mg/l were detected in 9 of the 31 wells sampled.

8) Most of the wells with elevated total nitrogen concentrations also contained elevated TOC concentrations. Four groups of wells were classified by the combination of TOC and total nitrogen concentration. Group 1 wells have total nitrogen and TOC concentrations both less than 10 mg/l and represent wells that are relatively unaffected by nitrogen species. Group 2 wells have TOC concentrations greater than 10 mg/l and total nitrogen concentrations between 1.0 and 2.0 mg/l. Four of the six Group 2 wells are located at the unsewered northwest side of the lake. Group 3 wells have TOC concentrations less than 20 mg/l and nitrate concentrations greater than 2.0 mg/l. All of

the Group 3 wells are located on the west side of the lake. Five wells are located in unsewered areas and three are in sewered areas, which suggests that septic tanks may not be the primary source of nitrate in these areas. Group 4 wells have TOC concentrations greater than 20 mg/l and ammonia concentrations greater than 2.0 mg/l. Six out of the eight Group 4 wells are located on the east side of the lake in an area of mixed sewered/unsewered use.

9) Nitrogen isotope analysis was used to attempt to identify the sources of nitrogen in the surficial aquifer. Comparison of isotopic compositions with nitrate or ammonia concentrations showed two trends. The first trend shows several samples with light isotopic compositions, and increasing nitrate concentrations (and therefore low NH_4 concentrations). These light isotopic values and higher NO_3 values suggest that fertilizer is the dominant source for this trend. The second trend shows enriched $\delta^{15}N$ values with increasing concentrations of either nitrate or ammonium. This trend suggests that animal/human waste is the dominant source for this trend.

10) The nutrient loading analysis showed that the loading of total nitrogen to Lake Tarpon was 22.6 pounds/day based on the October 2002 samples, and 28.1 pounds/day based on the May 2002 samples. Based on the average of these rates the total nitrogen loading to Lake Tarpon from the surficial aquifer is estimated to be 4.6 tons/year. The loading of total phosphorus to Lake Tarpon was 1.4 pounds/day based on the October 2002 samples, and 1.4 pounds/day based on the May 2002 samples. Based on the average of these rates the total phosphorous loading to Lake Tarpon from the surficial aquifer is estimated to be 0.26 tons/year.

Based on the results of this study, the following conclusions are provided that relate to the sources of nutrient loading to the surficial aquifer, the potential flux of the nutrient load to Lake Tarpon, and the potential nutrient load reduction from removal of the septic tanks around the lake.

1) The potential sources of elevated nutrients in the surficial aquifer are septic tanks, reclaimed water, and fertilizers. There were no consistent relationships between the locations of wells with elevated nutrient concentrations and the potential sources of the nutrients. For example, elevated nutrient concentrations were identified in both sewered and unsewered areas, where as relatively low nutrient concentrations were detected in some wells in unsewered areas. Of the three wells located in areas irrigated with reclaimed water, only one (WRAP-47) had elevated nutrient concentrations. However, this well is located 20 feet downgradient of a septic tank drainfield.

2) Most of the area around the lake has residential or golf course land use. Therefore, most of this area is routinely treated with turf fertilizer. Most of the area however, has more than one potential source of nutrients. Isotope analysis of samples from 9 of the 17 wells analyzed, indicated that fertilizer was the primary source of the nutrient load. This included wells from both sewered and unsewered areas, with four of these wells located in the unsewered northwest area of the lake. The nutrient loading analysis indicated that approximately 70 to 78 percent of the unit width total nitrogen loading to the lake is contributed from three specific areas: 1) adjacent to wells LT-01 on the northwest side of the lake; 2) LT-18 on the northeast side of the lake; 3) and NP-141 on the southeast corner of the lake. These wells are located in both sewered and unsewered areas. The isotope compositions of the water from these wells indicate a nitrogen fertilizer dominant source. The largest contributor of nitrogen loading identified as septic tank or reclaimed water is the area around WRAP-47 on the southwest side of the lake. This well is within a golf course irrigated with reclaimed water, but as previously stated is also 20 feet downgradient of a septic tank drainfield. Total nitrogen concentration in the effluent from the William F. Dunn Water Reclamation Facility ranged from 0.74 to 3.71 mg/l over the past five years, where as the total nitrogen concentration in the samples from WRAP-47 ranged from 5.04 to 12.8 mg/l. That is, the sample from WRAP-47 had a higher nitrogen concentration than that in the treatment plant discharge. Therefore, it appears that the nitrogen load in the sample from WRAP-47 is not from reclaimed water, but most likely from the nearby septic tank. Three of the wells with isotope analyses indicative of waste sources are located in unsewered areas, and the other two are in

sewered areas. One of these wells (LT-17) is located near a former reclaimed water sprayfield, which was associated with a package wastewater treatment plant that served the Lansbrook development. This package plant produced effluent with higher nutrient concentrations than the present reclaimed water provided to the development by the William F. Dunn Water Reclamation Facility.

3) The flux loading calculations were based on the assumptions that the nutrient concentration in a well is constant across the entire width of the flow panel assigned to that well, and that the nutrient concentrations remain constant along the entire flow path from the source area to the lake. The results of this analysis indicate that nutrient concentrations are highly variable between sample locations, and are associated with the local sources at each location (ERM (1998) made similar observation). Therefore, assigning a point concentration to a whole flow panel may over-estimates the nutrient load for an entire flow panel, particularly if the monitoring well was located close to a source such as a septic tank.

This study also showed that the dominant type of nitrogen species varied between sample locations. Wells with elevated nitrate concentrations are located close (a few hundred feet) to wells with elevated ammonia concentrations. The nitrogen species present in ground water are dependent on the subsurface geochemical conditions that control denitrification and nitrification reactions. Organic nitrogen, which occurs in naturally occurring organic material or animal waste sources, is generally converted to ammonia in the soil zone via the process of ammonification. Ammonia is then converted to nitrite and then nitrate by oxidation, and is referred to as nitrification. The elevated TOC concentrations and resulting reducing conditions detected at many locations indicate that this oxidation step may not be occurring, and the nitrogen may stay as either organic nitrogen or as ammonia. At several of the wells in an unsewered residential area along the northwest shore of the lake, organic nitrogen concentrations in May were very low compared with ammonia or nitrate concentrations, suggesting ammonification and nitrification were occurring. However, in October most of the total nitrogen was present as organic nitrogen, suggesting that these processes were not occurring. This may be due to the higher water-table elevations in October. The reducing wastewater percolating from the drainfields reached the reducing ground water without adequate time in the unsaturated zone for the conversion to nitrate resulting in the nitrogen remaining as organic or ammonium.

The data collected in this study showed the degree of variability not only of the potential sources of nitrogen, but also in the conditions affecting the conversion reactions in the subsurface. The location of monitoring wells used in the study does not provide the data needed to completely evaluate the fate of the nitrogen species as it leaves its source area and flows toward Lake Tarpon. This uncertainty and the aforementioned use of point concentrations to calculate loading along an entire flow panel are limiting factors in the estimation of nutrient loading to Lake Tarpon. These estimates may be over-conservative. The nitrogen-loading estimate of 4.6 tons/year from this study is slightly higher than the 2.35 tons/year calculated by ERM (1998).

4) The results of the nitrogen loading analysis and the nitrogen isotope analysis were used to estimate the relative nutrient loading attributed to fertilizer versus waste sources. The loading rates for each well attributed to a fertilizer source by isotope analysis were summed, which resulted in approximately 79 percent of the total nitrogen load to the lake. This percentage should be viewed as approximate because many of the monitoring wells were located in areas with multiple sources. If 79 percent of the total load is assumed to be contributed by fertilizer, then the remaining 21 percent is assumed to be contributed by waste sources. Only one of the three wells in areas irrigated with reclaimed water had elevated nitrogen concentrations, and the concentration in this well (WRAP-47) was more likely due to the nearby septic tank effluent. Therefore, reclaimed water, with its low total nitrogen concentrations (1.29 mg/l) is considered to be negligible. The remaining 21 percent of the nutrient load is therefore assumed to be contributed by septic tanks.

6.0 CERTIFICATION PAGE

This report was prepared under the direction of David A. Wiley, Licensed Professional Geologist in the State of Florida, PG 119. We hereby certify that any and all hydrogeologic and hydrogeochemical interpretations and opinions rendered in this report were made following acceptable professional practices by:

David A. Wiley, P.G. No. 119

and

Jeffrey M. Trommer, P.G. No. 1315

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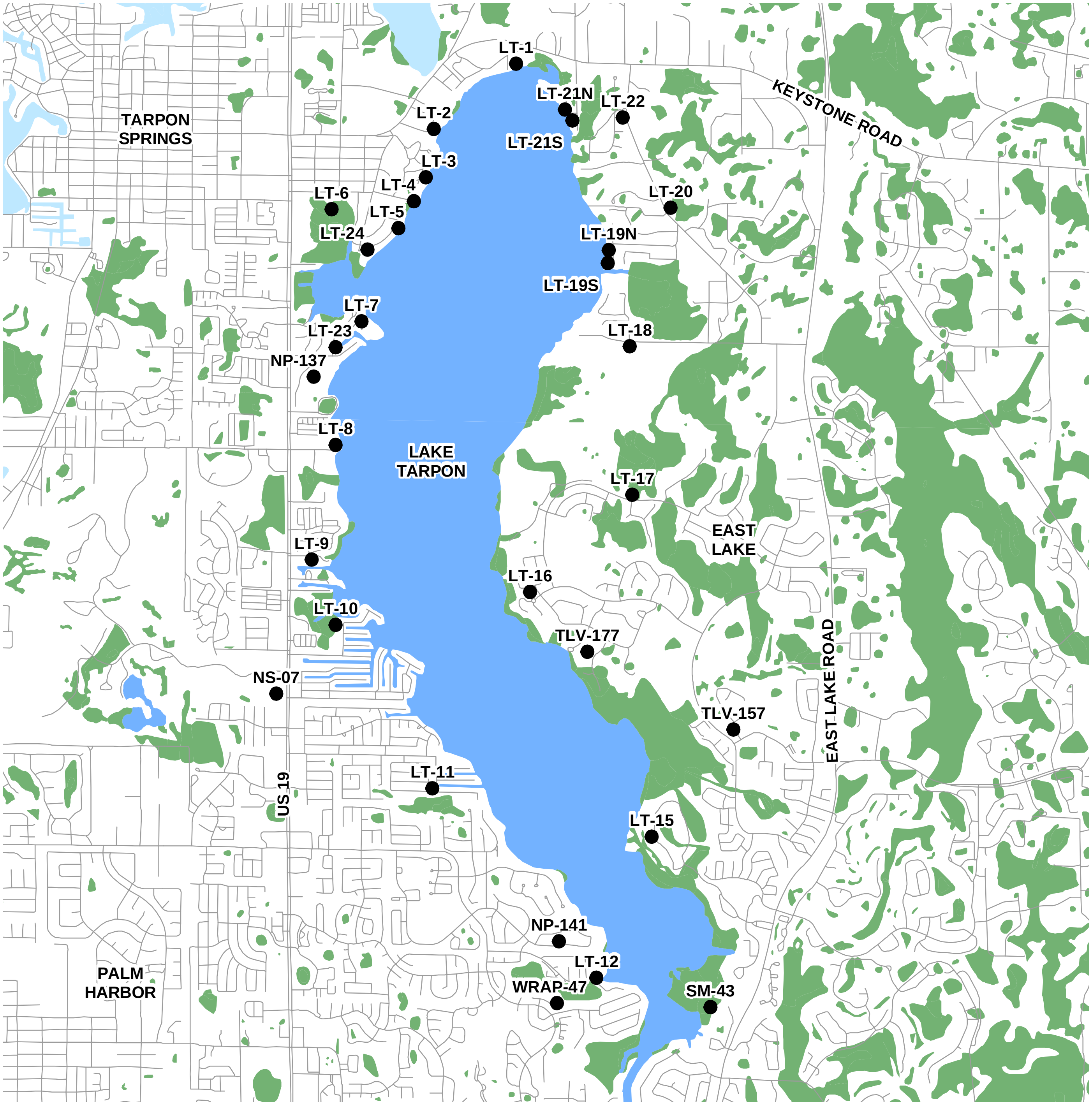
FIGURES



Legend

- ● Monitoring Well
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE

N

0 2,000 4,000 Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

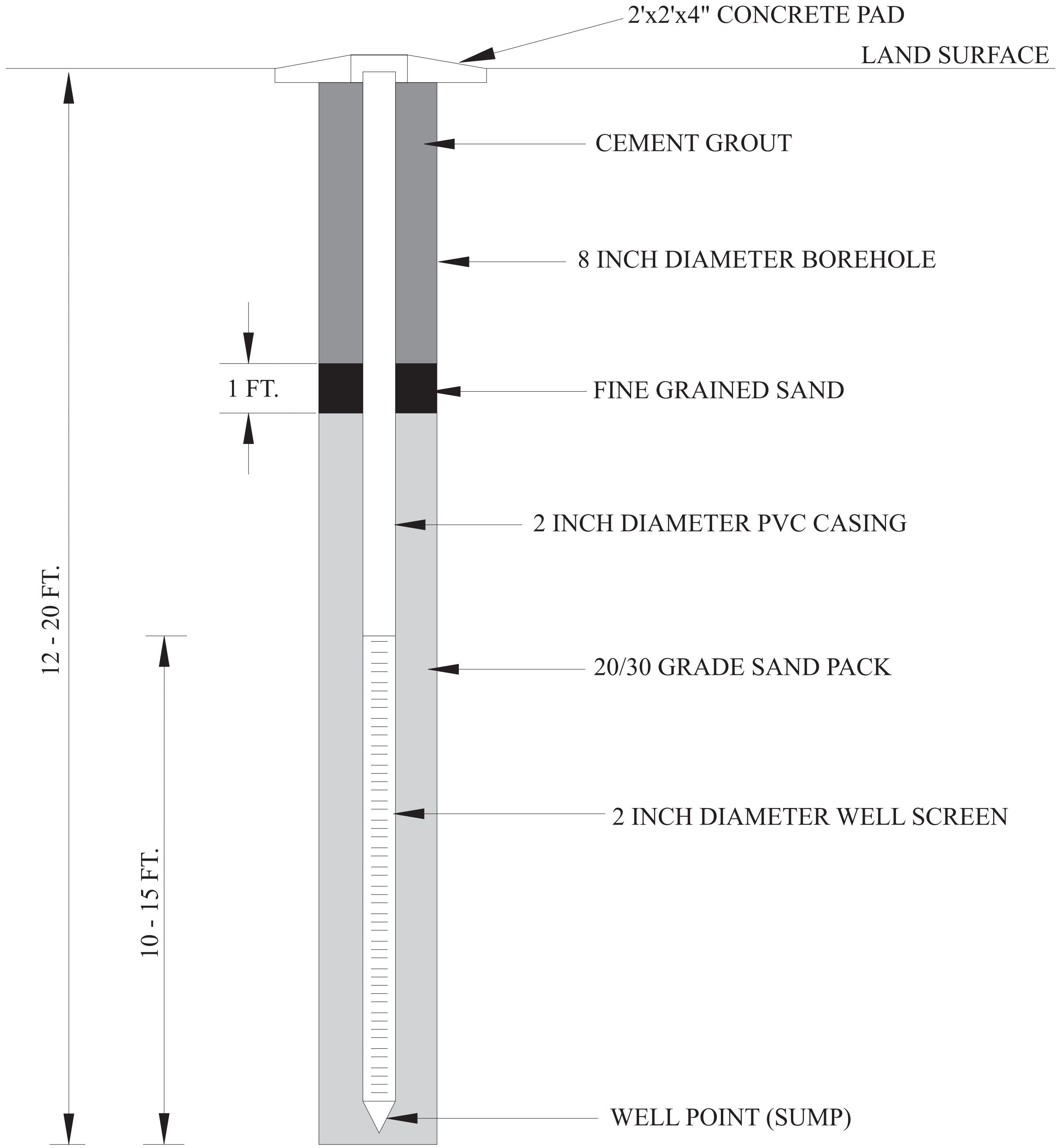
MONITORING WELL LOCATIONS

DATE	REVISED

PREPARED BY:

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Engineering Services
Cypress Point Office Park
10014 North Dale Mabry Highway, Suite 205
Tampa, FLorida 33618
(813) 968-5882

DRAWN:	TDH	CHECKED:	DAW	DATE:	MAR - 2004	FIGURE:	1



LAKE TARPON
GROUNDWATER NUTRIENT STUDY

TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM

DATE	REVISED

PREPARED BY:

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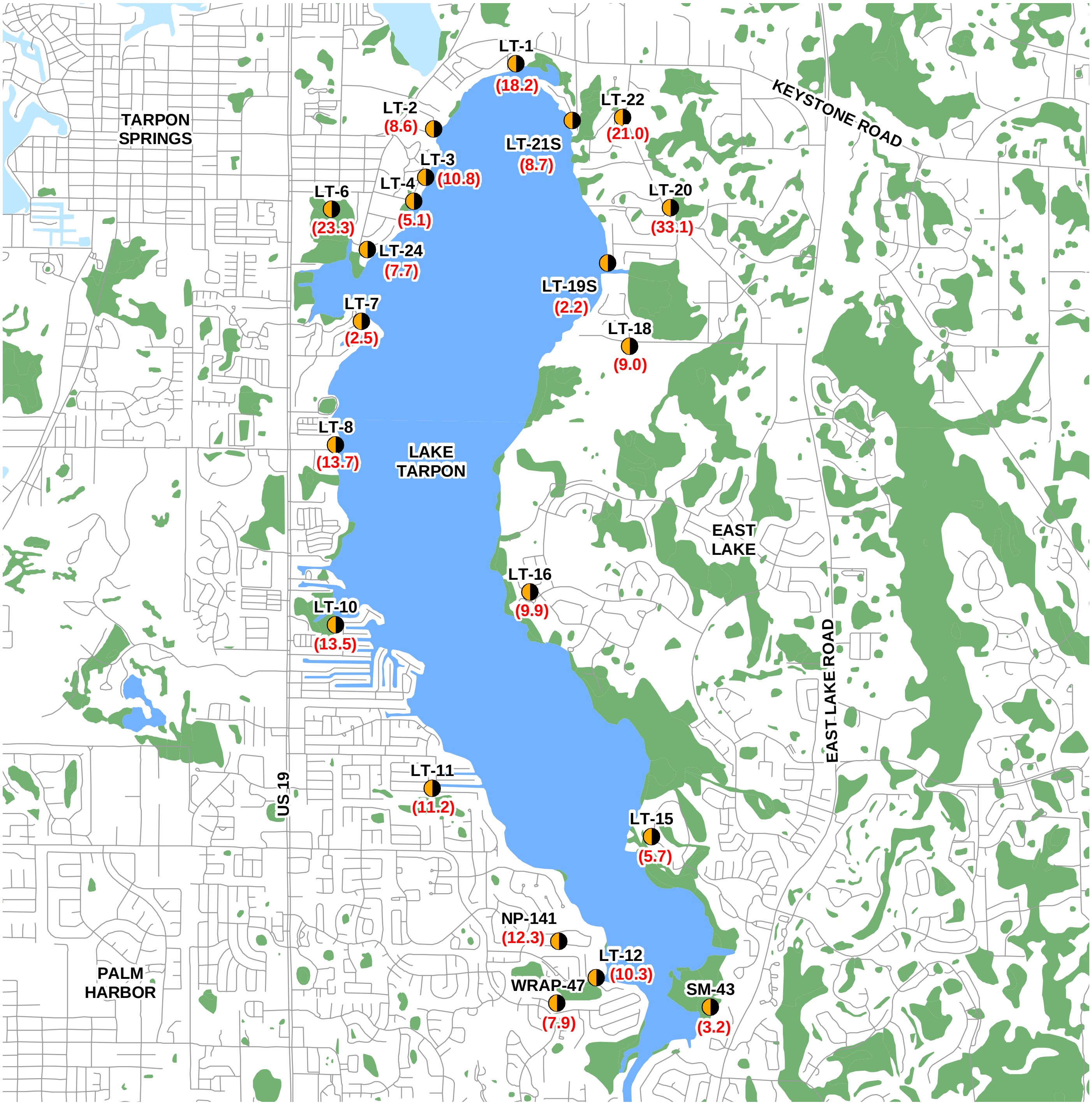
DATE: 8/2004 FIGURE: 2

Figure02.CDR



Legend

- Wells Used For Slug Testing **(K in ft/day)**
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE

N

0 2,000 4,000 Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

LOCATION OF SLUG TEST WELLS

DATE	REVISED

PREPARED BY:

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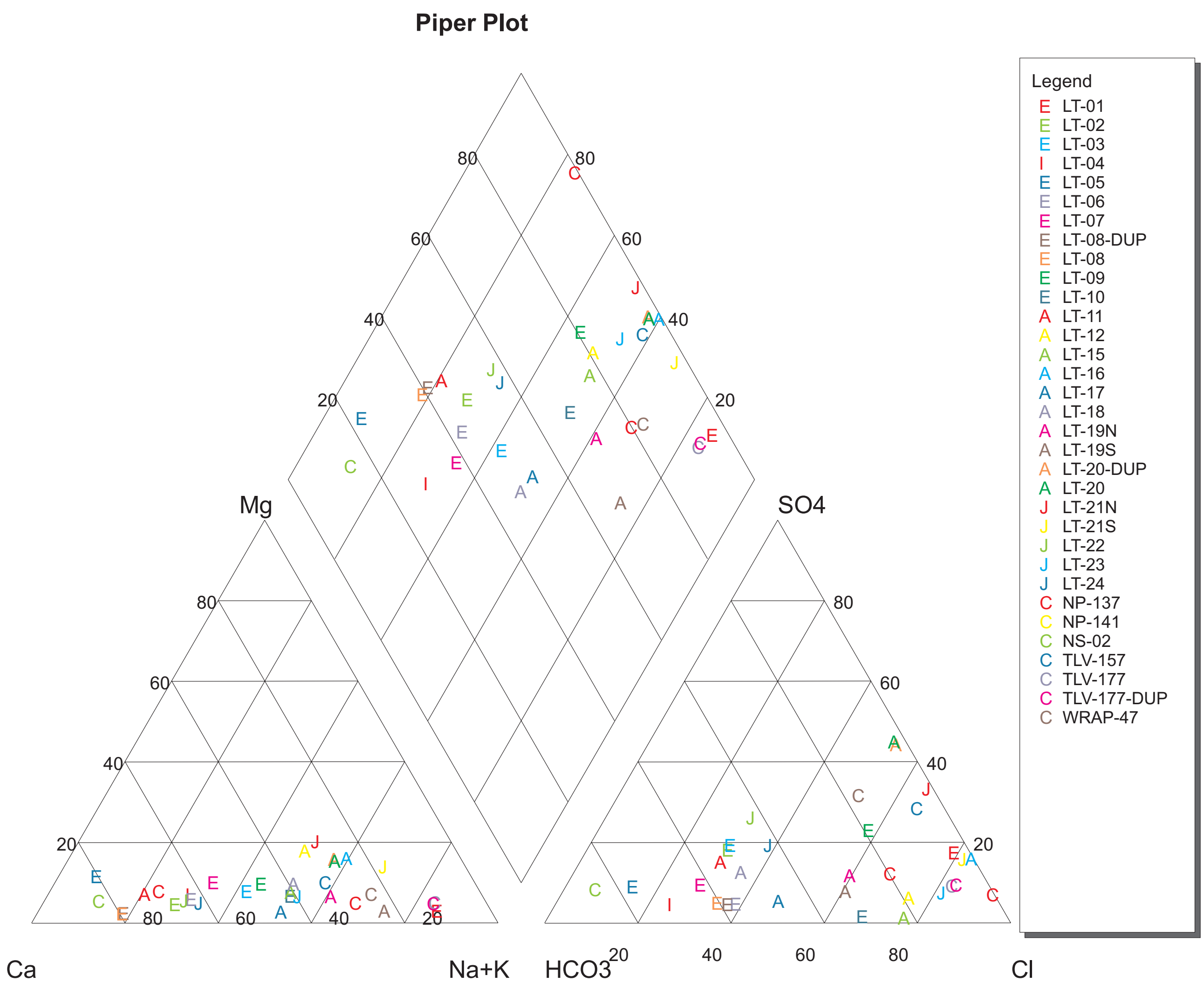
DRAWN: TDH	CHECKED: JMT	DATE: MAR - 2004	FIGURE: 3



LAKE TARPON
GROUNDWATER NUTRIENT STUDY

WET SEASON WATER QUALITY PIPER DIAGRAM

DATE	REVISED

PREPARED BY:

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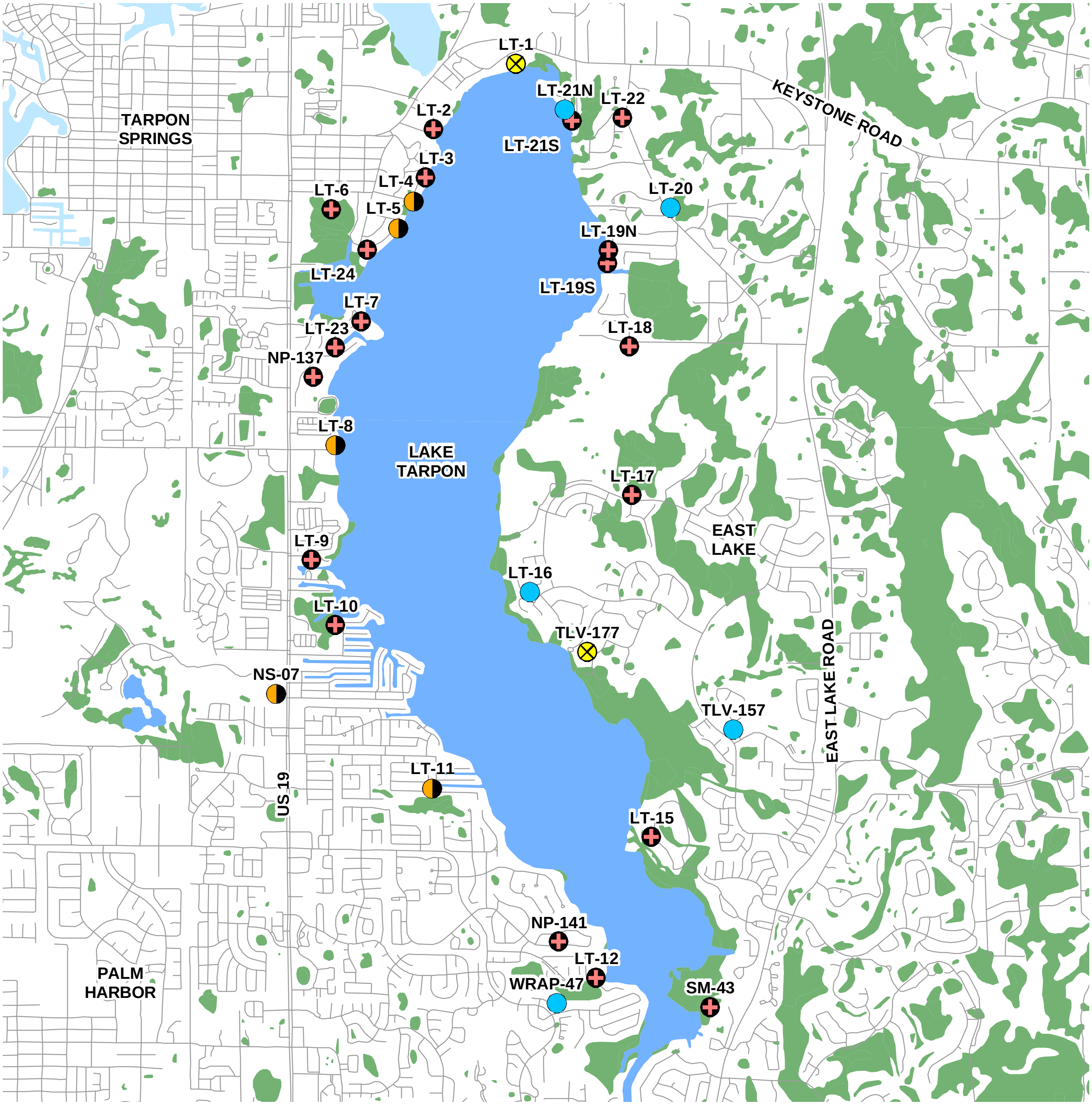
DATE: 8/2004 FIGURE: 4

Figure04.CDR



Legend

- Ca-HCO3 Facies
- Na-Cl Facies
- Na-Cl-SO4 Facies
- Transitional Facies
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE

N

0 2,000 4,000 Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

GEOCHEMICAL FACIES TYPES

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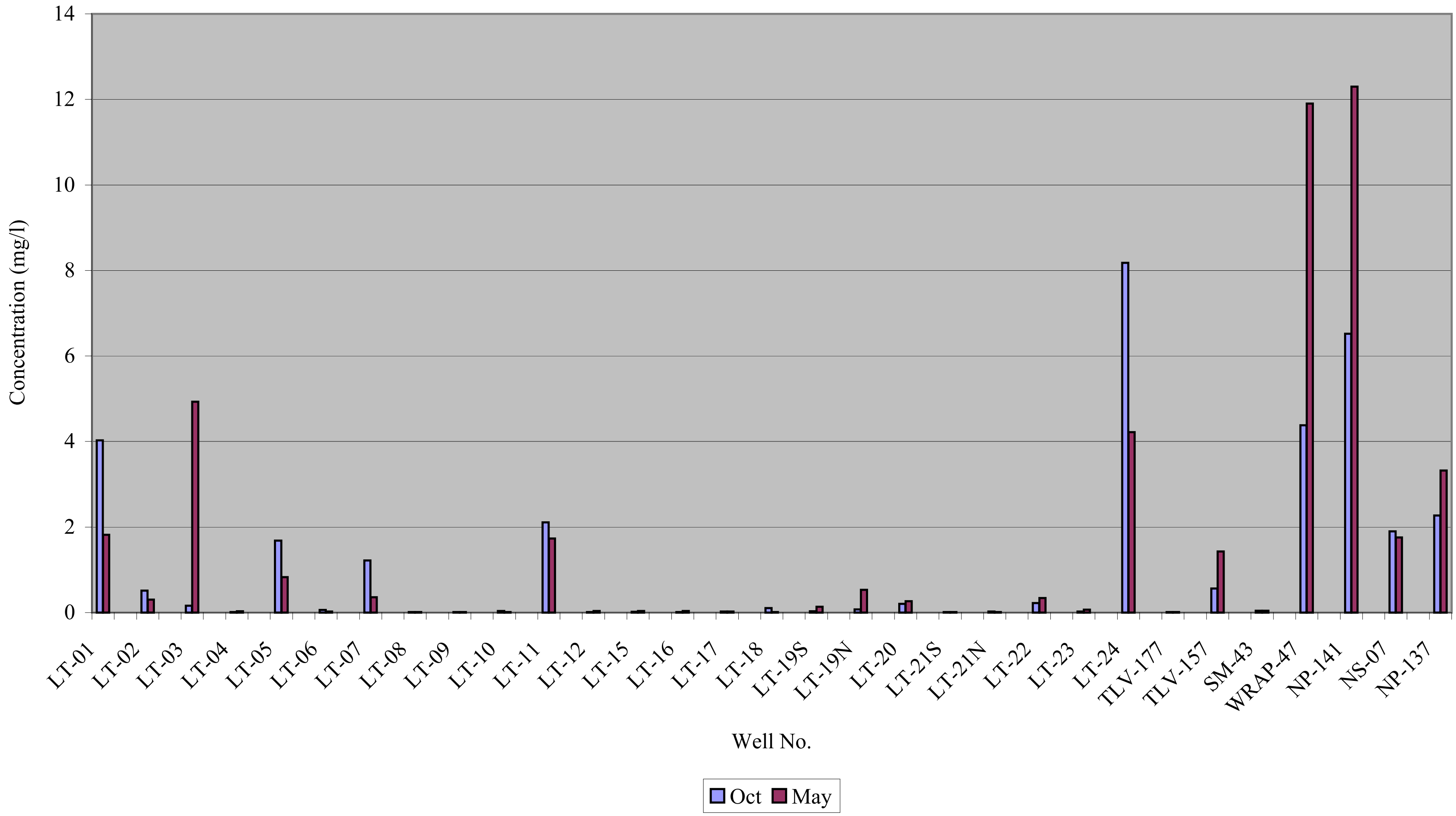
Figure 6
Nitrate Concentrations
Lake Tarpon Nutrient Study



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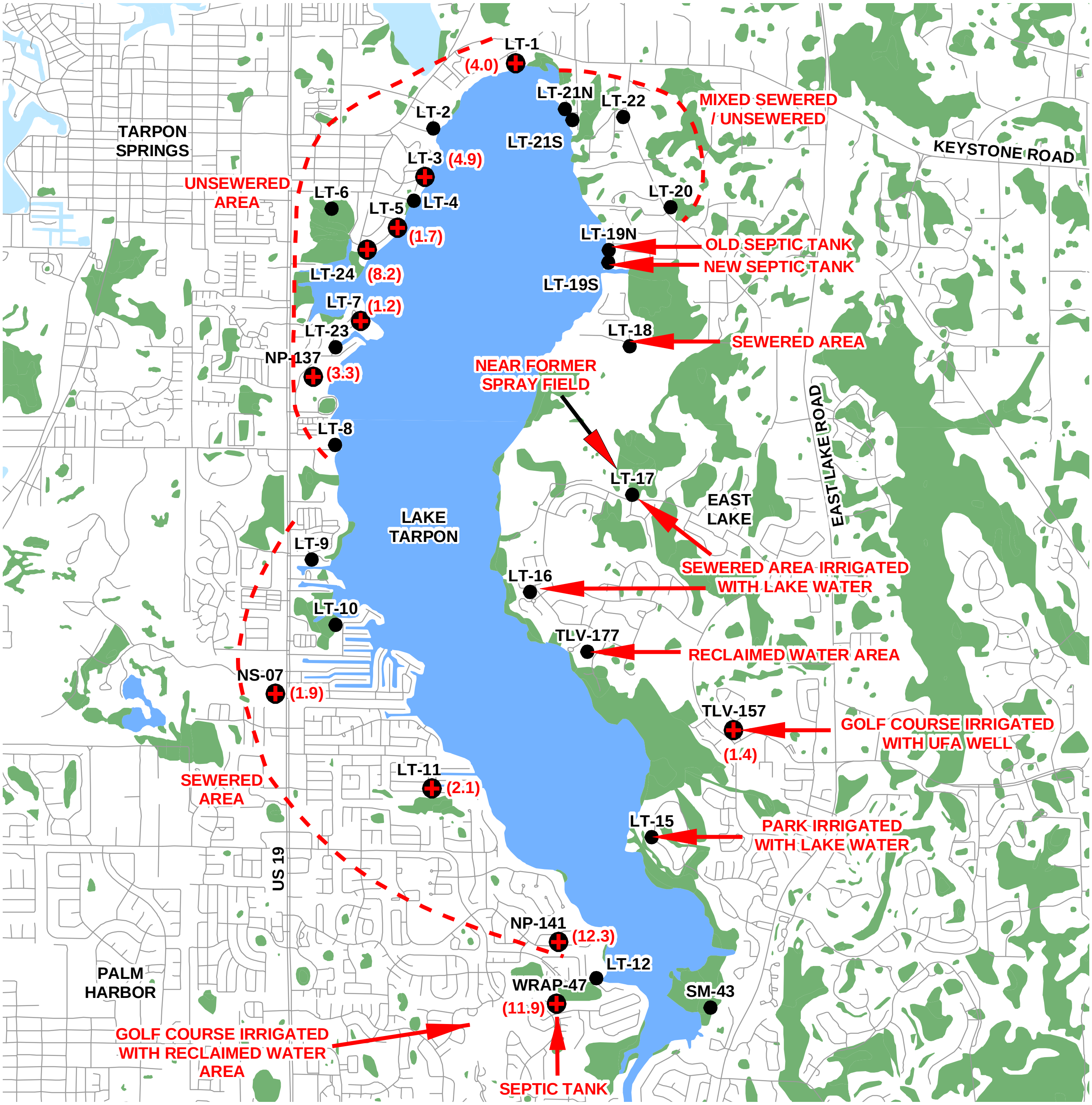

Legend

- Elevated Nitrate Concentrations (NO3> 1.0 mg/l)
- Non-elevated Nitrate Concentrations
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

0 2,000 4,000 Feet

N

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

LOCATION OF MONITORING WELLS
WITH ELEVATED NITRATE CONCENTRATION

DATE	REVISED

PREPARED BY:

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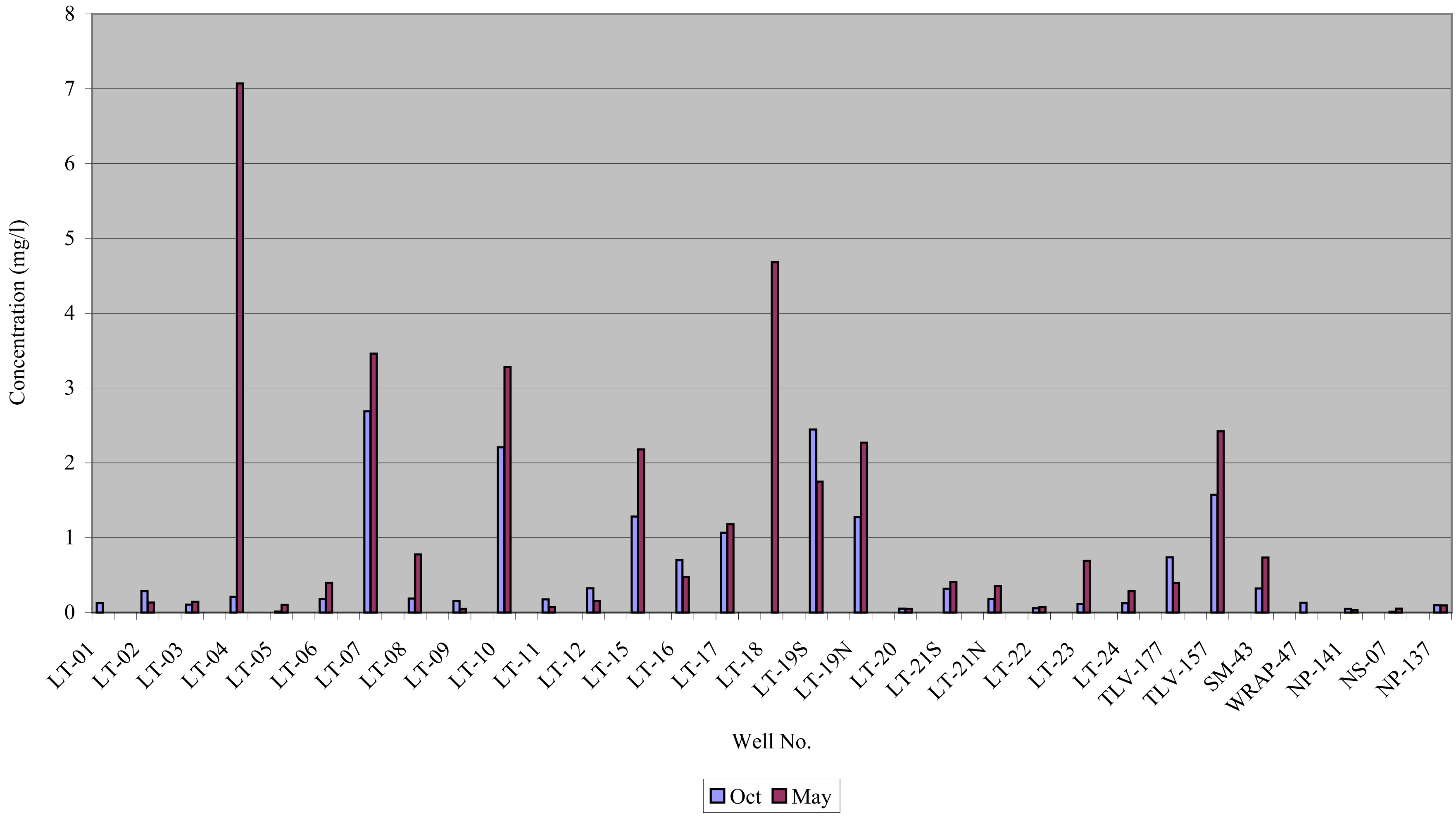
DRAWN: TDH | CHECKED: JMT | DATE: MAR - 2004 | FIGURE: 7

Figure 8
Ammonia Concentrations
Lake Tarpon Nutrient Study



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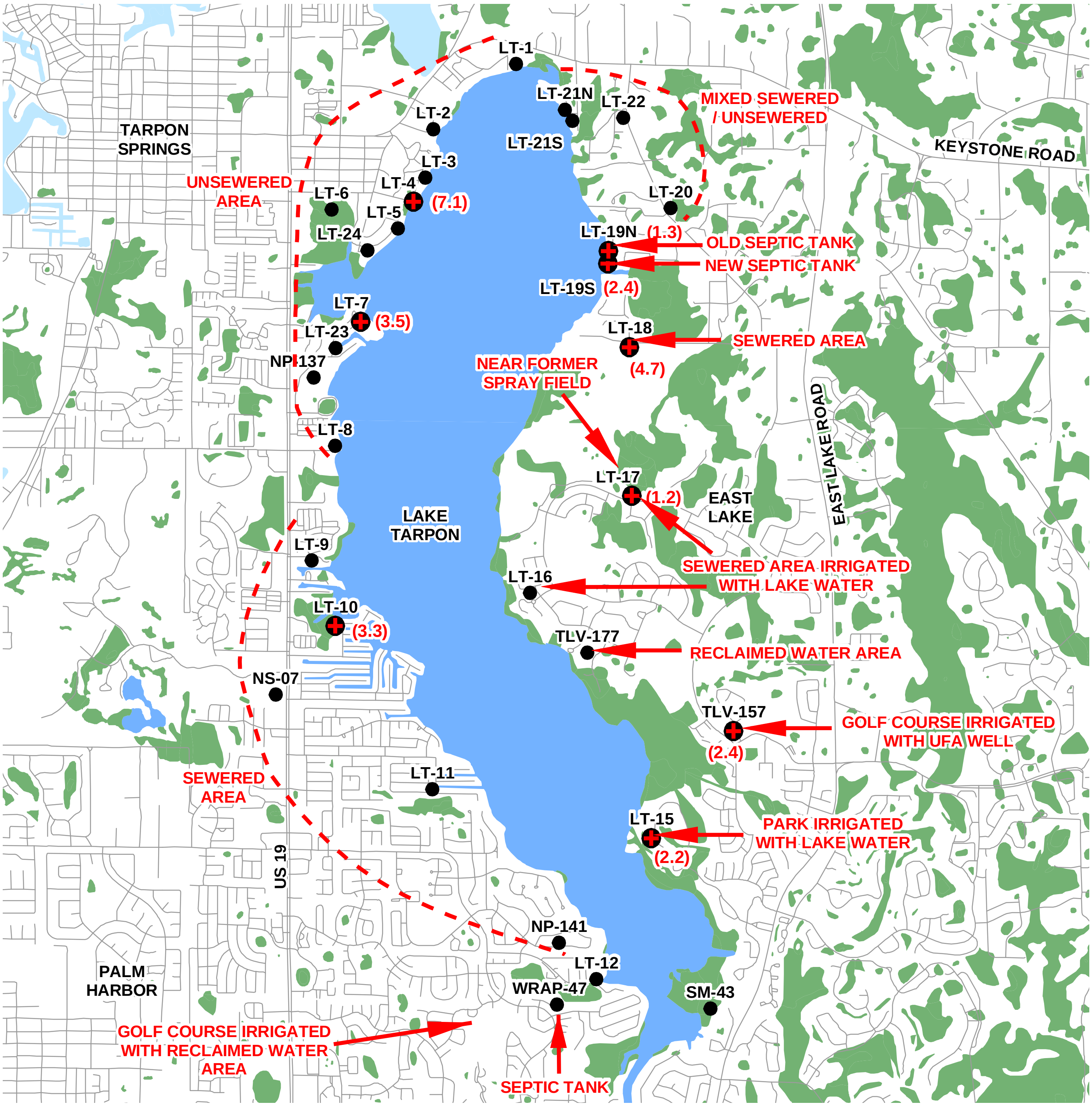

Legend

- Elevated Ammonia Concentrations **(NH3 > 1.0 mg/l)**
- Non-elevated Ammonia Concentrations
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

0 2,000 4,000 Feet

N

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

LOCATION OF MONITORING WELLS
WITH ELEVATED AMMONIA CONCENTRATION

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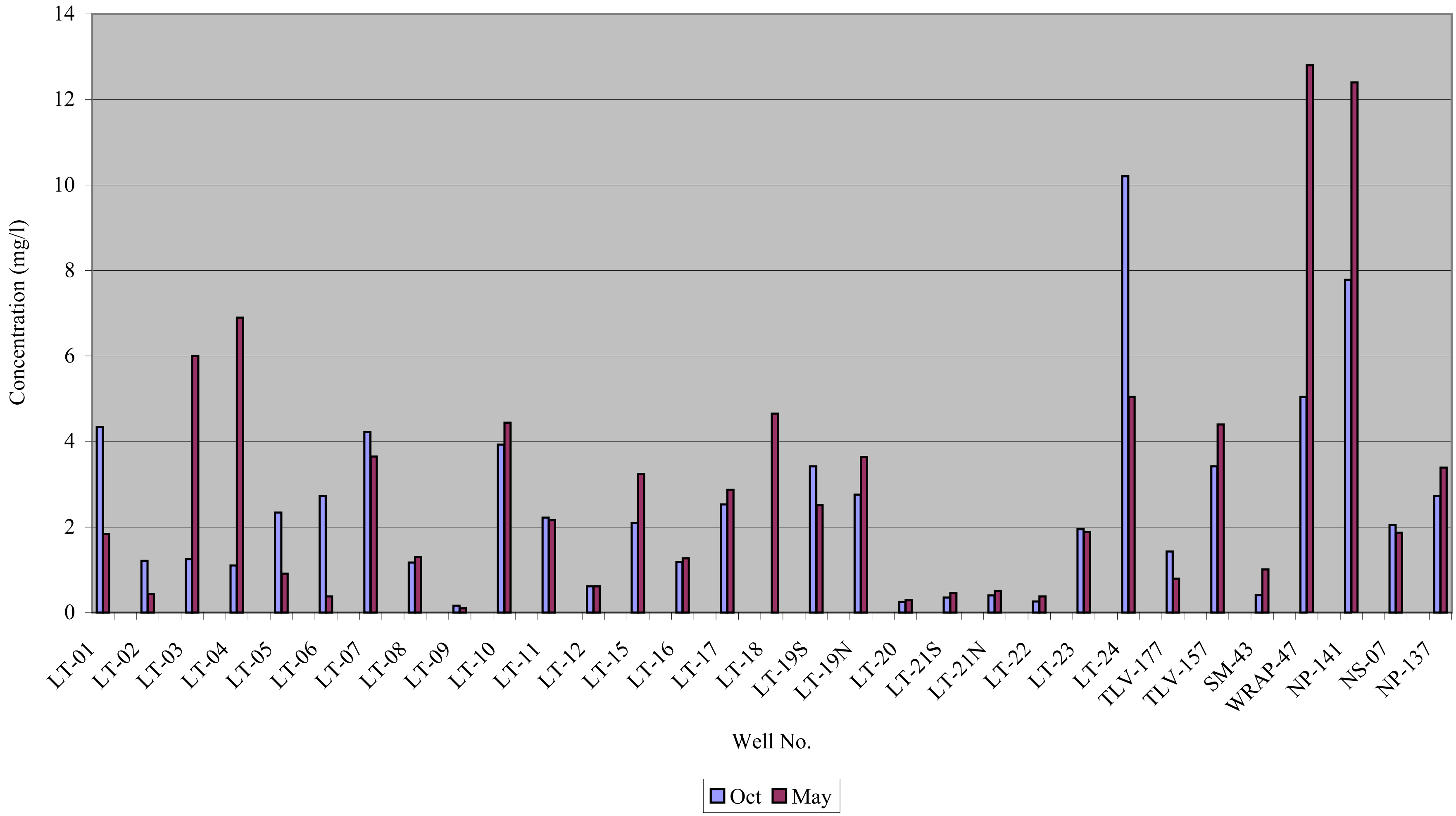
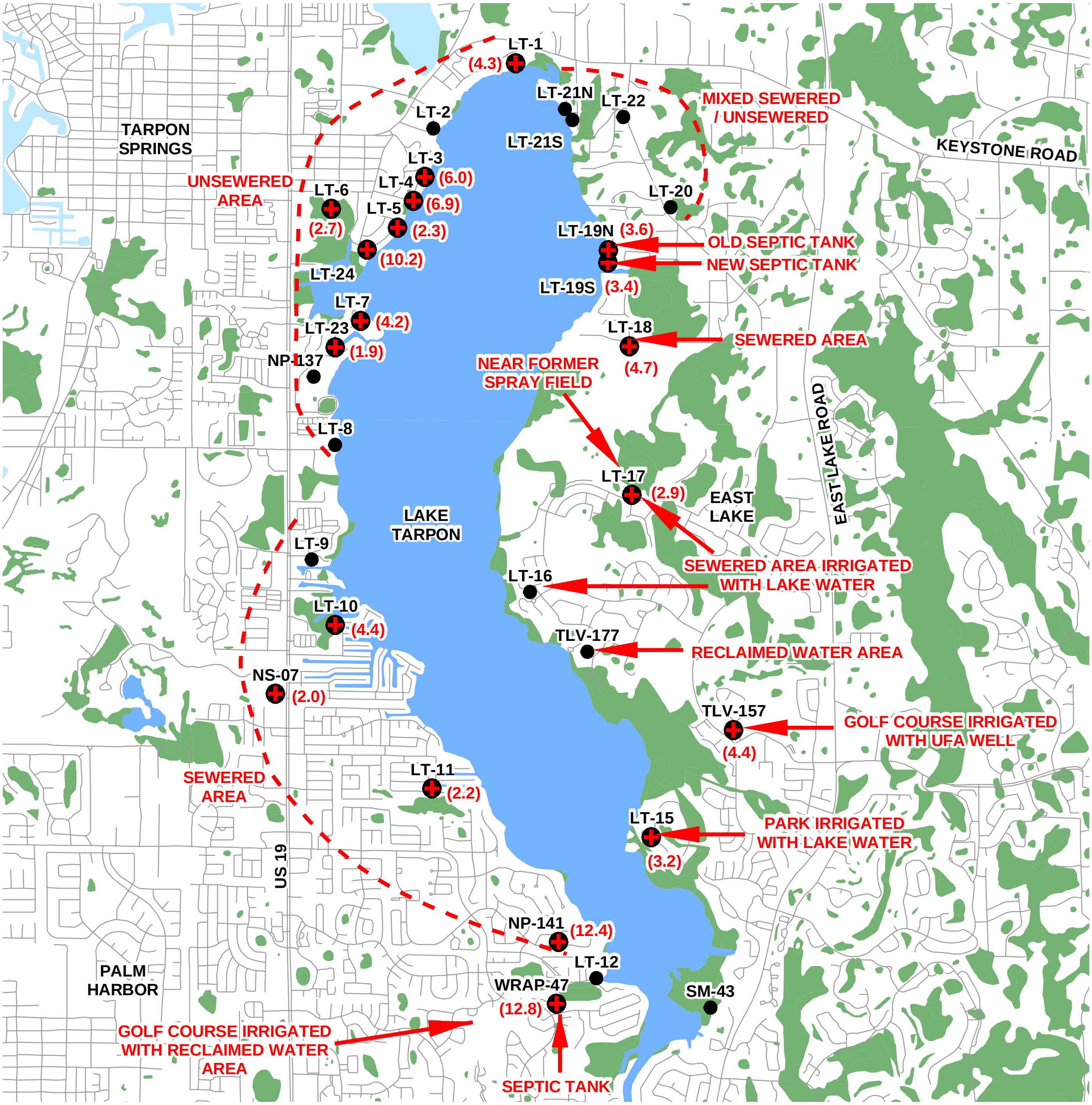
DRAWN:	TDH	CHECKED:	JMT	DATE:	MAR - 2004	FIGURE:	9

Figure 10
Total Nitrogen Concentrations
Lake Tarpon Nutrient Study



Leggette, Brashears & Graham, Inc.



Legend

- Elevated Total Nitrogen Concentrations (TN > 2.0 mg/l)
- Non-elevated Total Nitrogen Concentrations
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

N

0 2,000 4,000 Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

LOCATION OF MONITORING WELLS
WITH ELEVATED TOTAL NITROGEN CONCENTRATION

DATE	REVISED

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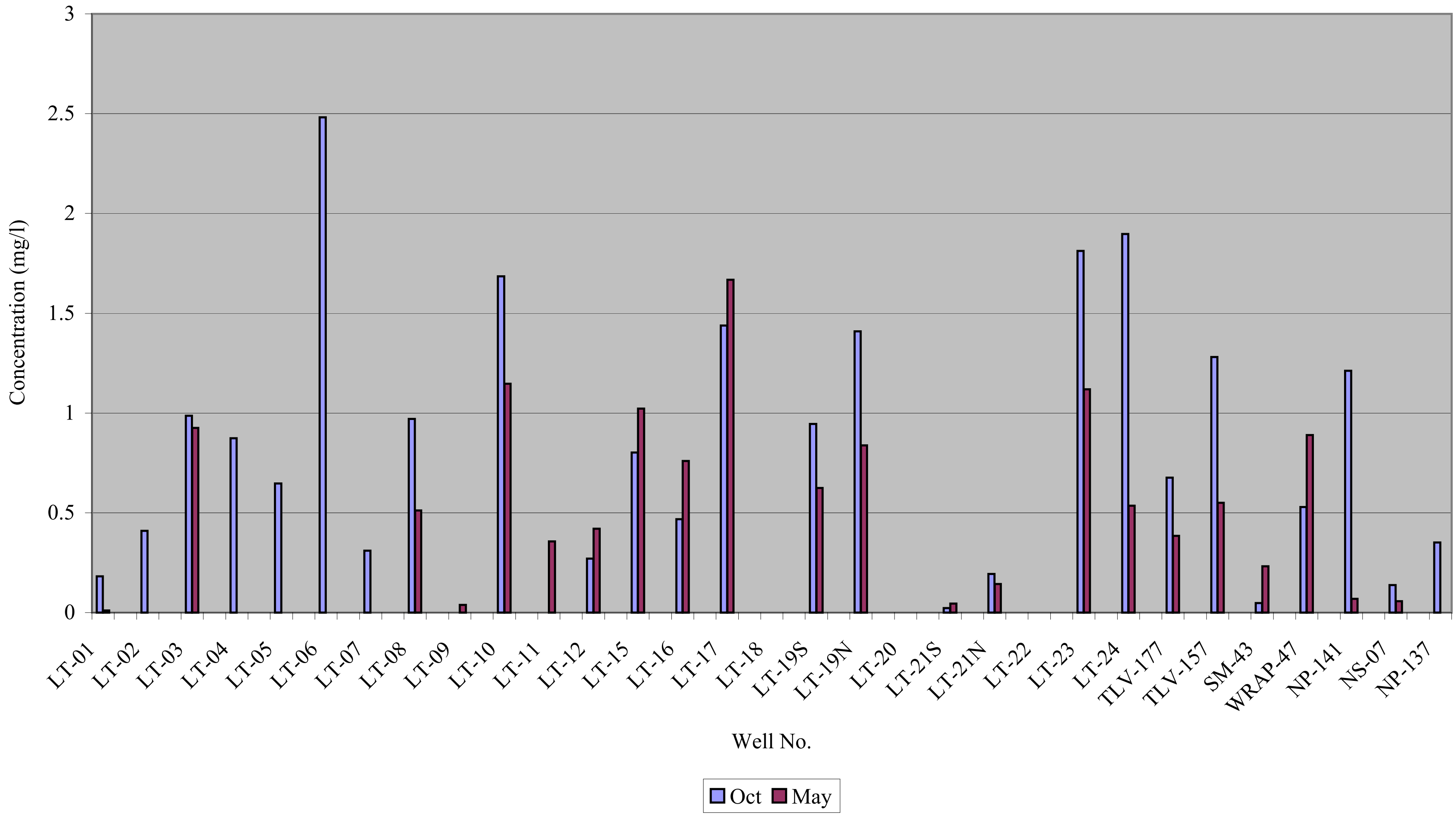
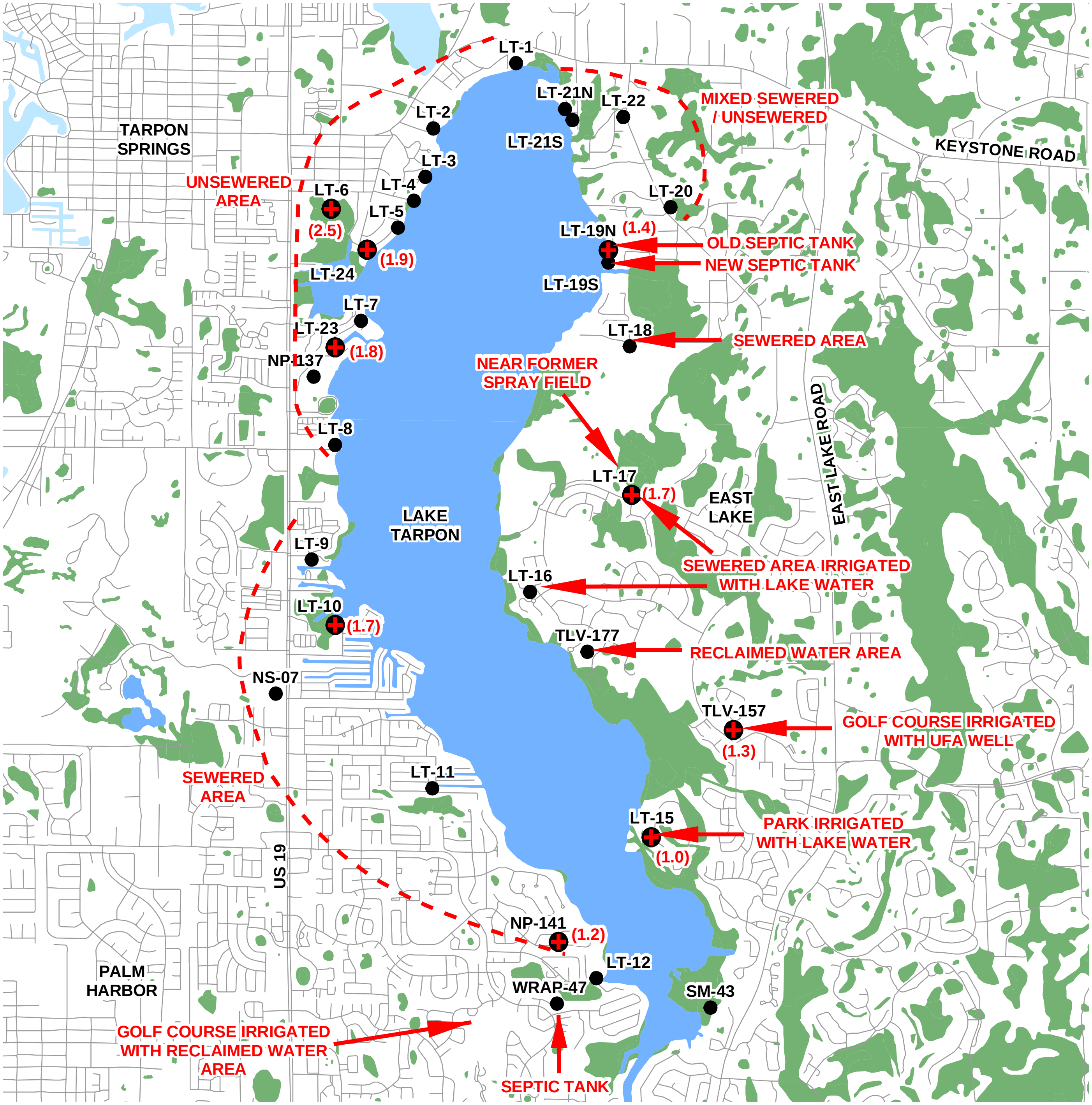
DRAWN:	TDH	CHECKED:	JMT	DATE:	MAR - 2004	FIGURE:	11

Figure 12
Organic Nitrogen Concentrations
Lake Tarpon Nutrient Study

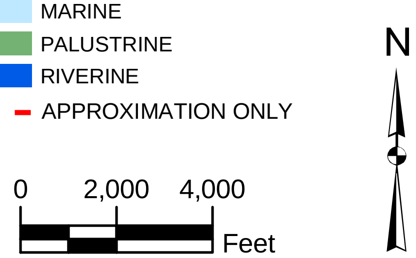


Leggette, Brashears & Graham, Inc.



Legend

- Elevated Organic Nitrogen Concentrations (ON > 1.0 mg/l)
- Non-elevated Organic Nitrogen Concentrations
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY



LAKE TARPON
GROUNDWATER NUTRIENT STUDY

LOCATION OF MONITORING WELLS
WITH ELEVATED ORGANIC NITROGEN CONCENTRATION

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DRAWN:	TDH	CHECKED:	JMT	DATE:	MAR - 2004	FIGURE:	13

Figure 14
Orthophosphate Concentrations
Lake Tarpon Nutrient Study

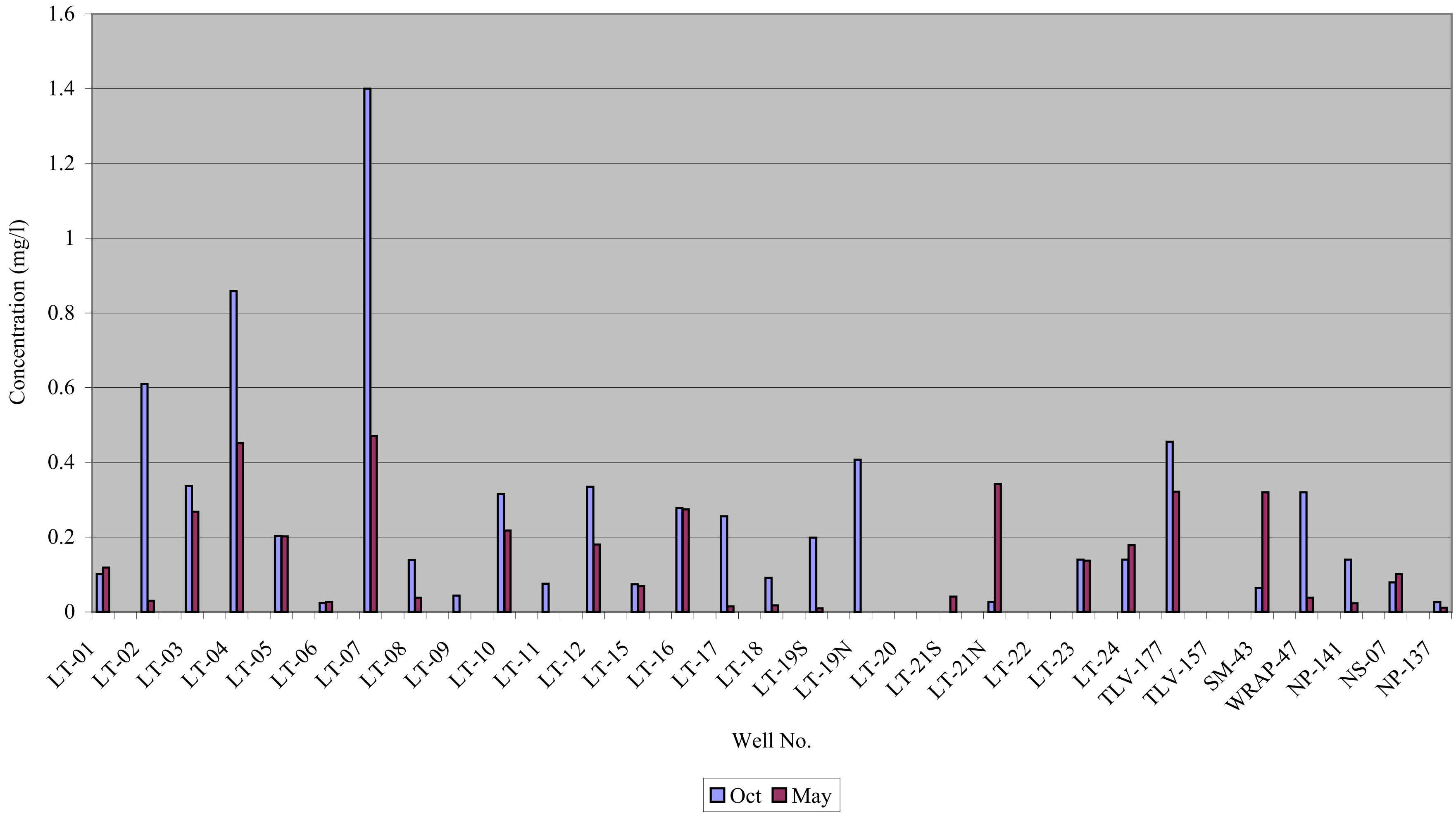

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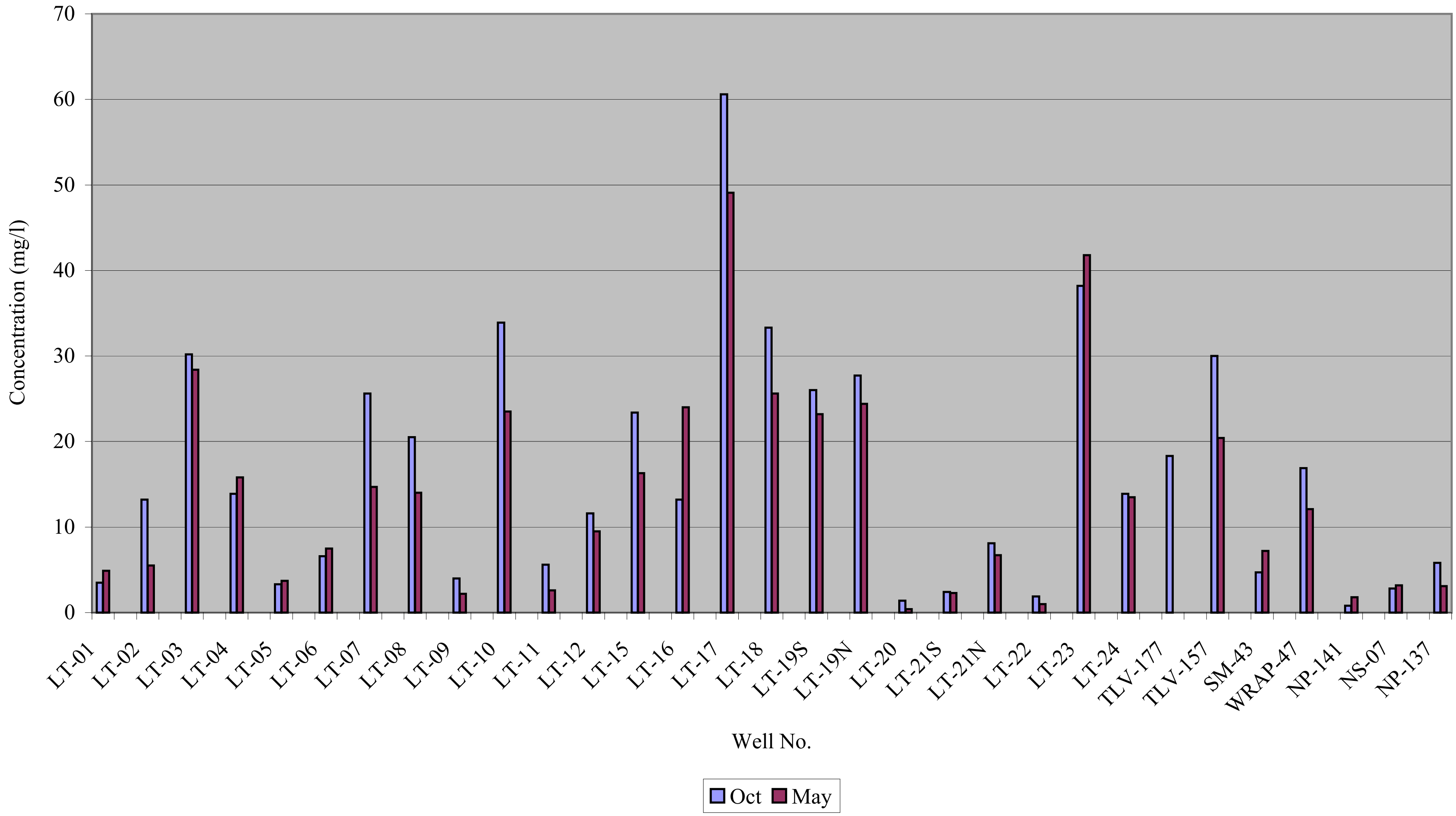
Figure 15
TOC Concentrations
Lake Tarpon Nutrient Study



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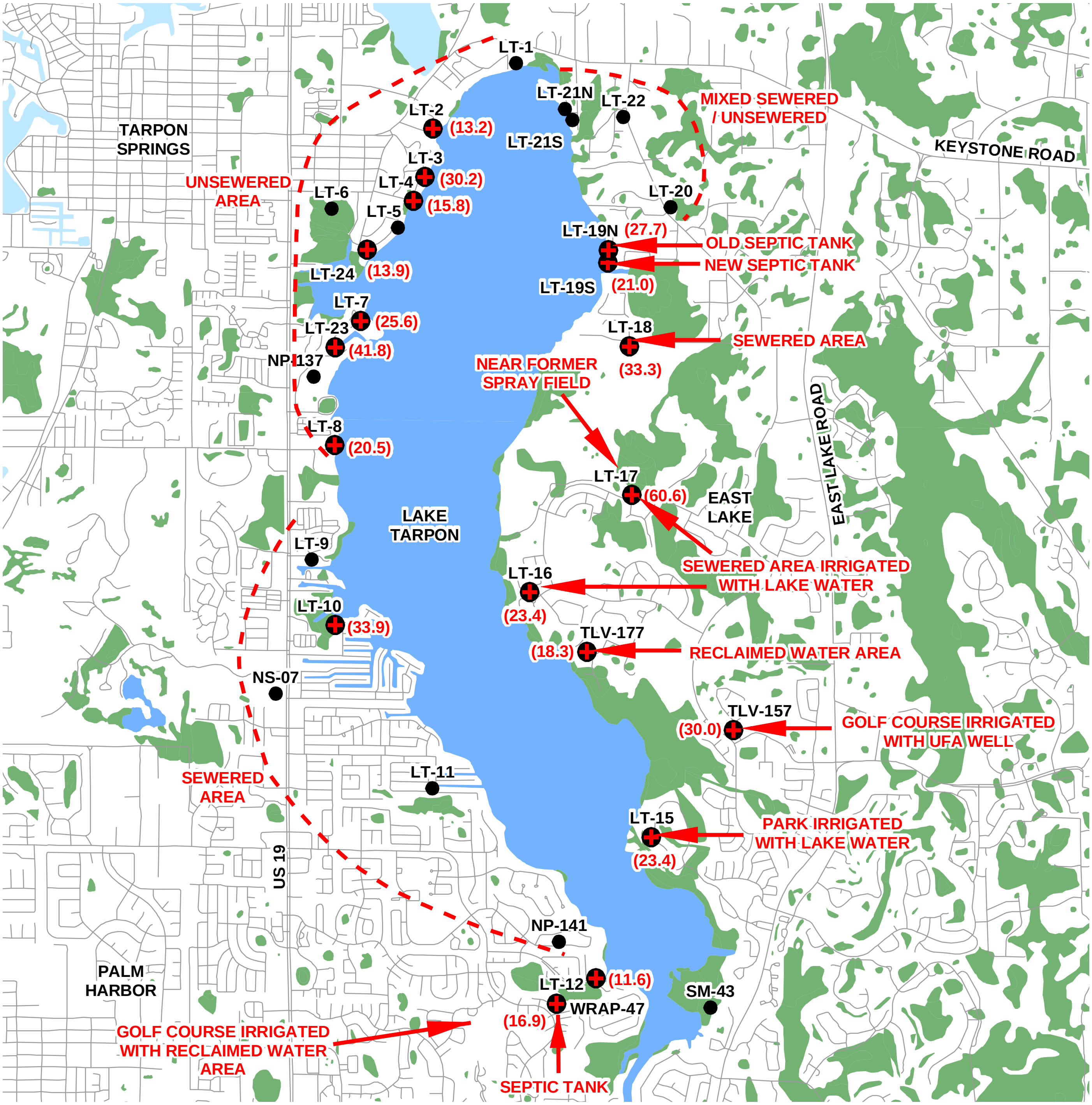

Legend

- Elevated TOC Concentrations (TOC > 10 mg/l)
- Non-elevated TOC Concentrations
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

0 2,000 4,000 Feet

N

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

LOCATION OF MONITORING WELLS
WITH ELEVATED TOC CONCENTRATION

DATE	REVISED

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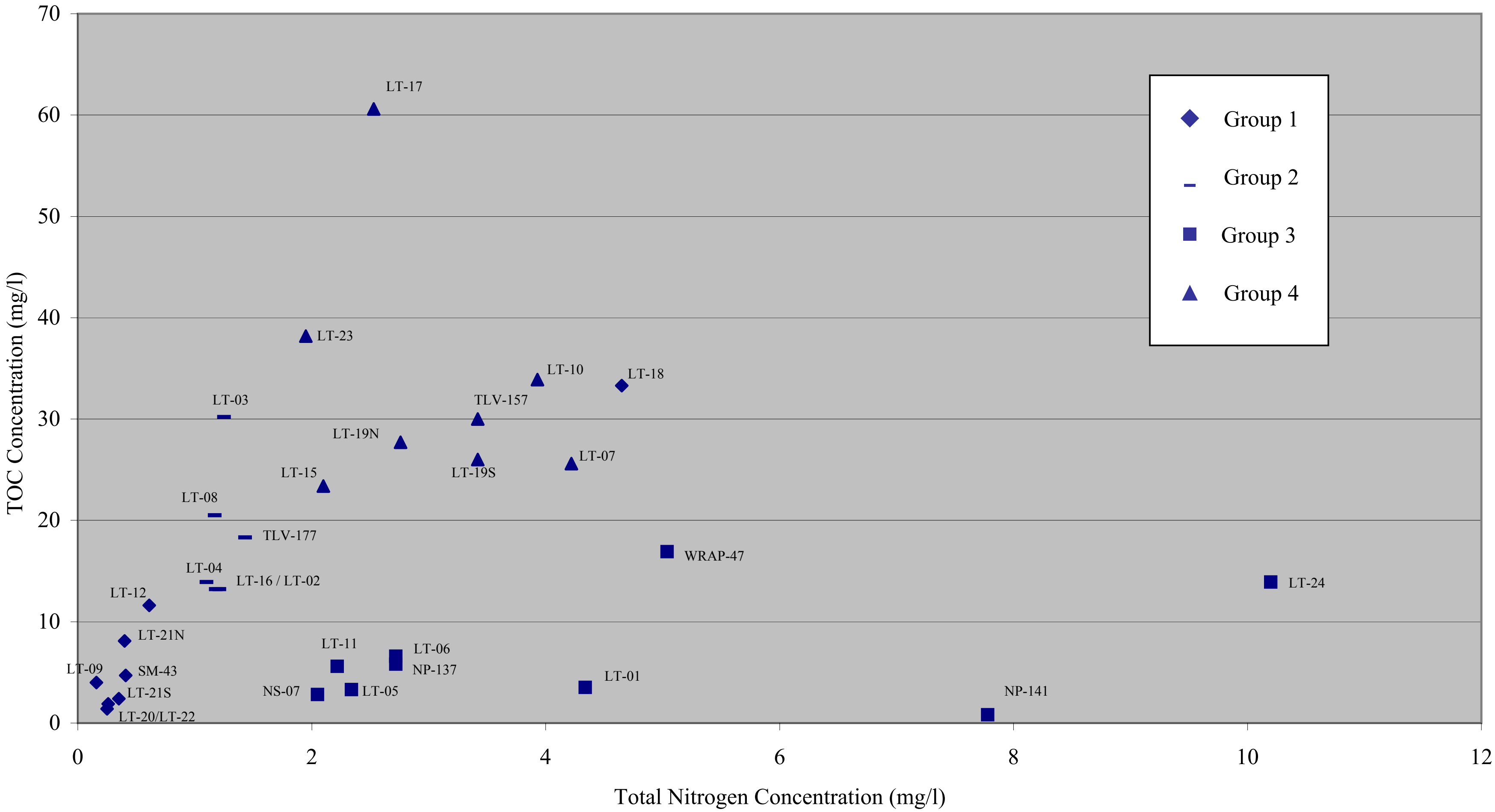
DRAWN:	TDH	CHECKED:	JMT	DATE:	MAR - 2004	FIGURE:	16

Figure 17
Total Nitrogen vs. TOC Concentration
Lake Tarpon Nutrient Study



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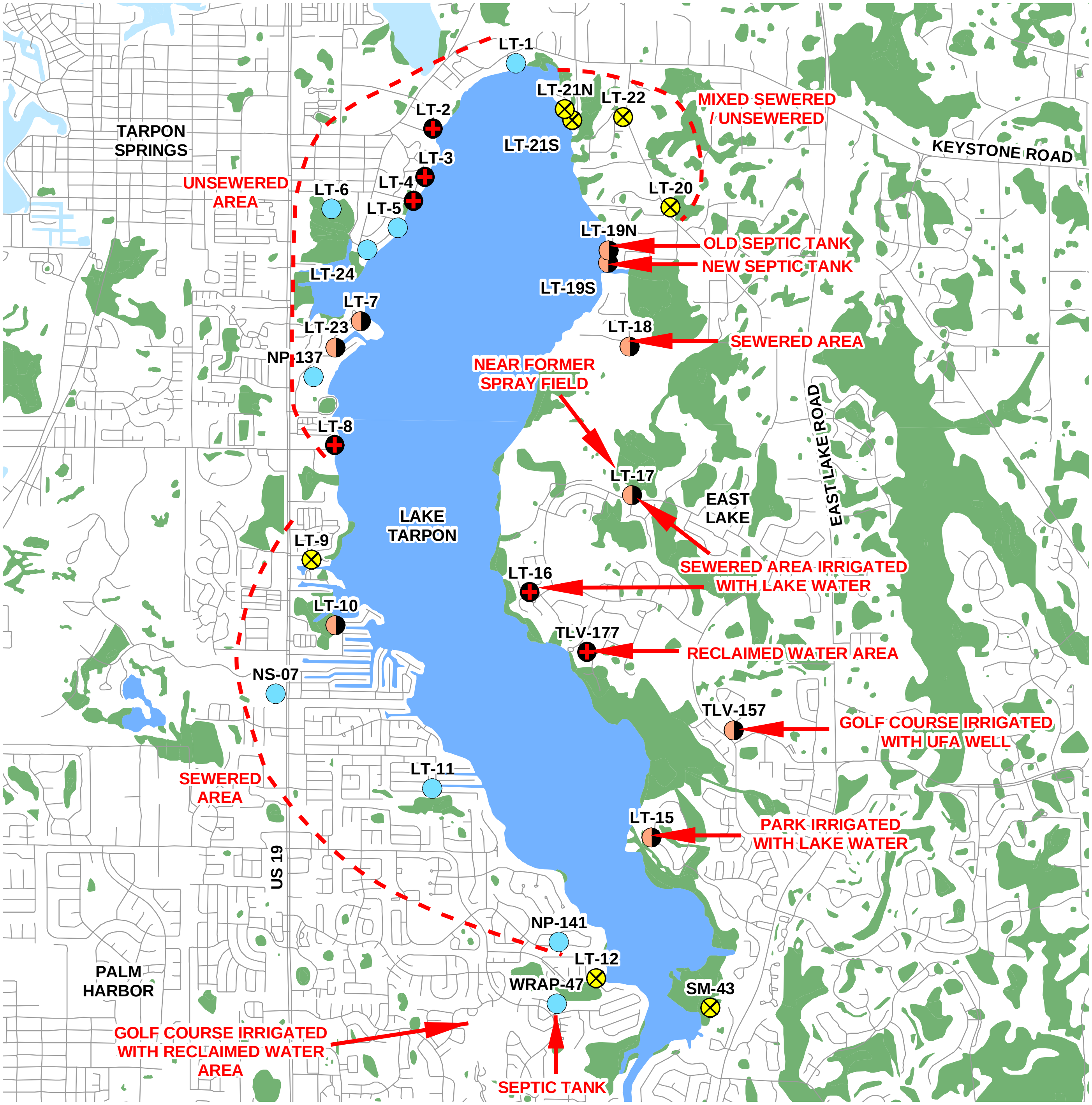

Legend

- Group 1 Wells (TN<1.0 / TOC <10)
- Group 2 Wells (TN <2.0 / TOC >10)
- Group 3 Wells (TN >2.0 / TOC <20)
- Group 4 Wells (TN>2.0 / TOC >20)
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

0 2,000 4,000 Feet

N

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

TOC / TOTAL NITROGEN TYPES

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DRAWN:	TDH	CHECKED:	JMT	DATE:	MAR - 2004	FIGURE:	18

Figure 19
Nitrate vs. TOC Concentration
Lake Tarpon Nutrient Study

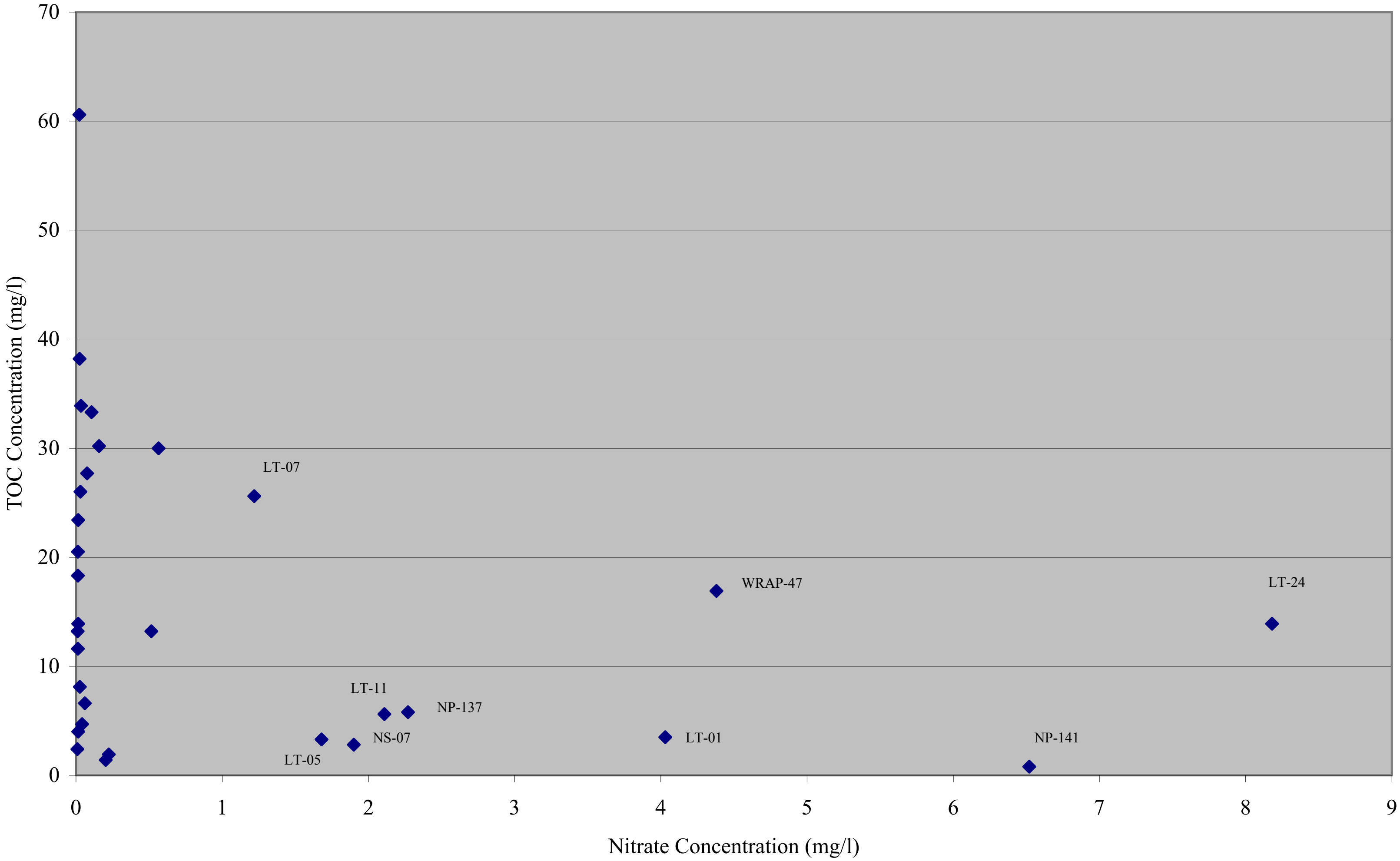

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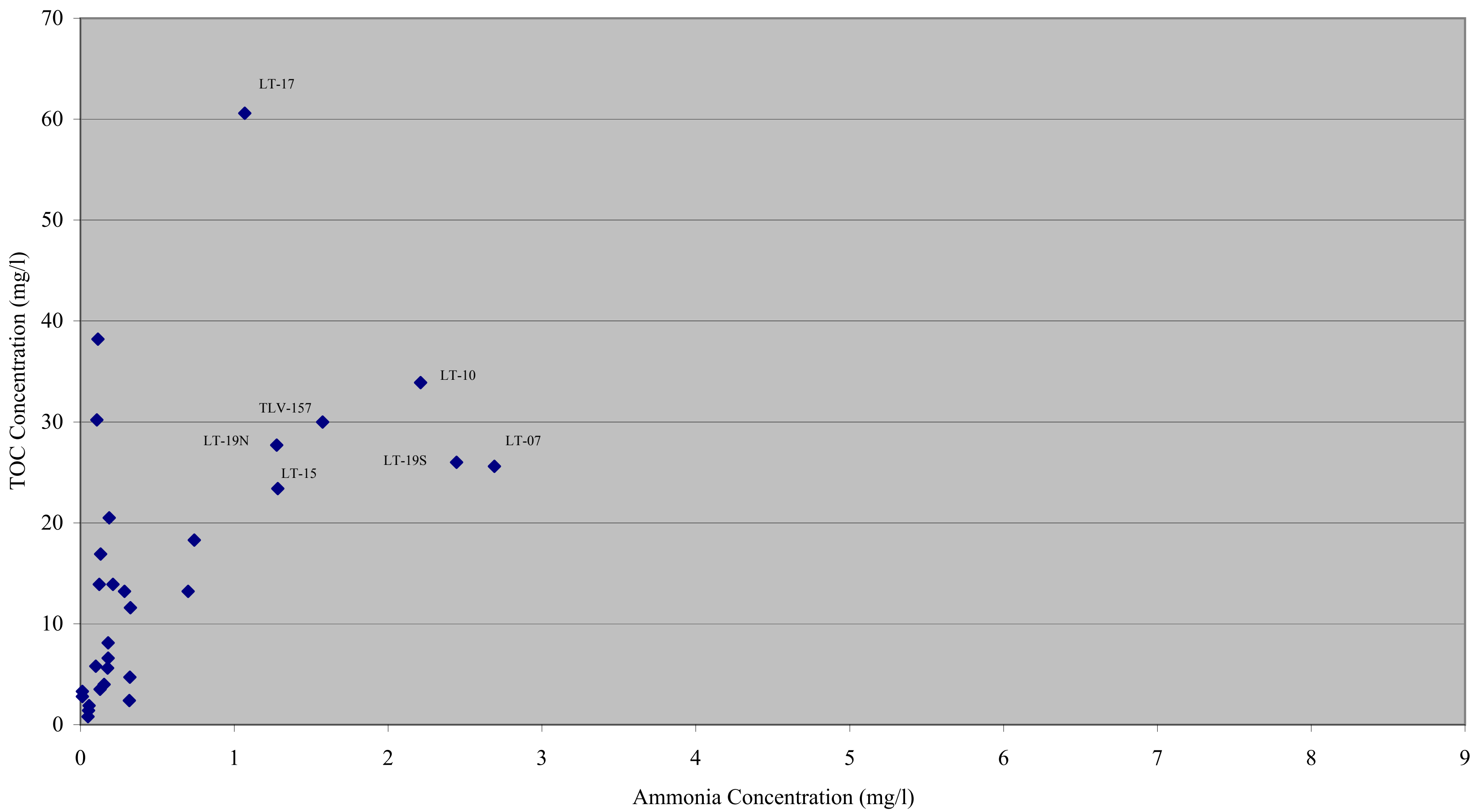
Figure 20
Ammonia vs. TOC Concentration
Lake Tarpon Nutrient Study



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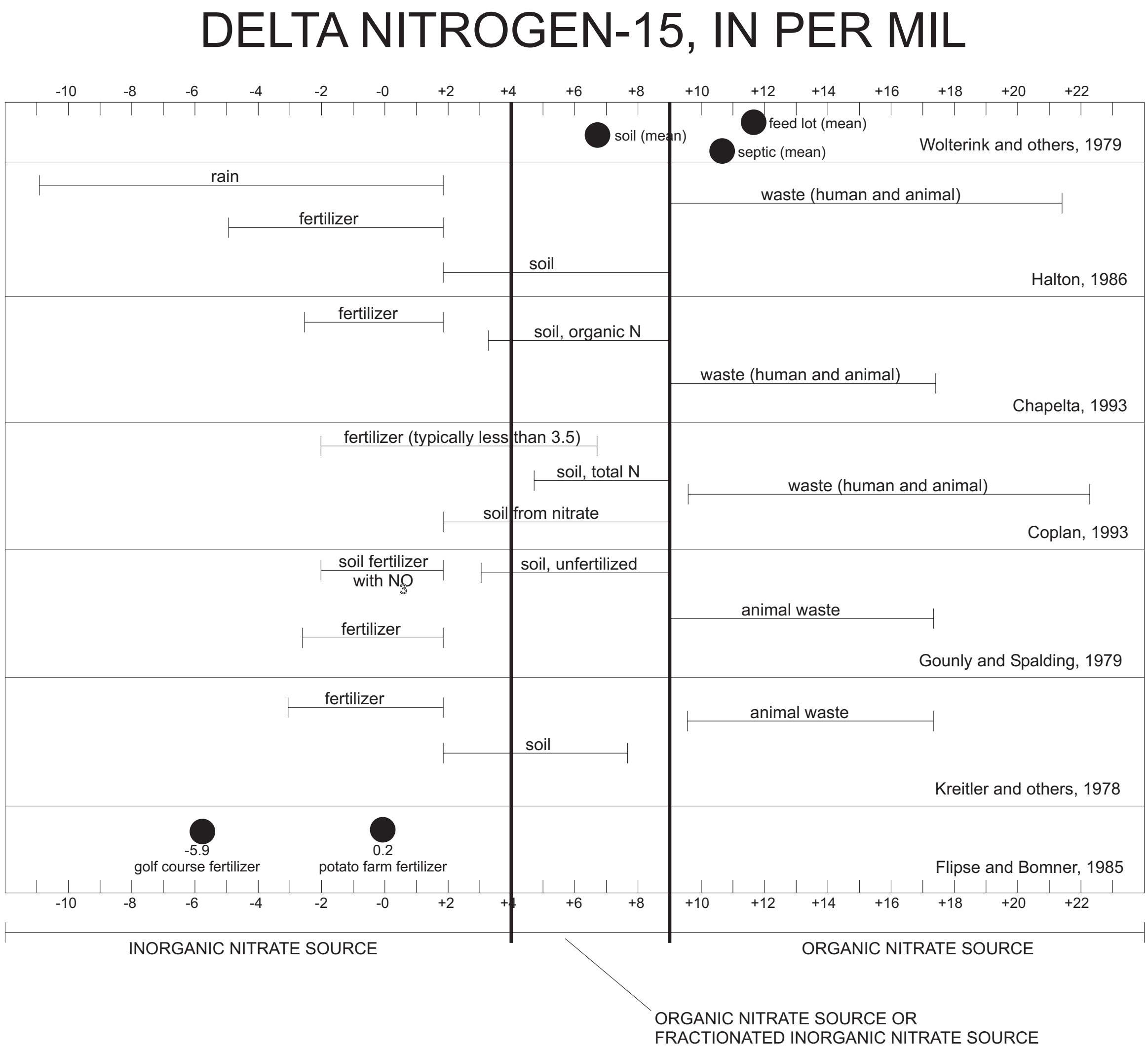

SOURCE: TIHANSKY AND SACK(1997)

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

NITROGEN ISOTOPE COMPOSITION OF DIFFERENT NITRATE SOURCES FROM PREVIOUS INVESTIGATIONS

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DATE: 8/2004 FIGURE: 21

Figure21.CDR

Figure 22

δ ^{15}N versus NO_3 for Citrus, Undeveloped and Residential Land Uses (U.S.G.S., 1997)

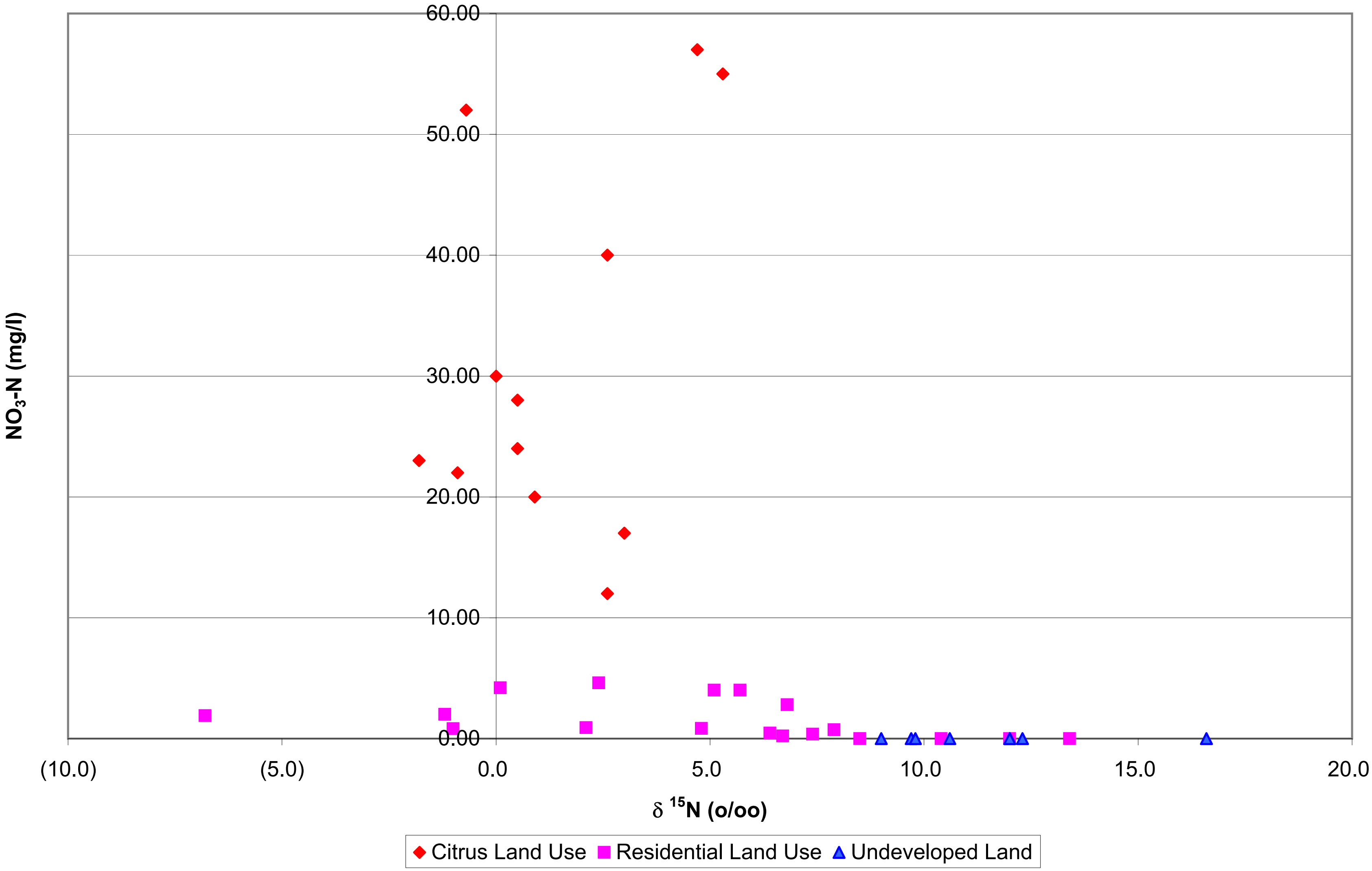

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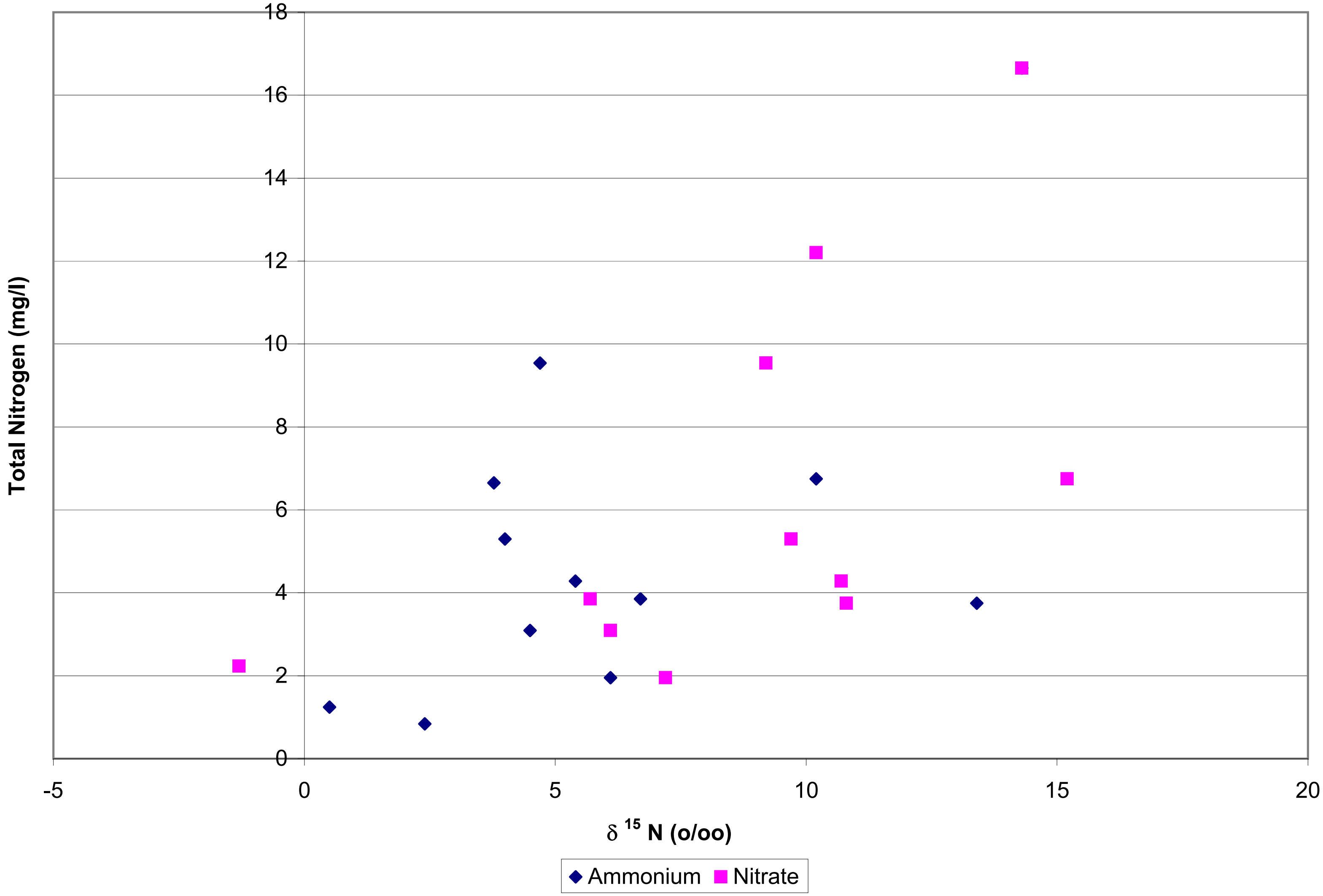
Figure 23
Total Nitrogen vs $\delta^{15}N$ of NH_4 and NO_3 (ERM, 1998)



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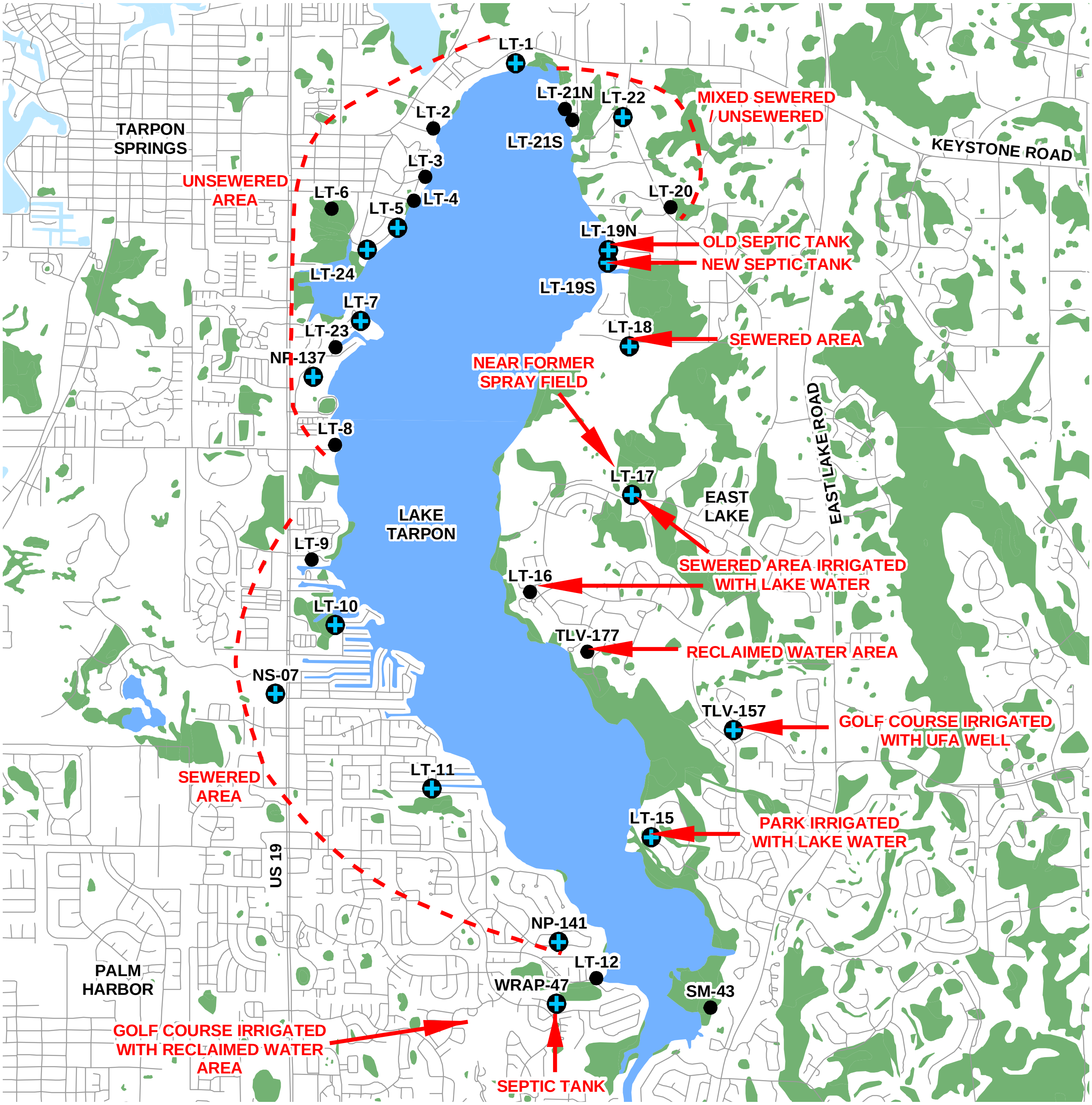

Legend

- Isotopic Analysis Monitoring well
- Monitoring Well
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

N

0 2,000 4,000 Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

MONITORING WELLS ANALYZED FOR NITROGEN ISOTOPIC COMPOSITION

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Figure 25

NO_3/NH_4 vs $\delta^{15}N$ (This study)

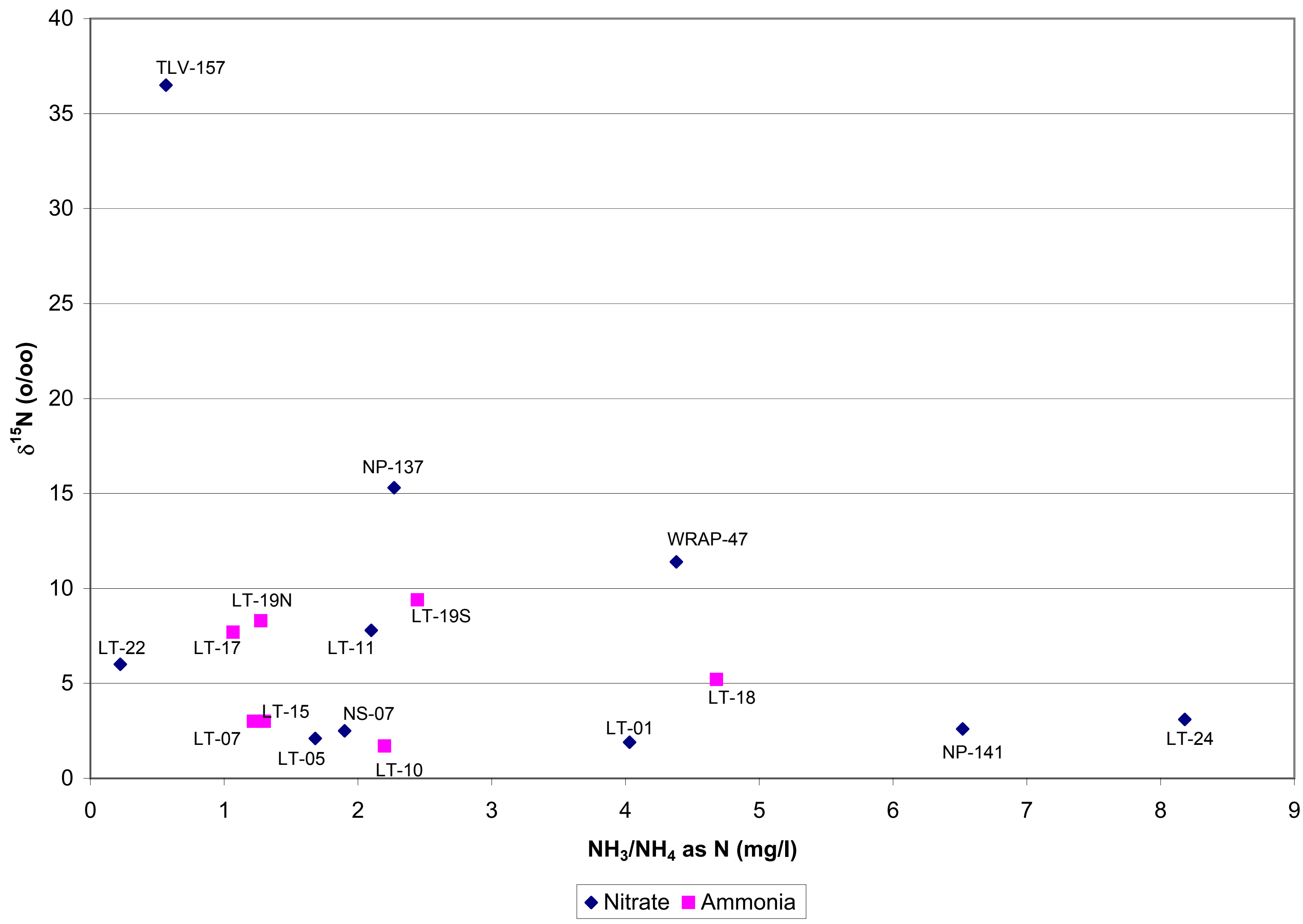

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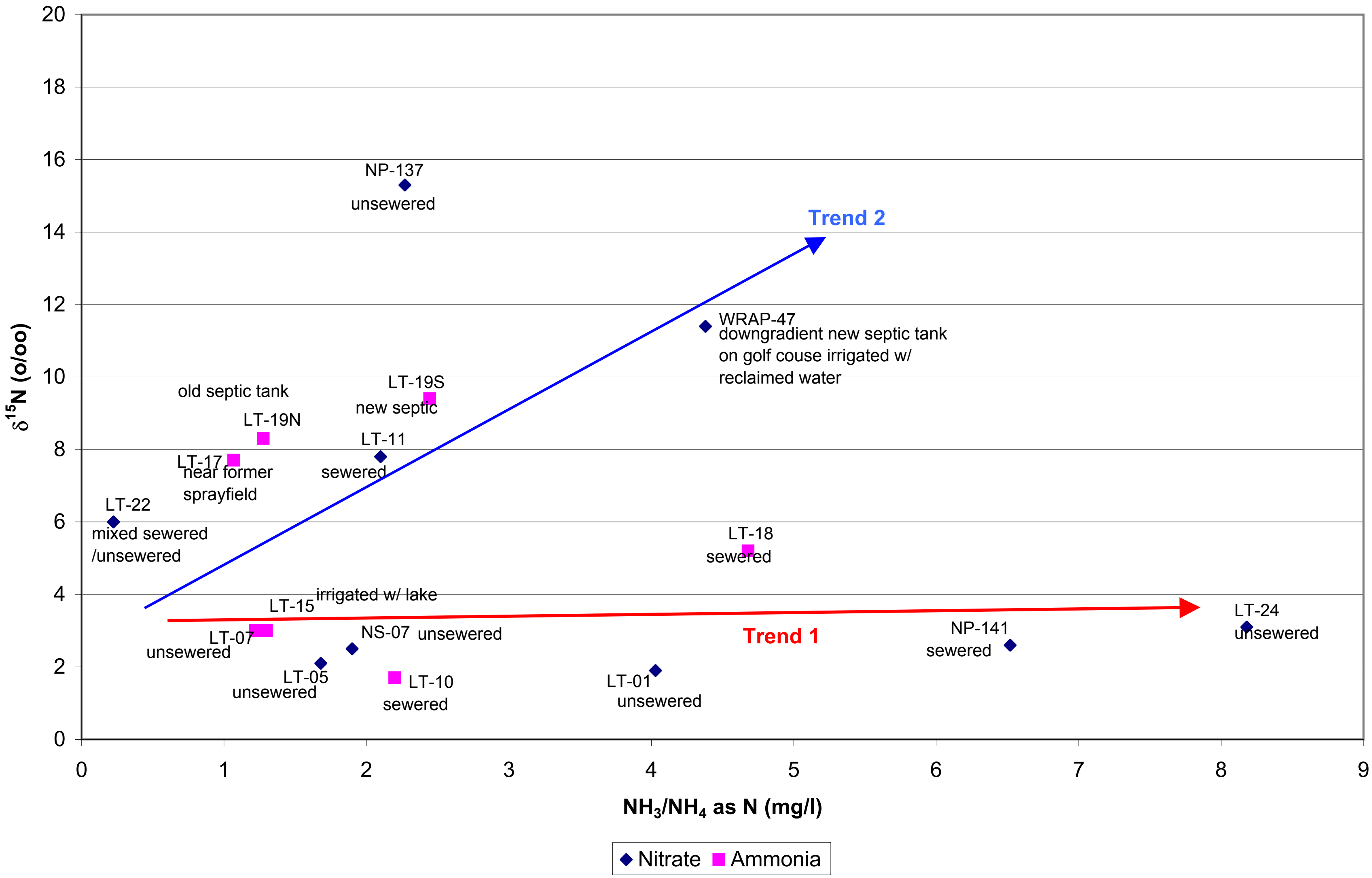
Figure 26

NO_3/NH_4 vs δ^{15} N with Land Use at Sampling Site (This study)



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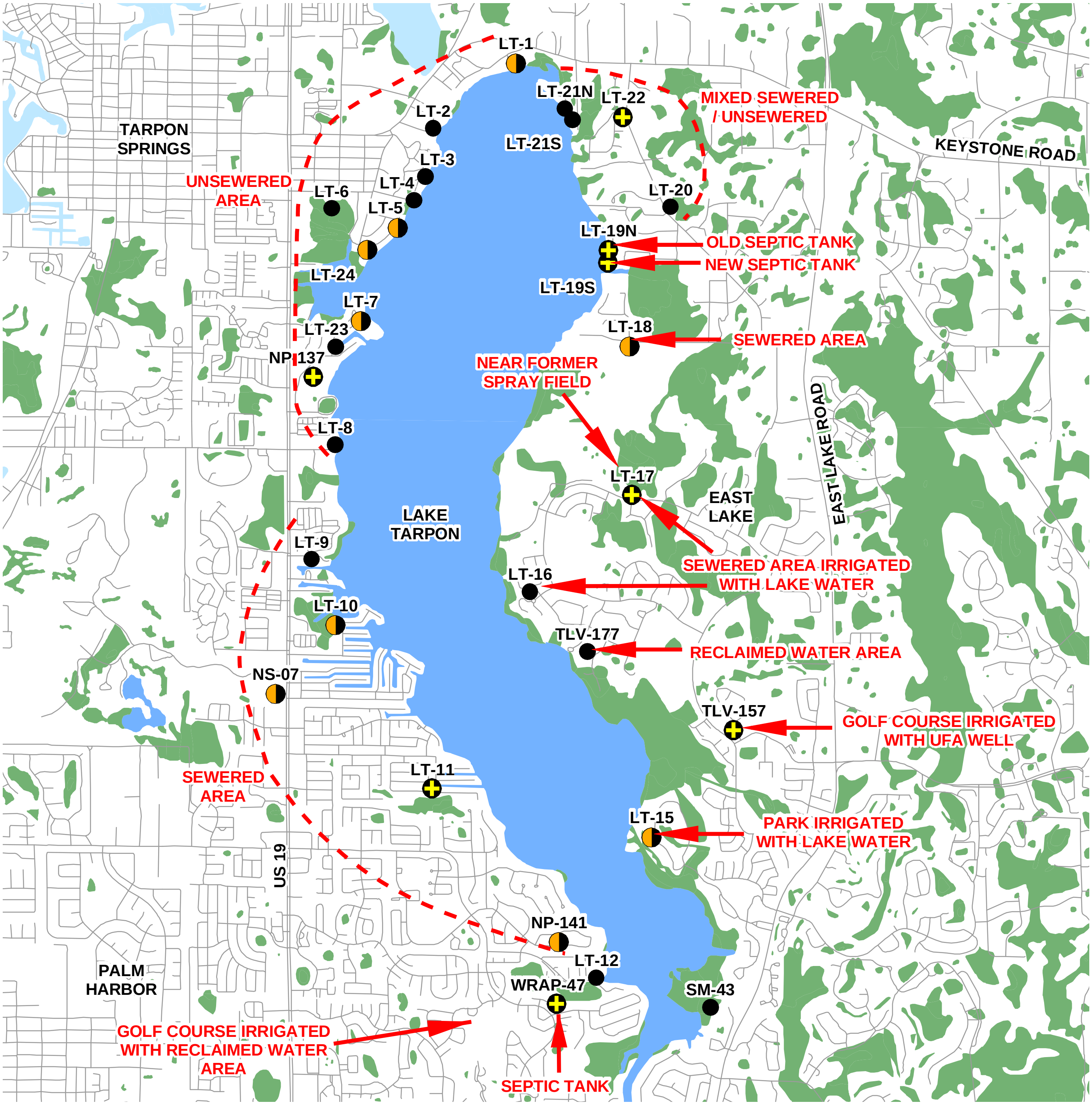

Legend

- Monitoring Well
- Trend 1 (Fertilizer Source)
- Trend 2 (Waste Source)
- ESTUARINE
- LACUSTRINE
- MARINE
- PALUSTRINE
- RIVERINE
- APPROXIMATION ONLY

N

0 2,000 4,000

Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

NITROGEN ISOTOPE ANALYSIS TRENDS

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EXPLANATION

MONITOR WELL LOCATION

FLUX MODEL SAS FLOW PANEL

0 1,500 3,000 6,000 9,000 12,000 Feet

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

MAP VIEW OF FLOW PANELS USED FOR THE
NUTRIENT FLUX CALCULATIONS FOR LAKE TARPON

DATE	REVISED

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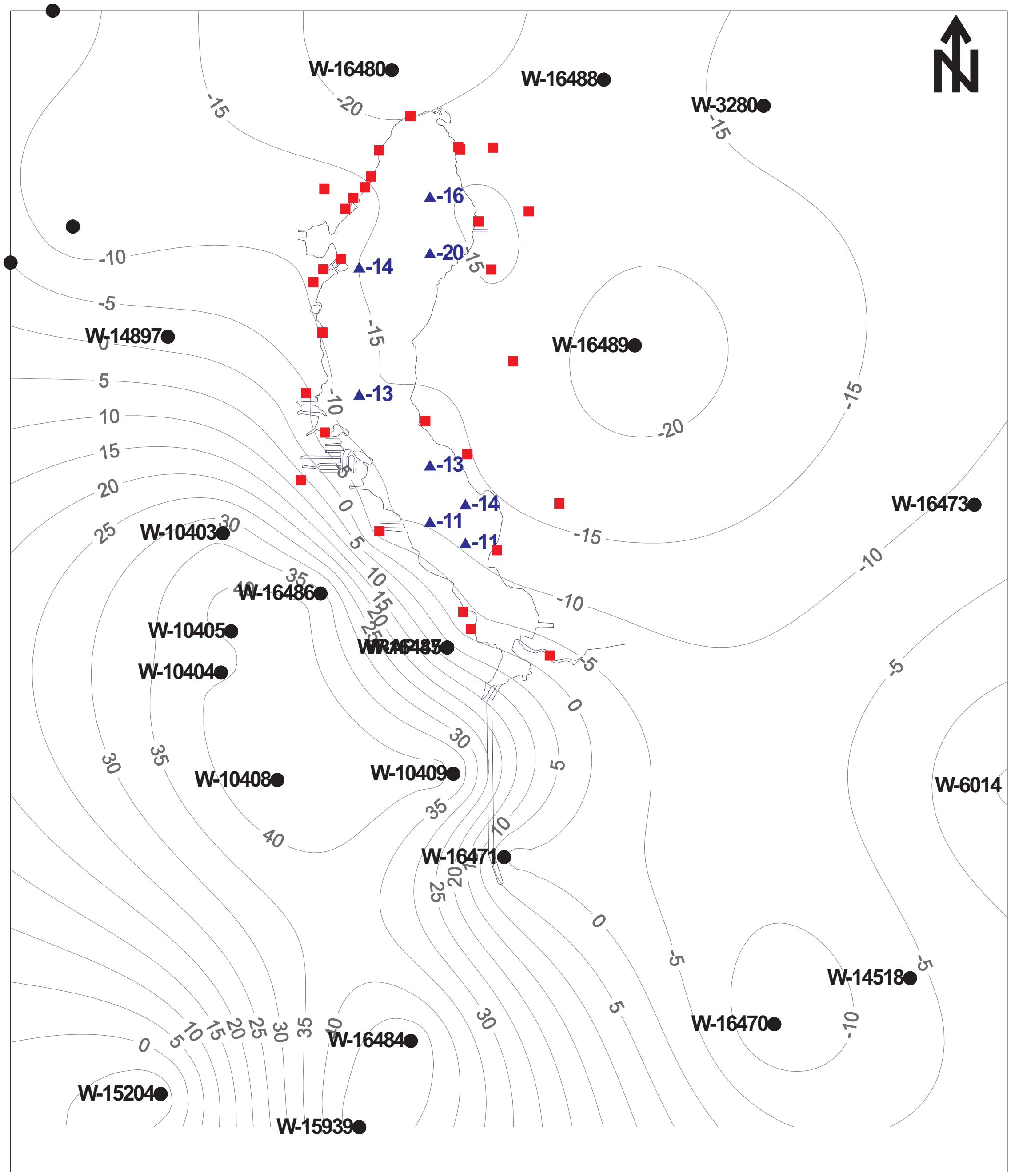
DATE: 8/2004 FIGURE: 28

Figure28.CDR



■ Lake Tarpon Nutrient Study Monitor Well

● Fla. Geological Survey Monitor Well Data Point
45

▲ Bathymetry Data Point
11

Contour of the Elevation of the Bottom of the SAS in Feet NGVD.
10

0 1 2
Miles

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

CONTOUR MAP OF THE BOTTOM
OF THE SURFICIAL AQUIFER SYSTEM

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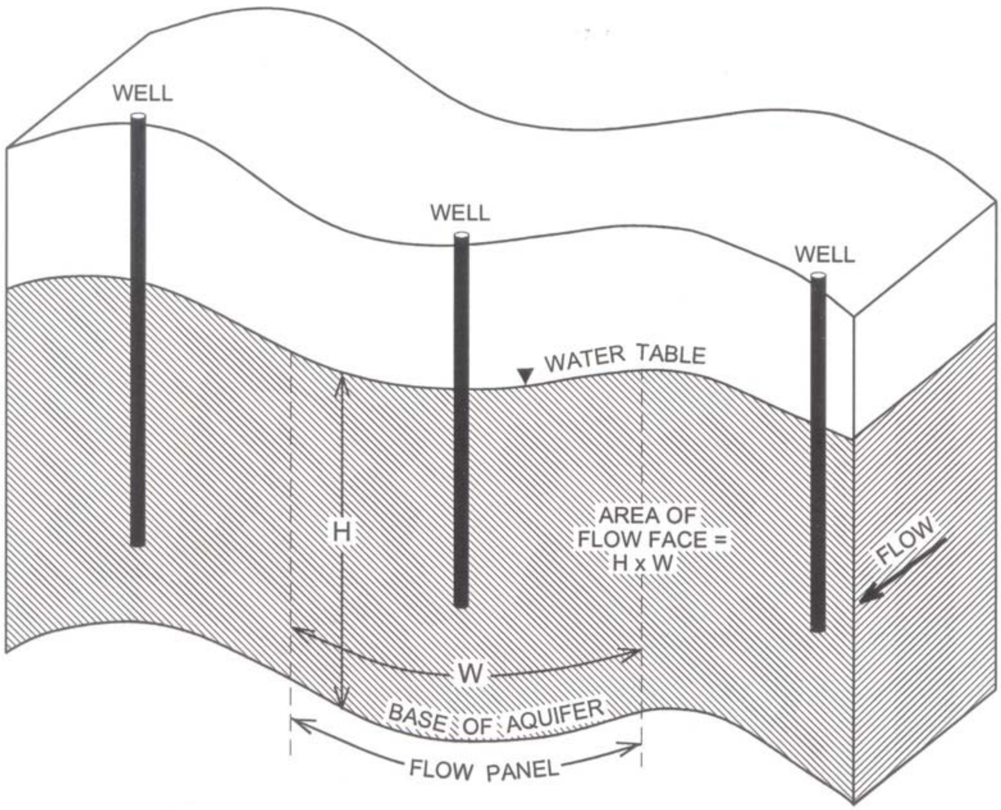
		DATE: 8/2004 FIGURE: 29

Figure29.CDR



LAKE TARPON
GROUNDWATER NUTRIENT STUDY

CROSS-SECTION OF FLOW PANEL USED FOR
CALCULATION OF NUTRIENT FLUXES INTO LAKE TARPON

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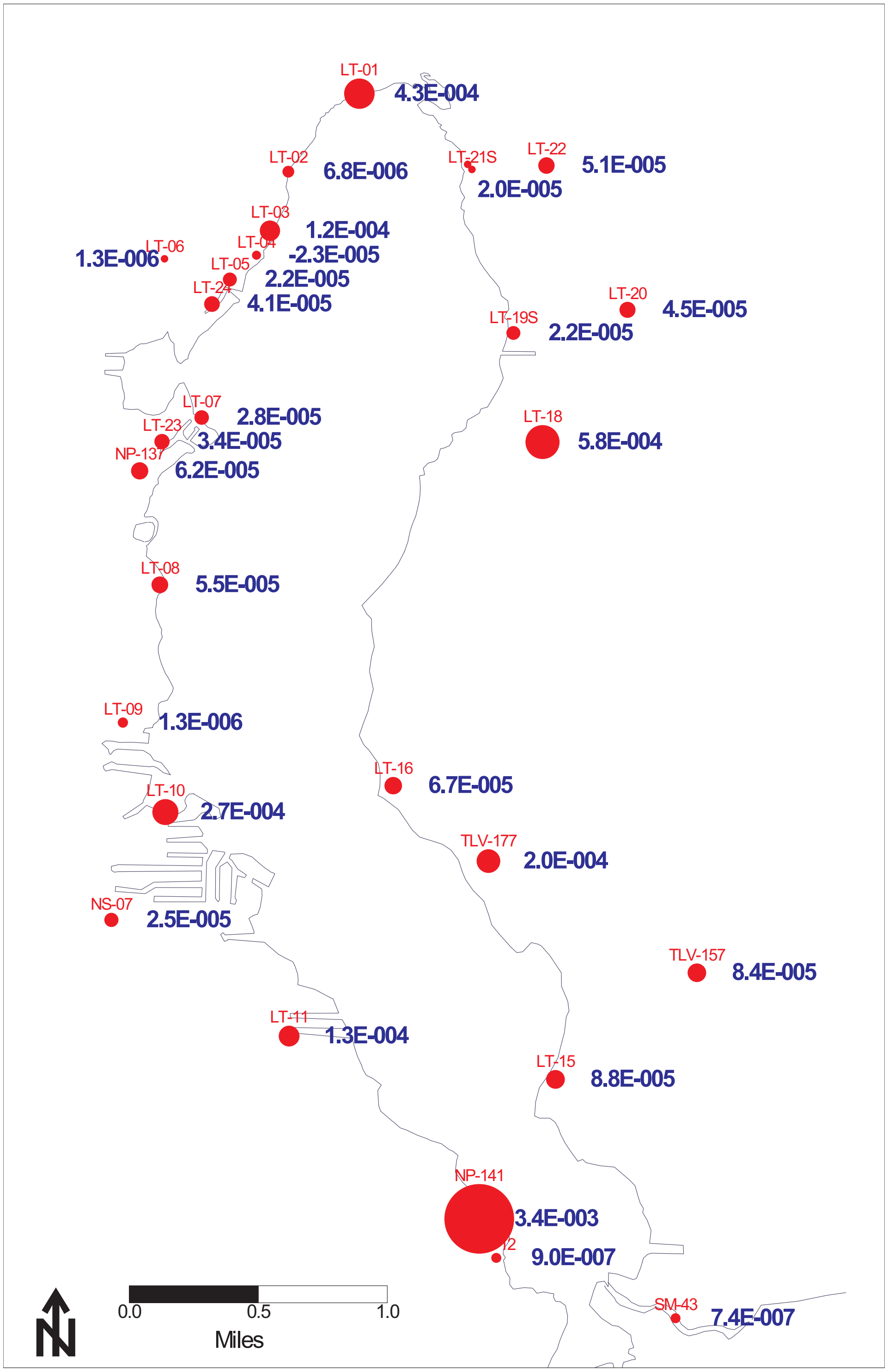
DATE: 8/2004 FIGURE: 30

Figure30.CDR



LT-11
1.3E-004
Monitoring Well Nitrogen Flux, lbs/day/foot
(Symbol size is proportional to value)

LAKE TARPON
GROUNDWATER NUTRIENT STUDY

WY02 DRY SEASON NITROGEN FLUXES PER UNIT
WIDTH OF AQUIFER INTO LAKE TARPON

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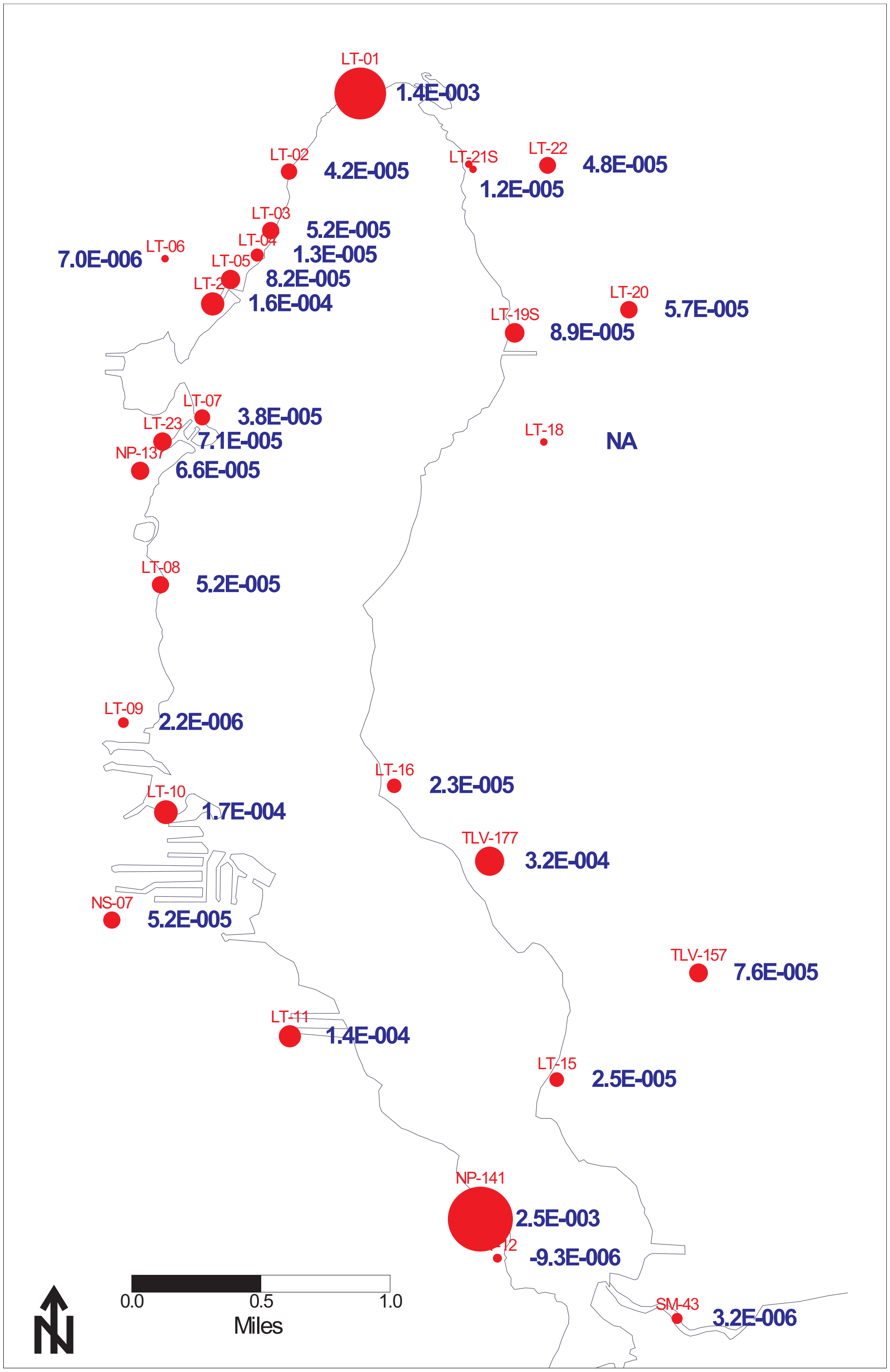
DATE: 8/2004
FIGURE: 31

Figure31.CDR



LT-11 1.4E-004 Monitoring Well Nitrogen Flux, lbs/day/foot
(Symbol size is proportional to value)

LAKE TARPON GROUNDWATER NUTRIENT STUDY	
WY02 WET SEASON NITROGEN PER UNIT WIDTH OF AQUIFER INTO LAKE TARPON	

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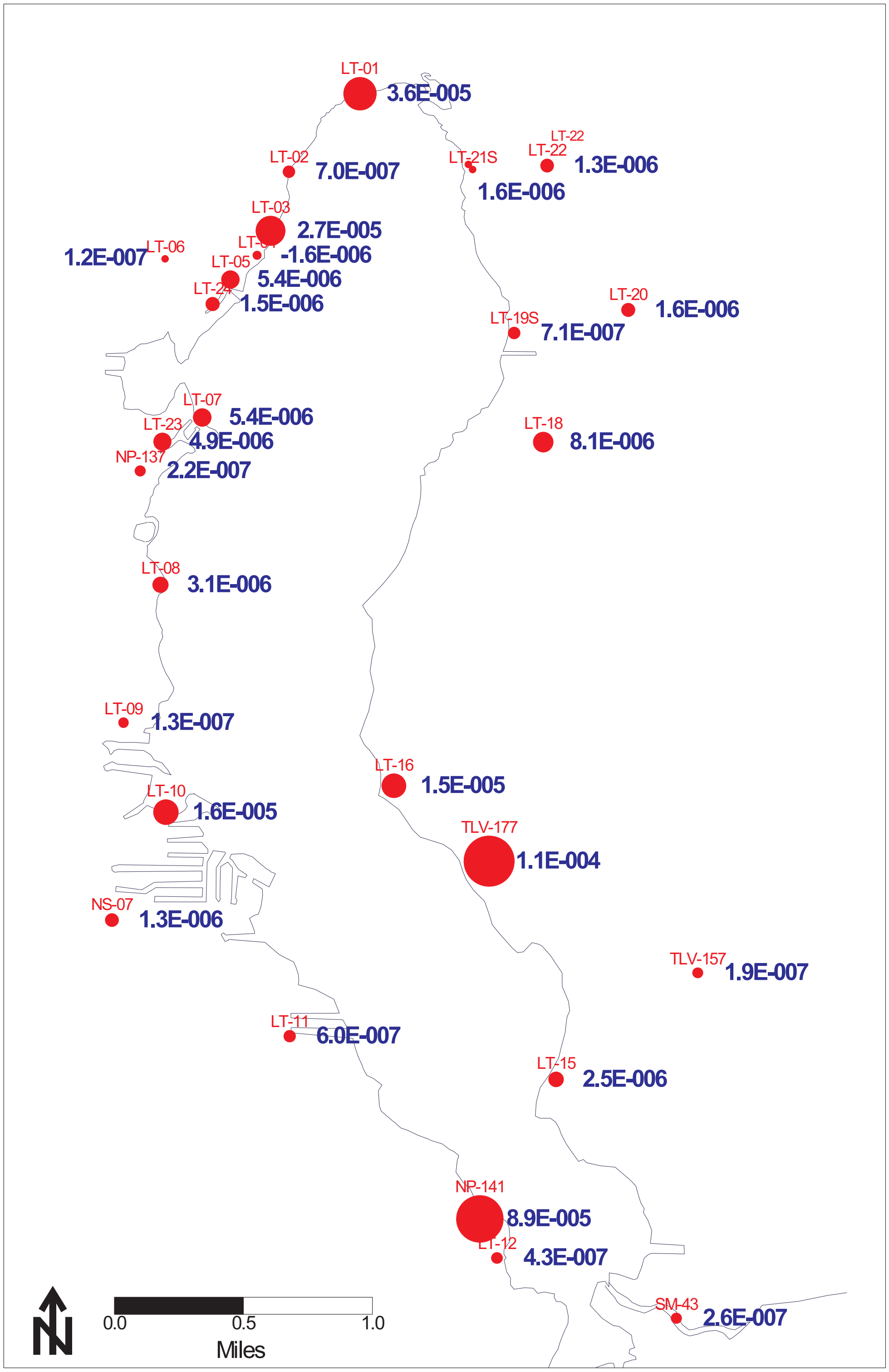
		DATE: 8/2004 FIGURE: 32

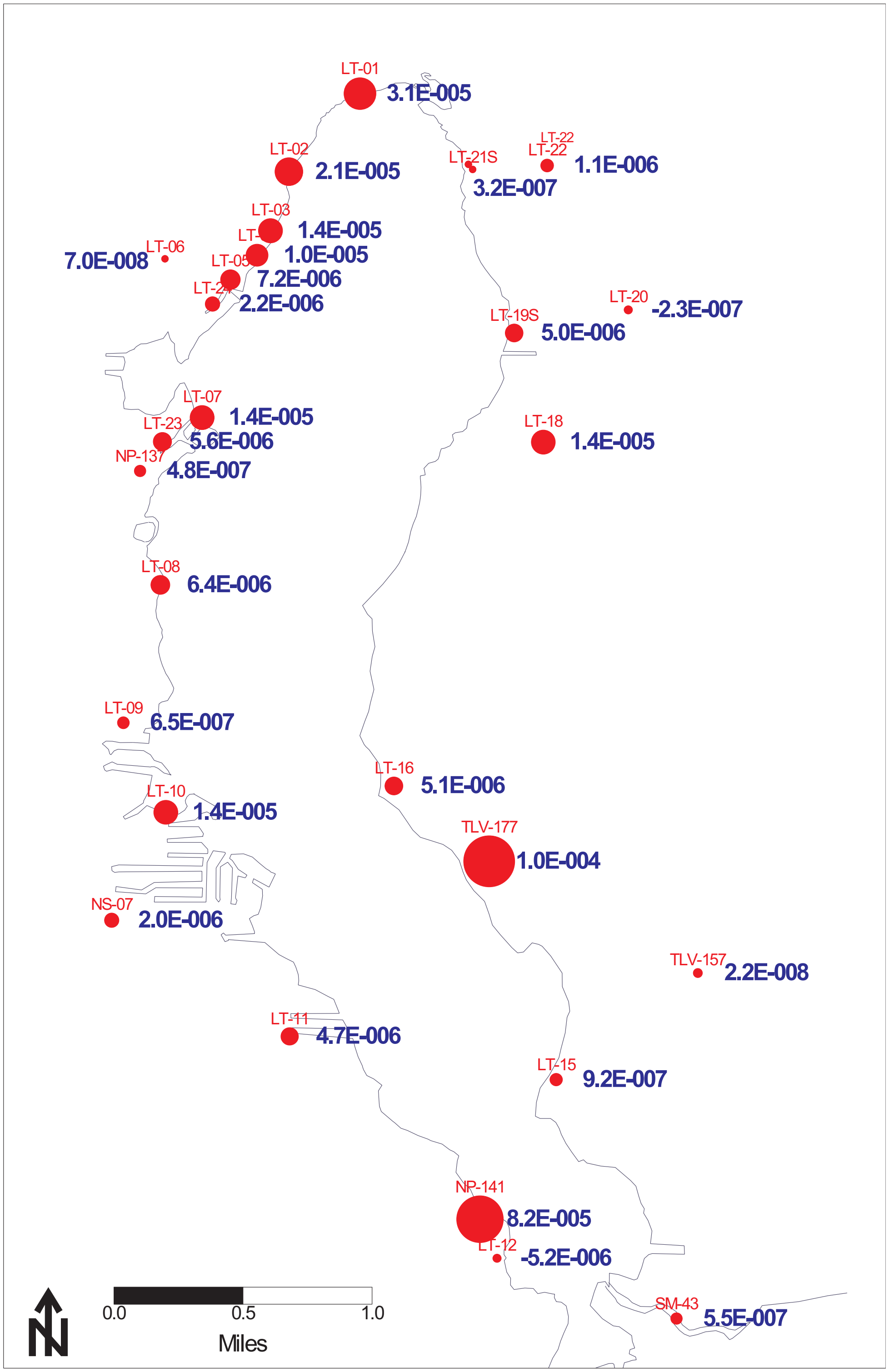
Figure32.CDR



LT-11 6.0E-007 Monitoring Well Phosphorous Flux, lbs/day/foot (Symbol size is proportional to value)

LAKE TARPON GROUNDWATER NUTRIENT STUDY		
WY02 DRY SEASON PHOSPHOROUS FLUXES PER UNIT WIDTH OF AQUIFER INTO LAKE TARPON		
DATE	REVISED	PREPARED BY: **LEGGETTE, BRASHEARS & GRAHAM, INC.** Professional Ground-Water And Environmental Engineering Services 10014 N. Dale Mabry Hwy, Suite 205 Tampa, Florida 33618 (813) 968-5882
		DATE: 8/2004 FIGURE: 33

Figure33.CDR



LT-11 4.7E-006

Monitoring Well Phosphorous Flux, lbs/day/foot
(Symbol size is proportional to value)

LAKE TARPON GROUNDWATER NUTRIENT STUDY			
WY02 WET SEASON PHOSPHOROUS FLUXES PER UNIT WIDTH OF AQUIFER INTO LAKE TARPON			
DATE	REVISED	PREPARED BY:	**LEGGETTE, BRASHEARS & GRAHAM, INC.** Professional Ground-Water And Environmental Engineering Services 10014 N. Dale Mabry Hwy, Suite 205 Tampa, Florida 33618 (813) 968-5882
		DATE: 8/2004	FIGURE: 34

Figure34.CDR

TABLES

Table 1

Well Locations Rationale
Lake Tarpon Nutrient Study

Well No.	Well Location	Location Rationale
LT-01	Richard Ervin Pkwy.	Unsewered area
LT-02	Lake Tarpon Ave.	Unsewered area
LT-03	Grand View Dr.	Unsewered area
LT-04	Lonesome Pine Ln.	Unsewered area
LT-05	Wegman Drive	Unsewered area
LT-06	Jasmine Avenue	Unsewered area
LT-07	Tookes Rd.	ROW; between residences and lake and lagoon. Relatively flat, unsewered area
LT-08	Klosterman Rd.	Close to lake edge, unsewered area
LT-09	Four Points Hotel	Logistic location; between urban landscape and lake - sewer installed
LT-10	Freshwater Dr.	Sewered area, MW near a wetland & home nursery
LT-11	Jodi Ln.	Sewered area, ROW - dog walking area, nearby ditch one of top five pollutant loads to lake
LT-12	Lake Pointe Rd.	At surface water discharge point from old fish hatchery
LT-15	Chestnut Park	MW near pond, irrigated w/Lk Tarpon, old capped artesian well to east
LT-16	Juniper Dr.	Lansbrook, sewered area, irrigates w/ Lake Tarpon water
LT-17	Lansbrook Parkway	Lansbrook, sewered area, near old reclaim spray field, L. Tarpon irrigation
LT-18	Bryan Ln.	Near Lansbrook, sewered area for subdivision
LT-19S	George St. South	Terrington property; aligned downgradient of new septic tank
LT-19N	George St. South	Terrington property; aligned downgradient of old septic tank
LT-20	Old East Lake Rd.	Mixed sewered and unsewered
LT-21S	George St.	Hoffman property; located away (southeast) from septic
LT-21N	George St.	Hoffman property; aligned downgradient with septic field
LT-22	Old East Lake Rd.	Mixed sewered and unsewered
LT-23	1271 Lagoon Rd.	Preference of homeowner; somewhat downgradient of leachfield; relatively flat
LT-24	1460 Lakeview Dr.	Fehrman property; located directly downgradient of septic; steep slope
WRAP 47	Highland Lakes GC	Near golf course rest room w/septic tank, irrigated w/ reclaimed water
NS-07	West of US 19	Background reclaimed water MW, entrance to Innisbrook
SM-43	Chesnut Park South	Part of saltwater monitoring model for SAS (near Brooker Creek)
NP-141	Woodbridge Place	Cobb's Landing subdivision - sewered area
TLV-157	Lansbrook Golf Course	Irrigated w/ Upper Floridan Aquifer System (UFAS) well
TLV-177	President's landing	Subdivision using reclaimed water
NP-137	Anderson Park	Unsewered, reclaimed water & Lk. Tarpon, MW near stormwater pond

Table 2
Monitoring Well Data
Lake Tarpon Nutrient Study

Well No.	Well Location	SWFWMD Well UID #	Installation Date	Installation Method	Sec.	Twn	Rng	Lattitude (o / ' / ")	Longitude (o / ' / ")	Total Well Depth (ft)	Screen Length (ft)	Depth to Water (ft)
LT-01	Richard Ervin Pkwy.	WEL 2147	28-May-02	HSA	8	27	16	28 / 09 / 03	82 / 43 / 26	12	10	3.60
LT-02	Lake Tarpon Ave.	WEL 2143	28-May-02	HSA	8	27	16	28 / 08 / 47	82 / 43 / 42	12	10	3.73
LT-03	Grand View Dr.	WEL 2148	28-May-02	HSA	17	27	16	28 / 08 / 35	82 / 43 / 46	13	10	6.72
LT-04	Lonesome Pine Ln.	WEL 2149	28-May-02	HSA	17	27	16	28 / 08 / 30	82 / 43 / 49	12	10	4.15
LT-05	Wegman Drive	WEL 2145	24-May-02	HSA	17	27	16	28 / 08 / 25	82 / 43 / 55	20	15	9.43
LT-06	Jasmine Avenue	WEL 2146	24-May-02	HSA	18	27	16	28 / 08 / 29	82 / 44 / 10	12	10	2.02
LT-07	Tookes Rd.	WEL 2150	24-May-02	HSA	18	27	16	28 / 07 / 57	82 / 44 / 01	12	10	3.24
LT-08	Klosterman Rd.	WEL 2137-0	21-May-02	HSA	19	27	16	28 / 07 / 23	82 / 44 / 10	17	15	4.25
LT-09	Four Points Hotel	WEL 2138-0	21-May-02	HSA	19	27	16	28 / 06 / 55	82 / 44 / 18	13	10	6.00
LT-10	Freshwater Dr.	WEL 2139-0	21-May-02	HSA	30	27	16	28 / 06 / 37	82 / 44 / 08	12	10	2.60
LT-11	Jodi Ln.	WEL 2140-0	21-May-02	HSA	32	27	16	28 / 05 / 52	82 /43 /39	15	15	6.90
LT-12	Lake Pointe Rd.	WEL 2141-0	15-May-02	HSA	4	28	16	28 / 05 / 03	82 / 43 / 50	17	15	9.00
LT-15	Chestnut Park	WEL 2118	14-May-02	HSA	33	27	16	28 / 05 / 44	82 / 42 / 38	12	10	2.56
LT-16	Juniper Dr.	WEL 2117	15-May-02	HSA	20	27	16	28 / 06 / 43	82 / 43 / 16	12	10	1.97
LT-17	Lansbrook Parkway	WEL 2116	14-May-02	HSA	21	27	16	28 / 07 / 11	82 / 42 / 31	18	15	4.04
LT-18	Bryan Ln.	WEL 2115	14-May-02	HSA	16	27	16	28 / 07 / 53	82 / 42 / 43	18	15	5.75
LT-19S	George St. South	WEL 2113	14-May-02	Hand auger	16	27	16	28 / 08 / 15	82 / 42 / 50	12	10	2.94
LT-19N	George St. South	WEL 2114	14-May-02	Hand auger	16	27	16	28 / 08 / 15	82 / 42 / 50	12	10	2.81
LT-20	Old East Lake Rd.	WEL 2112	13-May-02	HSA	16	27	16	28 / 08 / 20	82 / 42 / 24	19	15	10.80
LT-21S	George St.	WEL 2110	13-May-02	Hand auger	9	27	16	28 / 08 / 48	82 / 43 / 00	12	10	1.50
LT-21N	George St.	WEL 2111	13-May-02	Hand auger	9	27	16	28 / 08 / 49	82 / 43 / 01	12	10	2.85
LT-22	Old East Lake Rd.	WEL 2109	13-May-02	HSA	8	27	16	28 / 08 / 49	82 / 42 / 43	19	15	9.45
LT-23	1271 Lagoon Rd.	WEL 2142-0	21-May-02	Hand auger	18	27	16	28 / 07 / 52	82 / 44 / 10	12	10	3.55
LT-24	1460 Lakeview Dr.	WEL 2144	24-May-02	Hand auger	18	27	16	28 / 08 / 20	82 / 43 / 59	12	10	3.80

Note:
1. All wells constructed with 2-inch diameter PVC well screens (0.01 slot size) & solid PVC risers. Riser lengths = total well depth - screen length.
2. Well No. LT-06 constructed with a 3 ft PVC stickup enclosed in a protective metal casing, all other wells flush mounted with metal manholes.
3. HSA = Hollow Stem Auger
4. Depth to water data measurements gauged between May16 and June 4, 2002.

Leggette, Brashears & Graham, Inc.

Table 3
Sampling Schedule
Lake Tarpon Nutrient Study

Dry Season Samping Event										
Monitor Well Sample Dates	Quality Control Samples	Sampling Locations								
16-May-02	Dup and EQB	LT-17	LT-18	LT-19S	LT-19N	LT-20	LT-21S	LT-21N	LT-22	
28-May-02	Dup and EQB	LT-12	LT-15	LT-16	TLV-177	TLV-157	SM-43	NP-141	NS-07	
29-May-02	Dup and EQB	LT-06	LT-07	LT-08	LT-09	LT-10	LT-11	LT-23	LT-24	NP-137
30-May-02	Dup and EQB	LT-01	LT-02	LT-03	LT-04	LT-05	WRAP-47			
4-Jun-02	Dup and EQB	LT-01	LT-02	LT-03	LT-04	LT-05	WRAP-47			

Notes:	
General:	Dup = Duplicate sample; EQB = Equipment blank
16-May-02	Filtered & unfiltered metals sample collected from LT-19N due to high sample turbidity. Dup from well LT-17.
28-May-02	Dup from well LT-12.
29-May-02	Dup from well LT-06.
30-May-02	Sample temperatures exceeded upper limit (6 degrees C) for proper preservation - not analyzed, resampled on June 4.
4-Jun-02	Filtered & unfiltered metals sample collected from LT-03 due to high sample turbidity. Dup from well LT-01.

Table 3
Sampling Schedule
Lake Tarpon Nutrient Study

Wet Season Samping Event										
Monitor Well Sample Dates	Quality Control Samples	Sampling Locations								
22-Oct-02	Dup	LT-16	LT-17	LT-18	LT-20	LT-21S	LT-21N	LT-22		
23-Oct-02	Dup and EQB	LT-12	LT-15	TLV177	TLV157	SM-43	NP-141	NS-07		
24-Oct-02	Dup	LT-05	LT-07	LT-08	LT-09	LT-10	LT-11	LT-23	WRAP-47	NP-137
28-Oct-02	EQB	LT-01	LT-02	LT-03	LT-04	LT-06	LT-19S	LT-19N	LT-24	

Notes:	
General:	Nitrogen Isoptope samples collected from all wells during Oct. event and frozen pending selection of samples for analysis.
22-Oct-02	Dup from well LT-20.
23-Oct-02	Dup from well TLV-177.
24-Oct-02	Dup from well LT-08.
28-Oct-02	QC Equipment Blank (EQB) sample collected.

Table 4
May 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total Phosphorous (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)	pH field measured
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A	
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A	6.5-8.5**
EPA Method		353.2	353.2	353.2	18THED 4500	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	SM4500F-C	18TH ED 2540C	18TH ED 5310B	
LT-01	4-Jun-02	1.84	1.82	0.02	< 0.01	0.0	0.119	0.154	30	1.81	14.1	7.4	84.2	< 0.1	54.7	20.7	105	< 0.012	295	4.9	5.17
LT-01 Dup	4-Jun-02	1.98	1.90	0.019	0.026	0.054	0.121	0.156	< 30	1.76	14.4	7.42	85.8	< 0.1	52.5	21.8	105	< 0.012	307	4.9	5.17
LT-02	4-Jun-02	0.43	0.304	0.009	0.133	0.0	0.030	0.044	120	0.93	17.4	3.03	11.1	< 0.1	20.8	21.8	23.2	< 0.012	114	5.5	5.11
LT-03	4-Jun-02	6.00	4.93	0.034	0.145	0.925	0.268	1.32	620	5.46	41	10.4	40.6	< 0.1	57.8	64.8	59	< 0.012	369	28.4	5.37
LT-03 (filterd)	4-Jun-02		Filed filtered (dissolved) samples collected for metals due to high turbidity						280	5.46	42	10.3	41.2	< 0.1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LT-04	4-Jun-02	6.90	0.034	0.005	7.07	0.0	0.452	0.487	490	13.2	54.1	10.4	88.6	0.14	4.00	217	140	0.06	451	15.8	5.63
LT-05	4-Jun-02	0.91	0.832	< 0.005	0.101	0.0	0.202	0.221	< 30	3.32	62.1	268	10.0	< 0.1	18.7	140	24	0.03	214	3.7	6.80
LT-06	29-May-02	0.38	0.023	< 0.005	0.396	0.0	0.027	0.035	1780	1.62	18.9	0.59	8.23	< 0.1	1.39	49.6	13.7	0.05	7.7	97	5.05
LT-06 Dup	29-May-02	0.41	0.03	0.007	0.367	0.013	0.026	0.034	1,830	1.68	19.9	0.56	8.45	< 0.1	4.69	48.2	14.7	0.04	95	7.5	5.05
LT-07	29-May-02	3.65	0.359	0.01	3.46	0.0	0.471	0.713	1540	9.78	83.5	16.9	61.7	0.24	84.7	212	64.8	0.97	479	14.7	5.73

Table 4
May 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total Phosphorous (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)	pH field measured
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A	
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A	6.5-8.5**
EPA Method		353.2	353.2	353.2	18THED 4500	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	SM4500F-C	18TH ED 2540C	18TH ED 5310B	
LT-08	29-May-02	1.30	< 0.01	0.005	0.778	0.52	0.038	0.072	500	3.26	51.7	4.51	52.1	< 0.1	17.7	69.6	115	0.02	349	14	5.14
LT-09	29-May-02	< 0.1	0.01	< 0.005	0.051	0.0	< 0.01	< 0.01	2,380	2.86	6.53	1.34	10.4	< 0.1	10.5	5.47	25.7	0.02	85	2.2	4.05
LT-10	29-May-02	4.44	0.013	0.007	3.28	1.147	0.218	0.272	140	19.1	141	3.15	260	0.48	33.8	187	527	0.68	1,370	23.5	6.15
LT-11	29-May-02	2.16	1.73	0.011	0.074	0.356	< 0.01	< 0.01	40	4.65	15.9	4.18	13.2	< 0.1	25.7	9.78	36	0.16	136	2.6	4.57
LT-12	28-May-02	0.61	0.037	0.006	0.153	0.42	0.18	0.289	360	6.46	30.8	10.4	66.5	< 0.1	14.3	48.9	127	0.24	351	9.5	5.39
LT-12 Dup	28-May-02	0.64	< 0.01	0.006	0.166	0.474	0.185	0.272	320	6.38	31	10.3	66.5	< 0.1	13.8	48.6	127	0.23	362	13	5.39
LT-15	28-May-02	3.24	0.038	0.44	2.18	1.022	0.069	0.094	650	10.4	97.1	12.1	159	0.29	44.5	103	335	0.06	863	16.3	6.06
LT-16	28-May-02	1.27	0.035	0.014	0.475	0.76	0.274	0.281	1,550	10.4	25.1	13.7	66.5	< 0.1	48.1	< 1	151	0.33	389	24	4.04
LT-17	16-May-02	2.87	0.022	0.02	1.18	1.668	0.015	0.144	550	3.96	99.7	12.1	160	0.16	27.7	238	214	3.73	846	49.1	5.99
LT-17 Dup	16-May-02	2.53	0.025	0.017	1.29	1.215	0.012	0.159	580	3.81	95.9	11.7	159	< 0.1	27.5	237	213	3.59	836	51.8	5.99

Table 4
May 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total Phosphorous (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)	pH field measured
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A	
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A	6.5-8.5**
EPA Method		353.2	353.2	353.2	18THED 4500	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	SM4500F-C	18TH ED 2540C	18TH ED 5310B	
LT-18	16-May-02	4.65	0.013	0.009	4.68	0.0	0.018	0.065	2060	2.99	35.3	12.2	18	< 0.1	13.3	63	36.9	0.02	247	25.6	5.01
LT-19S	16-May-02	2.51	0.136	0.046	1.75	0.624	0.01	0.079	180	0.86	5.1	2.8	144	< 0.1	31.1	122	113	0.02	465	23.2	5.90
LT-19N	16-May-02	3.64	0.532	0.038	2.27	0.838	< 0.01	0.276	1200	3.55	12.6	5.64	206	< 0.1	112	94.4	183	0.02	734	24.4	5.51
LT-20	16-May-02	0.29	0.264	0.007	0.051	0.0	< 0.01	< 0.01	250	1.76	4.4	2.55	8.39	< 0.1	11.2	< 1	19.3	0.02	61	0.4	4.59
LT-21S	16-May-02	0.46	< 0.01	0.01	0.405	0.05	0.041	0.037	720	1.9	3.33	2.20	21	< 0.1	5.74	9.68	35.1	0.03	106	2.3	4.84
LT-21N	16-May-02	0.51	0.014	0.011	0.353	0.143	0.342	0.386	4,030	6.99	18.2	6.41	37.7	< 0.1	82.6	12.2	52.7	0.04	266	6.7	4.72
LT-22	16-May-02	0.38	0.342	< 0.005	0.073	0.0	< 0.01	< 0.01	80	0.93	9.22	2.72	9.35	< 0.1	15.5	14.1	12.7	0.02	77	1	5.80
LT-23	29-May-02	1.88	0.069	0.019	0.692	1.119	0.137	0.272	910	2.54	12.5	2.27	83.2	< 0.1	66.6	40	67.7	0.04	366	41.8	5.12
LT-24	29-May-02	5.04	4.22	0.016	0.285	0.535	0.179	0.188	< 30	5.51	91.3	5.35	174	0.33	85.2	181	241	0.7	759	13.5	6.90
TLV-177	28-May-02	0.79	0.01	0.014	0.396	0.384	0.322	0.42	90	2.35	10.5	12.2	103	< 0.1	28.4	26.8	153	0.05	384	6.0	4.73

Table 4
May 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total Phosphorous (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)	pH field measured
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A	
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A	6.5-8.5**
EPA Method		353.2	353.2	353.2	18THED 4500	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	SM4500F-C	18TH ED 2540C	18TH ED 5310B	
TLV-157	28-May-02	4.4	1.43	0.008	2.42	0.55	< 0.01	< 0.01	900	12.3	65.4	32.1	90.3	< 0.1	102	15.8	220	0.03	636	20.4	4.45
SM-43	28-May-02	1.01	0.044	0.018	0.734	0.232	0.32	0.353	9,150	3.15	7.38	1.37	12.2	< 0.1	6.29	15.4	26.9	0.08	107	7.2	5.07
WRAP-47	4-Jun-02	12.8	11.9	0.007	< 0.01	0.9	0.038	0.055	< 30	6.24	31.5	23.4	60.8	< 0.1	91.0	11.5	87.1	< 0.012	373	12.1	4.59
NP-141	28-May-02	12.4	12.3	0.007	0.031	0.069	0.023	0.323	200	4.08	30.5	8.54	148	< 0.1	15.5	< 1	245	0.08	573	1.8	3.88
NS-07	28-May-02	1.87	1.76	0.007	0.053	0.057	0.101	0.102	80	1.75	37.6	1.86	5.81	< 0.1	10.1	77.4	9.32	0.2	136	3.2	6.35
NP-137	29-May-02	3.39	3.32	0.009	0.094	0.0	0.011	0.012	< 30	6.00	51.3	9.66	108	< 0.1	71.6	53.9	184	0.02	495	3.1	5.37

Notes:
1. CTL = Cleanup Target Level (per Rule Chapter 62-777 FAC).
2. * = Primary Drinking Water Standard
3. ** = Secondary Drinking Water Standard
4. *** = Shall not be increased more than 50% above background or 1,275 whichever is greater (per Chapter 62-302, F.A.C.)
5. Total Alkalinity is equivalent to the value for bicarbonate alkalinity when pH of sample is less than 8.3 pH units.

Table 5
October 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total hosphorou (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A
EPA Method		353.2	353.2	353.2	8THED 450	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	M4500F-(	18TH ED 2540C	18TH ED 5310B
LT-01	28-Oct-02	4.34	4.03	0.014	0.128	0.182	0.102	0.094	< 30	2.71	15.8	8.34	132	< 0.25	53.7	12.4	178	< 0.02	423	3.5
LT-02	28-Oct-02	1.21	0.515	0.021	0.286	0.409	0.610	0.610	300	1.19	27	2.32	11.9	< 0.25	14.1	50.3	17.3	1.11	160	13.2
LT-03	28-Oct-02	1.25	0.158	0.013	0.106	0.986	0.337	0.335	50	3.07	31.8	7.74	26.5	< 0.25	24.5	80.4	28.2	0.02	250	30.2
LT-04	28-Oct-02	1.10	0.015	< 0.006	0.212	0.873	0.858	0.889	110	9.88	142	14.2	72.7	0.29	23.6	435	91.8	0.23	658	13.9
LT-05	24-Oct-02	2.34	1.68	< 0.006	0.013	0.647	0.203	0.203	< 30	6.03	67.9	2.59	6.5	0.29	15.9	167	18.4	0.22	270	3.3
LT-06	28-Oct-02	2.72	0.06	< 0.006	0.179	2.481	0.024	0.027	450	2.49	43.1	1.66	23.9	< 0.25	7.38	107	42.7	0.2	230	6.6
LT-07	24-Oct-02	4.22	1.22	0.011	2.69	0.31	1.40	1.53	2,780	8.03	72.5	14.9	42.1	0.37	26.2	211	57.2	1.17	427	25.6
LT-08	24-Oct-02	1.17	0.013	0.007	0.186	0.971	0.139	0.143	90	0.95	49.3	0.69	12.7	< 0.25	6.49	98.6	33.0	0.26	234	20.5
LT-08 (Dup)	24-Oct-02	1.20	0.025	0.007	0.235	0.94	0.140	0.144	100	0.98	49.5	0.72	13.0	< 0.25	6.32	99.3	36.7	0.29	242	20.5
LT-09	24-Oct-02	0.159	0.015	0.006	0.153	0.0	0.044	0.047	2,390	2.74	20.8	1.48	22.4	< 0.25	21.2	21.7	39.2	0.2	166	4.0

Table 5
October 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total hosphorou (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A
EPA Method		353.2	353.2	353.2	8THED 450	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	M4500F-(	18TH ED 2540C	18TH ED 5310B
LT-10	24-Oct-02	3.93	0.035	0.008	2.210	1.685	0.315	0.315	30	16.4	160	1.53	234	0.46	15.2	336	429	3.12	1,210	33.9
LT-11	24-Oct-02	2.22	2.11	0.007	0.176	0.0	0.076	0.076	< 30	3.95	63.5	5.93	17.5	< 0.25	27.9	126	40.7	0.27	258	5.6
LT-12	23-Oct-02	0.61	0.014	< 0.006	0.325	0.271	0.335	0.341	240	10.8	31.6	4.43	53.6	< 0.25	14.1	51.6	122	1.08	353	11.6
LT-15	23-Oct-02	2.1	0.016	0.006	1.282	0.802	0.074	0.079	2,220	9.53	82.1	5.23	118	0.27	6.15	124	250	0.084	648	23.4
LT-16	22-Oct-02	1.18	0.012	0.007	0.700	0.468	0.278	0.262	1,150	16.8	41.4	17.3	107	0.39	66.5	< 1	255	0.474	618	13.2
LT-17	22-Oct-02	2.53	0.023	0.013	1.068	1.439	0.256	0.247	150	4.22	107	11.3	136	0.39	25.8	271	160	5.02	706	60.6
LT-18	22-Oct-02		0.106	0.008			0.091	0.097	370	2.5	16.2	9.7	19	< 0.25	11.9	60.8	24.7	0.021	216	33.3
LT-19S	28-Oct-02	3.42	0.03	0.006	2.445	0.945	0.199	0.194	720	2.6	30.3	6.09	111	< 0.25	23.9	118	133	0.09	436	26
LT-19N	28-Oct-02	2.76	0.076	0.008	1.275	1.409	0.407	0.436	1310	5.3	42.2	4.43	89	< 0.25	32.9	100	122	0.28	426	27.7
LT-20	22-Oct-02	0.25	0.203	< 0.006	0.053	0.0	< 0.01	< 0.01	160	1.33	3.82	2.17	8.06	< 0.25	15.9	< 1.0	13.7	0.028	65	1.4

Table 5
October 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total Phosphorou (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A
EPA Method		353.2	353.2	353.2	8THED 450	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	M4500F-(	18TH ED 2540C	18TH ED 5310B
LT-20 (Dup)	22-Oct-02	0.28	0.217	< 0.006	0.012	0.051	< 0.01	< 0.01	180	1.38	3.83	2.02	8.15	< 0.25	15.8	< 1.0	14	0.025	75	1.3
LT-21S	22-Oct-02	0.35	< 0.01	< 0.006	0.318	0.03	< 0.01	< 0.01	470	1.59	3.19	1.30	13.8	< 0.25	6.5	1.1	24.6	< 0.02	77	2.4
LT-21N	22-Oct-02	0.4	0.026	0.006	0.180	0.194	0.027	0.024	2,910	5.08	11.8	4.91	21.2	< 0.25	32.1	1.36	46.5	< 0.02	168	8.1
LT-22	22-Oct-02	0.26	0.224	< 0.006	0.055	0.0	< 0.01	< 0.01	30	0.81	14.9	1.96	6.88	< 0.25	13.6	27.8	12	0.176	87	1.9
LT-23	24-Oct-02	1.95	0.024	0.011	0.114	1.812	0.140	0.153	440	6.69	63.9	2.51	99.4	< 0.25	27.3	48.4	213	0.36	600	38.2
LT-24	28-Oct-02	10.2	8.18	0.026	0.123	1.897	0.14	0.141	30	5.16	102	6.75	60.3	< 0.25	69.9	192	102	0.59	578	13.9
TLV-177	23-Oct-02	1.43	0.014	0.01	0.74	0.676	0.455	0.457	140	3.5	12	15.5	95.9	< 0.25	23.5	25.3	152	0.074	259	18.3
TLV-177 (Dup)	23-Oct-02	1.37	0.022	< 0.006	0.774	0.574	0.442	0.436	120	3.37	12.7	15.9	97.5	< 0.25	23.6	21.9	152	0.05	378	18.3
TLV-157	23-Oct-02	3.42	0.565	0.007	1.574	1.281	< 0.01	< 0.01	530	8.66	44.9	28.2	76.5	< 0.25	88.8	23.4	150	0.032	478	30
SM-43	23-Oct-02	0.41	0.041	0.019	0.321	0.048	0.064	0.072	6,640	3.35	6.39	1.88	26.3	< 0.25	9.78	< 1	64.2	0.1	167	4.7

Table 5
October 2002 Ground-Water Analytical Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	Total Nitrogen (mg/l)	Nitrate + Nitrite (mg/l)	Total Nitrite (mg/l)	Total Ammonia (mg/l)	Organic Nitrogen (mg/l)	Ortho Phosphate (mg/l)	Total hosphorou (mg/l)	Total Iron (ug/l)	Total Magnesium (mg/l)	Total Calcium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Strontium (mg/l)	Sulfate (mg/l)	Total Alkalinity (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	TDS (mg/l)	TOC (mg/l)
Surfacewater CTL (mg/l)		N/A	N/A	N/A	0.02	N/A	N/A	N/A		N/A	N/A	N/A	***	N/A		N/A				N/A
Groundwater CTL (mg/l)		N/A	10	1	2.8	N/A	N/A	N/A	300**	N/A	N/A	N/A	160*	4,200	250**	N/A	250**	2.0**	500**	N/A
EPA Method		353.2	353.2	353.2	8THED 450	N/A	4500-P	365.1	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	18TH ED 3111-B	18TH ED 3111-B	18TH ED 3111-D	300.0	310.1	300.0	M4500F-(	18TH ED 2540C	18TH ED 5310B
WRAP-47	24-Oct-02	5.04	4.38	0.024	0.131	0.529	0.32	0.478	130	1.82	9.6	13.1	24.6	< 0.25	23	15.5	27.4	< 0.02	172	16.9
NP-141	23-Oct-02	7.78	6.52	< 0.006	0.048	1.212	0.14	0.259	70	5.57	79.8	4.58	28.2	< 0.25	17	< 1	160	0.12	495	0.8
NS-07	23-Oct-02	2.05	1.9	<0.006	< 0.012	0.1	0.079	0.08	< 30	1.78	43.7	1.6	6.05	< 0.25	8.99	114	5.07	0.17	185	2.8
NP-137	24-Oct-02	2.72	2.27	< 0.006	0.099	0.351	0.026	0.020	30	7.56	68.7	12.3	181	< 0.25	67.3	137	273	0.18	728	5.8

Notes: 1.CTL = Cleanup Target Level (per Rule Chapter 62-777 FAC).
2. * = Primary Drinking Water Standard
3. ** = Secondary Drinking Water Standard
4. *** = Shall not be increased more than 50% above background or 1,275 whichever is greater (per Chapter 62-302, F.A.C.)

TABLE 6
GROUNDWATER ELEVATION SURVEY
LAKE TARPON NUTRIENT STUDY

LOCATION	TOP OF CASING ELEVATION (NGVD)	May, 2002			October, 2002		
		DATE MEASURED	DEPTH TO WATER (Ft. BTOC)	GROUND WATER ELEVATION (NGVD)	DATE MEASURED	DEPTH TO WATER (Ft. BTOC)	GROUND WATER ELEVATION (NGVD)
LT-01	6.10	30-May-02	3.60	2.50	28-Oct-02	2.38	3.72
LT-02	5.96	30-May-02	3.70	2.26	28-Oct-02	2.45	3.51
LT-03	9.20	30-May-02	6.72	2.48	28-Oct-02	5.28	3.92
LT-04	6.19	30-May-02	4.21	1.98	28-Oct-02	2.63	3.56
LT-05	11.72	30-May-02	9.42	2.30	24-Oct-02	8.20	3.52
LT-06	7.38	29-May-02	5.06	2.32	28-Oct-02	4.05	3.33
LT-07	5.35	29-May-02	3.05	2.30	24-Oct-02	1.88	3.47
LT-08	6.91	29-May-02	4.20	2.71	24-Oct-02	3.07	3.84
LT-09	9.30	29-May-02	5.95	3.35	24-Oct-02	4.89	4.41
LT10	4.98	29-May-02	2.65	2.33	24-Oct-02	1.58	3.40
LT-11	10.22	29-May-02	6.82	3.40	24-Oct-02	5.75	4.47
LT-12	9.15	28-May-02	6.86	2.29	23-Oct-02	7.95	1.20
LT-15	4.87	28-May-02	2.18	2.69	23-Oct-02	1.45	3.42
LT-16	4.13	28-May-02	1.04	3.09	22-Oct-02	0.60	3.53
LT-17	17.28	16-May-02	4.12	13.16	22-Oct-02	2.60	14.68
LT-18	20.27	16-May-02	5.82	14.45	22-Oct-02	3.94	16.33
LT-19S	5.28	16-May-02	3.00	2.28	28-Oct-02	1.91	3.37
LT-19N	5.11	16-May-02	3.12	1.99	28-Oct-02	1.80	3.31

TABLE 6
GROUNDWATER ELEVATION SURVEY
LAKE TARPON NUTRIENT STUDY

LOCATION	TOP OF CASING ELEVATION (NGVD)	May, 2002			October, 2002		
		DATE MEASURED	DEPTH TO WATER (Ft. BTOC)	GROUND WATER ELEVATION (NGVD)	DATE MEASURED	DEPTH TO WATER (Ft. BTOC)	GROUND WATER ELEVATION (NGVD)
LT-20	21.14	16-May-02	11.00	10.14	22-Oct-02	7.42	13.72
LT-21S	3.80	16-May-02	1.30	2.50	22-Oct-02	0.40	3.40
LT-21N	5.27	16-May-02	3.00	2.27	22-Oct-02	1.83	3.44
LT-22	18.94	16-May-02	9.50	9.44	22-Oct-02	6.55	12.39
LT-23	5.89	29-May-02	3.55	2.34	24-Oct-02	2.20	3.69
LT-24	6.04	29-May-02	3.85	2.19	28-Oct-02	2.70	3.34
NP-137	9.23	29-May-02	6.28	2.95	24-Oct-02	4.95	4.28
NS-07	17.28	28-May-02	10.00	7.28	23-Oct-02	7.10	10.18
NP-141	38.47	28-May-02	18.27	20.20	23-Oct-02	16.60	21.87
WRAP-47	N/D	30-May-02	15.15	#VALUE!	24-Oct-02	13.58	#VALUE!
SM-43	11.08	28-May-02	8.55	2.53	23-Oct-02	4.65	6.43
TLV-157	15.39	28-May-02	8.22	7.17	23-Oct-02	6.71	8.68
TLV-177	12.46	28-May-02	5.31	7.15	23-Oct-02	5.00	7.46

All elevations are in feet and are based on NGVD 1929 Vertical Datum. Top of casing elevations are from Pinellas County Division of Survey & Mapping Specific Purpose Survey Report SFN 1238 - Lake Tarpon Monitor Wells, Report Date: August 26, 2002 (survey date: August 8, 2002).

NGVD Nation Geodedic Vertical Datum
Ft. BTOC Feet Below Top of Casing.
N/D No Data

Table 7
Hydraulic Conductivity Data
Lake Tarpon Nutrient Study

Well Name	Hydraulic Conductivity Value	Test Date
LT-01	18.2 feet / day	21-Jan-03
LT-02	8.6 feet / day	21-Jan-03
LT-03	10.8 feet / day	21-Jan-03
LT-04	5.1 feet / day	21-Jan-03
LT-06	23.3 feet / day	21-Jan-03
LT-07	2.5 feet / day	21-Jan-03
LT-08	13.7 feet / day	21-Jan-03
LT-10	13.5 feet / day	21-Jan-03
LT-11	11.2 feet / day	21-Jan-03
LT-12	10.3 feet / day	20-Jan-03
LT-15	5.7 feet / day	20-Jan-03
LT-16	9.9 feet / day	23-Jan-03
LT-18	9.0 feet / day	23-Jan-03
LT-19S	2.2 feet / day	23-Jan-03
LT-20	33.1 feet / day	23-Jan-03
LT-21S	8.7 feet / day	23-Jan-03
LT-22	21.0 feet / day	23-Jan-03
LT-24	7.7 feet / day	21-Jan-03
SM-43	3.2 feet / day	25-Oct-02
WRAP-47	7.9 feet / day	20-Jan-03
NP-141	12.3 feet / day	21-Jan-03
Average Value	**11.3 feet / day**	

* All tests, except SM-43 conducted as slug-out test using a 1-inch diameter slug. Test for SM-43 (6-inch diameter well) used centrifugal pump to lower water level in well, test recorded recovery from depressed level to static.

** Wells LT-19S & LT-21S installed with hand auger, analysis utilized 6.0-inch diam. borehole parameter, all others except SM-43 utilized 8-inch borehole. Well SM-43 (6-inch diam. casing) utilized a 14-inch diam borehole for the analysis.

Table 8
Stable Nitrogen Isotope Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	$\delta\ ^{15}N_{AIR}$ of NH3	$\delta\ ^{15}N_{AIR}$ of NO3	Total Nitrogen (mg/l)	Total Nitrate (mg/l)	Total Ammonia (mg/l)	Land Use Classification
LT-01	28-Oct-02	--	1.9	4.34	0.014	0.128	Unsewered Area
LT-05	24-Oct-02	--	2.1	2.34	< 0.006	0.013	Unsewered Area
LT-07	24-Oct-02	3.0 / 2.7	INS	4.22	0.011	2.69	Unsewered Area
LT-10	24-Oct-02	1.7 / 1.2	--	3.93	0.008	2.21	Sewered, near wetland & nursery
LT-11	24-Oct-02	--	7.8	2.22	0.007	0.176	Sewered, dog walk area, near ditch with top 5 pollutant loads to lake
LT-15	23-Oct-02	3.0	--	2.1	0.006	1.282	Near pond irrigated with Lake Tarpon Water
LT-17	22-Oct-02	7.7	--	2.53	0.013	1.068	Sewered area, near old reclaimed spray field
LT-18	22-Oct-02 19-Mar-03	5.4 5.2	-- --	--	0.008	--	Sewered area for subdivision
LT-19S	28-Oct-02	9.4 / 8.6	--	3.42	0.006	2.445	Unsewered area, downgradient of new septic tank
LT-19N	28-Oct-02	8.30	--	2.76	0.008	1.275	Unsewered area, downgradient of old septic tank
LT-22	22-Oct-02	--	6.0	0.26	< 0.006	0.055	Mixed sewered and unsewered

Table 8
Stable Nitrogen Isotope Data
Lake Tarpon Nutrient Study

Sample Location	Sample Date	$\delta\, ^{15}N_{AIR}$ of NH3	$\delta\, ^{15}N_{AIR}$ of NO3	Total Nitrogen (mg/l)	Total Nitrate (mg/l)	Total Ammonia (mg/l)	Land Use Classification
LT-24	28-Oct-02	--	3.1	10.2	0.026	0.123	Unsewered, downgradient of septic on steep slope
WRAP-47	24-Oct-02	--	11.4 / 13.9	5.04	0.024	0.131	Golf course, near restroom septic, irrigated with reclaimed reclaimed water
NS-07	23-Oct-02	--	2.5	2.05	< 0.006	< 0.012	Background reclaimed water MW, near entrance to Innisbrook
NP-141	23-Oct-02	--	2.6	7.78	< 0.006	0.048	Sewered area
TLV-157	23-Oct-02	7.9 / 7.7	36.5 / 36.5	3.42	0.007	1.574	Irrigated with UFAS well
NP-137	23-Oct-02	--	15.3	2.72	< 0.006	0.099	Unsewered area, near stormwater pond

INS - Concentration too low for analysis
7.9 / 7.7 - Indicates data results for split sample. Duplicate analysis run on each split sample to evaluate reproducability of analytical results.

Table 9
Loading Rate Analysis Discharge Calculations - May 2002
Lake Tarpon Nutrient Study

Well ID	TOC Elevation, Feet NGVD	X-UTM	Y-UTM	Fence Length, Feet	Hydraulic Conductivity, Feet/Day	Lake Tarpon Water Level, Feet NGVD	SAS Depth to Water, Feet	SAS Water Level, Feet NGVD	SAS Bottom Elevation, Feet NGVD	Distance to Lake Feet	SAS Discharge $Feet^3/Day$	SAS Unit Width Discharge $Feet^2/Day$
LT-01	6.1	330722	3114940	3229	18	2.10	3.60	2.50	-20	43	12,015	3.72
LT-02	5.96	330278	3114454	1790	9	2.10	3.70	2.26	-16	98	455	0.25
LT-03	9.2	330164	3114086	963	11	2.10	6.72	2.48	**-16**	226	310	0.32
LT-04	6.19	330080	3113934	655	5	2.10	4.21	1.98	**-15**	187	-35	-0.05
LT-05	11.72	329914	3113782	676	16	2.10	9.42	2.30	-13	121	262	0.39
LT-24	6.04	329803	3113630	1464	8	2.10	3.85	2.19	-12	75	190	0.13
LT-06	7.38	329507	3113911	4372	23	2.10	5.06	2.32	-14	1417	248	0.06
LT-07	5.35	329738	3112923	4315	3	2.10	3.05	2.30	-11	52	522	0.12
LT-23	5.89	329490	3112772	1760	13	2.10	3.55	2.34	**-11**	141	511	0.29
NP-137	9.23	329351	3112590	1651	8	2.10	6.28	2.95	**-11**	318	483	0.29
LT-08	6.91	329478	3111880	2844	14	2.10	4.20	2.71	**-11**	164	1,942	0.68
LT-09	9.3	329247	3111021	4083	14	2.10	5.95	3.35	**-4**	558	837	0.20
LT-10	4.98	329512	3110463	4433	14	2.10	2.65	2.33	**-8**	33	4,285	0.97
NS-07	17.28	329175	3109791	5402	12	2.10	10.00	7.28	**0**	1417	1,143	0.21
LT-11	10.22	330284	3109067	**7585**	11	2.10	6.82	3.40	**-8**	164	7,237	0.95
NP-141	38.47	**331470**	**3107928**	**4891**	12	2.10	18.27	20.20	**-1**	**612**	21,618	4.42
LT-12	9.15	**331576**	**3107685**	**4836**	10	2.10	6.86	2.29	**-3**	**431**	114	0.02
SM-43	11.08	332695	3107309	9745	3	2.10	8.55	2.53	**-4**	741	114	0.01
LT-15	4.87	331945	3108797	9498	6	2.10	2.18	2.69	**-12**	112	4,122	0.43
TLV-157	15.39	332828	3109462	**4514**	8	2.10	8.22	7.17	**-15**	2526	1,387	0.31
TLV-177	12.46	331528	3110158	**4247**	8	2.10	5.31	7.15	-13	171	17,283	4.07
LT-16	4.13	330934	3110628	6329	10	2.10	1.04	3.09	**-13**	180	5,361	0.85
LT-18	20.27	331865	3112769	7443	9	2.21	5.82	14.45	-14	1234	14,843	1.99
LT-20	21.14	332395	3113593	3973	33	2.21	11.00	10.14	-16	2339	9,885	2.49
LT-19S	5.28	331683	3113449	1278	2	2.21	3.00	2.28	-13	16	183	0.14
LT-19N	5.11	331683	3113449	1994	2	2.21	3.12	1.99	-13	16	-888	-0.45
LT-22	18.94	331889	3114493	3780	21	2.21	9.50	9.44	-17	1572	8,153	2.16
LT-21S	3.8	331425	3114469	1866	9	2.21	1.30	2.50	-16	66	1,317	0.71
LT-21N	5.27	331398	3114500	2194	9	2.21	3.00	2.27	-16	23	909	0.41

Table 10
Loading Rate Analysis Discharge Calculations - October 2002
Lake Tarpon Nutrient Study

Well ID	TOC Elevation, Feet NGVD	X-UTM	Y-UTM	Fence Length, Feet	Hydraulic Conductivity, Feet/Day	Lake Tarpon @ Lake Tarpon Sink Water	SAS Depth to Water, Feet	SAS Water Level, Feet NGVD	SAS Bottom Elevation, Feet NGVD	Distance to Lake Feet	SAS Discharge Feet^3/Day	SAS Unit Width Discharge Feet^2/Day
LT-01	6.10	330722	3114940	3229	18.2	3.18	2.38	3.72	-20	43	17,076	5.29
LT-02	5.96	330278	3114454	1790	8.6	3.18	2.45	3.51	-16	98	998	0.56
LT-03	9.20	330164	3114086	963	10.8	3.18	5.28	3.92	**-16**	226	647	0.67
LT-04	6.19	330080	3113934	655	5.1	3.18	2.63	3.56	**-15**	187	121	0.19
LT-05	11.72	329914	3113782	676	15.5	3.25	8.20	3.52	-13	121	382	0.56
LT-24	6.04	329803	3113630	1464	7.7	3.18	2.70	3.34	-12	75	365	0.25
LT-06	7.38	329507	3113911	4372	23.3	3.18	4.05	3.33	-14	1417	181	0.04
LT-07	5.35	329738	3112923	4315	2.5	3.25	1.88	3.47	-11	52	627	0.15
LT-23	5.89	329490	3112772	1760	12.9	3.25	2.20	3.69	**-11**	141	1,025	0.58
NP-137	9.23	329351	3112590	1651	8.1	3.25	4.95	4.28	**-11**	318	639	0.39
LT-08	6.91	329478	3111880	2844	13.7	3.25	3.07	3.84	**-11**	164	2,038	0.72
LT-09	9.30	329247	3111021	4083	13.6	3.25	4.89	4.41	**-4**	558	904	0.22
LT-10	4.98	329512	3110463	4433	13.5	3.25	1.58	3.40	**-8**	33	3,098	0.70
NS-07	17.28	329175	3109791	5402	12.4	3.18	7.10	10.18	**0**	1417	2,201	0.41
LT-11	10.22	330284	3109067	**7585**	11.2	3.25	5.75	4.47	**-8**	164	7,493	0.99
NP-141	38.47	**331470**	**3107928**	**4891**	12.3	3.18	16.60	21.87	**-1**	**612**	24,848	5.08
LT-12	9.15	**331576**	**3107685**	**4836**	10.3	3.18	7.95	1.20	**-3**	**431**	-1,188	-0.25
SM-43	11.08	332695	3107309	9745	3.2	3.18	4.65	6.43	**-4**	741	1,204	0.12
LT-15	4.87	331945	3108797	9498	5.7	3.18	1.45	3.42	**-12**	112	1,782	0.19
TLV-157	15.39	332828	3109462	**4514**	7.8	3.18	6.71	8.68	**-15**	2526	1,604	0.36
TLV-177	12.46	331528	3110158	**4247**	7.8	3.18	5.00	7.46	-13	171	15,225	3.58
LT-16	4.13	330934	3110628	6329	9.9	3.18	0.60	3.53	**-13**	180	1,988	0.31
LT-18	20.27	331865	3112769	7443	9.0	3.18	3.94	16.33	-14	1234	16,964	2.28
LT-20	21.14	332395	3113593	3973	33.1	3.18	7.42	13.72	-16	2339	14,486	3.65
LT-19S	5.28	331683	3113449	1278	2.2	3.18	1.91	3.37	-13	16	530	0.41
LT-19N	5.11	331683	3113449	1994	2.2	3.18	1.80	3.31	-13	16	565	0.28
LT-22	18.94	331889	3114493	3780	21.0	3.18	6.55	12.39	-17	1572	11,298	2.99
LT-21S	3.80	331425	3114469	1866	8.7	3.18	0.40	3.40	-16	66	1,050	0.56
LT-21N	5.27	331398	3114500	2194	8.7	3.18	1.83	3.44	-16	23	4,172	1.90

Table 11
Loading Rate Results - May 2002
Lake Tarpon Nutrient Study

	DATA ENTRY										
Well ID	Collection Date	Lake Tarpon @ Lake Tarpon Sink Water Level, Feet NGVD	SAS Depth to Water, Feet	Nitrate + Nitrite mg/l	Total Nitrogen mg/l	Nitrite mg/l	Ammonia mg/l	Ortho Phosphorus mg/l	Total Phosphorus mg/l	Blank Parameter mg/l	Blank Parameter mg/l
LT-01	5/30/2002	2.10	3.60	1.82	1.84	0.02	**0.01**	0.119	0.154		
LT-02	5/30/2002	2.10	3.70	0.304	0.43	0.009	0.133	0.03	0.044		
LT-03	5/30/2002	2.10	6.72	4.93	6.00	0.034	0.145	0.268	1.32		
LT-04	5/30/2002	2.10	4.21	0.034	6.90	0.005	7.07	0.452	0.487		
LT-05	5/30/2002	2.10	9.42	0.832	0.91	**0.005**	0.101	0.202	0.221		
LT-24	5/29/2002	2.10	3.85	4.22	5.04	0.016	0.285	0.179	0.188		
LT-06	5/29/2002	2.10	5.06	0.023	0.38	**0.005**	0.396	0.027	0.035		
LT-07	5/29/2002	2.10	3.05	0.359	3.65	0.01	3.46	0.471	0.713		
LT-23	5/29/2002	2.10	3.55	0.069	1.88	0.019	0.692	0.137	0.272		
NP-137	5/29/2002	2.10	6.28	3.32	3.39	0.009	0.094	0.011	0.012		
LT-08	5/29/2002	2.10	4.20	**0.01**	1.30	0.005	0.778	0.038	0.072		
LT-09	5/29/2002	2.10	5.95	0.01	**0.10**	**0.005**	0.051	**0.01**	**0.01**		
LT-10	5/29/2002	2.10	2.65	0.013	4.44	0.007	3.28	0.218	0.272		
NS-07	5/28/2002	2.10	10.00	1.76	1.87	0.007	0.053	0.101	0.102		
LT-11	5/29/2002	2.10	6.82	1.73	2.16	0.011	0.074	**0.01**	**0.01**		
NP-141	5/28/2002	2.10	18.27	12.3	12.40	0.007	0.031	0.023	0.323		
LT-12	5/28/2002	2.10	6.86	0.037	0.61	0.006	0.153	0.18	0.289		
SM-43	5/28/2002	2.10	8.55	0.044	1.01	0.018	0.734	0.32	0.353		
LT-15	5/28/2002	2.10	2.18	0.038	3.24	0.44	2.18	0.069	0.094		
TLV-157	5/28/2002	2.10	8.22	1.43	4.40	0.008	2.42	**0.01**	**0.01**		
TLV-177	5/28/2002	2.10	5.31	0.01	0.79	0.014	0.396	0.322	0.42		
LT-16	5/28/2002	2.10	1.04	0.035	1.27	0.014	0.475	0.274	0.281		
LT-18	5/16/2002	2.21	5.82	0.013	4.65	0.009	4.68	0.018	0.065		
LT-20	5/16/2002	2.21	11.00	0.264	0.29	0.007	0.051	**0.01**	**0.01**		
LT-19S	5/16/2002	2.21	3.00	0.136	2.51	0.046	1.75	0.01	0.079		
LT-19N	5/16/2002	2.21	3.12	0.532	3.64	0.038	2.27	**0.01**	0.276		
LT-22	5/16/2002	2.21	9.50	0.342	0.38	**0.005**	0.073	**0.01**	**0.01**		
LT-21S	5/16/2002	2.21	1.30	**0.01**	0.46	0.01	0.405	0.041	0.037		
LT-21N	5/16/2002	2.21	3.00	0.014	0.51	0.011	0.353	0.342	0.386		
Total	Items in blue were reported as < value										

Table 11
Loading Rate Results - May 2002
Lake Tarpon Nutrient Study

Well ID	SAS GROUNDWATER NUTRIENT FLUX TO LAKE TARPON, (lbs/day)									
	Collection Date	SAS Discharge to Lake, Feet^3/Day	Nitrate + Nitrite	Total Nitrogen	Nitrite	Ammonia	Ortho Phosphorus	Total Phosphorus	Blank Parameter	Blank Parameter
LT-01	5/30/2002	12,015	1.36	1.38	0.01	0.01	0.089	0.115	0.00	0.00
LT-02	5/30/2002	455	0.01	0.01	0.00	0.00	0.001	0.001	0.00	0.00
LT-03	5/30/2002	310	0.10	0.12	0.00	0.00	0.005	0.026	0.00	0.00
LT-04	5/30/2002	-35	0.00	-0.02	0.00	-0.02	-0.001	-0.001	0.00	0.00
LT-05	5/30/2002	262	0.01	0.01	0.00	0.00	0.003	0.004	0.00	0.00
LT-24	5/29/2002	190	0.05	0.06	0.00	0.00	0.002	0.002	0.00	0.00
LT-06	5/29/2002	248	0.00	0.01	0.00	0.01	0.000	0.001	0.00	0.00
LT-07	5/29/2002	522	0.01	0.12	0.00	0.11	0.015	0.023	0.00	0.00
LT-23	5/29/2002	511	0.00	0.06	0.00	0.02	0.004	0.009	0.00	0.00
NP-137	5/29/2002	483	0.10	0.10	0.00	0.00	0.000	0.000	0.00	0.00
LT-08	5/29/2002	1,942	0.00	0.16	0.00	0.09	0.005	0.009	0.00	0.00
LT-09	5/29/2002	837	0.00	0.01	0.00	0.00	0.001	0.001	0.00	0.00
LT-10	5/29/2002	4,285	0.00	1.19	0.00	0.88	0.058	0.073	0.00	0.00
NS-07	5/28/2002	1,143	0.13	0.13	0.00	0.00	0.007	0.007	0.00	0.00
LT-11	5/29/2002	7,237	0.78	0.98	0.00	0.03	0.005	0.005	0.00	0.00
NP-141	5/28/2002	21,618	16.59	16.73	0.01	0.04	0.031	0.436	0.00	0.00
LT-12	5/28/2002	114	0.00	0.00	0.00	0.00	0.001	0.002	0.00	0.00
SM-43	5/28/2002	114	0.00	0.01	0.00	0.01	0.002	0.003	0.00	0.00
LT-15	5/28/2002	4,122	0.01	0.83	0.11	0.56	0.018	0.024	0.00	0.00
TLV-157	5/28/2002	1,387	0.12	0.38	0.00	0.21	0.001	0.001	0.00	0.00
TLV-177	5/28/2002	17,283	0.01	0.85	0.02	0.43	0.347	0.453	0.00	0.00
LT-16	5/28/2002	5,361	0.01	0.42	0.00	0.16	0.092	0.094	0.00	0.00
LT-18	5/16/2002	14,843	0.01	4.31	0.01	4.33	0.017	0.060	0.00	0.00
LT-20	5/16/2002	9,885	0.16	0.18	0.00	0.03	0.006	0.006	0.00	0.00
LT-19S	5/16/2002	183	0.00	0.03	0.00	0.02	0.000	0.001	0.00	0.00
LT-19N	5/16/2002	-888	-0.03	-0.20	0.00	-0.13	-0.001	-0.015	0.00	0.00
LT-22	5/16/2002	8,153	0.17	0.19	0.00	0.04	0.005	0.005	0.00	0.00
LT-21S	5/16/2002	1,317	0.00	0.04	0.00	0.03	0.003	0.003	0.00	0.00
LT-21N	5/16/2002	909	0.00	0.03	0.00	0.02	0.019	0.022	0.00	0.00
Total		**114,808**	**19.63**	**28.12**	**0.18**	**6.91**	**0.738**	**1.368**	**0.00**	**0.00**

* Negative discharges and fluxes may occur if calculated monitor well water level is less than Lake Tarpon water level.
Check monitor well depth to water and/or top of casing elevation if values are consistently negative.

Table 11
Loading Rate Results - May 2002
Lake Tarpon Nutrient Study

Well ID	SAS UNIT WIDTH GROUNDWATER NUTRIENT FLUX TO LAKE TARPON, (lbs/day/ft)									
	Collection Date	SAS Unit Width Discharge to Lake, Feet^2/Day	Nitrate + Nitrite	Total Nitrogen	Nitrite	Ammonia	Ortho Phosphorus	Total Phosphorus	Blank Parameter	Blank Parameter
LT-01	5/30/2002	3.72	4.23E-04	4.27E-04	4.64E-06	2.32E-06	2.76E-05	3.58E-05	0.00E+00	0.00E+00
LT-02	5/30/2002	0.25	4.82E-06	6.82E-06	1.43E-07	2.11E-06	4.76E-07	6.98E-07	0.00E+00	0.00E+00
LT-03	5/30/2002	0.32	9.92E-05	1.21E-04	6.84E-07	2.92E-06	5.39E-06	2.66E-05	0.00E+00	0.00E+00
LT-04	5/30/2002	-0.05	-1.15E-07	-2.33E-05	-1.69E-08	-2.39E-05	-1.53E-06	-1.64E-06	0.00E+00	0.00E+00
LT-05	5/30/2002	0.39	2.02E-05	2.20E-05	1.21E-07	2.45E-06	4.89E-06	5.35E-06	0.00E+00	0.00E+00
LT-24	5/29/2002	0.13	3.42E-05	4.09E-05	1.30E-07	2.31E-06	1.45E-06	1.52E-06	0.00E+00	0.00E+00
LT-06	5/29/2002	0.06	8.15E-08	1.35E-06	1.77E-08	1.40E-06	9.57E-08	1.24E-07	0.00E+00	0.00E+00
LT-07	5/29/2002	0.12	2.71E-06	2.76E-05	7.55E-08	2.61E-05	3.56E-06	5.38E-06	0.00E+00	0.00E+00
LT-23	5/29/2002	0.29	1.25E-06	3.40E-05	3.44E-07	1.25E-05	2.48E-06	4.92E-06	0.00E+00	0.00E+00
NP-137	5/29/2002	0.29	6.06E-05	6.19E-05	1.64E-07	1.72E-06	2.01E-07	2.19E-07	0.00E+00	0.00E+00
LT-08	5/29/2002	0.68	4.26E-07	5.54E-05	2.13E-07	3.32E-05	1.62E-06	3.07E-06	0.00E+00	0.00E+00
LT-09	5/29/2002	0.20	1.28E-07	1.28E-06	6.40E-08	6.52E-07	1.28E-07	1.28E-07	0.00E+00	0.00E+00
LT-10	5/29/2002	0.97	7.84E-07	2.68E-04	4.22E-07	1.98E-04	1.32E-05	1.64E-05	0.00E+00	0.00E+00
NS-07	5/28/2002	0.21	2.32E-05	2.47E-05	9.25E-08	7.00E-07	1.33E-06	1.35E-06	0.00E+00	0.00E+00
LT-11	5/29/2002	0.95	1.03E-04	1.29E-04	6.55E-07	4.41E-06	5.95E-07	5.95E-07	0.00E+00	0.00E+00
NP-141	5/28/2002	4.42	3.39E-03	3.42E-03	1.93E-06	8.55E-06	6.34E-06	8.91E-05	0.00E+00	0.00E+00
LT-12	5/28/2002	0.02	5.45E-08	8.98E-07	8.83E-09	2.25E-07	2.65E-07	4.25E-07	0.00E+00	0.00E+00
SM-43	5/28/2002	0.01	3.22E-08	7.39E-07	1.32E-08	5.37E-07	2.34E-07	2.58E-07	0.00E+00	0.00E+00
LT-15	5/28/2002	0.43	1.03E-06	8.77E-05	1.19E-05	5.90E-05	1.87E-06	2.55E-06	0.00E+00	0.00E+00
TLV-157	5/28/2002	0.31	2.74E-05	8.44E-05	1.53E-07	4.64E-05	1.92E-07	1.92E-07	0.00E+00	0.00E+00
TLV-177	5/28/2002	4.07	2.54E-06	2.01E-04	3.56E-06	1.01E-04	8.18E-05	1.07E-04	0.00E+00	0.00E+00
LT-16	5/28/2002	0.85	1.85E-06	6.71E-05	7.40E-07	2.51E-05	1.45E-05	1.49E-05	0.00E+00	0.00E+00
LT-18	5/16/2002	1.99	1.62E-06	5.79E-04	1.12E-06	5.82E-04	2.24E-06	8.09E-06	0.00E+00	0.00E+00
LT-20	5/16/2002	2.49	4.10E-05	4.50E-05	1.09E-06	7.92E-06	1.55E-06	1.55E-06	0.00E+00	0.00E+00
LT-19S	5/16/2002	0.14	1.21E-06	2.24E-05	4.11E-07	1.56E-05	8.93E-08	7.06E-07	0.00E+00	0.00E+00
LT-19N	5/16/2002	-0.45	-1.48E-05	-1.01E-04	-1.06E-06	-6.31E-05	-2.78E-07	-7.67E-06	0.00E+00	0.00E+00
LT-22	5/16/2002	2.16	4.60E-05	5.11E-05	6.73E-07	9.83E-06	1.35E-06	1.35E-06	0.00E+00	0.00E+00
LT-21S	5/16/2002	0.71	4.40E-07	2.03E-05	4.40E-07	1.78E-05	1.81E-06	1.63E-06	0.00E+00	0.00E+00
LT-21N	5/16/2002	0.41	3.62E-07	1.32E-05	2.85E-07	9.13E-06	8.85E-06	9.99E-06	0.00E+00	0.00E+00
Total										

Table 12
Loading Rate Results - October 2002
Lake Tarpon Nutrient Study

	DATA ENTRY										
Well ID	Collection Date	Lake Tarpon @ Lake Tarpon Sink Water Level, Feet NGVD	SAS Depth to Water, Feet	Nitrate + Nitrite mg/l	Total Nitrogen mg/l	Nitrite mg/l	Ammonia mg/l	Ortho Phosphorus mg/l	Total Phosphorus mg/l	Blank Parameter mg/l	Blank Parameter mg/l
LT-01	10/28/2002	3.18	2.38	4.03	4.34	0.014	0.128	0.102	0.094		
LT-02	10/28/2002	3.18	2.45	0.515	1.21	0.021	0.286	0.61	0.61		
LT-03	10/28/2002	3.18	5.28	0.158	1.25	0.013	0.106	0.337	0.335		
LT-04	10/28/2002	3.18	2.63	0.015	1.1	0.002	0.212	0.858	0.889		
LT-05	10/24/2002	3.25	8.20	1.68	2.34	0.002	0.013	0.203	0.203		
LT-24	10/28/2002	3.18	2.70	8.18	10.2	0.026	0.123	0.14	0.141		
LT-06	10/28/2002	3.18	4.05	0.06	2.72	0.002	0.179	0.024	0.027		
LT-07	10/24/2002	3.25	1.88	1.22	4.22	0.011	2.69	1.4	1.53		
LT-23	10/24/2002	3.25	2.20	0.024	1.95	0.011	0.114	0.14	0.153		
NP-137	10/24/2002	3.25	4.95	2.27	2.72	0.004	0.099	0.026	0.02		
LT-08	10/24/2002	3.25	3.07	0.013	1.17	0.007	0.186	0.139	0.143		
LT-09	10/24/2002	3.25	4.89	0.015	0.159	0.006	0.153	0.044	0.047		
LT-10	10/24/2002	3.25	1.58	0.035	3.93	0.008	2.21	0.315	0.315		
NS-07	10/23/2002	3.18	7.10	1.9	2.05	0.001	0.009	0.079	0.08		
LT-11	10/24/2002	3.25	5.75	2.11	2.22	0.007	0.176	0.076	0.076		
NP-141	10/23/2002	3.18	16.60	6.52	7.78	0	0.048	0.14	0.259		
LT-12	10/23/2002	3.18	7.95	0.014	0.61	0.002	0.325	0.335	0.341		
SM-43	10/23/2002	3.18	4.65	0.041	0.41	0.019	0.321	0.064	0.072		
LT-15	10/23/2002	3.18	1.45	0.016	2.1	0.006	1.282	0.074	0.079		
TLV-157	10/23/2002	3.18	6.71	0.565	3.42	0.007	1.574	0.001	0.001		
TLV-177	10/23/2002	3.18	5.00	0.014	1.43	0.01	0.74	0.455	0.457		
LT-16	10/22/2002	3.18	0.60	0.012	1.18	0.007	0.7	0.278	0.262		
LT-18	10/22/2002	3.18	3.94	0.106		0.008		0.091	0.097		
LT-20	10/22/2002	3.18	7.42	0.203	0.25	0	0.053	-0.004	-0.001		
LT-19S	10/28/2002	3.18	1.91	0.03	3.42	0.006	2.445	0.199	0.194		
LT-19N	10/28/2002	3.18	1.80	0.076	2.76	0.008	1.275	0.407	0.436		
LT-22	10/22/2002	3.18	6.55	0.224	0.26	0.001	0.055	0.002	0.006		
LT-21S	10/22/2002	3.18	0.40	0.008	0.35	0.002	0.318	0.007	0.009		
LT-21N	10/22/2002	3.18	1.83	0.026	0.4	0.006	0.18	0.027	0.024		
Total											

Table 12
Loading Rate Results - October 2002
Lake Tarpon Nutrient Study

Well ID	SAS GROUNDWATER NUTRIENT FLUX TO LAKE TARPON, (lbs/day)									
	Collection Date	SAS Discharge to Lake, Feet^3/Day	Nitrate + Nitrite	Total Nitrogen	Nitrite	Ammonia	Ortho Phosphorus	Total Phosphorus	Blank Parameter	Blank Parameter
LT-01	10/28/2002	17,076	4.29	4.62	0.01	0.14	0.109	0.100	0.00	0.00
LT-02	10/28/2002	998	0.03	0.08	0.00	0.02	0.038	0.038	0.00	0.00
LT-03	10/28/2002	647	0.01	0.05	0.00	0.00	0.014	0.014	0.00	0.00
LT-04	10/28/2002	121	0.00	0.01	0.00	0.00	0.006	0.007	0.00	0.00
LT-05	10/24/2002	382	0.04	0.06	0.00	0.00	0.005	0.005	0.00	0.00
LT-24	10/28/2002	365	0.19	0.23	0.00	0.00	0.003	0.003	0.00	0.00
LT-06	10/28/2002	181	0.00	0.03	0.00	0.00	0.000	0.000	0.00	0.00
LT-07	10/24/2002	627	0.05	0.17	0.00	0.11	0.055	0.060	0.00	0.00
LT-23	10/24/2002	1,025	0.00	0.12	0.00	0.01	0.009	0.010	0.00	0.00
NP-137	10/24/2002	639	0.09	0.11	0.00	0.00	0.001	0.001	0.00	0.00
LT-08	10/24/2002	2,038	0.00	0.15	0.00	0.02	0.018	0.018	0.00	0.00
LT-09	10/24/2002	904	0.00	0.01	0.00	0.01	0.002	0.003	0.00	0.00
LT-10	10/24/2002	3,098	0.01	0.76	0.00	0.43	0.061	0.061	0.00	0.00
NS-07	10/23/2002	2,201	0.26	0.28	0.00	0.00	0.011	0.011	0.00	0.00
LT-11	10/24/2002	7,493	0.99	1.04	0.00	0.08	0.036	0.036	0.00	0.00
NP-141	10/23/2002	24,848	10.11	12.06	0.00	0.07	0.217	0.402	0.00	0.00
LT-12	10/23/2002	-1,188	0.00	-0.05	0.00	-0.02	-0.025	-0.025	0.00	0.00
SM-43	10/23/2002	1,204	0.00	0.03	0.00	0.02	0.005	0.005	0.00	0.00
LT-15	10/23/2002	1,782	0.00	0.23	0.00	0.14	0.008	0.009	0.00	0.00
TLV-157	10/23/2002	1,604	0.06	0.34	0.00	0.16	0.000	0.000	0.00	0.00
TLV-177	10/23/2002	15,225	0.01	1.36	0.01	0.70	0.432	0.434	0.00	0.00
LT-16	10/22/2002	1,988	0.00	0.15	0.00	0.09	0.034	0.032	0.00	0.00
LT-18	10/22/2002	16,964	0.11	0.00	0.01	0.00	0.096	0.103	0.00	0.00
LT-20	10/22/2002	14,486	0.18	0.23	0.00	0.05	-0.004	-0.001	0.00	0.00
LT-19S	10/28/2002	530	0.00	0.11	0.00	0.08	0.007	0.006	0.00	0.00
LT-19N	10/28/2002	565	0.00	0.10	0.00	0.04	0.014	0.015	0.00	0.00
LT-22	10/22/2002	11,298	0.16	0.18	0.00	0.04	0.001	0.004	0.00	0.00
LT-21S	10/22/2002	1,050	0.00	0.02	0.00	0.02	0.000	0.001	0.00	0.00
LT-21N	10/22/2002	4,172	0.01	0.10	0.00	0.05	0.007	0.006	0.00	0.00
Total		**132,323**	**16.61**	**22.59**	**0.05**	**2.27**	**1.162**	**1.357**	**0.00**	**0.00**

* Negative discharges and fluxes may occur if calculated monitor well water level is less than Lake Tarpon water level. Check monitor well depth to water and/or top of casing elevation if values are consistently negative.

Table 12
Loading Rate Results - October 2002
Lake Tarpon Nutrient Study

Well ID	SAS UNIT WIDTH GROUNDWATER NUTRIENT FLUX TO LAKE TARPON, (lbs/day/ft)									
	Collection Date	SAS Unit Width Discharge to Lake, Feet^2/Day	Nitrate + Nitrite	Total Nitrogen	Nitrite	Ammonia	Ortho Phosphorus	Total Phosphorus	Blank Parameter	Blank Parameter
LT-01	10/28/2002	5.29	1.33E-03	1.43E-03	4.62E-06	4.22E-05	3.37E-05	3.10E-05	0.00E+00	0.00E+00
LT-02	10/28/2002	0.56	1.79E-05	4.21E-05	7.31E-07	9.95E-06	2.12E-05	2.12E-05	0.00E+00	0.00E+00
LT-03	10/28/2002	0.67	6.63E-06	5.25E-05	5.46E-07	4.45E-06	1.41E-05	1.41E-05	0.00E+00	0.00E+00
LT-04	10/28/2002	0.19	1.73E-07	1.27E-05	2.31E-08	2.45E-06	9.92E-06	1.03E-05	0.00E+00	0.00E+00
LT-05	10/24/2002	0.56	5.92E-05	8.25E-05	7.05E-08	4.58E-07	7.16E-06	7.16E-06	0.00E+00	0.00E+00
LT-24	10/28/2002	0.25	1.27E-04	1.59E-04	4.04E-07	1.91E-06	2.18E-06	2.19E-06	0.00E+00	0.00E+00
LT-06	10/28/2002	0.04	1.55E-07	7.01E-06	5.16E-09	4.62E-07	6.19E-08	6.96E-08	0.00E+00	0.00E+00
LT-07	10/24/2002	0.15	1.11E-05	3.82E-05	9.97E-08	2.44E-05	1.27E-05	1.39E-05	0.00E+00	0.00E+00
LT-23	10/24/2002	0.58	8.72E-07	7.08E-05	4.00E-07	4.14E-06	5.09E-06	5.56E-06	0.00E+00	0.00E+00
NP-137	10/24/2002	0.39	5.48E-05	6.57E-05	9.66E-08	2.39E-06	6.28E-07	4.83E-07	0.00E+00	0.00E+00
LT-08	10/24/2002	0.72	5.81E-07	5.23E-05	3.13E-07	8.32E-06	6.22E-06	6.40E-06	0.00E+00	0.00E+00
LT-09	10/24/2002	0.22	2.07E-07	2.20E-06	8.29E-08	2.11E-06	6.08E-07	6.50E-07	0.00E+00	0.00E+00
LT-10	10/24/2002	0.70	1.53E-06	1.71E-04	3.49E-07	9.64E-05	1.37E-05	1.37E-05	0.00E+00	0.00E+00
NS-07	10/23/2002	0.41	4.83E-05	5.21E-05	2.54E-08	2.29E-07	2.01E-06	2.03E-06	0.00E+00	0.00E+00
LT-11	10/24/2002	0.99	1.30E-04	1.37E-04	4.32E-07	1.08E-05	4.69E-06	4.69E-06	0.00E+00	0.00E+00
NP-141	10/23/2002	5.08	2.07E-03	2.47E-03	0.00E+00	1.52E-05	4.44E-05	8.21E-05	0.00E+00	0.00E+00
LT-12	10/23/2002	-0.25	-2.15E-07	-9.35E-06	-3.06E-08	-4.98E-06	-5.13E-06	-5.23E-06	0.00E+00	0.00E+00
SM-43	10/23/2002	0.12	3.16E-07	3.16E-06	1.46E-07	2.47E-06	4.93E-07	5.55E-07	0.00E+00	0.00E+00
LT-15	10/23/2002	0.19	1.87E-07	2.46E-05	7.03E-08	1.50E-05	8.66E-07	9.25E-07	0.00E+00	0.00E+00
TLV-157	10/23/2002	0.36	1.25E-05	7.59E-05	1.55E-07	3.49E-05	2.22E-08	2.22E-08	0.00E+00	0.00E+00
TLV-177	10/23/2002	3.58	3.13E-06	3.20E-04	2.24E-06	1.66E-04	1.02E-04	1.02E-04	0.00E+00	0.00E+00
LT-16	10/22/2002	0.31	2.35E-07	2.31E-05	1.37E-07	1.37E-05	5.45E-06	5.13E-06	0.00E+00	0.00E+00
LT-18	10/22/2002	2.28	1.51E-05	0.00E+00	1.14E-06	0.00E+00	1.29E-05	1.38E-05	0.00E+00	0.00E+00
LT-20	10/22/2002	3.65	4.62E-05	5.69E-05	0.00E+00	1.21E-05	-9.10E-07	-2.28E-07	0.00E+00	0.00E+00
LT-19S	10/28/2002	0.41	7.76E-07	8.85E-05	1.55E-07	6.33E-05	5.15E-06	5.02E-06	0.00E+00	0.00E+00
LT-19N	10/28/2002	0.28	1.34E-06	4.88E-05	1.41E-07	2.25E-05	7.19E-06	7.71E-06	0.00E+00	0.00E+00
LT-22	10/22/2002	2.99	4.18E-05	4.85E-05	1.87E-07	1.03E-05	3.73E-07	1.12E-06	0.00E+00	0.00E+00
LT-21S	10/22/2002	0.56	2.81E-07	1.23E-05	7.02E-08	1.12E-05	2.46E-07	3.16E-07	0.00E+00	0.00E+00
LT-21N	10/22/2002	1.90	3.09E-06	4.75E-05	7.12E-07	2.14E-05	3.20E-06	2.85E-06	0.00E+00	0.00E+00
Total										

APPENDIX A:

Geologic Well Logs

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-1		
PAGE	1 OF 1		
LOCATION	Richard Ervin Park	SCREEN TYPE	Schedule 40 PVC
	Pinellas County, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	5/25/02	SETTING	2 to 12 feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0 to 2 feet bls
SAMPLING METHOD	Return cuttings	DEVELOPMENT	Rig-mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	15 minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	3.60 feet bls
ELEVATION OF RP		YIELD	10 to 12 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	3	Silty-sand, very-fine grained, brownish gray, (5YR, 4/1)
3	5	Sand, clean-quartz to slightly silty, very-fine grained, light gray, (N8), damp to
		Wet @ 3-4 ft bls
5	7	Sand, slightly silty to silty, very-fine grained, dark yellowish brown (10 YR, 4/2)
7	10	Sand, silty, very-fine grained, moderate brown, (5YR, 4/4)
10	12	Sand, slightly silty, very-fine grained, very pale orange, (10 YR, 8/20

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-2		
PAGE	1	OF	1
LOCATION	Lake Tarpon Avenue	SCREEN TYPE	Schedule 40 PVC
	Tarpon Springs, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	5/28/02	SETTING	2 – 12 feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0 – 2 feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	20 minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	3.73 feet bls
ELEVATION OF RP		YIELD	15 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	0.5	Topsoil, leaves, red paving bricks
0.5	4	Sand, clean quartz, very-fine grained, very light gray, (N8), damp at 2-3 feet bls.
4	8	Sand, very-silty, very-fine grained, brownish black, (YR, 2/1) well compacted, high
		Organic content, wet.
8	9	Sand, slightly silty to silty, very-fine grained, dusky yellowish brown (10 YR, 5/4).
9	12	Sand, slightly silty to silty, very-fine grained, moderate yellowish brown (10 YR,
		5/4)

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-3		
PAGE	1 OF 1		
LOCATION	Grandview Avenue	SCREEN TYPE	Schedule 40 PVC
	Tarpon Springs, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	5/28/02	SETTING	3 to 13 feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0 to 3 feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	25 minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	
ELEVATION OF RP		YIELD	9-10 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	1	Silty sand, very-fine grained, dark yellowish brown, (10 YR, 4/2), some ½ -1 inch
		Diameter limestone cobbles.
1	4	Sand, clean quartz “sugar sand”, very-fine grained, very light gray, (N8).
4	5	Sand, slightly silty, very-fine grained, moderate yellowish brown, (10YR, 5/4).
5	7	Silty sand, very-fine grained, grayish brown, (5YR, 3/2), damp at 6 feet bls.
7	10	Sand, silty to slightly silty, very-fine grained, pale yellowish brown, (10 YR, 6/2),
		Wet at 7 feet bls.
10	13	Silty sand, very-fine grained, moderate yellowish brown, (10 YR, 5/4).

GEOLOGIC LOG		OWNER	Pinellas County Project No. 922398
LEGGETTE, BRASHEARS & GRAHAM, INC.		WELL NO.	LT-4
TAMPA, FLORIDA		PAGE	1 OF 1
LOCATION	Lonesome Pine Place	SCREEN TYPE	Schedule 40 PVC
	Tarpon Springs, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	5/28/02	SETTING	2-12 Feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0-2 feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	21 minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	4.15 feet bls
ELEVATION OF RP		YIELD	3 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	2	Sand, very silty, very fine-grained, dark yellowish brown, (10YR, 4/2).
2	5	Sand, quartz, clean to slightly silty, very fine-grained, pale yellowish brown,
		(10YR, 4/2).
5	7	Sand, silty, very fine-grained, dark yellowish brown, (10YR, 4/2), damp to wet at
		5 feet bls.
7	9	Sand, very silty, very fine-grained, dusky yellowish brown, (10YR, 2/2), some
		Plant roots and organic content, wet.
9	12	Silt, high organic content, dusky yellowish brown (10YR/ 2/2), some very fine-
		Grained sand, slightly plastic (able to mold between fingers), wet.

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-5		
PAGE	1	OF	1
LOCATION	Wegman Drive Tarpon Springs, FL	SCREEN TYPE	Schedule 40 PVC
		DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	5/24/02	SETTING	5-20 feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0-5 feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	20 minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	9.43 feet bls
ELEVATION OF RP		YIELD	
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	3	Sand, quartz, clean to slightly silty, very fine-grained, pale yellowish brown
		(10YR, 6/2), dry and loose.
3	10	Sand, slightly silty, very fine-grained, moderate yellowish brown, (10YR, 5/4).
10	20	Sand, quartz, clean to slightly silty, very fine-grained, pale yellowish brown,
		(10YR, 6/2).

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**		
WELL NO.	**LT-6**		
PAGE	**1** OF **1**		
LOCATION	**Jasmine Avenue**	SCREEN TYPE	**Schedule 40 PVC**
	Tarpon Springs, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**5/24/02**	SETTING	**2-12 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0-2 Feet bls**
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**
OBSERVER	**Ron Ewinski**	DURATION	**15 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**2.02 Feet bls**
ELEVATION OF RP		YIELD	**10 gpm**
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**2**	**Sand slightly silty, very fine-grained, dark yellowish brown, (10YR, 4/2), damp to**
		Wet at 2 feet bls.
2	**6**	**Silt (muck), very high organic content, some plant roots and wood, brownish black**
		(5YR, 2/1), wet and spongey.
6	**12**	**Sand, silty to slightly silty, very fine-grained, dusky yellowish brown, (10YR, 2/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-7		
PAGE	1	OF	1
LOCATION	Tookes Road	SCREEN TYPE	Schedule 40 PVC
	Tarpon Springs, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	5/24/02	SETTING	2-12 Feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0-2 Feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	45 Minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	3.24 Feet bls
ELEVATION OF RP		YIELD	5 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	0.5	Topsoil, grass and roots
0.5	5	Sand, silty, very fine-grained, pale yellowish brown, (10YR, 6/2), wet at 3 feet bls.
5	9	Silt, organic, “muck”, some clay and trace of very fine-grained sand, dusky
		Yellowish brown, (10YR, 2/2) to black, slightly plastic.
9	12	Sand, silty, very fine-grained, dark yellowish brown, (10YR, 4/2).

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER			Pinellas County Project No. 922398
WELL NO.			LT- 8
PAGE			1 OF 1
LOCATION	Klosterman Road	SCREEN TYPE	Schedule 40 PVC
	Palm Harbor, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	May 21, 2002	SETTING	2 to 17 Feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0 to 2 Feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	25 Minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	4.25 Feet bls
ELEVATION OF RP		YIELD	15 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	7	Sand, silty, very fine-grained, very light gray (N8), wet @ ~ 6 ft bls.
7	10	Sand, silty, very fine-grained, dark yellowish brown (10YR, 4/2), saturated @ 9 to
		10 ft bls.
10	15	Sand, very silty, very fine-grained, dusky yellowish brown (10YR, 2/2).
15	17	Sand, silty, very fine-grained, moderate yellowish brown (10YR, 5/4).

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GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**		
WELL NO.	**LT- 9**		
PAGE	**1** OF **1**		
LOCATION	**Four Points Hotel**	SCREEN TYPE	**Schedule 40 PVC**
	37611 U.S. Hwy 19, N., Palm Harbor	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**May 21, 2002**	SETTING	**3 to 13 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 3 Feet bls**
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**
OBSERVER	**Ron Ewinski**	DURATION	**25 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**6.0 Feet bls**
ELEVATION OF RP		YIELD	**3 gpm**
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**5**	**Sand, silty, very fine-grained, pale yellowish brown (10YR, 7/4).**
5	**8**	**Sand, silty, very fine-grained, dark yellowish brown (10YR, 4/2), damp to wet at**
		6 to 7 ft bls.
8	**10**	**Sand, clean quartz, very fine-grained, pale yellowish brown (10YR, 6/2).**
10	**13**	**Sand, very silty, very fine-grained, very light gray (N8).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT- 10		
PAGE	1 OF 1		
LOCATION	Freshwater Drive	SCREEN TYPE	Schedule 40 PVC
	Palm Harbor, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	May 21, 2002	SETTING	2 to 12 Feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0 to 2 Feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	15 Minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	3.0 Feet bls
ELEVATION OF RP		YIELD	5 to 6 gpm
REMARKS			

DEPTH (FEET) FROM	TO	DESCRIPTION
0	3	Sand, silty, very fine-grained, grayish brown (5YR, 3/2), some organics, rocks,
		& plant roots.
3	7	Sand, slightly silty, very fine-grained, pale yellowish brown (10YR, 6/2), wet at
		4 ft bls.
7	10	Silt, very fine-grained, high organic content with some wood matter, dusky
		Brown (5YR, 2/2), trace of very fine-grained sand, saturated.
10	12	Sand, very silty, very fine-grained,olive gray (5Y, 4/1).

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**		
WELL NO.	**LT- 11**		
PAGE	**1** OF **1**		
LOCATION	**Jodi Lane**	SCREEN TYPE	**Schedule 40 PVC**
	Palm Harbor, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**May 21, 2002**	SETTING	**3 to 18 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 3 Feet bls**
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**
OBSERVER	**Ron Ewinski**	DURATION	**20 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**7.0 Feet bls**
ELEVATION OF RP		YIELD	**9 to 10 gpm**
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**7**	**Sand, slightly silty, very fine-grained, well sorted, pale yellowish brown (10YR, 6/2)**
7	**10**	**Sand, silty, very fine-grained, very pale orange, (10YR, 8/2), wet at ~ 8 ft bls.**
10	**14**	**Sand, silty to slightly silty, very fine-grained, grayish orange (10YR, 7/4).**
14	**18**	**Sand, silty, very fine-grained, pale brown (5YR, 5/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398				
WELL NO.	LT- 12				
PAGE	1	OF	1		
LOCATION	Lake Pointe Road	SCREEN TYPE	Schedule 40 PVC		
	Palm Harbor, FL	DIAM.	2-INCH	SLOT NO.	0.01
DATE COMPLETED	May 15, 2002	SETTING	2 to 15 Feet bls		
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand		
		CASING	2-Inch Diameter Schedule PVC Riser		
DRILLING METHOD	Hollow Stem Auger	SETTING	0 to 2 Feet bls		
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump		
OBSERVER	Ron Ewinski	DURATION	22 Minutes		
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	9.0 Feet bls		
ELEVATION OF RP		YIELD	2 to 3 gpm		
REMARKS					

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	4	Sand, very silty, very fine-grained, pale yellowish brown, (10YR, 6/2) to light gray
		(N7), some shell and lime rock fragments (road base material).
4	6	Sand, silty, very fine-grained, dusky yellowish brown (10YR, 2/2), damp at 6 ft bls.
6	12	Sand, slightly silty, very fine-grained, pale yellowish brown (10YR, 6/2), wet at
		7 to 8 ft bls.
12	15	Sandy clay, with very fine-grained sand, pale olive (10YR, 6/2), very soft, damp to
		Wet.
15	16	Very sandy clay to very clayey sand, very fine-grained sand, pale olive (10YR, 6/2)
		Very soft and wet.
16	17	Sandy clay, with very fine-grained sand, pale olive (10YR, 6/2), very soft, damp to
		Wet, some chert inclusions.
17	EOB	Hard resistive layer at 17 ft bls (end of borehole), possibly chert or hardpan layer.

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**				
WELL NO.	**LT- 15**				
PAGE	**1**	OF	**1**		
LOCATION	**Chestnut Park**	SCREEN TYPE	**Schedule 40 PVC**		
	East Lake, Pinellas Co., FL	DIAM.	**2-INCH**	SLOT NO.	**0.01**
DATE COMPLETED	**May 14, 2002**	SETTING	**2 to 12 Feet bls**		
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**		
		CASING	**2-Inch Diameter Schedule PVC Riser**		
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 2 Feet bls**		
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**		
OBSERVER	**Ron Ewinski**	DURATION	**22 Minutes**		
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**2.5 Feet bls**		
ELEVATION OF RP		YIELD	**10 gpm**		
REMARKS					

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**2**	**Sand, silty, very fine-grained, well sorted, dark yellowish brown (10YR, 4/2).**
2	**3**	**Sand, silty, very fine-grained, brownish black (5Y, 2/1), some organic content.**
3	**6**	**Sand, silty, fine to very fine-grained, moderate yellowish brown (10YR, 5/4), trace**
		Of black fine-grained phosphate, damp to wet at 3 ft bls.
6	**12**	**Sand, clean quartz “sugar sand”, very fine-grained, very light gray (N8) to**
		Yellowish gray (5Y, 8/1).

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**				
WELL NO.	**LT-16**				
PAGE	**1**	OF	**1**		
LOCATION	**Juniper Drive**	SCREEN TYPE	**Schedule 40 PVC**		
	East Lake, Pinellas County, FL	DIAM.	**2-INCH**	SLOT NO.	**0.01**
DATE COMPLETED	**May 15, 2002**	SETTING	**2 to 12 Feet bls**		
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**		
		CASING	**2-Inch Diameter Schedule PVC Riser**		
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 2 Feet bls**		
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**		
OBSERVER	**Ron Ewinski**	DURATION	**25 Minutes**		
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**2.0 Feet bls**		
ELEVATION OF RP		YIELD	**7.5 gpm**		
REMARKS					

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**3**	**Sand, clean quartz, well sorted, very fine-grained, very light gray (N8), wet at**
		2 ft bls.
3	**6**	**Sand, slightly silty, very fine-grained, moderate yellowish brown (10YR, 5/4).**
6	**12**	**Sand, silty, very fine-grained, dusky brown (5YR, 2/2), very wet and loose.**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**		
WELL NO.	**LT-17**		
PAGE	**1** OF **1**		
LOCATION	**Landsbrook Parkway**	SCREEN TYPE	**Schedule 40 PVC**
	East Lake, Pinellas County, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**May 14, 2002**	SETTING	**3 to 18 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 3 Feet bls**
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**
OBSERVER	**Ron Ewinski**	DURATION	**25 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**4.0 Feet bls**
ELEVATION OF RP		YIELD	**10 to 11 gpm**
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**1**	**Sand, slightly silty, very fine-grained, dark yellowish brown, (10YR, 4/2).**
1	**2**	**Sand, slightly silty, very fine-grained, moderate yellowish brown (10YR. 5/4).**
2	**3**	**Sand, silty, very fine-grained, olive black (5Y, 2/1).**
3	**4**	**Sand, clean quartz, well sorted, very fine-grained, very light gray, (N8).**
4	**8**	**Sand, silty, very fine-grained, dark yellowish brown (10YR, 4/2), wet at 6 ft bls,**
		Becoming loose and “soupy” with depth.
8	**14**	**Sand, silty, very fine-grained, very pale orange (10YR, 8/2) to grayish orange**
		(10YR, 7/4)
14	**18**	**Sand, very silty to slightly clayey, very fine-grained, pale yellowish brown**
		(10YR, 6/2), very soft and wet.

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER			**Pinellas County Project No. 922398**
WELL NO.			**LT-18**
PAGE			**1** OF **1**
LOCATION	**Bryan Lane**	SCREEN TYPE	**Schedule 40 PVC**
	East Lake, Pinellas County, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED		SETTING	**3 to 18 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 3 Feet bls**
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**
OBSERVER	**Ron Ewinski**	DURATION	**12 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**5.5 Feet bls**
ELEVATION OF RP		YIELD	**8 gpm**
REMARKS			

DEPTH (FEET) FROM	TO	DESCRIPTION
0	**2**	**Sand, silty, well sorted, very fine-grained, pale yellowish brown (10YR, 6/2), some**
		Plant roots, dry.
2	**4**	**Sand, clean quartz "sugar sand", very fine-grained, very light gray (N8).**
4	**6**	**Sand, silty, very fine-grained, pale brown (5YR, 5/2), dry.**
6	**8**	**Sand, silty, very fine-grained, moderate yellowish brown (10YR, 5/4), damp to**
		Wet at 6 ft bls.
8	**11**	**Sand, silty, very fine-grained, dark yellowish brown (10YR, 4/2), very wet, "soupy"**
11	**15**	**Sand, slightly silty, very fine-grained, pale yellowish brown (10YR, 6/2).**
15	**18**	**Sand, clayey, very fine-grained, very soft and loose, wet, olive gray (5Y, 5/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**		
WELL NO.	**LT-19N (north)**		
PAGE	**1** OF **1**		
LOCATION	**680 George Street, South**	SCREEN TYPE	**Schedule 40 PVC**
	East Lake, Pinellas County, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**May 14, 2002**	SETTING	**2 to 12 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hand Auger**	SETTING	**0 to 2 Feet bls**
SAMPLING METHOD	**Auger Bucket Samples**	DEVELOPMENT	**Submersible Pump**
OBSERVER	**Ron Ewinski**	DURATION	**30 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**3.0 Feet bls**
ELEVATION OF RP		YIELD	**0.75 to 1.0 gpm**
REMARKS	**Low recharge, well purged dry during development – allowed to recover and repeated.**		

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**4**	**Sand, silty, very fine-grained, high organic content "topsoil", dark yellowish brown**
		(10YR, 4/2), some plant roots.
4	**8**	**Sand, silty, very fine-grained, moderately well sorted, moderate yellowish brown**
		(10YR, 4/4).
8	**12**	**Sand, clean quartz "sugar" sand, very fine-grained, yellowish gray (5Y, 7/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	**Pinellas County Project No. 922398**				
WELL NO.	**LT-19S (south)**				
PAGE	**1**	OF	**1**		
LOCATION	**680 George Street, South**	SCREEN TYPE	**Schedule 40 PVC**		
	East Lake, Pinellas County, FL	DIAM.	**2-INCH**	SLOT NO.	**0.01**
DATE COMPLETED	**May 14, 2002**	SETTING	**2 to 12 Feet bls**		
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**		
		CASING	**2-Inch Diameter Schedule PVC Riser**		
DRILLING METHOD	**Hand Auger**	SETTING	**0 to 2 Feet bls**		
SAMPLING METHOD	**Auger Bucket Samples**	DEVELOPMENT	**Submersible Pump**		
OBSERVER	**Ron Ewinski**	DURATION	**45 Minutes**		
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**3.0 Feet bls**		
ELEVATION OF RP		YIELD	**1 to 1.5 gpm**		
REMARKS	**Low recharge, well purged dry during development – allowed to recover and repeated.**				

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**4**	**Sand, silty, very fine-grained, high organic content "topsoil", dark yellowish brown**
		(10YR, 4/2), some plant roots.
4	**9**	**Sand, silty, very fine-grained, moderately well sorted, moderate yellowish brown**
		(10YR, 4/4).
9	**12**	**Sand, clean quartz "sugar" sand, very fine-grained, yellowish gray (5Y, 7/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

		OWNER	**Pinellas County Project No. 922398**
		WELL NO.	**LT-20**
		PAGE	**1** OF **1**
LOCATION	**Old East Lake Road**	SCREEN TYPE	**Schedule 40 PVC**
	East Lake, Pinellas County, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**May 13, 2002**	SETTING	**4 to 19 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hollow Stem Auger**	SETTING	**0 to 4 Feet bls**
SAMPLING METHOD	**Return Cuttings**	DEVELOPMENT	**Rig mounted centrifugal pump**
OBSERVER	**Ron Ewinski**	DURATION	**15 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**10.5 Feet bls**
ELEVATION OF RP		YIELD	**10 gpm**
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**2**	**Sand, slightly silty, well sorted, very fine-grained, pale yellowish brown (10YR, 6/2)**
3	**6**	**Sand, slightly silty, well sorted, very fine-grained, grayish orange (10YR, 7/4).**
6	**19**	**Sand, clean quartz, well sorted, very fine-grained, very pale orange (10YR, 8/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-21N (north)		
PAGE	1	OF	1
LOCATION	216 George Street, South East Lake, Pinellas County, FL	SCREEN TYPE	Schedule 40 PVC
		DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	May 13, 2002	SETTING	2 to 12 Feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hand Auger	SETTING	0 to 2 Feet bls
SAMPLING METHOD	Auger Bucket Samples	DEVELOPMENT	Submersible Pump
OBSERVER	Ron Ewinski	DURATION	40 Minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	2.5 Feet bls
ELEVATION OF RP		YIELD	1 gpm
REMARKS	Very low recharge, well purged dry during development – allowed to recover and repeated.		

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	0.5	Topsoil, some organics and plant roots.
0.5	12	Sand, silty, fine to very fine-grained, well sorted, pale yellowish brown (10YR, 6/2).

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER		**Pinellas County Project No. 922398**			
WELL NO.		**LT-21S (south)**			
PAGE		**1**	OF	**1**	
LOCATION	**216 George Street, South**	SCREEN TYPE	**Schedule 40 PVC**		
	East Lake, Pinellas County, FL	DIAM.	**2-INCH**	SLOT NO.	**0.01**
DATE COMPLETED	**May 13, 2002**	SETTING	**2 to 12 Feet bls**		
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**		
		CASING	**2-Inch Diameter Schedule PVC Riser**		
DRILLING METHOD	**Hand Auger**	SETTING	**0 to 2 Feet bls**		
SAMPLING METHOD	**Auger Bucket Samples**	DEVELOPMENT	**Submersible Pump**		
OBSERVER	**Ron Ewinski**	DURATION	**35 Minutes**		
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**1.5 Feet bls**		
ELEVATION OF RP		YIELD	**2 gpm**		
REMARKS	**Low recharge, well purged dry during development – allowed to recover and repeated.**				

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**0.5**	**Topsoil, some organics and plant roots.**
0.5	**12**	**Sand, silty, fine to very fine-grained, well sorted, pale yellowish brown (10YR, 6/2).**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-22		
PAGE	1	OF	1
LOCATION	175 Old East Lake Road	SCREEN TYPE	Schedule 40 PVC
	East Lake, Pinellas County, FL	DIAM.	2-INCH SLOT NO. 0.01
DATE COMPLETED	May 13, 2002	SETTING	4 to 19 Feet bls
DRILLING COMPANY	Diversified Drilling Corporation	SAND PACK	20 / 30 Silica Sand
		CASING	2-Inch Diameter Schedule PVC Riser
DRILLING METHOD	Hollow Stem Auger	SETTING	0 to 4 Feet bls
SAMPLING METHOD	Return Cuttings	DEVELOPMENT	Rig mounted centrifugal pump
OBSERVER	Ron Ewinski	DURATION	16 Minutes
REFERENCE POINT (RP)	Land Surface	STATIC WATER LEVEL	9.5 Feet bls
ELEVATION OF RP		YIELD	10 gpm
REMARKS			

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	13	Sand, well sorted, very fine-grained, very pale orange (10YR, 8/2).
13	19	Sand, well sorted, very fine-grained, grayish orange (10YR, 7/4).

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER			**Pinellas County Project No. 922398**		
WELL NO.			**LT-23**		
PAGE			**1**	OF	**1**
LOCATION	**1271 Lagoon Road**	SCREEN TYPE	**Schedule 40 PVC**		
	Tarpon Springs, FL	DIAM.	**2-INCH**	SLOT NO.	**0.01**
DATE COMPLETED	**May 21, 2002**	SETTING	**2 to 12 Feet bls**		
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**		
		CASING	**2-Inch Diameter Schedule PVC Riser**		
DRILLING METHOD	**Hand Auger**	SETTING	**0 to 2 Feet bls**		
SAMPLING METHOD	**Auger Bucket Samples**	DEVELOPMENT	**Submersible Pump**		
OBSERVER	**Ron Ewinski**	DURATION	**35 Minutes**		
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**3.5 Feet bls**		
ELEVATION OF RP		YIELD	**2.0 to 2.5 gpm**		
REMARKS	**Low recharge, well purged dry during development – allowed to recover and repeated.**				

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**1**	**Topsoil and grass roots.**
1	**4**	**Sand, clean quartz to slightly silty, very fine-grained, very light gray (N8), damp at**
		3 ft bls.
4	**8**	**Sand, silty, very fine-grained, dusky yellowish brown (10YR, 2/2), wet at 4 ft bls.**
		Saturated below 4 ft bls.
8	**12**	**Sand, slightly silty to silty, very fine-grained, moderate yellowish brown (10YR, 5/4)**

GEOLOGIC LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

TAMPA, FLORIDA

OWNER	Pinellas County Project No. 922398		
WELL NO.	LT-24		
PAGE	1	OF	1
LOCATION	**1460 Lakeview Drive**	SCREEN TYPE	**Schedule 40 PVC**
	Tarpon Springs, FL	DIAM.	**2-INCH** SLOT NO. **0.01**
DATE COMPLETED	**May 24, 2002**	SETTING	**2 to 12 Feet bls**
DRILLING COMPANY	**Diversified Drilling Corporation**	SAND PACK	**20 / 30 Silica Sand**
		CASING	**2-Inch Diameter Schedule PVC Riser**
DRILLING METHOD	**Hand Auger**	SETTING	**0 to 2 Feet bls**
SAMPLING METHOD	**Auger Bucket Samples**	DEVELOPMENT	**Submersible Pump**
OBSERVER	**Ron Ewinski**	DURATION	**30 Minutes**
REFERENCE POINT (RP)	**Land Surface**	STATIC WATER LEVEL	**3.5 Feet bls**
ELEVATION OF RP		YIELD	**< 1.0 gpm**
REMARKS	**Low recharge, well purged dry during development – allowed to recover and repeated.**		

DEPTH (FEET)		DESCRIPTION
FROM	TO	
0	**0.5**	**Grass, grass roots and topsoil.**
0.5	**5**	**Sand, slightly silty to silty, very fine-grained, pale yellowish brown (10YR, 6/2),**
		Wet at 4 ft bls.
5	**8**	**Sand, silty, very fine-grained, moderate yellowish brown (10YR, 5/4).**
8	**12**	**Sand, slightly silty to silty, very fine-grained, pale yellowish brown (10YR, 6/2),**
		Very loose.

APPENDIX B:

Specific Purpose Survey Report

SFN 1238 – Lake Tarpon Monitor Wells

DIVISION OF SURVEY & MAPPING

PINELLAS COUNTY PUBLIC WORKS
DIVISION OF SURVEY & MAPPING
22211 U.S. HIGHWAY 19 NORTH, BLDG. 16
CLEARWATER, FLORIDA 33765-2347
PHONE: (727) 464-8904 FAX: (727) 464-8906

SPECIFIC PURPOSE SURVEY REPORT

SFN 1238 – LAKE TARPON MONITOR WELLS

SECTION TIONS 08, 09, 16, 17, 18, 19, 21, 29, 30, 32 & 33 TOWNSHIP 27 SOUTH, RANGE 16 EAST
SECTION TION 04 TOWNSHIP 28 SOUTH, RANGE 16 EAST

Type of Survey: Specific Purpose Survey (Chapter 61G17-6.0052 F.A.C.) to provide elevations at specified locations at twenty-four (24) monitor wells around Lake Tarpon identified as LT1-LT12 and LT15-LT 18, LT19A, LT19B, LT20, LT21A, LT21B and LT22.

Field Book: YB 3035

Survey Date: August 8, 2002

Date of Computations: None required.

BEARINGS AND COORDINATES not applicable to this report.

PARENT BENCHMARKS are:

DESIGNATION	ELEVATION	MAP #
SLIP 1973 (STAMPED "SLIP 1972")	41.49 feet	925
SLIP H	22.99 feet	923
SLIP B	20.50 feet	795
INNISBROOK A-AZ-2	46.97 feet	1521
INNISBROOK A	23.93 feet	1516
PCDSM GPS 49 1999	10.08 feet	N/A
PCDSM GPS 50 1999	9.90 feet	N/A
CLARK B	24.99 feet	933
CLARK D	29.65 feet	934
MARGE C	15.77 feet	968
MARGE 1972	16.52 feet	966
MARGE B	32.73 feet	962

ELEVATIONS are in feet and are based on NGVD 1929 Vertical Datum.

THE SURVEY REPORT IS NOT COVERED BY PROFESSIONAL LIABILITY INSURANCE.

ACCURACY STATEMENT: All measurements, distances, elevations and features shown were performed in strict accordance with the Minimum Technical Standards set forth in Chapter 61G17-6, F.A.C.

INTENDED FEATURES: elevations at the north top edge of the well rim and on an "X" cut in concrete pad around well.

The CONSTRUCTION REFERENCE LINE is not required for this report.

RESPONSIBILITY: The undersigned, Susan C.V. Scholpp, P.S.M., is the responsible Surveyor and Mapper for all information contained in this report.

Not valid without the Signature and the original raised Seal of a Florida Licensed Surveyor and Mapper.

Additions or deletions to survey report by other than the signing party or parties is prohibited without written consent of the signing party or parties.

ABBREVIATIONS:

PCED	Pinellas County Engineering Department
P.V.C.	Poly Vinyl Chloride pipe
SXCUT	Set cut "X" as a survey mark

ALL ELEVATIONS ARE IN FEET AND ARE BASED ON NGVD 1929 VERTICAL DATUM

THE SURVEY REPORT IS NOT COVERED BY PROFESSIONAL LIABILITY INSURANCE.

	ELEVATION
Lake Tarpon Monitor Well Site # LT-1 (Section 08-27-16)	
Elevation on north top rim of P.V.C. well	6.10 feet
Elevation on SXCUT in concrete pad	6.50 feet
Lake Tarpon Monitor Well Site # LT-2 (Section 08-27-16)	
Elevation on north top rim of P.V.C. well	5.96 feet
Elevation on SXCUT in concrete pad	6.42 feet
Lake Tarpon Monitor Well Site # LT-3 (Section 17-27-16)	
Elevation on north top rim of P.V.C. well	9.20 feet
Elevation on SXCUT in concrete pad	9.50 feet
Lake Tarpon Monitor Well Site # LT-4 (Section 17-27-16)	
Elevation on north top rim of P.V.C. well	6.19 feet
Elevation on SXCUT in concrete pad	6.55 feet
Lake Tarpon Monitor Well Site # LT-5 (Section 17-27-16)	
Elevation on north top rim of P.V.C. well	11.72 feet
Elevation on SXCUT in concrete pad	12.02 feet
Lake Tarpon Monitor Well Site # LT-6 (Section 18-27-16)	
Elevation on north top rim of P.V.C. well	7.38 feet
Elevation on SXCUT in concrete pad	4.61 feet
Lake Tarpon Monitor Well Site # LT-7 (Section 18-27-16)	
Elevation on north top rim of P.V.C. well	5.35 feet
Elevation on SXCUT in concrete pad	5.59 feet
Lake Tarpon Monitor Well Site # LT-8 (Section 19-27-16)	
Elevation on north top rim of P.V.C. well	6.91 feet
Elevation on SXCUT in concrete pad	7.15 feet
Lake Tarpon Monitor Well Site # LT-9 (Section 30-27-16)	
Elevation on north top rim of P.V.C. well	9.30 feet
Elevation on SXCUT in concrete pad	9.58 feet

ALL ELEVATIONS ARE IN FEET AND ARE BASED ON NGVD 1929 VERTICAL DATUM

THE SURVEY REPORT IS NOT COVERED BY PROFESSIONAL LIABILITY INSURANCE.

	ELEVATION
Lake Tarpon Monitor Well Site # LT-10 (Section 30-27-16)	
Elevation on north top rim of P.V.C. well	4.98 feet
Elevation on SXCUT in concrete pad	5.36 feet
Lake Tarpon Monitor Well Site # LT-11 (Section 32-27-16)	
Elevation on north top rim of P.V.C. well	10.22 feet
Elevation on SXCUT in concrete pad	10.55 feet
Lake Tarpon Monitor Well Site # LT-12 (Section 04-28-16)	
Elevation on north top rim of P.V.C. well	9.15 feet
Elevation on SXCUT in concrete pad	9.50 feet
Lake Tarpon Monitor Well Site # LT-15 (Section 33-27-16)	
Elevation on north top rim of P.V.C. well	4.87 feet
Elevation on SXCUT in concrete pad	5.07 feet
Lake Tarpon Monitor Well Site # LT-16 (Section 29-27-16)	
Elevation on north top rim of P.V.C. well	4.13 feet
Elevation on SXCUT in concrete pad	4.42 feet
Lake Tarpon Monitor Well Site # LT-17 (Section 21-27-16)	
Elevation on north top rim of P.V.C. well	17.28 feet
Elevation on SXCUT in concrete pad	17.69 feet
Lake Tarpon Monitor Well Site # LT-18 (Section 16-27-16)	
Elevation on north top rim of P.V.C. well	20.27 feet
Elevation on SXCUT in concrete pad	20.51 feet
Lake Tarpon Monitor Well Site # LT-19 with TWO WELLS (Section 16-27-16)	
LT-19A (Southerly well site)	
Elevation on north top rim of P.V.C. well	5.28 feet
Elevation on SXCUT in concrete pad	5.53 feet
LT-19B (Northerly well site)	
Elevation on north top rim of P.V.C. well	5.11 feet
Elevation on SXCUT in concrete pad	5.36 feet

ALL ELEVATIONS ARE IN FEET AND ARE BASED ON NGVD 1929 VERTICAL DATUM

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	ELEVATION
Lake Tarpon Monitor Well Site # LT-20 (Section 16-27-16)	
Elevation on north top rim of P.V.C. well	21.14 feet
Elevation on SXCUT in concrete pad	21.38 feet
Lake Tarpon Monitor Well Site # LT-21 with TWO WELLS (Section 09-27-16)	
LT-21A (Northerly well site)	
Elevation on north top rim of P.V.C. well	5.27feet
Elevation on SXCUT in concrete pad	5.57 feet
LT-21B (Southerly well site)	
Elevation on north top rim of P.V.C. well	3.80 feet
Elevation on SXCUT in concrete pad	4.09 feet
Lake Tarpon Monitor Well Site # LT-22 (Section 09-27-16)	
Elevation on north top rim of P.V.C. well	18.94 feet
Elevation on SXCUT in concrete pad	19.16 feet
Lake Tarpon Monitor Well Site # LT-23 (Section 18-27-16)	
Elevation on north top rim of P.V.C. well	5.89 feet
Elevation on SXCUT in concrete pad	6.18 feet
Lake Tarpon Monitor Well Site # LT-24 (Section 18-27-16)	
Elevation on north top rim of P.V.C. well	6.04 feet
Elevation on SXCUT in concrete pad	6.35 feet

Susan C V Scholpp   08/29/02

Susan C.V. Scholpp, P.S.M., Land Surveyor   Date   Seal
FLORIDA LICENSED SURVEYOR AND MAPPER
FLORIDA LICENSE NUMBER 6034

PINELLAS COUNTY PUBLIC WORKS
DIVISION OF SURVEY & MAPPING
22211 U.S. HIGHWAY 19 NORTH, BLDG. 16
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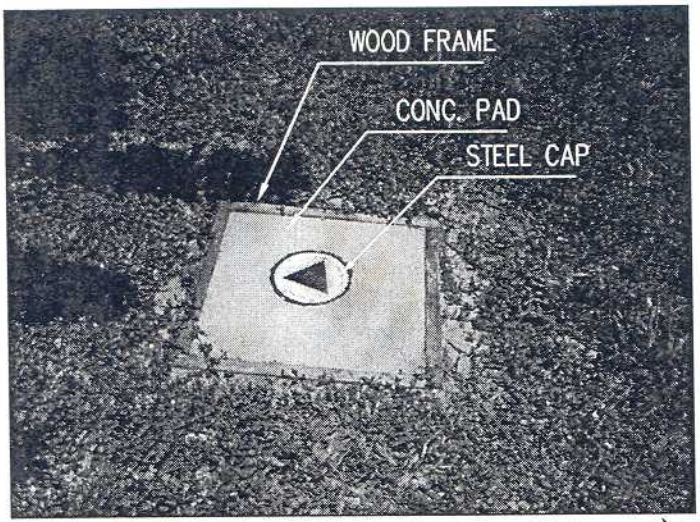
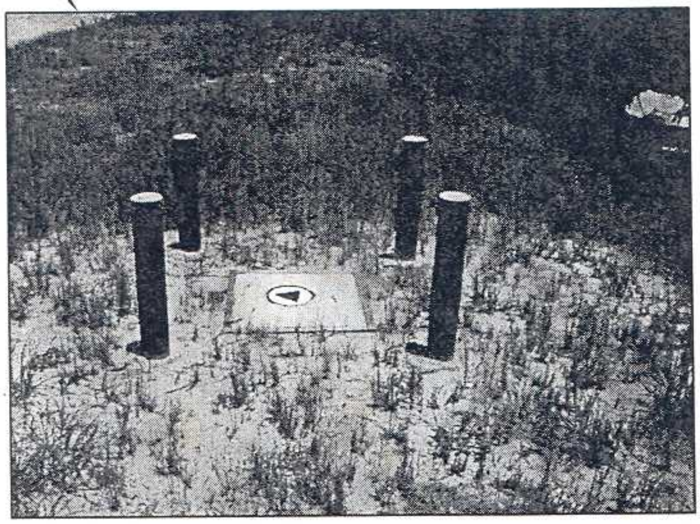
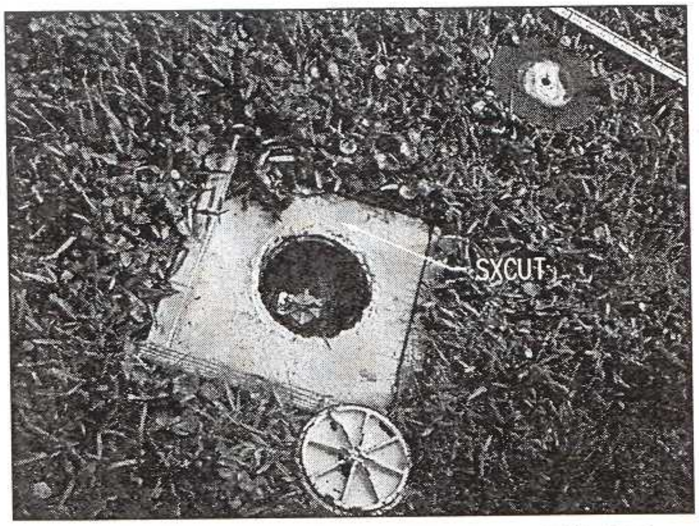




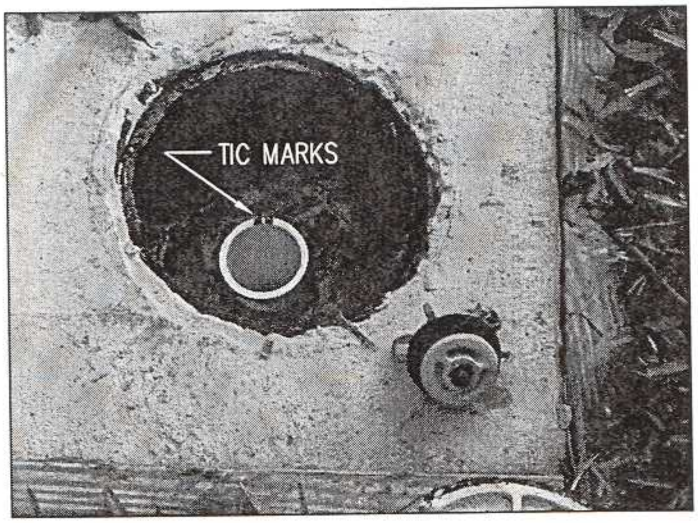
TYPICAL MONITOR WELL SITES

LT–6 MONITOR WELL SITE



MONITOR WELL SITE
WITH STEEL CAP REMOVED

ELEVATIONS SHOT ON SXCUT's IN CONCRETE PAD NORTH OF STEEL CAP

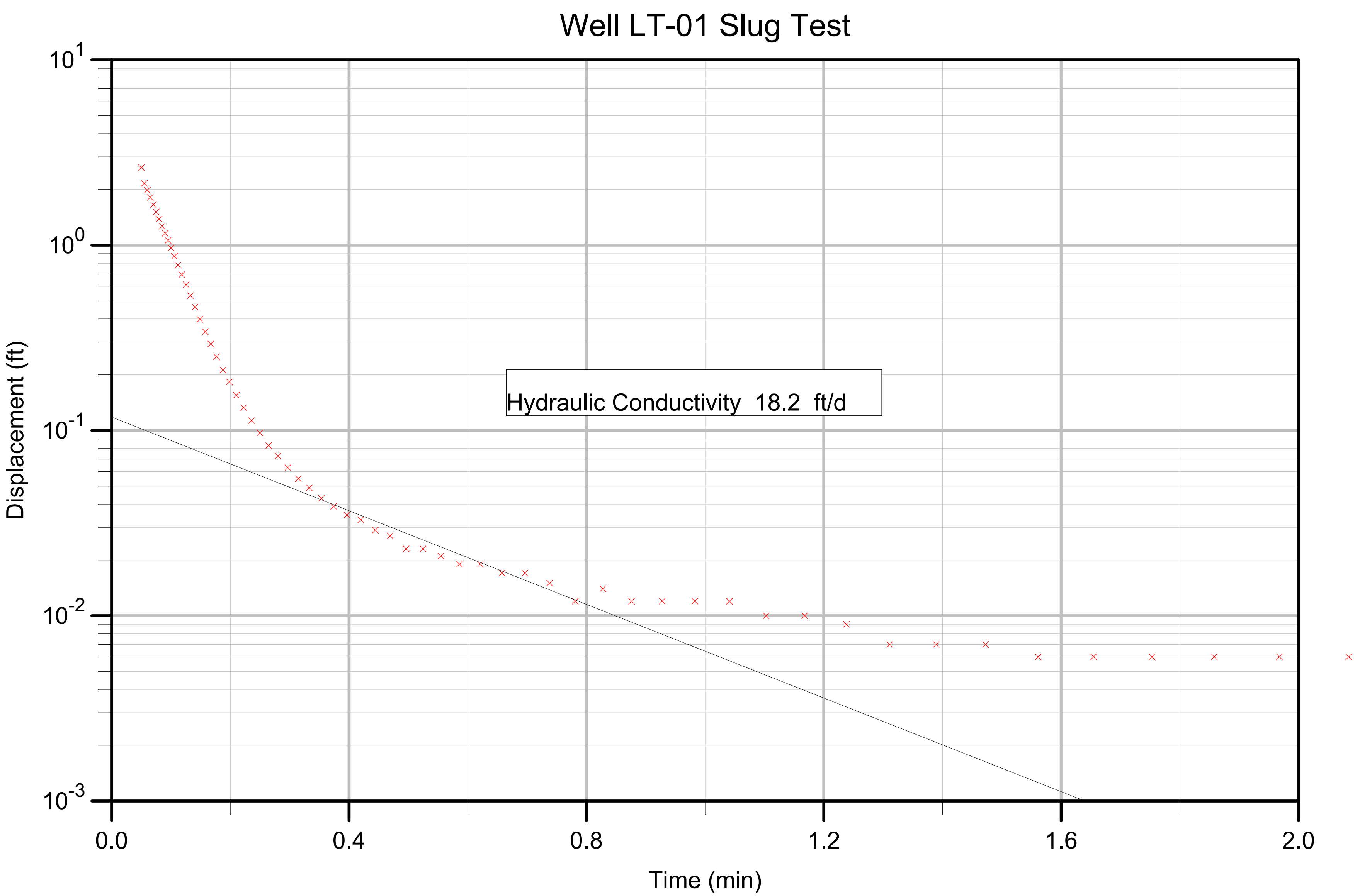


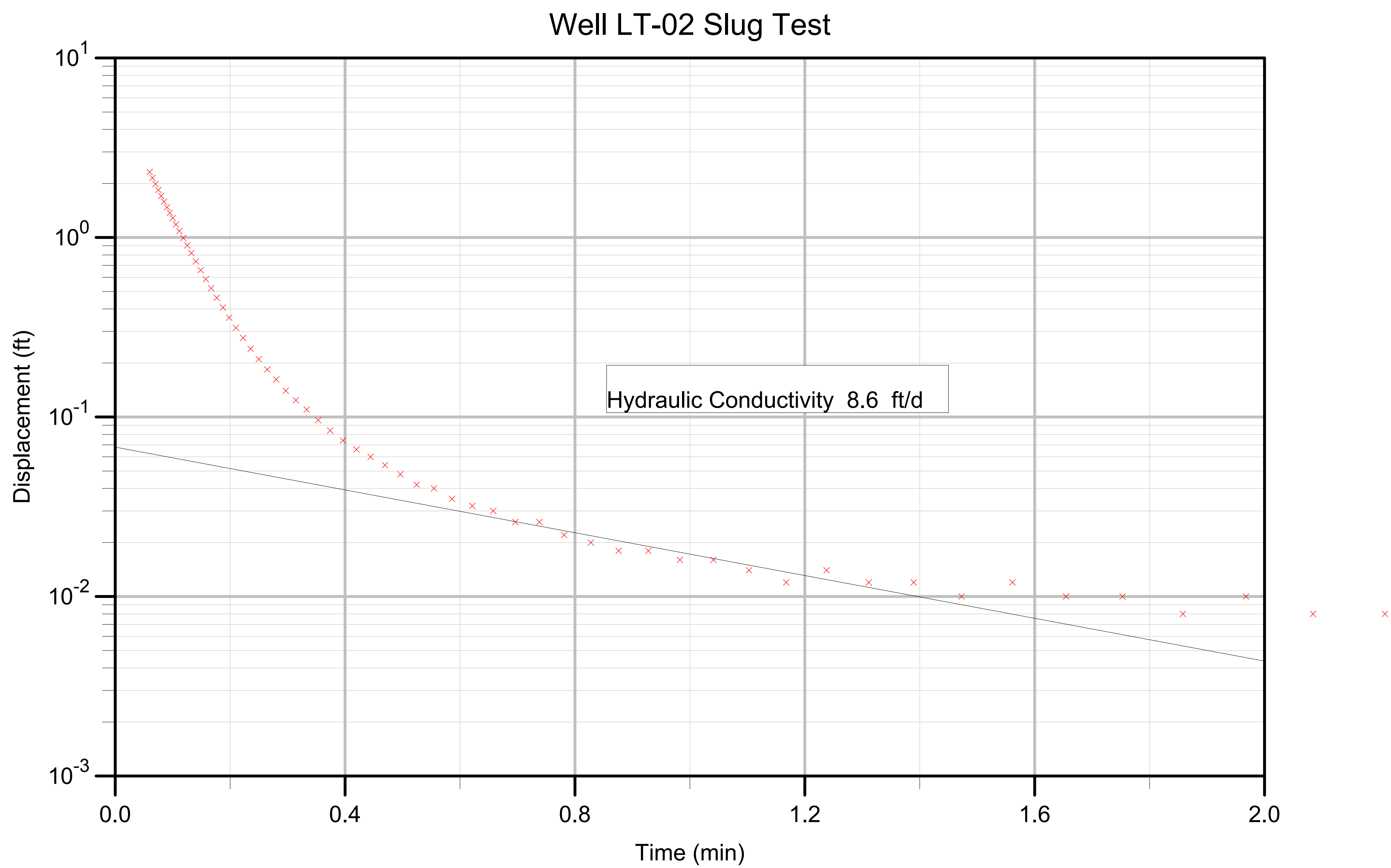
PVC MONITOR WELL TOP
WITH LOCKING CAP REMOVED

ELEVATIONS SHOT ON NORTH TOP RIM OF PVC WELL

APPENDIX C:

Hydraulic Conductivity Reports


Well LT-01 Slug Test
Hydraulic Conductivity 18.2 ft/d
Displacement (ft)
Time (min)
10^1
10^0
10^-1
10^-2
10^-3
0.0
0.4
0.8
1.2
1.6
2.0



Well LT-02 Slug Test
Displacement (ft)
Time (min)
Hydraulic Conductivity 8.6 ft/d
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10^-1
10^-2
10^-3
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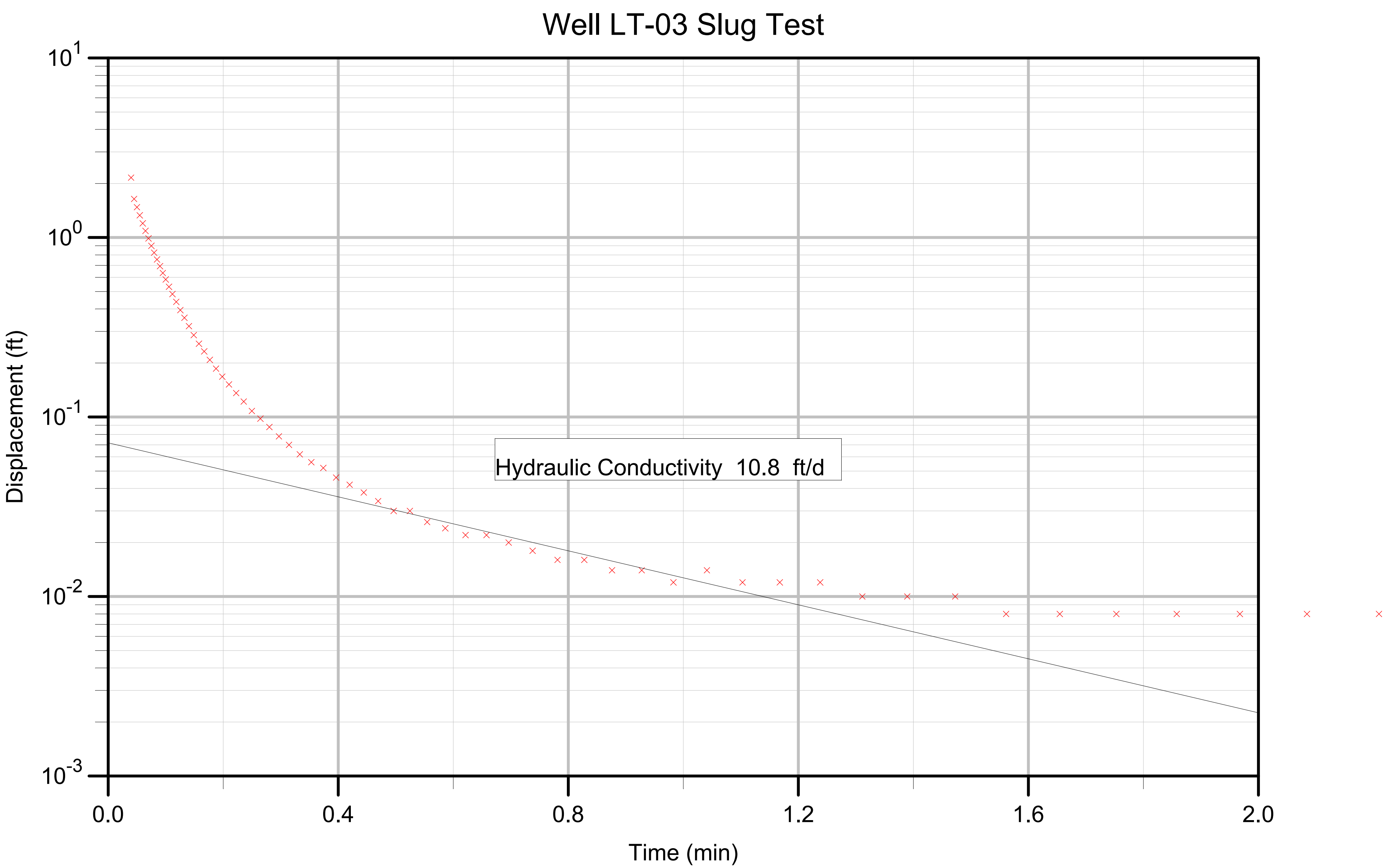
0.4
0.8
1.2
1.6
2.0


Well LT-03 Slug Test
Hydraulic Conductivity 10.8 ft/d
Displacement (ft)
Time (min)
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10^0
10^-1
10^-2
10^-3
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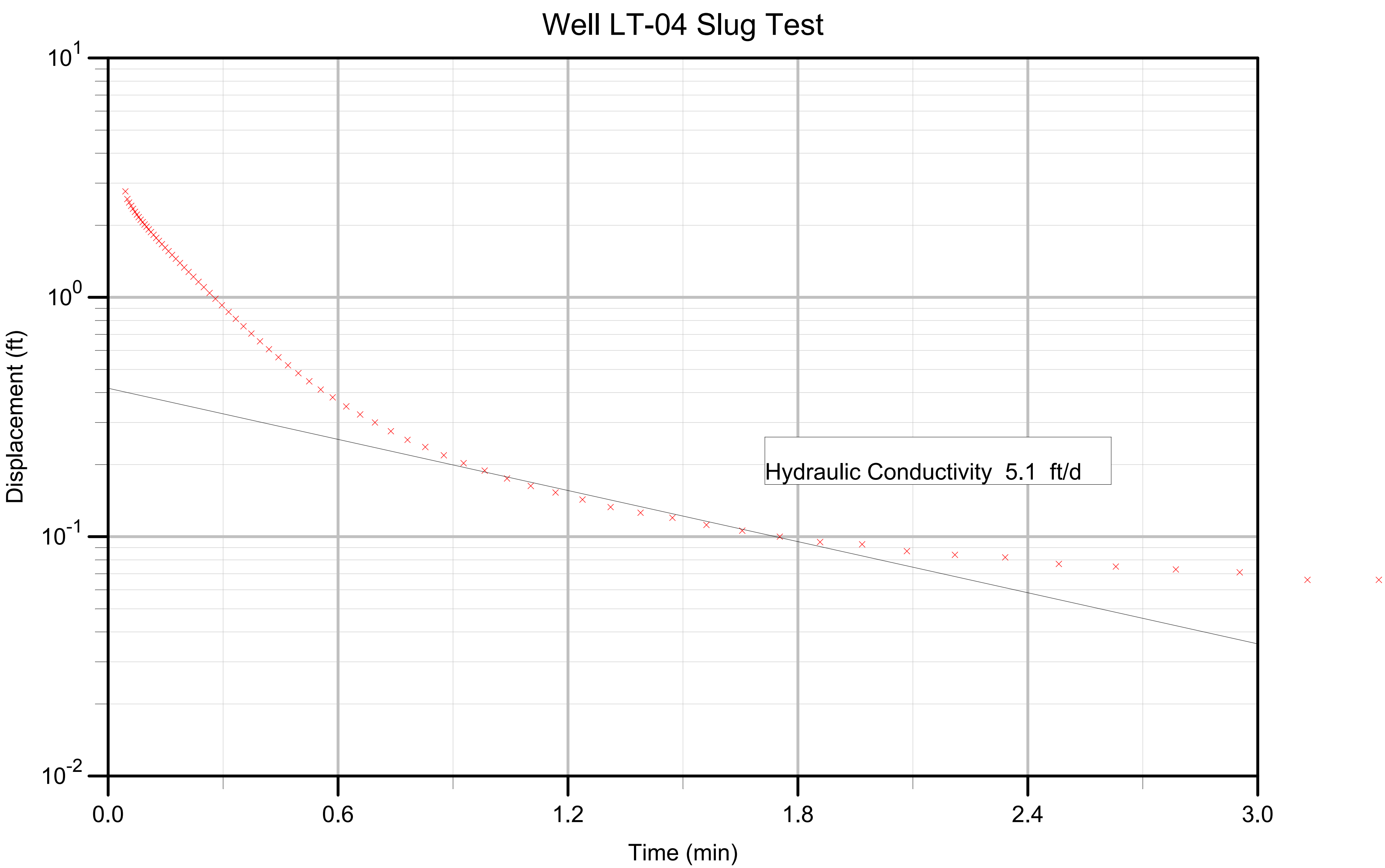
0.4
0.8
1.2
1.6
2.0



Well LT-04 Slug Test
10^1
10^0
10^{-1}
10^{-2}
Displacement (ft)
Hydraulic Conductivity 5.1 ft/d
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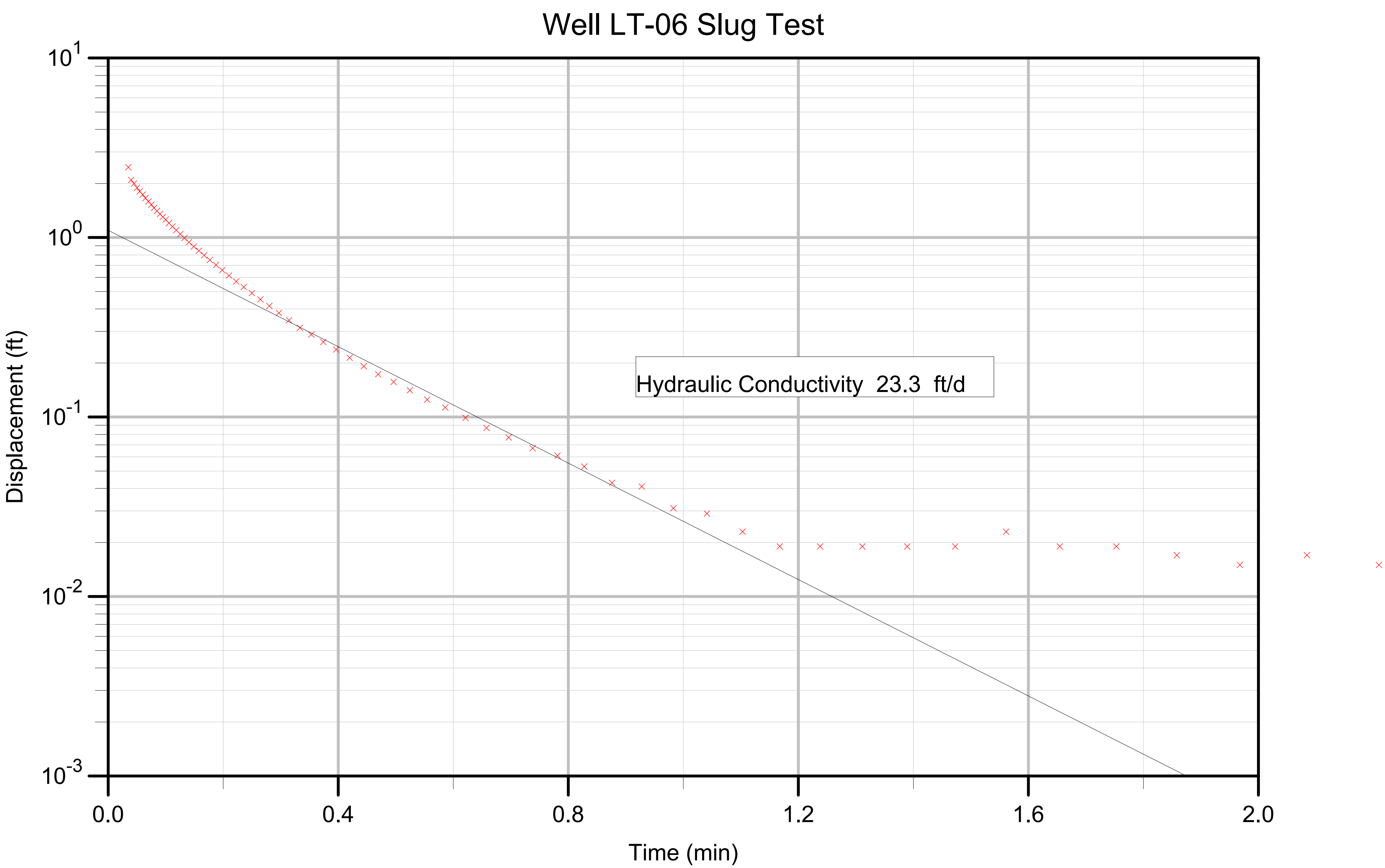
0.6
1.2
1.8
2.4
3.0
Time (min)


Well LT-06 Slug Test
Displacement (ft)
Time (min)
Hydraulic Conductivity 23.3 ft/d
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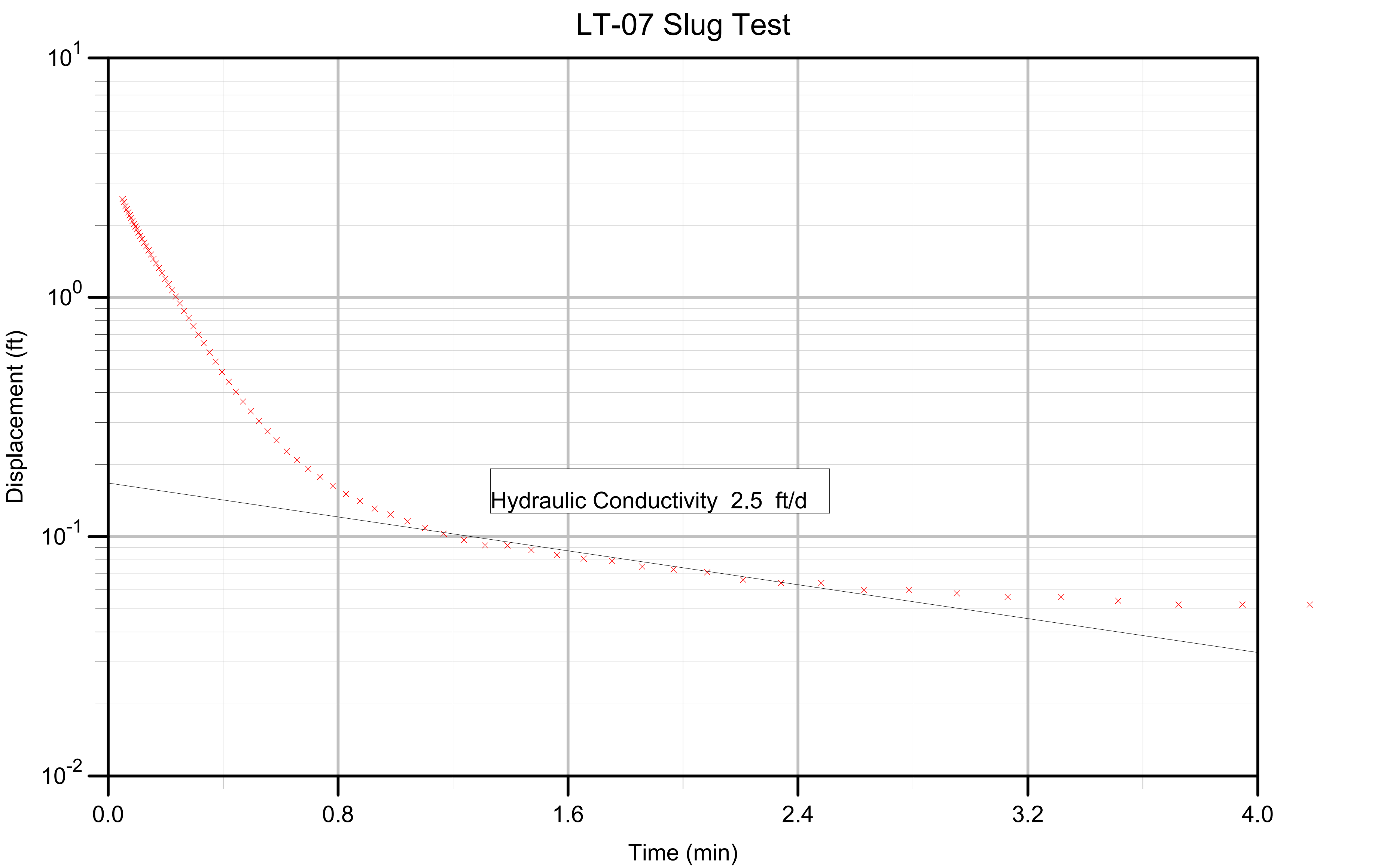
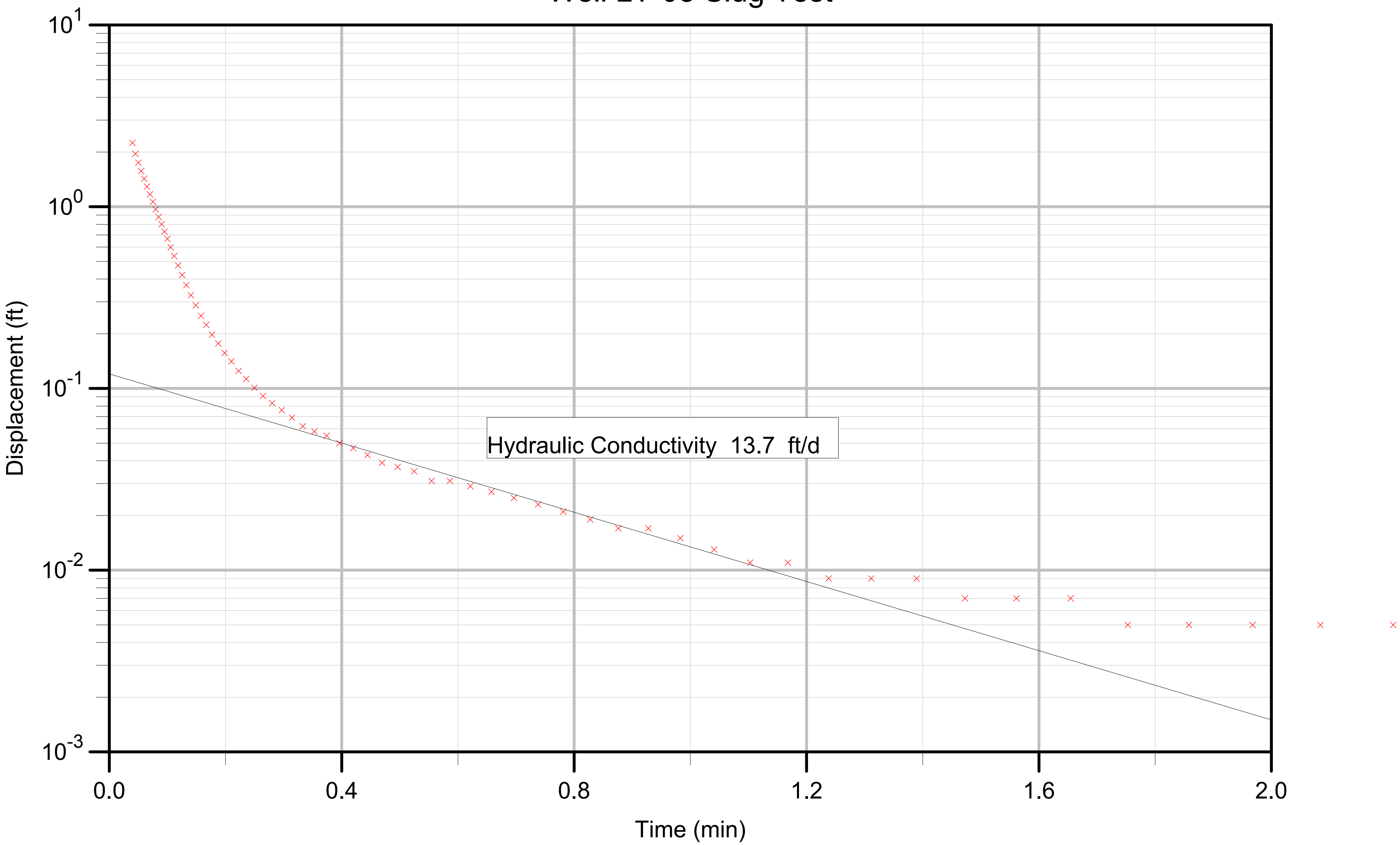
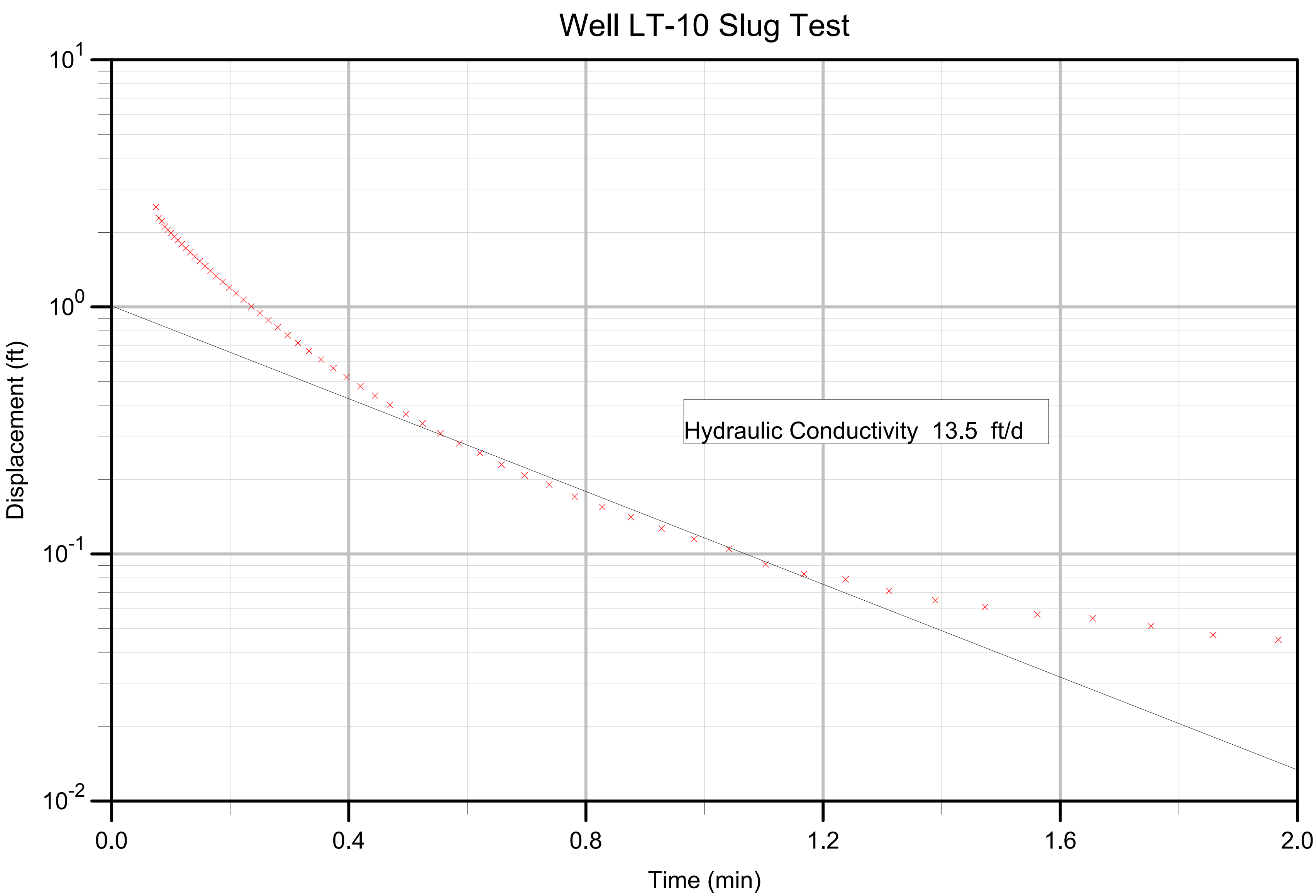
10^0
10^{-1}
10^{-2}
10^{-3}
0.0
0.4
0.8
1.2
1.6
2.0



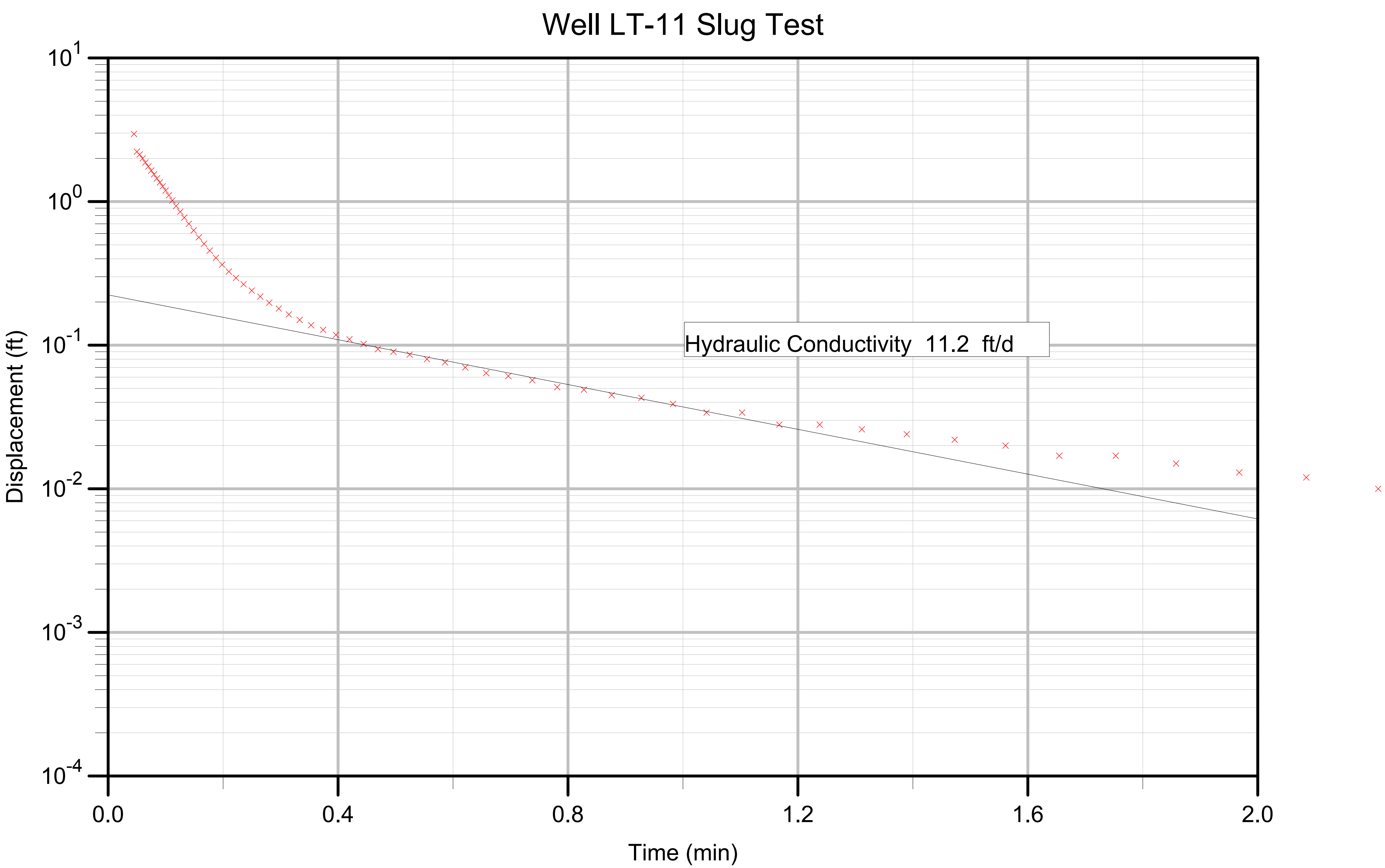
LT-07 Slug Test
Displacement (ft)
10^1
10^0
10^{-1}
10^{-2}
0.0
0.8
1.6
2.4
3.2
4.0
Time (min)
Hydraulic Conductivity 2.5 ft/d

Well LT-08 Slug Test





Well LT-10 Slug Test
Displacement (ft)
10^1
10^0
10^{-1}
10^{-2}
Hydraulic Conductivity 13.5 ft/d
0.0
0.4
0.8
1.2
1.6
2.0
Time (min)



Well LT-11 Slug Test
Hydraulic Conductivity 11.2 ft/d
Displacement (ft)
Time (min)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
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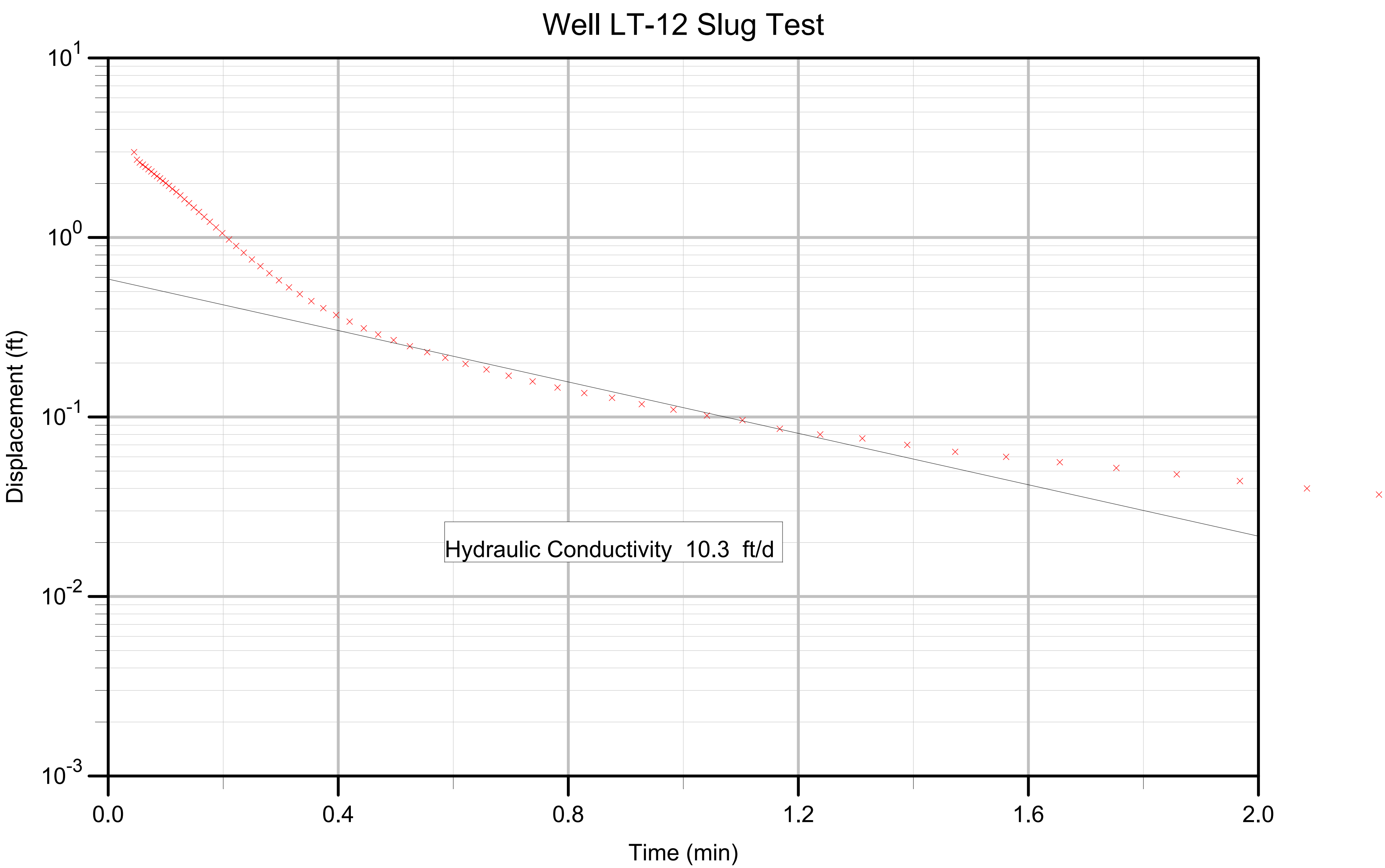
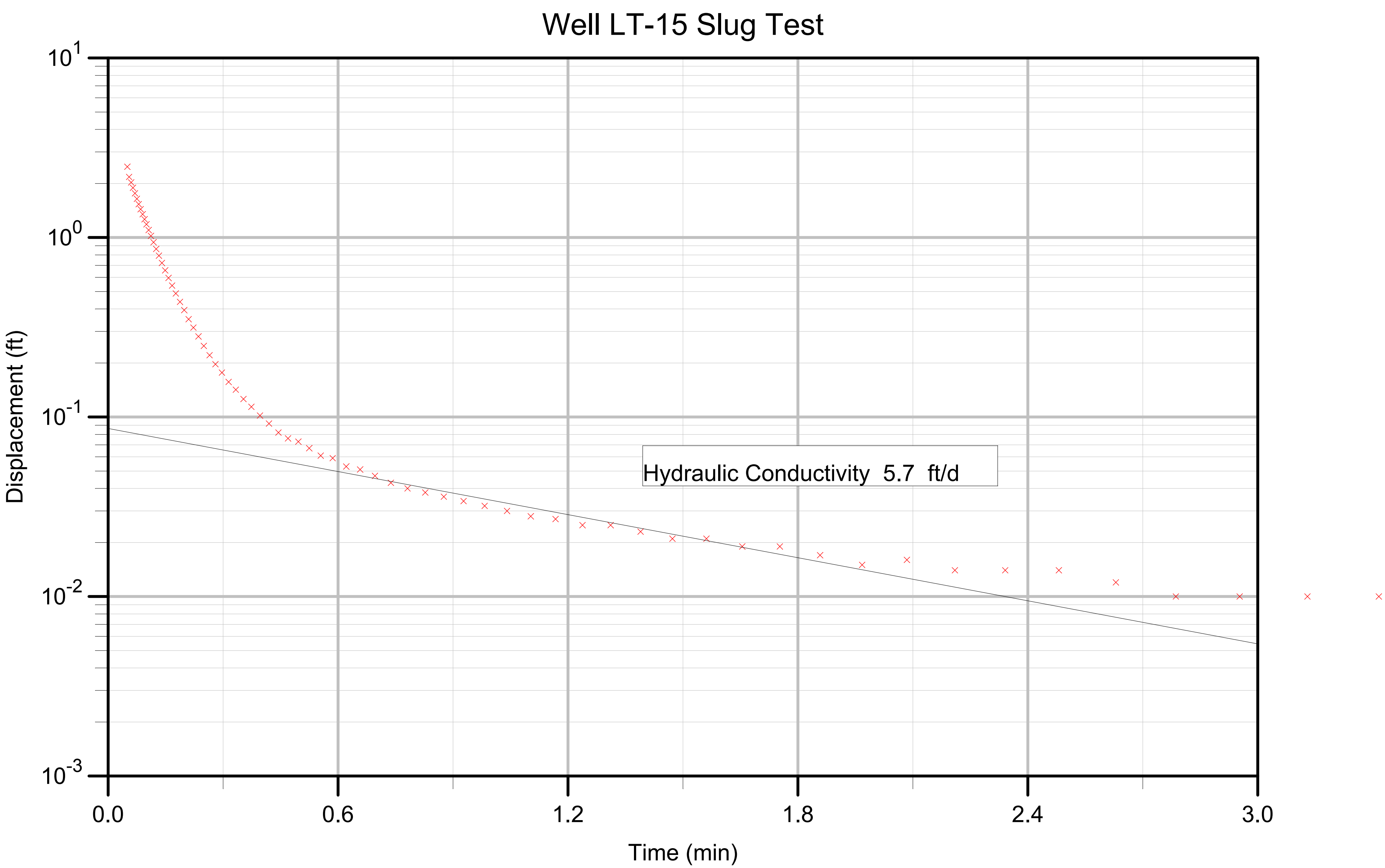
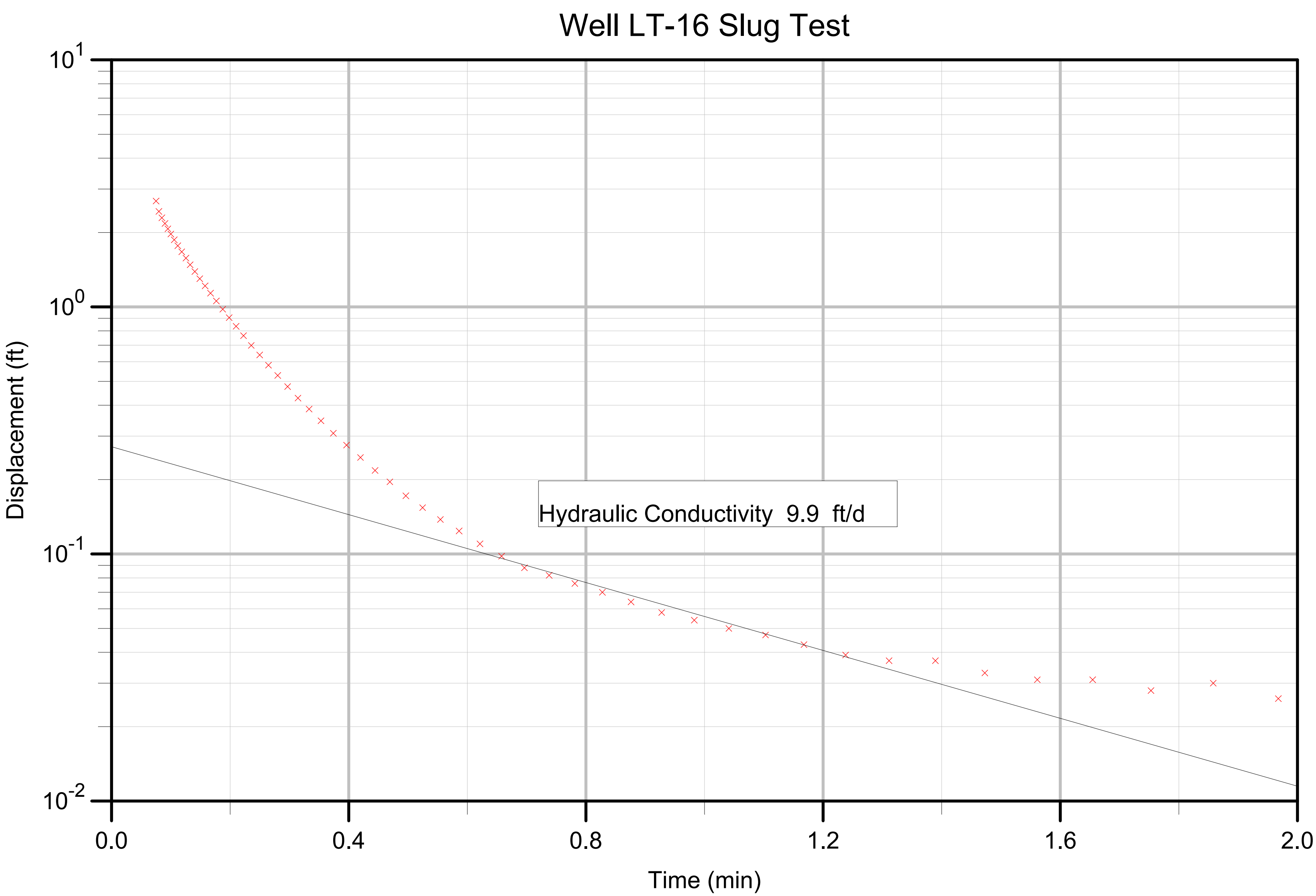
0.4
0.8
1.2
1.6
2.0

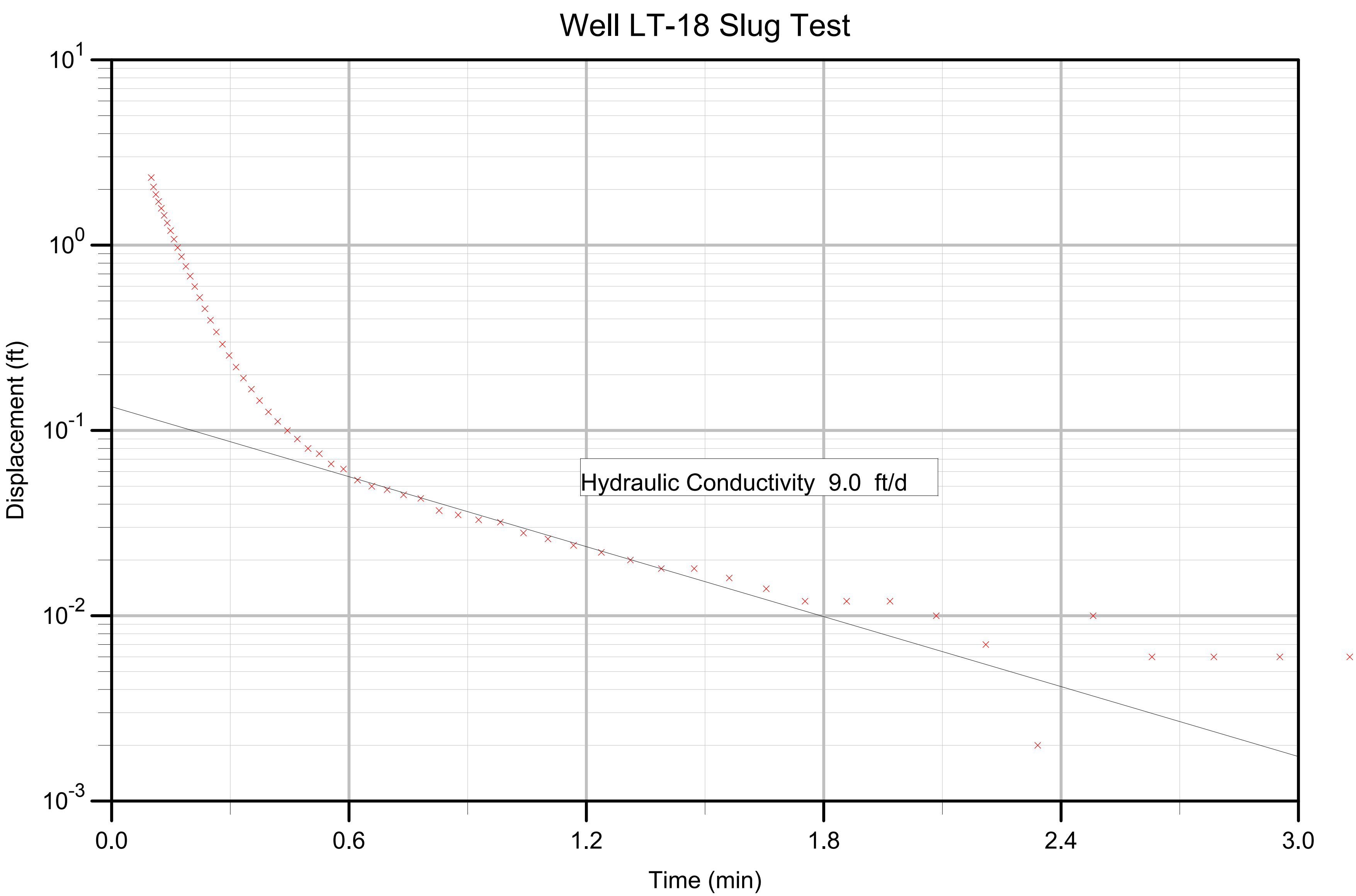


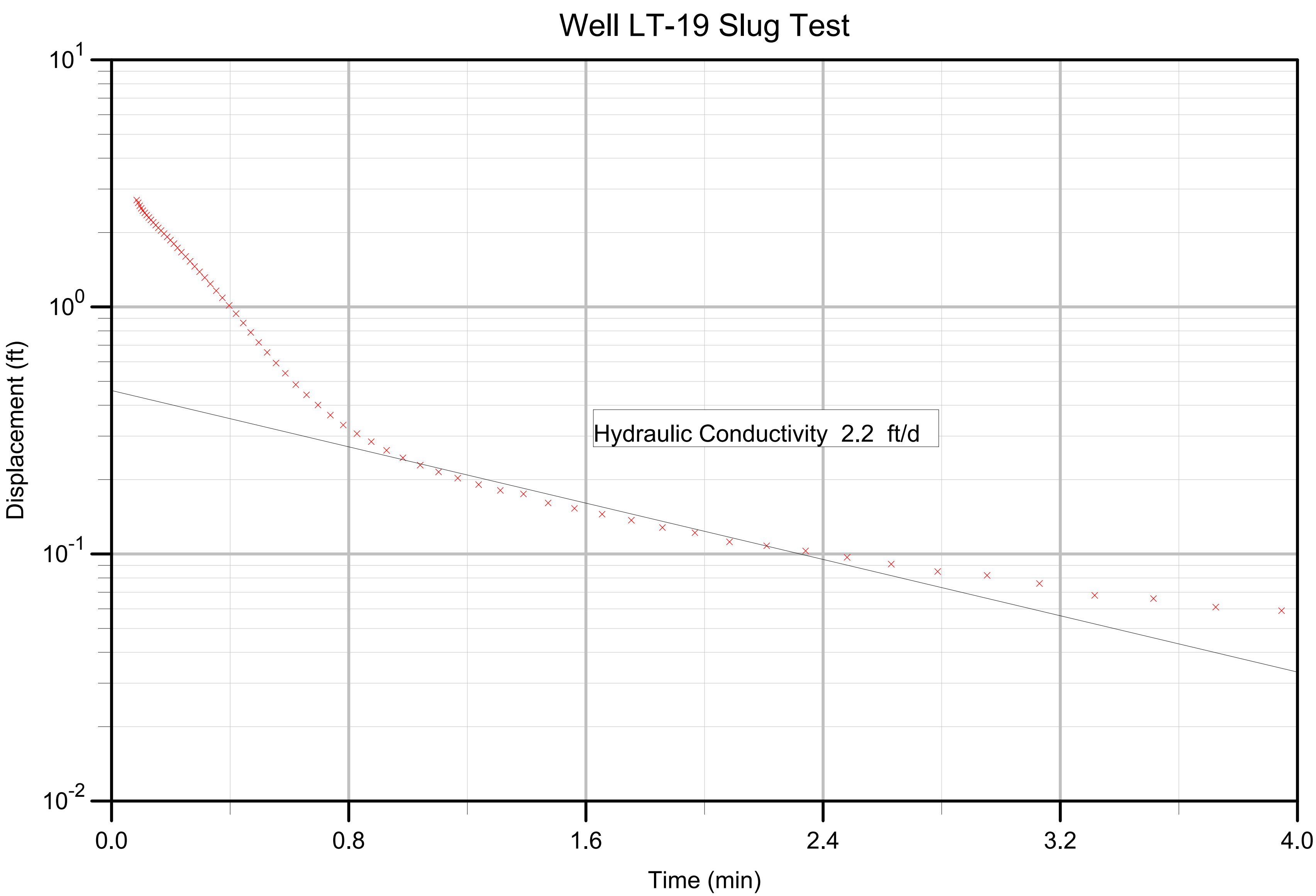
Well LT-12 Slug Test
Displacement (ft)
10^1
10^0
10^-1
10^-2
10^-3
0.0
0.4
0.8
1.2
1.6
2.0
Time (min)
Hydraulic Conductivity 10.3 ft/d



Well LT-15 Slug Test
Displacement (ft)
Time (min)
Hydraulic Conductivity 5.7 ft/d
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
0.0
0.6
1.2
1.8
2.4
3.0


Well LT-16 Slug Test
Displacement (ft)
10^1
10^0
10^-1
10^-2
0.0
0.4
0.8
1.2
1.6
2.0
Time (min)
Hydraulic Conductivity 9.9 ft/d


Well LT-18 Slug Test
Displacement (ft)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
Hydraulic Conductivity 9.0 ft/d
0.0
0.6
1.2
1.8
2.4
3.0
Time (min)



Well LT-19 Slug Test
Displacement (ft)
10^1
10^0
10^{-1}
10^{-2}
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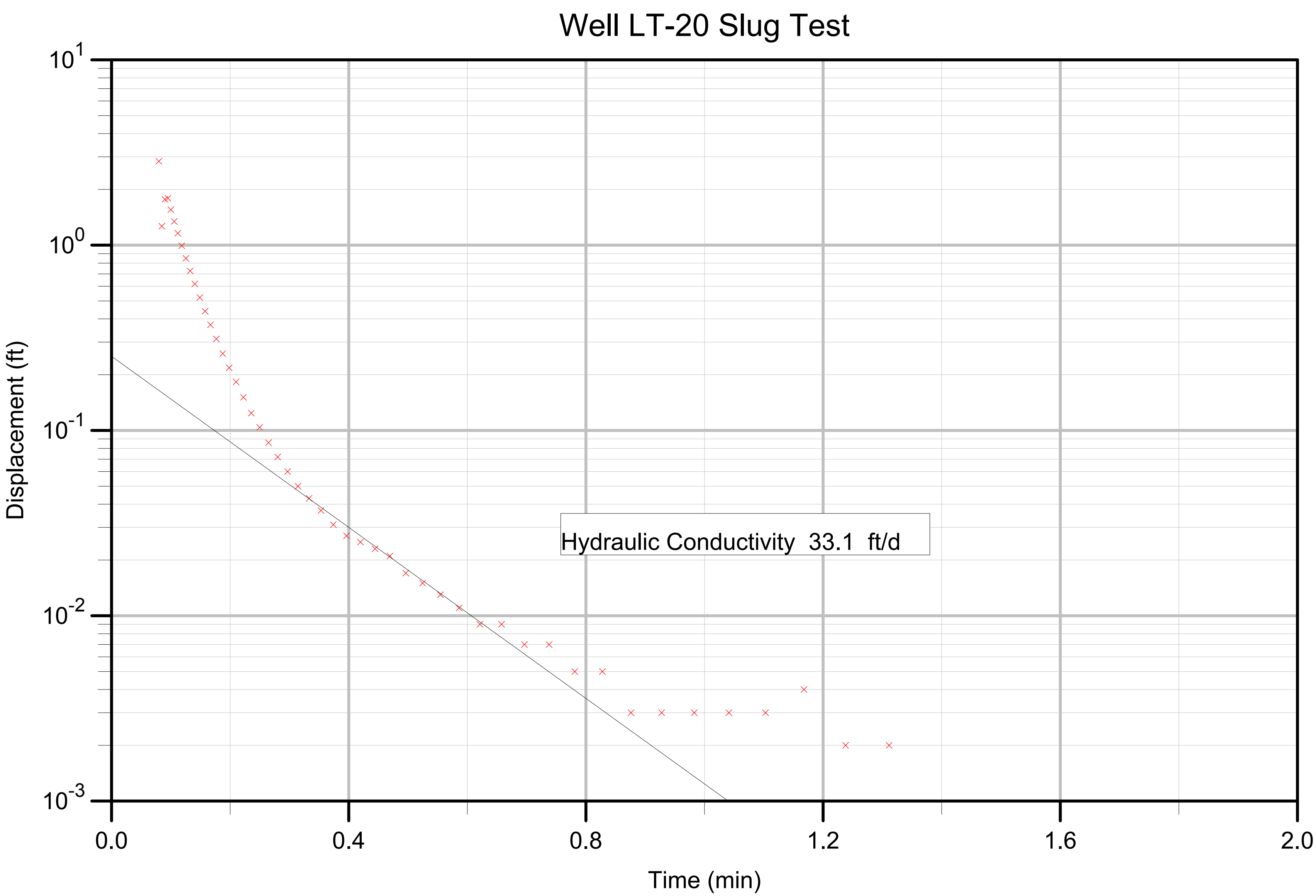
0.8
1.6
2.4
3.2
4.0
Time (min)
Hydraulic Conductivity 2.2 ft/d



Well LT-20 Slug Test
Hydraulic Conductivity 33.1 ft/d
Displacement (ft)
Time (min)
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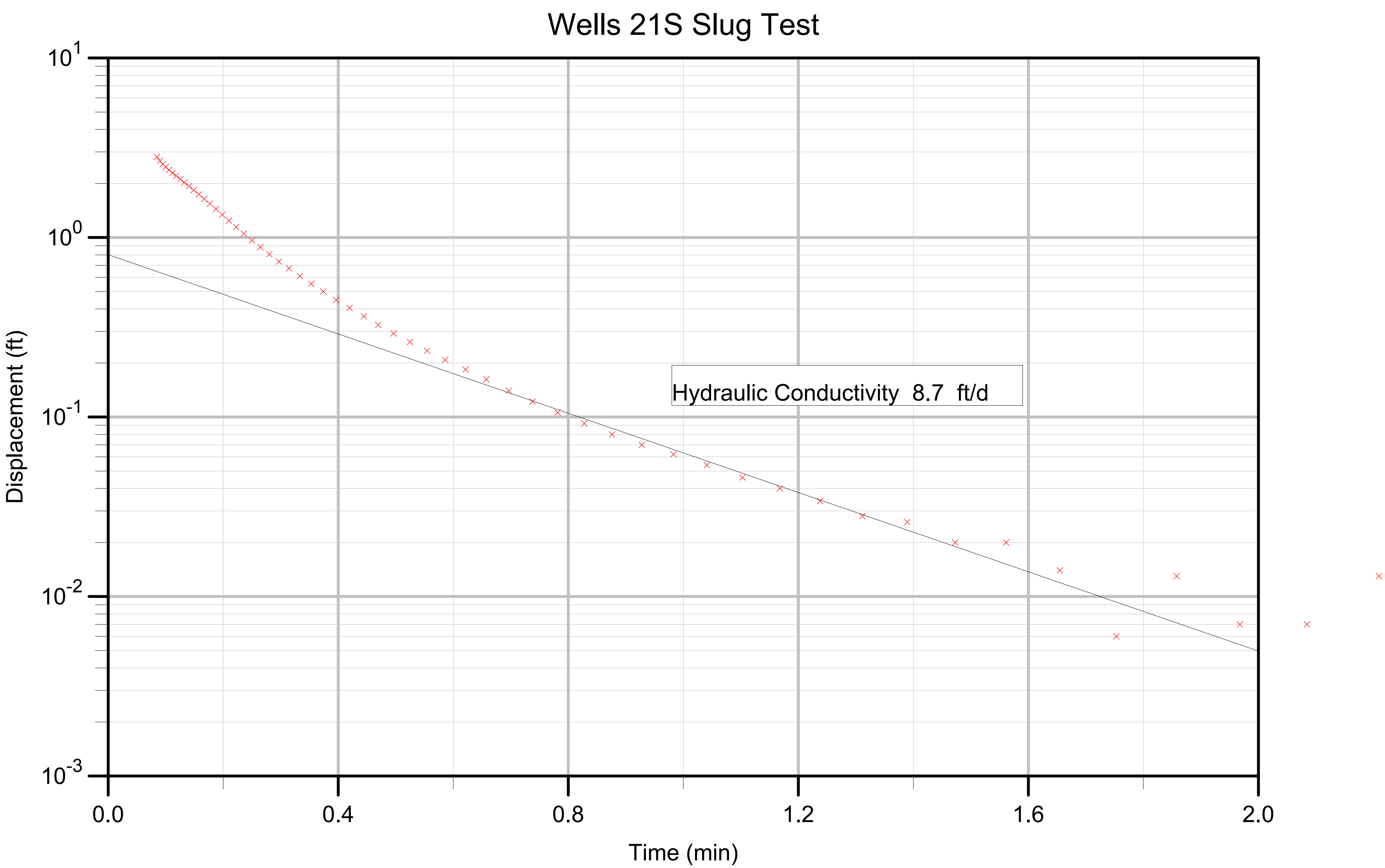
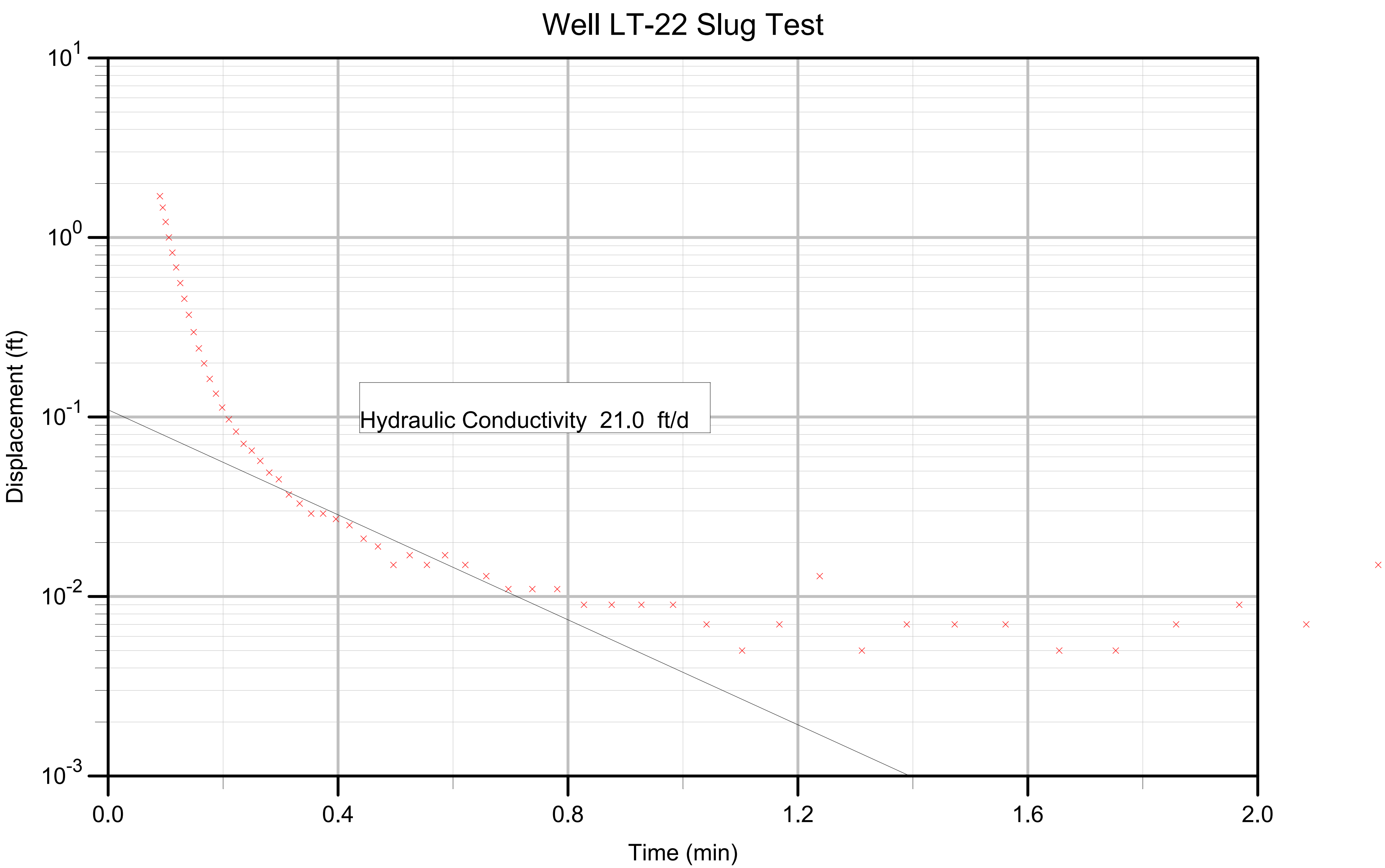
10^0
10^-1
10^-2
10^-3
0.0
0.4
0.8
1.2
1.6
2.0



Wells 21S Slug Test
Displacement (ft)
Time (min)
Hydraulic Conductivity 8.7 ft/d
10^1
10^0
10^-1
10^-2
10^-3
0.0
0.4
0.8
1.2
1.6
2.0



Well LT-22 Slug Test
Hydraulic Conductivity 21.0 ft/d
Displacement (ft)
Time (min)
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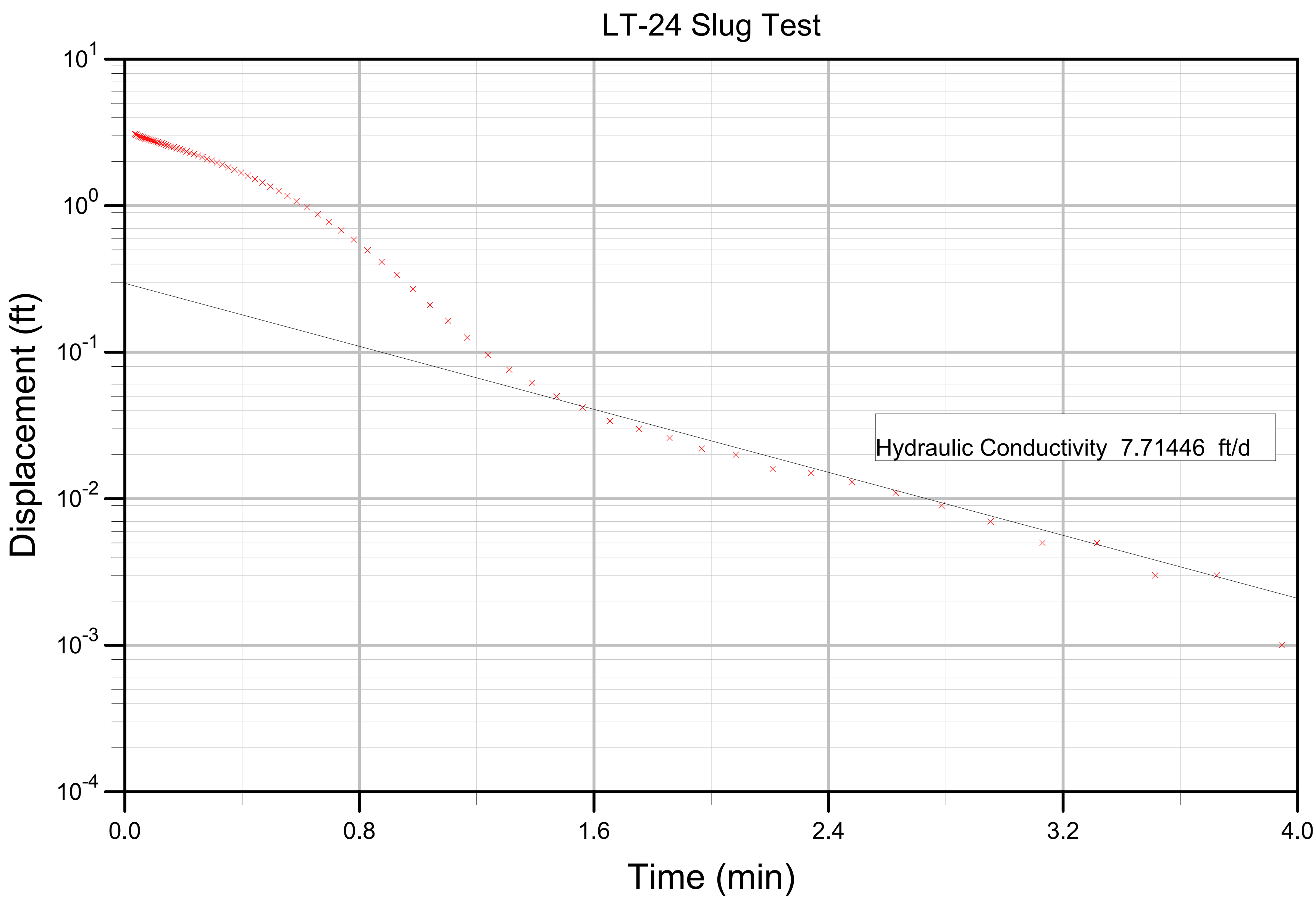
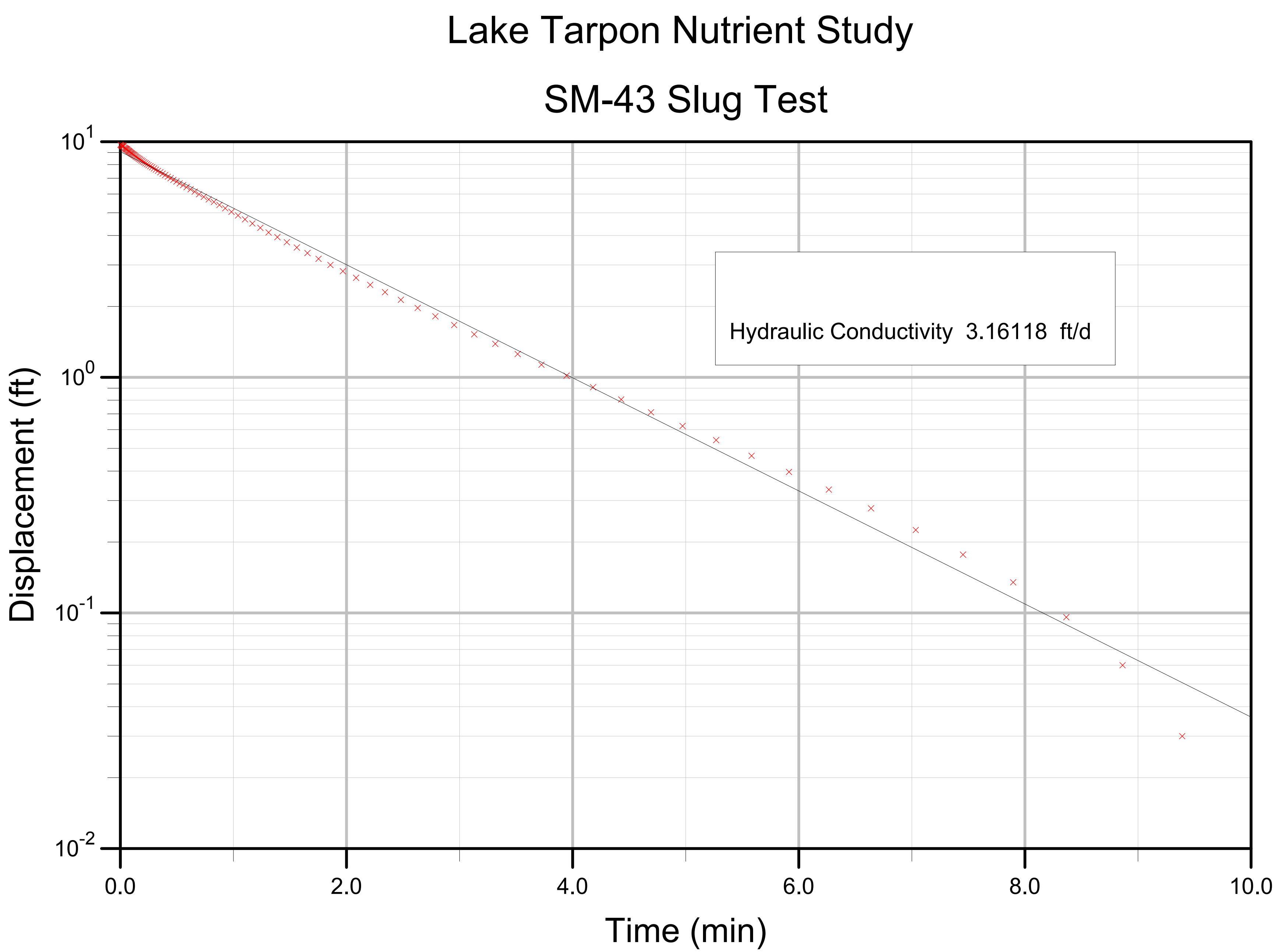
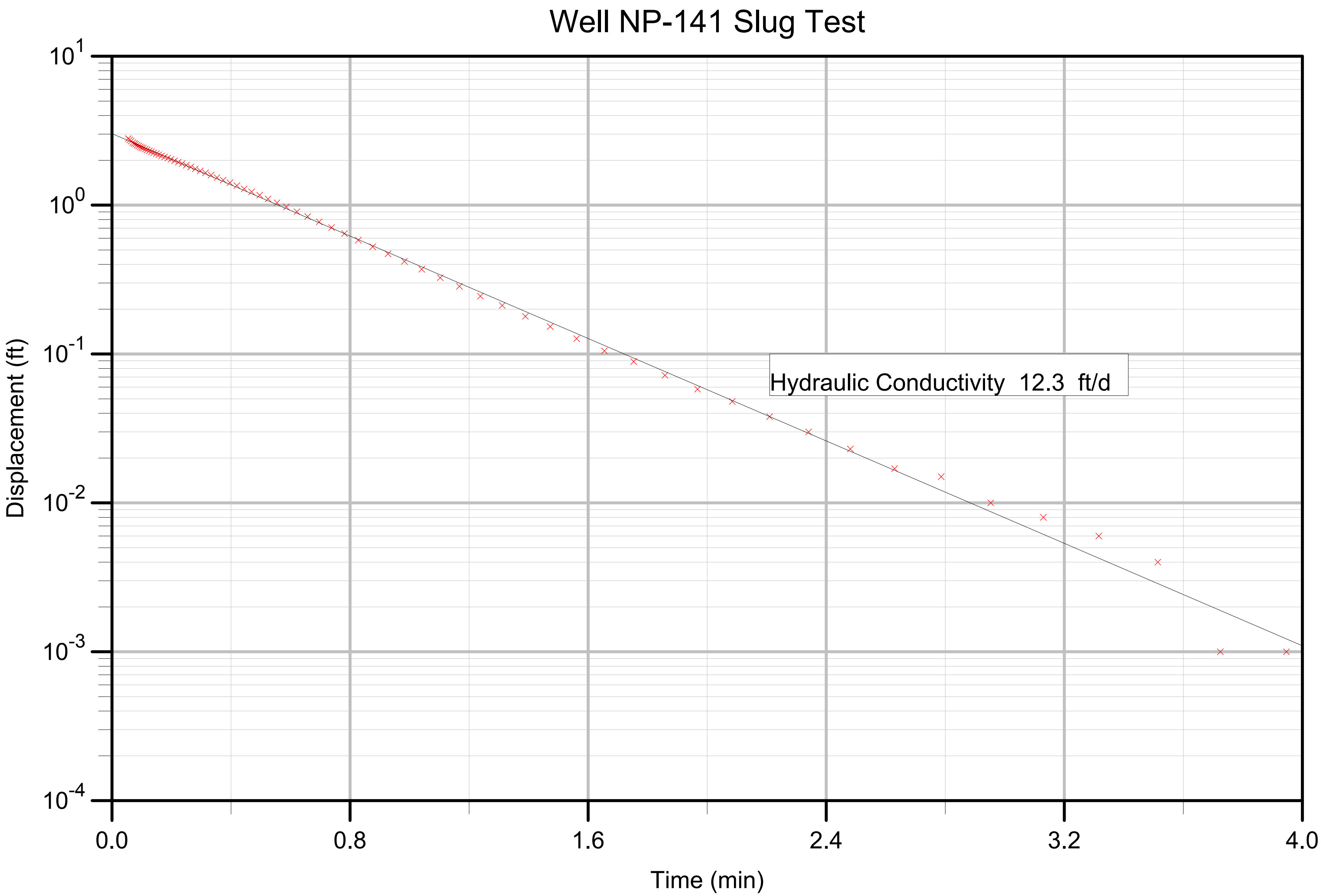
10^0
10^-1
10^-2
10^-3
0.0
0.4
0.8
1.2
1.6
2.0



LT-24 Slug Test
Displacement (ft)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
0.0
0.8
1.6
2.4
3.2
4.0
Time (min)
Hydraulic Conductivity 7.71446 ft/d


Lake Tarpon Nutrient Study
SM-43 Slug Test
Hydraulic Conductivity 3.16118 ft/d
Displacement (ft)
Time (min)
10^1
10^0
10^-1
10^-2
0.0
2.0
4.0
6.0
8.0
10.0


Well NP-141 Slug Test
Hydraulic Conductivity 12.3 ft/d
Displacement (ft)
Time (min)
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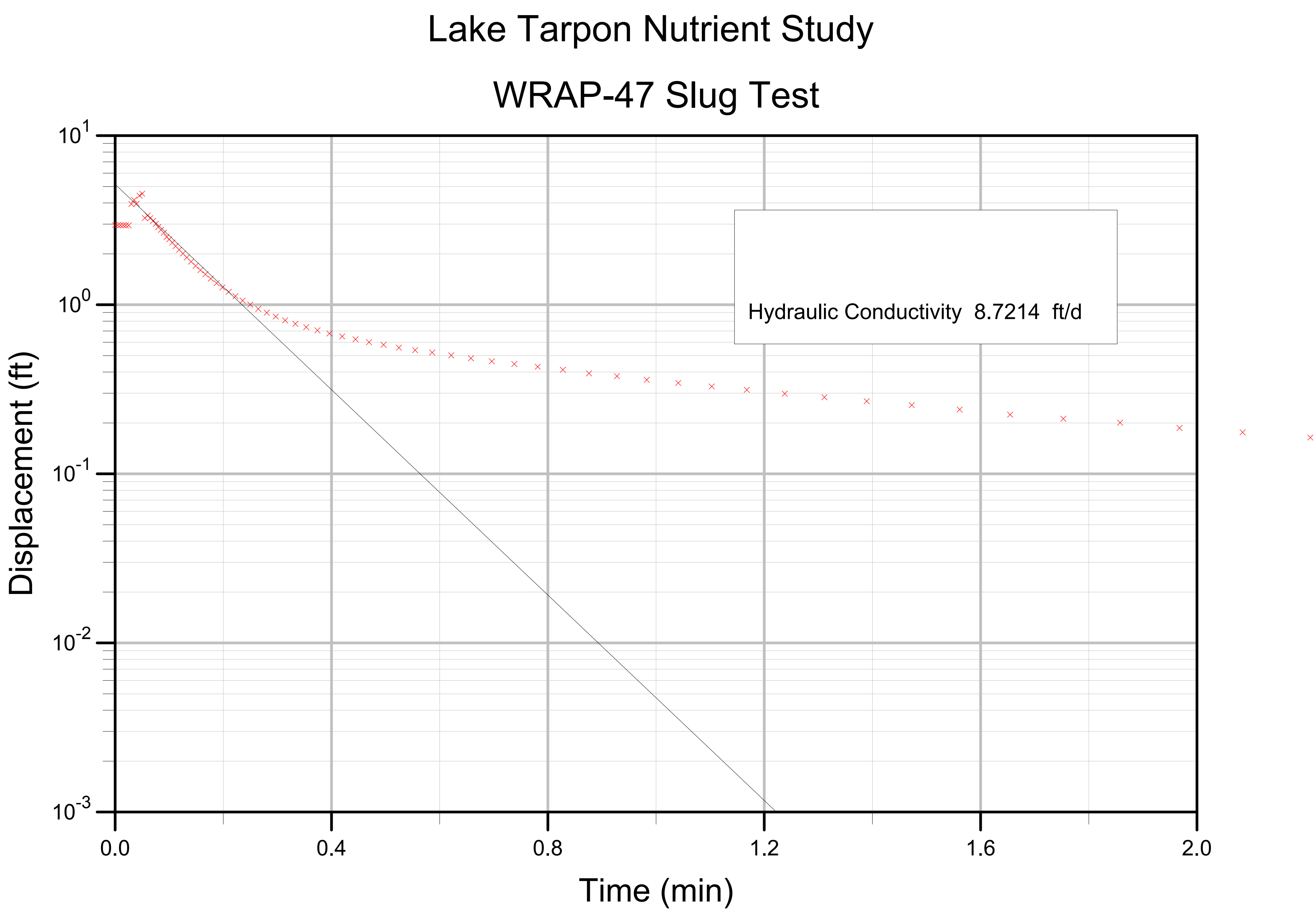
10^-1
10^-2
10^-3
10^-4
0.0
0.8
1.6
2.4
3.2
4.0



Lake Tarpon Nutrient Study
WRAP-47 Slug Test
Hydraulic Conductivity 8.7214 ft/d
Displacement (ft)
Time (min)
10^1
10^0
10^-1
10^-2
10^-3
0.0
0.4
0.8
1.2
1.6
2.0