



# Florida Department of Environmental Protection

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August 10, 2010

Dr. Lisa Conti, Director  
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Dear Lisa:

As you know between August 2009 and April 2010, the Florida Department of Environmental Protection (DEP) conducted seven sampling events in The Acreage community in Palm Beach County to collect water and soil samples in support of the Florida Department of Health's (DOH) investigation of elevated rates of pediatric brain cancer. On October 1, 2009 DEP submitted its final report on the water sampling conducted in August and September 2009. Having shared the preliminary results of the subsequent water and soil samples with your agency, we have now completed our review of the laboratory results and are enclosing a copy of the final report for your review.

In February, March and April 2010, DEP collected additional water samples from residences in The Acreage. DEP also collected 140 soil samples from 35 case and control residences along with 11 background locations. These samples were tested for more than 200 individual chemicals used currently or historically in industrial or agricultural operations. As requested by DOH, the homes sampled by DEP included residences where cases of pediatric brain cancer have been identified, as well as a number of other nearby homes to serve as a control group. We have personally contacted the affected residents and provided them a copy of their sampling results.

This report outlines the process and findings for the February, March and April 2010 water and soil sampling events. It also explains how these results compare to Florida's Ground Water Quality Standards and Soil Cleanup Target Levels. Although contaminants were detected above these levels in some samples, the investigation found no evidence of substantial spills, dumping or area-wide contamination. The elevated contaminant levels in water collected post-treatment were attributed to naturally occurring metals or chemical by-products from the water disinfection process. Since the benefits of a water treatment system that adds a disinfectant typically outweigh the relatively small risk from the formation of these chemicals, DEP suggested that residents consult with the manufacturer or a servicing

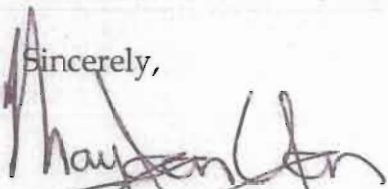
Dr. Lisa Conti  
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company for maintenance and adjustment instructions for their treatment systems. Overall, DEP's sampling analyses showed the water quality in The Acreage is generally good and residential property in The Acreage is safe for families to enjoy outside activities in their yards.

With the release of this final report, DEP remains available to support DOH but has no plans for further investigation at The Acreage community. The sampling DEP conducted was to investigate the possibility of industrial or agricultural hazards in the community which might affect the drinking water supply or residential soils. The results of the report show no indication of such hazards.

Please let us know if you need any additional information regarding DEP's final report.

Sincerely,



Mary Jean Lon, Director  
Division of Waste Management

MJY/lf

cc: Jack Long, Director, DEP Southeast District

Enclosure



*The Acreage  
Drinking Water & Soil Sampling  
February, March & April 2010  
Loxahatchee, Palm Beach County, Florida*

*SIS Report Number 2010-04  
Issued August 2010*

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*The Acreage  
Drinking Water & Soil Sampling  
February, March & April 2010  
Loxahatchee, Palm Beach County, Florida*



**Photo # 1: SIS staff collecting shallow soil sample from residence**

***SIS Report Number 2010-04  
Issued August 2010***

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## *Glossary of Terms*

**Analyte:** A chemical substance that is the subject of chemical analysis.

**BLS:** Below land surface.

**Dissolved Oxygen:** The amount of oxygen freely available in water.

**DOE:** Department of Energy

**Florida Primary Drinking Water Standard (FPDWS):** Health-based drinking water standards defined in Florida Administrative Code (F.A.C.) 62-550. Also applicable to ground water as defined in F.A.C. 62-520.

**Florida Secondary Drinking Water Standard (FSDWS):** Organoleptic-based drinking water standards defined in Florida Administrative Code (F.A.C.) 62-550. They ensure that drinking water has acceptable taste, odor or color.

**Gamma spectroscopy:** The quantitative study of the energy spectra of gamma or gamma-ray sources. Radionuclides emit gamma rays when they undergo radioactive decay.

**Gram:** A unit of measurement equivalent to 0.035 ounce.

**Groundwater Cleanup Target Level (GCTL):** Health- and organoleptic-based cleanup criteria defined in Florida Administrative Code (F.A.C.) 62-777.

**Herbicide:** A chemical designed to control or destroy plants, weeds or grasses.

**Ion Exchange:** A common water-softening method that removes some organics and radium by adding calcium oxide or calcium hydroxide to increase the pH to a level where the metals will precipitate out of solution.

**Kilogram:** A unit of measurement. A Kilogram is equal to 1,000 grams. A Kilogram is equivalent to 2.20 pounds.

**Liter:** A unit of measurement equivalent to 1.06 quart.

**Maximum Contaminant Level (MCL):** The maximum permissible level of a contaminant in drinking water which is delivered to any user.

**Method Detection Limit (MDL):** The minimum concentration of a substance being analyzed that has a 99 percent probability of being identified.

**micrograms/Kilogram(ug/Kg):** A unit of measurement. A microgram is equal to one millionth of a gram.

**micrograms/Liter (ug/L):** A unit of measurement. A microgram is equal to one millionth of a gram.

**microSiemens:** A unit of measurement of electrical conductivity.

**milligrams/Kilogram(mg/Kg):** A unit of measurement. A milligram is equal to one thousandth of a gram.

**milligrams/Liter (mg/L):** A unit of measurement. A milligram is equal to one thousandth of a gram.

**nanograms/Kilogram(ng/Kg):** A unit of measurement. A nanogram is equal to one billionth of a gram.

**Non-Detect (ND):** The analyte being measured is not present in the sample above the MDL.

**Organoleptic:** Pertaining to the senses.

**Oxidation-Reduction Potential (ORP):** The electric potential required to transfer electrons from one compound or element (the oxidant) to another compound (the reductant).

**Pesticides:** Substances intended to prevent, destroy, repel or mitigate any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant or desiccant.

**pH:** An expression of the intensity of the basic or acidic condition of a liquid; may range from 0 to 14, where 0 is the most acidic, 7 is neutral and 14 is the most basic.

**picoCuries/gram (pCi/g):** A unit of measurement. A picoCurie is equal to one trillionth of a Curie. A Curie is a unit of radioactivity.

**Point of Entry (P.O.E.) Treatment Device:** A device that treats water entering a house or building in order to reduce contaminants in the drinking water distributed throughout the house or building.

**Polychlorinated biphenyls(PCBs):** Organic compounds commonly used as insulating fluids in transformers, capacitors and coolants.

**Radionuclide:** Radioactive element or particle, man-made (anthropogenic) or natural, with a distinct atomic weight. It can have a long life as a soil or water pollutant.

**Radium 226/228 (I):** Radium (Ra) is a naturally occurring radioactive element that is present in varying amounts in rocks and soil within the earth's crust. Small amounts of radium also can be found in ground water supplies. Radium can be present in several forms, called isotopes, of which radium 226 and radium 228 are examples. The main type of radiation emitted by radium 226 is the alpha particle.

**Reducing:** The addition of hydrogen, removal of oxygen or addition of electrons to an element or compound.

**Reject/Concentrate Water:** Water containing high levels of dissolved solids removed by the filter membrane in the RO process.

**Reverse Osmosis (RO):** A treatment process used in water systems by adding pressure to force water through a semi-permeable membrane. Reverse osmosis removes most drinking water contaminants.

**Semivolatile Organic Compounds (SVOCs):** Organic compounds that volatilize slowly at standard temperature (20 degrees Celsius and 1 atmosphere) and pressure. Examples of SVOCs include naphthalene and benzo(a)pyrene.

**Soil Cleanup Target Level (SCTL):** Health-based cleanup criteria defined in Chapter 62-777, Florida Administrative Code (F.A.C.). Used to determine when cleanup is complete at a site where there has been a discharge of contaminants to the environment. The SCTLs are set to prevent human health effects, either non-cancer illness or an increased incidence of cancer above one in one million. These values were developed taking into account all sources of possible soil exposure for an individual over a period of 30 years through ingestion, dermal absorption and inhalation of dust or vapors. SCTLs are classified as either residential or industrial based upon land usage.

**Specific Conductance:** Rapid method of estimating the dissolved solid content of a water supply by testing its capacity to carry an electrical current.

**Total Alpha:** The total radioactivity due to alpha particle emissions as inferred from measurements on a dry sample.

**Total Beta:** The total radioactivity due to beta particle emissions as inferred from measurements on a dry sample.

**Total Dissolved Solids (TDS):** All material that passes the standard glass fiber filter; also called total filterable residue. Term is used to reflect salinity.

**Total Recoverable Petroleum Hydrocarbons (TRPH):** Chemical compounds originally from crude oil.

**Toxicity Equivalent (TEQ):** Toxic potency of a chemical mixture calculated by adding the product of the concentration of each individual compound in the mixture multiplied by its respective toxic equivalency factor.

**Treated Water:** Ground water passed through a water treatment system to remove any potential contaminants or undesirable properties.

**Turbidity:** A cloudy condition in water due to suspended silt or organic matter.

**Untreated Water:** Native ground water.

**Volatile Organic Compounds (VOCs):** Organic compounds that have high vapor pressure and relatively low water solubility. The gasoline constituents benzene and toluene are examples of VOCs.

## **Executive Summary**

In May 2009, the Department of Health (DOH) State Epidemiologist received a request for an investigation from a concerned parent on the multiple occurrences of pediatric brain cancer in The Acreage, a residential neighborhood in Palm Beach County. DOH immediately began collecting and analyzing data to evaluate the extent of the illnesses and whether a possible environmental exposure could be causing the situation. As part of this evaluation, DOH contacted the Palm Beach County Health Department and the Department of Environmental Protection (DEP) regarding the testing of drinking water in the area for possible environmental contamination.

Between August 2009 and April 2010, DEP conducted seven sampling events in The Acreage to collect various water and soil samples. To provide DOH the data needed for its investigation, these samples were tested for more than 200 individual chemicals associated with industrial or agricultural operations used currently and historically. This extensive sampling included:

- Water samples from over 70 private drinking water wells from homes in The Acreage,
- Pre-treatment and post-treatment water samples from the Seminole Improvement District water treatment plant that provides drinking water to schools and businesses located in The Acreage,
- Soil samples from 35 private residences and 11 background locations, and
- Water samples from nearby canals.

As requested by DOH, the homes sampled by DEP included residences where cases of pediatric brain cancer have been identified, as well as a number of other nearby homes to serve as a control group. Control homes were identified by DOH as residences where no children have been diagnosed with a brain tumor, but other characteristics were similar to the case homes. DEP control homes were selected based on geographic proximity to case homes in order to evaluate sites solely on environmental conditions.

This report outlines the process and findings for the February, March and April 2010 water and soil sampling events. It also explains how these results compare to Florida's Ground Water Quality Standards and Soil Cleanup Target Levels. Although contaminants were detected above these levels in some samples, the investigation found no evidence of substantial spills, dumping or area-wide contamination. The elevated contaminant levels in water collected post-treatment were attributed to naturally occurring metals or chemical by-products from the water disinfection process. Since the benefits of a water treatment system that adds a disinfectant typically outweigh the relatively small risk from the formation of these chemicals, DEP suggested that residents consult with the manufacturer or a servicing company for maintenance and adjustment instructions for their treatment systems. The sampling conducted during August and September 2009 is summarized in SIS Report Number 2009-11, issued September 2009.

Overall, DEP's sampling analyses showed the water quality in The Acreage is generally good and residential property in The Acreage is safe for families to enjoy outside activities in their yards.

## **1.0 Introduction**

During February, March and April 2010, the Site Investigation Section (SIS) of the Florida Department of Environmental Protection (DEP) supervised the collection of pre- and post-treatment drinking water samples from selected residences located in The Acreage, a residential community located in Palm Beach County, Florida. In addition to the collection of drinking water samples, SIS collected 140 soil samples from 35 of these residences and eleven background locations in March and April 2010. This environmental sampling was coordinated with Joe Lurix, Waste Program Administrator for the DEP Southeast District. These environmental samples were collected and analyzed in support of the Florida Department of Health's (DOH) ongoing study regarding pediatric brain cancer cases in The Acreage. The environmental sampling conducted in the spring of 2010 was a follow-up to DEP's previous sampling of 50 private wells from Acreage residences and the Seminole Improvement District (SID) public supply wells and water treatment plant in August and September 2009. The August and September 2009 sampling activities are summarized in SIS Report Number 2009-11, issued in September 2009.

During the spring 2010 sampling events, water samples were collected from 37 residences. At 26 of these residences, both pre- and post-treatment drinking water samples were collected. At 10 residences, only the post-treatment drinking water sample was collected as SIS had previously collected the pre-treatment water sample in August 2009. At one residence, the well was not connected to the home, so only the pre-treatment sample was collected.

The residences where water samples were collected during spring 2010 included 12 case homes (residences identified by DOH as homes where a child was diagnosed with a brain tumor between 1994 and 2008), 14 DOH control homes (residences identified by DOH as homes where no children have been diagnosed with a brain tumor, but other characteristics were similar to the case homes) and nine DEP control homes (residences located in close geographic proximity to case homes). In addition, DEP collected post-treatment drinking water samples from several residences that showed elevated levels of radionuclides in water samples collected from the pre-treatment side of the home's water treatment system when they were sampled in August 2009. SIS also collected a sample of the treated water from the SID water plant.

The drinking water samples collected during the spring 2010 sampling events were analyzed by the DEP Central Laboratory for a complete suite of potential contaminants including volatile and semi-volatile organic compounds; 1,4-dioxane; pesticides; herbicides; metals such as arsenic, lead, mercury and chromium; petroleum hydrocarbons and nitrite/nitrate. In addition, Florida Radiochemistry Services, Inc., in Orlando analyzed all water samples for total alpha, total beta and radium 226 and radium 228 (radium 226/228) and Test America in Savannah, Georgia analyzed all samples for perchlorate.

During March and April 2010, 140 soil samples were collected from the 35 case and control residences along with 11 background locations. These soil samples were analyzed by the DEP Central Laboratory for potential contaminants including volatile and semi-volatile organic compounds; pesticides; metals such as arsenic, lead, mercury and chromium and petroleum hydrocarbons. In addition, GEL Laboratories in

Charleston, South Carolina analyzed all soil samples for total alpha, total beta and conducted a gamma spectroscopy analysis. This analytical suite was designated as the “basic” soil sample analytical group.

At each of the 35 residences and 11 background locations, one soil sample was collected and submitted for the basic analytical group plus a group of additional analyses. These additional analyses consisted of herbicides, carbamates, dioxins/furans and diquat/paraquat. This analytical suite consisting of the basic analyses plus the additional analyses was designated as the “expanded” soil sample analytical group.

The herbicide and carbamate analyses were conducted by the DEP Central Laboratory while the dioxins/furans and diquat/paraquat analyses were conducted by Columbia Analytical Services in Houston, Texas and Sunlabs in Tampa, respectively.

## **2.0 Site Background**

The Acreage is located in north-central Palm Beach County, Florida, just north of the city limits of Royal Palm Beach. The Acreage consists of approximately 17,000 lots with a minimum size of 1.14 acres (2). The most recent U.S. census (2000) determined the population to be approximately 29,000 (3). The community is located in a rural area and the residences primarily consist of site-built homes. Visual observations by SIS staff and interviews with residents indicate that the majority of developed lots in The Acreage used fill dirt to raise the base elevation of the home site and yard.

Residents of The Acreage primarily use private wells and septic tank systems for their potable water and waste water disposal needs. According to South Florida Water Management District records reviewed by SIS, production intervals in the private wells in The Acreage ranged from 20 to 100 feet below land surface (BLS), with the typical

private well producing water from between 25 to 45 feet BLS. Well completion reports indicate that the private potable wells are completed into the sand and shell-hash lithology of the area's surficial aquifer system. Topographically, elevations at the site range from approximately 10 to 20 feet (National Geodetic Vertical Datum, 1929).

The Seminole Improvement District well field is located in the south-central portion of the community. This well field is located in a citrus grove and consists of five public supply wells that provide water to schools and businesses in The Acreage. The five public supply wells range in depth from 65 to 80 feet BLS and produce water from the surficial aquifer system. Two of the wells are 5 inches in diameter and produce ground water at a rate of 50 gallons per minute (GPM) while the three remaining 12-inch diameter wells produce ground water at a rate of 200 GPM. Water from the well field is treated using a reverse osmosis (RO) process prior to distribution. Water containing the elevated dissolved solids removed by the RO process is designated reject/concentrate water. For disposal purposes, the reject/concentrate water is blended with surface water from a canal and used to irrigate the citrus grove property upon which the well field is located.

Near the western and southern boundaries of The Acreage are the L-8 and M canals. The L-8 canal draws water from Lake Okeechobee and transports it southward. Water from the L-8 canal is also pumped into the M canal which flows eastward towards West Palm Beach.

### **3.0 Site Investigation Section Field Activities**

#### **3.1 Drinking Water Sampling February 2010**

During February 12 through February 14, 2010, SIS supervised and assisted with the collection of drinking water samples from 27 residences and the SID water plant. To ensure anonymity and protect the privacy of the residents, each of the 27 residences was assigned an arbitrary number from 1-28 (the number 13 was not used). Drinking water samples collected from the pre-treatment side of the residence were identified with the assigned residence's numerical ID and the suffix "pre" while the post-treatment water sample was assigned the same numerical ID and the suffix "post". Therefore the water samples collected from location 1 were identified as "1-pre" and "1-post". The treated water sample collected from the SID water plant was designated "29-post" and was collected at the point of entry (P.O.E.).

The drinking water samples were collected by SIS personnel and by staff from Ecology and Environment, Inc. (E&E), an SIS environmental contractor. All pre-treatment water sampling was conducted in accordance with DEP Standard Operating Procedure (SOP) 001/01 FS 2300 Drinking Water Sampling. To ensure accurate representation of ground water quality, private wells were typically purged at a high flow rate (approximately 10 to 15 GPM) for approximately 15 minutes while ground water parameters including pH, temperature, specific conductance, dissolved oxygen, oxidation-reduction potential and turbidity were measured using calibrated meters. The pre-treatment water samples were collected after ground water parameters had stabilized and the well's pressure tank and piping had been completely purged.

The post-treatment water samples were collected from inside the home at the kitchen sink faucet or through the tap for the reverse osmosis system (typically located under the sink), if so equipped. However, at locations 24 and 25, two post-treatment samples were collected. Sample “24-post” and “25-post” were collected from the kitchen sink after passing through the primary water treatment system while samples “24-RO” and “25-RO” were collected after passing through both the primary water treatment system and the reverse osmosis unit.

After the water samples were collected, they were preserved as required by the SOP and placed in a cooler with ice. The sample names were recorded on a chain-of-custody form and the coolers containing the samples were then delivered to the appropriate laboratories for analyses.

Analyses conducted by the DEP Central Laboratory included volatile organic compounds (VOCs) by United States Environmental Protection Agency (EPA) Method 8260C, semi-volatile organic compounds (SVOCs) by EPA Method 8270D, 1,4-dioxane by EPA Method 522, organochlorine pesticides and polychlorinated biphenyls (PCBs) by DEP SOP GC-011-5, organophosphorus and organonitrogen pesticides by DEP SOP GC-012-3, herbicides by DEP SOP LC-001-2, petroleum hydrocarbons by FL-PRO, fumigants by EPA Method 504, metals by EPA Methods 6010C, 6020A and 7470A and nitrite/nitrate by EPA Method 353.2 Rev. 2.0. Total alpha, total beta and radium 226/228 analyses were conducted by Florida Radiochemistry Services, Inc., using EPA Methods 900.0 for total alpha and total beta, and EPA Method 903.1 and Ra-05 for radium 226 and radium 228. Test America analyzed for perchlorate using EPA Method 314.

A complete list of chemical compounds and elements analyzed for by the laboratories is provided in Appendix A. Concentrations are reported in micrograms per liter (ug/L), milligrams per liter (mg/L) or, for radionuclides, picoCuries per Liter (pCi/L).



**Photo # 2: SIS staff collecting water sample from pre-treatment side of a residential water treatment system**

### **3.2 Drinking Water Sampling March 2010**

During the week of March 1, 2010, SIS collected pre- and post-treatment water samples from locations 30 and 31. Sampling protocol and laboratory analyses used in March were identical to the February 2010 sampling event.

### **3.3 Soil Sampling March 2010**

During the week of March 1, 2010, SIS collected soil samples from 25 residences and 11 background locations. At case homes, five soil samples were typically collected. Four of the samples collected were shallow (0-3inches BLS) and the remaining sample was collected from approximately 24 inches BLS to characterize the fill material at depth. At most soil sample locations, a layer of sod was present and prior to sample collection the sod was removed with a stainless steel shovel.

At residential locations, soil samples were identified by the assigned location number followed by the suffixes “A”, “B”, “C” or “D”. For example at hypothetical residence # 99, a case home, samples collected would include “99-A”, “99-B”, “99-C” and “99-D”. The sample collected from approximately 24 inches BLS was typically collected as a second sample at the A location and would therefore be identified as “99-A Deep”. Typically, the A and B samples were collected adjacent to the residence on the filled portion of the lot, while the C and D samples were collected in high-use areas such as playgrounds or areas of concern pointed out by the resident.

At control homes, three soil samples were typically collected. These samples consisted of A and B samples along with an additional A Deep sample.

At both case and control homes, one of the shallow soil samples was designated for expanded laboratory analyses (see description below). The soil sample selected for expanded laboratory analyses was based on either input from the resident or left to the discretion of the sampler.

Background soil sample locations included undeveloped/unfilled lots located within The Acreage (samples designated “BG-1” through “BG-8”) and natural wetlands

surrounding the Acreage (“BG-9” through “BG-11”). At each background location, one shallow soil sample was collected and submitted for the expanded laboratory analytical group.

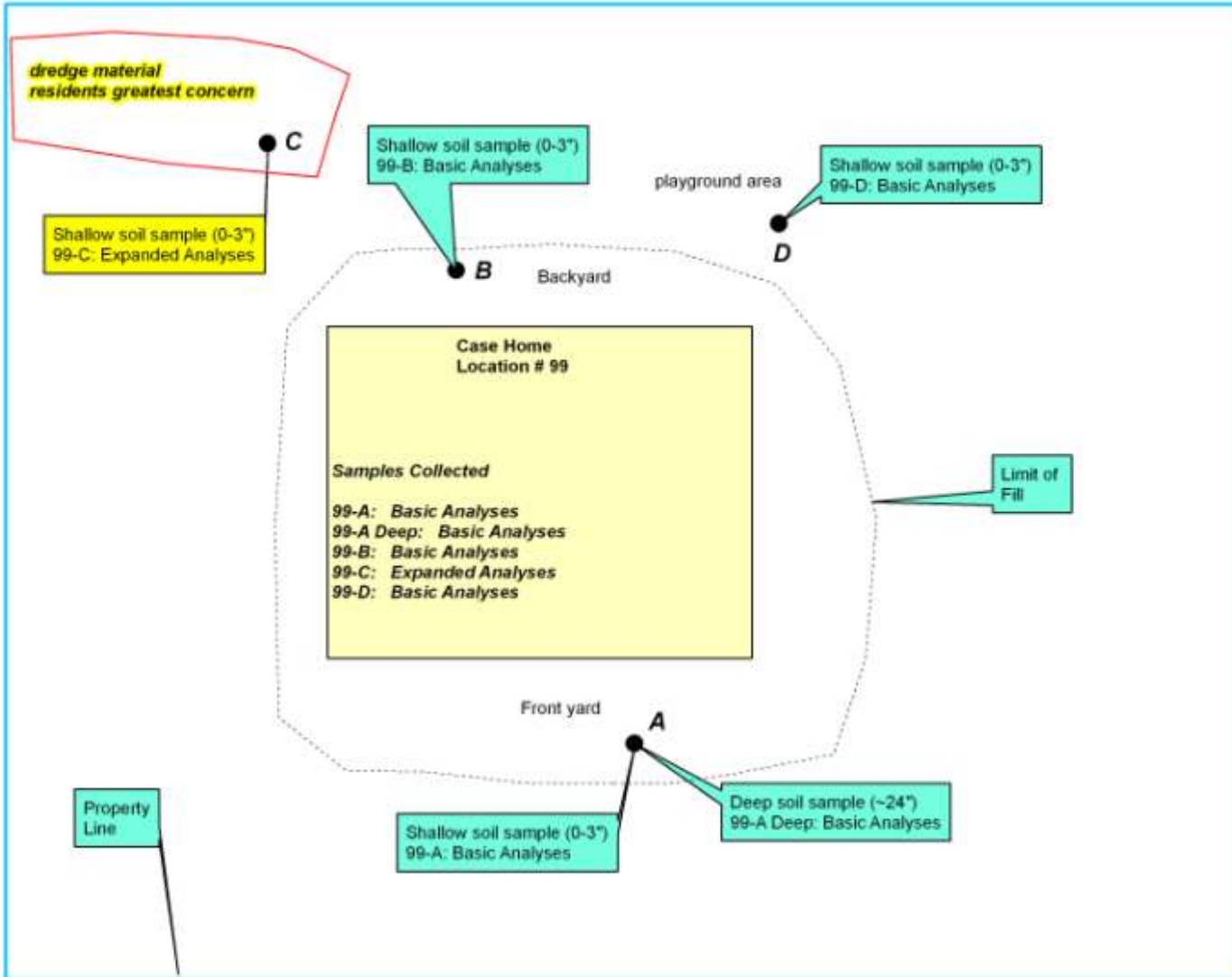
Soil samples were collected according to the DEP SOP FS 3000. Shallow samples were collected by first removing any sod present at the sampling location and then collecting the sample using a stainless steel spoon. The deeper sample was collected by using a pan and stainless steel bucket auger. After the samples were placed on ice, the sample names were recorded on a chain-of-custody form. Coolers containing the samples were then delivered to the appropriate laboratories for analyses.

The basic analyses conducted on most of the soil samples included VOCs by EPA Method 8260C, SVOCs by EPA Method 8270D, total recoverable petroleum hydrocarbons (TRPH) by FL-PRO, mercury by DEP SOP: HG-008-03, metals by EPA Methods 6010C/6020A, PCBs by EPA Method 8082A, organochlorine pesticides by EPA Method 8081B, organonitrogen and organophosphorus pesticides by EPA Method 8141B, total alpha and total beta by EPA Method 900.00/SW 9130 modified and gamma spectroscopy by DOE Method 4.5.2.3.

The expanded analyses for soil samples included the analytes listed above, as well as dioxins/furans using EPA Method 8290, diquat/paraquat by SLI 549.2-modified, acid/urea herbicides by DEP SOP:LC-001-2/DEP SOP:LC-008-3 and carbamates by DEP SOP: LC-006-2.

A complete list of chemical compounds and elements analyzed for by the laboratories is provided in the Appendix A. Concentrations are reported in micrograms per Kilogram (ug/Kg), milligrams per Kilogram (mg/Kg), nanograms per Kilogram (ng/Kg) for the dioxins/furans and picoCuries/gram (pCi/g) for the radionuclides.

Example of Soil Sampling Methodology at Hypothetical Case Home



### **3.4 Drinking Water Sampling April 2010**

In April 2010, SIS collected water samples from locations 32 through 38 and location 75. A post-treatment water sample was also collected from the reverse osmosis unit at location 25 as the post-treatment sample collected from this location in February 2010 was collected directly from the faucet. Sampling protocol and laboratory analyses used in April 2010 were identical to the February 2010 sampling event.

### **3.5 Soil Sampling April 2010**

In April 2010, SIS collected soil samples from the remaining 10 residences. Sampling protocol and laboratory analyses used in April 2010 were identical to the March 2010 sampling event.

## **4.0 Results of Investigations**

### **4.1 Florida Ground Water Quality Standards and Soil Cleanup Target Levels (SCTL)**

Table I in DEP's Contaminant Cleanup Target Levels rule, Chapter 62-777, Florida Administrative Code (F.A.C.) lists the Groundwater Cleanup Target Levels (GCTLs) developed for contaminated sites in Florida. GCTLs annotated in Table I of Chapter 62-777, F.A.C., as "Primary Standard" or "Secondary Standard" correspond to the drinking water standards previously established in Chapter 62-550, F.A.C. (Drinking Water Standards, Monitoring, and Reporting) and referenced in Chapter 62-520, F.A.C. (Ground Water Classes, Standards, and Exemptions). Florida Primary Drinking Water Standards (FPDWS) are health-based standards and establish maximum contaminant

levels (MCLs) in drinking water for chemicals such as benzene and toxaphene. Florida Secondary Drinking Water Standards (FSDWS) are not health-based standards, but are based instead on organoleptic (pertaining to the senses) properties such as taste, odor, or color of the water. Examples of elements with secondary standards include iron, aluminum and manganese. In addition to the Florida Primary and Secondary Drinking Water Standards, Table I of Chapter 62-777, F.A.C., includes GCTLs developed specifically for 62-777, F.A.C. These GCTLs are annotated as minimum criteria and are also either health-based or based on organoleptic criteria. Health-based GCTLs are established to protect people from carcinogens or systemic toxicants. Organoleptic-based GCTLs are established to prevent problems in ground water such as unpleasant taste and odor.

DEP's Soil Cleanup Target Levels (SCTLs) list can be found in Table II of Chapter 62-777, F.A.C.. SCTLs are used to determine when cleanup is complete at a site where there has been a discharge of contaminants to the environment. The SCTLs are set to prevent human health effects, either non-cancer illness or an increased incidence of cancer above one in one million. These values were developed taking into account all sources of possible soil exposure for an individual over a period of 30 years through ingestion, dermal absorption and inhalation of dust or vapors. SCTLs have been calculated for both residential and commercial/industrial settings.

In summary:

- Florida Primary Drinking Water Standards (FPDWS) are health-based standards defined in Chapter 62-550, F.A.C., and listed in Table I of Chapter 62-777, F.A.C.;

- Florida Secondary Drinking Water Standards (FSDWS) are not health-based standards, but are based on organoleptic criteria (taste, odor, or color). FSDWS are defined in Chapter 62-550, F.A.C., and listed in Table I of Chapter 62-777, F.A.C.;
- Groundwater Cleanup Target Levels (GCTLs) are defined in Chapter 62-777, F.A.C., and are subdivided into health-based and organoleptic criteria;
- Soil Cleanup Target Levels (SCTLs) are defined in Chapter 62-777, F.A.C. SCTLs are health-based guideline values used to evaluate cleanup at a contaminated site. SCTLs are provided for both residential and commercial/industrial settings.

## **4.2 Water Sampling Results**

### **4.2.1 Discussion of Ground Water Parameters**

A review of ground water parameters collected during well purging (*Table 1 in Appendix B*) indicates the following:

- pH values ranged from approximately 6.6 to 7.5 standard units in the surficial aquifer;
- specific conductance values, which provide an estimate of total dissolved solids (TDS), ranged from approximately 400 to 2,200 microSiemens per centimeter;

- Dissolved Oxygen (DO) and Oxidation-Reduction Potential (ORP) measurements indicate that the surficial aquifer is anaerobic and exists under reducing conditions.

#### **4.2.2 Pre-Treatment Water Sample Results for DOH Case Homes**

A review of analytical results indicates that pre-treatment water samples collected from the 12 DOH case homes meet all applicable Florida drinking water quality standards with the exception of the Florida Secondary Drinking Water Standard (FSDWS) for iron. Iron exceeded its FSDWS of 300 ug/L in eight of the 12 pre-treatment water samples collected from the DOH case homes.

Total alpha, total beta and radium 226/228 concentrations in pre-treatment water samples collected from the twelve DOH case homes did not exceed Florida ground water quality standards. VOCs, SVOCs, PCBs, pesticides, herbicides, fumigants, 1,4-dioxane or perchlorate were not detected in pre-treatment water samples from 11 of the 12 case homes. One pre-treatment water sample collected from a case home had 1,4-dioxane detected at a level below its GCTL.

#### **4.2.3 Pre-Treatment Water Sample Results for Control Homes**

A review of analytical results for pre-treatment water samples indicates that 19 of the 23 control homes meet all Florida Primary Drinking Water Standards (FPDWS). Two of the control homes exceeded the FPDWS of 160 mg/L for sodium while two additional control homes exceed the FPDWS for total alpha of 15 pCi/L and the radium 226/228 FPDWS of 5 pCi/L. Iron concentrations in pre-treatment water samples from seven of the 23 control homes and iron and manganese concentrations in pre-treatment

water samples from three of the 23 control homes exceeded their respective FSDWS of 300 ug/L and 50 ug/L.

VOCs, SVOCs, PCBs, pesticides, herbicides, fumigants, 1,4-dioxane and perchlorate were not detected in pre-treatment water samples collected from 22 of the 23 control homes sampled . One pre-treatment water sample collected from a control home had 1,4-dioxane detected below its GCTL.

#### **4.2.4 Post-Treatment Water Sample Results for DOH Case Homes**

Because the well at one case home had been disconnected, only 11 post-treatment samples were collected from case homes. Of the 11 post-treatment samples, six exceeded the FPDWS for sodium and one exceeded the FPDWS for sodium and the GCTL for bromodichloromethane – a member of the trihalomethane group. Both the elevated sodium and the presence of a trihalomethane in the post-treatment water samples are attributed to the operation of the water treatment system. Water softeners typically use sodium chloride (salt) to reduce the calcium and magnesium concentrations in the water by exchanging sodium ions for calcium and magnesium ions. Trihalomethanes are considered disinfection by-products that are created when chlorine is added to water containing organic matter.

Iron exceeded its FSDWS in a post-treatment water sample from one of the 11 case homes sampled and iron and manganese exceeded their respective FSDWS in a post-treatment water sample collected from a second case home.

As with the pre-treatment samples, the post-treatment samples collected from the case homes were generally free of VOCs (except for some trihalomethanes detected), SVOCs, PCBs, pesticides, herbicides, fumigants, 1,4-dioxane and perchlorate. One post-

treatment water sample collected from a case home had 1,4-dioxane detected below its GCTL.

#### **4.2.5 Post-Treatment Water Sample Results for Control Homes**

Analytical results for post-treatment water samples collected from the control homes were similar to results of post-treatment water samples collected from the case homes. Elevated levels of sodium were noted in 12 of the 23 control homes and trihalomethanes were detected above their respective GCTLs in three of the 12 homes with elevated sodium levels.

Concentrations of iron exceeding its FSDWS were noted in two post-treatment water samples while manganese exceeding its FSDWS was detected in an additional post-treatment water sample.

Except for the trihalomethanes in some post-treatment water samples, post-treatment samples collected from the control homes were free of VOCs, SVOCs, PCBs, pesticides, herbicides and fumigants. Perchlorate was detected in a post-treatment sample from one control home and 1,4-dioxane was detected in a post-treatment sample from another, both at levels below their respective GCTLs.

#### **4.2.6 Post-Treatment Water Sample Results for Four Previously Sampled**

##### **Residences**

Analyses of pre-treatment water samples from 50 residences sampled by SIS in August 2009 indicated the presence of the radionuclides total alpha and radium 226/228 exceeding their respective FPDWS in a few drinking water wells. In February 2010, SIS returned to four of these residences and collected post-treatment water samples to

determine the effectiveness of the residence’s water treatment system in reducing elevated radionuclide concentrations detected in pre-treatment water samples.

A review of the analyses of these post-treatment water samples indicates that the water treatment systems in place at the residences reduce the radionuclide concentrations to either non-detectable levels or levels well below the Florida Primary Drinking Water Standards. The pre- and post-treatment radionuclide results for the four residences are provided in the table below.

| <i>Radionuclides</i>  | <i>Pre-treatment water sample results pCi/L</i> | <i>Post-treatment water sample results pCi/L</i> |
|---|---|--|
| Location 22: Total Alpha  | 16.1  | Non-detect                                       |
| Location 22: Radium 226/228   | 7.6   | 1.8  |
| Location 22: Total Beta   | 5.4   | Non-detect                                       |
| Location 23: Total Alpha  | 23.7  | Non-detect                                       |
| Location 23: Radium 226/228   | 13.3  | 0.2  |
| Location 23: Total Beta   | Not analyzed                                    | Non-detect                                       |
| Location 24: Total Alpha  | 9.8   | Non-detect*                                      |
| Location 24: Radium 226/228   | 5.2   | Non-detect*                                      |
| Location 24: Total Beta   | Not analyzed                                    | Non-detect*                                      |
| Location 25: Total Alpha  | 10.7  | Non-detect#                                      |
| Location 25: Radium 226/228   | 4.6   | 0.1#   |
| Location 25: Total Beta   | Not analyzed                                    | Non-detect#                                      |
| * Non-detect in both 24-Post and 24-RO samples<br># 25-RO sample results<br>Yellow shading indicates exceedance of FPDWS<br>Total Alpha FPDWS = 15 picoCuries/L<br>Radium 226/228 FPDWS = 5 picoCuries/L (combined) |   |  |

#### **4.2.7 Seminole Improvement District Water Plant Results**

Analyses of the post-treatment water sample collected from the Seminole Improvement District P.O.E. indicates that finished water from the water plant meets all applicable Florida drinking water standards. No VOCs, SVOCs, PCBs, pesticides, herbicides, fumigants, 1,4-dioxane or perchlorate were detected in the SID post-treatment sample. The radionuclides total alpha and total beta and radium 228 were not detected in the post-treatment water sample while radium 226 was detected at 0.3 pCi/L.

*Table 2 in Appendix B* provides detail of the radionuclide analyses and highlights any exceedance for all pre- and post-treatment water samples.

#### **4.3 Soil Sampling Results**

SIS collected 129 soil samples from 35 case and control homes located within the Acreage (*Table 3 in Appendix B*). Laboratory analyses indicate that at 24 of the 35 residences, soils met all applicable DEP SCTLs for VOCs, SVOCs, metals, pesticides, herbicides, petroleum hydrocarbons, dioxins/furans and PCBs. These 24 residences include eight case homes and 16 control homes. At seven residences (2 case homes and 5 control homes), arsenic was detected above the residential SCTL of 2.1 mg/Kg with concentrations ranging from 2.4 mg/Kg to 7.3 mg/Kg. Benzo(a)pyrene exceeded the 0.1 mg/Kg residential SCTL at five residences (3 case homes and 2 control homes) with concentrations ranging from 0.13 mg/Kg to 1.9 mg/Kg. At one case home, TRPH exceeding the residential SCTL of 460 mg/Kg was detected in two of the samples collected from the residence. At the 11 residences where an SCTL was exceeded, one or more soil samples collected from the same residence met all DEP SCTLs. No exceedances of SCTLs were reported in any of the background samples.

Because DEP does not have SCTLs for radionuclides, the U.S. Environmental Protection Agency and DOH have reviewed the radionuclide data from The Acreage and concluded that the levels detected were all within the range of general background conditions in Florida.

## **5.0 Conclusions**

Laboratory analyses of the pre-treatment water samples collected by SIS in August 2009 and February, March and April 2010 indicate the absence of any anthropogenic (man-made) contaminants at concentrations exceeding Florida Primary or Secondary Drinking Water Standards or Groundwater Cleanup Target Levels. Some of the pre-treatment water samples exceeded FPDWS for sodium, total alpha and radium 226/228 and FSDWS for iron and manganese. All of these analytes are naturally occurring within the surficial aquifer that supplies water to the majority of homes within The Acreage.

Laboratory analyses of the post-treatment water samples collected in February, March and April 2010 indicate that both the SID water plant and the residential water treatment systems reduce elevated radionuclide concentrations observed in some pre-treatment water samples to either non-detectable levels or levels well below the Florida Primary Drinking Water Standards. However, levels of sodium above Florida Primary Drinking Water Standards and the presence of trihalomethanes above Groundwater Cleanup Target Levels in some of the residential post-treatment water samples are attributable to the operation of the water treatment system.

Comparison of water quality data between case and control homes did not indicate any substantial differences between the two. The absence of VOCs (with the

exception of some trihalomethanes detected), SVOCs, PCBs, pesticides, herbicides and fumigants in water samples collected from both the case homes and the control homes was notable. Exceedances of the FPDWS for total alpha and radium 226/228 were reported in pre-treatment samples collected from two control homes, however the post-treatment water samples collected from the same homes were either non-detect or at concentrations below their respective FPDWS for all radionuclides. Elevated levels of sodium and the presence of trihalomethanes were noted in post-treatment samples collected from both case homes and the control homes.

Laboratory analyses indicate that, at 24 of the 35 residences, soils met all applicable DEP SCTLs for VOCs, SVOCs, metals, pesticides, herbicides, petroleum hydrocarbons, dioxins/furans and PCBs. At 11 residences, 14 of 41 soil samples exceeded SCTLs for one or more of the following contaminants: arsenic, benzo(a)pyrene and TRPH. Comparison of soil data between case and control homes did not indicate any substantial differences between the two groups in that arsenic and benzo(a)pyrene were detected at similar concentrations at both case and control homes. Radionuclide levels throughout The Acreage were comparable to general background conditions in Florida.

The water and soil sampling that SIS conducted during spring 2010 was designed to investigate the possible presence of industrial or agricultural contamination associated with spills or dumping, historical agricultural practices or the use of potentially contaminated fill at case and control homes in The Acreage. Although some contaminants were detected above DEP cleanup criteria in some samples, the investigation found no evidence of significant spills, dumping or area wide contamination. Based on DEP's 2009 and 2010 environmental assessments, water

quality in The Acreage is generally good and residential property in The Acreage is safe for families to enjoy outside activities in their yards.

## Summary of Soil and Water Quality in Case and Control Homes in The Acreage

| Location ID | Residence Type | Exceedances of DEP Soil Cleanup Target Levels (SCTL) | Exceedances of DEP FDWS/GCTLs in Pre-Treatment Water Samples | Exceedances of DEP FDWS/GCTLs in Post-Treatment Water Samples     |
|-------------|----------------|--|--|---|
| 1           | Case           |  |  | sodium  |
| 2           | Case           |  | iron   | iron  |
| 3           | Case           |  |  |   |
| 5           | Case           |  | iron   | sodium  |
| 9           | Case           |  |  | sodium  |
| 10          | Case           | 1 benzo(a)pyrene                                     | iron   | sodium  |
| 11          | Case           | 1 arsenic  |  | sodium  |
| 12          | Case           |  | iron   |   |
| 14          | Case           | 2 benzo(a)pyrene, 1 arsenic, 2 TRPH                  | iron   | sodium  |
| 15          | Case           |  | iron   | bromodichloromethane, sodium                                      |
| 16          | Case           |  | iron   | No sample, well is not connected to home                          |
| 30          | Case           | 1 benzo(a)pyrene                                     | iron   | iron, manganese   |
| 6           | Control        |  | iron   | sodium  |
| 8           | Control        | 2 arsenic  |  |   |
| 18          | Control        |  | iron   |   |
| 22          | Control        |  | total alpha, radium 226/228                                  | iron, sodium  |
| 25          | Control        | 1 arsenic  |  | Sodium, RO sodium below FPDWS                                     |
| 28          | Control        | 2 arsenic  | iron, manganese  |   |
| 32          | Control        |  |  | bromodichloromethane, chloromethane, dibromochloromethane, sodium |
| 33          | Control        |  |  | sodium  |
| 34          | Control        |  |  | iron  |
| 35          | Control        |  |  | sodium  |
| 36          | Control        |  |  | manganese   |
| 37          | Control        |  |  |   |
| 38          | Control        |  | iron, manganese  | sodium  |
| 75          | Control        | 1 arsenic  |  |   |
| 17          | Control (DEP)  | 1 arsenic  | sodium   | bromodichloromethane, dibromochloromethane, sodium                |
| 4           | Control (DEP)  |  | iron   |   |
| 7           | Control (DEP)  |  | sodium   | bromodichloromethane, sodium                                      |
| 19          | Control (DEP)  |  |  |   |
| 20          | Control (DEP)  |  | iron   | sodium  |
| 21          | Control (DEP)  |  | iron, manganese, total alpha, radium 226/228                 | sodium  |
| 26          | Control (DEP)  |  | iron   | sodium  |
| 27          | Control (DEP)  | 1 benzo(a)pyrene                                     | iron   |   |
| 31          | Control (DEP)  | 1 benzo(a)pyrene                                     | iron   |   |
|             |                |  |  |   |

### **References**

- (1) <http://www.idph.state.il.us/envhealth/factsheets/radium.htm>
- (2) <http://www.welcometowestpalm.com/acreage/index.htm>
- (3) [http://www.pbchd.com/pdfs/environmental/acreage\\_cancer\\_cluster\\_review.pdf](http://www.pbchd.com/pdfs/environmental/acreage_cancer_cluster_review.pdf)