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Lockheed Martin Information Systems & Global Solutions - Civil
Environmental Services SERAS
2890 Woodbridge Avenue, Building 209 Annex
Edison, NJ 08837-3679
Telephone 732-321-4200, Facsimile 732-494-4021

DATE: July 18, 2016

TO: Terrence Johnson, Ph.D., U.S. EPA/ERT Work Assignment Manager

THROUGH: Kevin Taylor, SERAS Program Manager
Rick Leuser, SERAS Deputy Program Manager

FROM: David Aloysius, PG/CPG, SERAS Sr. Hydrogeologist

SUBJECT: **TECHNICAL SPECIFICATION:**
CONSTRUCTION OF OIL INTERCEPTOR TRENCH
J&L STEEL/FUEL OIL SITE, TOWN OF CLIFTON, NEW YORK
WORK ASSIGNMENT - SERAS 0-245: TECHNICAL MEMORANDUM

1.0 INTRODUCTION

This technical memorandum presents specifications for construction of a free product (oil) interceptor trench along the south bank of the Little River at the former J&L Steel Site, located in the Town of Clifton, New York (NY). This work was performed by Lockheed Martin staff from the Scientific, Engineering, Response and Analytical Services (SERAS) contract in collaboration with the Environmental Protection Agency (EPA) Environmental Response Team (ERT) Work Assignment Manager (WAM).

2.0 BACKGROUND

The J&L Steel Site is a former iron ore processing facility located on a 38 acre parcel located at the intersection of NY State Route 3 and St. Lawrence County Route 60 in the Town of Clifton, NY. The site includes several large abandoned buildings in various states of disrepair as well as numerous piles of mining and demolition debris. The buildings are surrounded by parking lots, access roads and unused rail spurs. The remainder of the site is partially wooded with the Little River flowing through the site from East to West. The site was previously used as an Iron Mining and Ore Processing Facility. The Defense Plant Corporation constructed the existing facility at the beginning of World War II. In 1946, J&L purchased the property from the War Assets Administration and continued its operations until approximately 1978 when the plant was permanently closed.

Fuel oil that was used by the operation of the facility was stored on site. A substantial quantity of this fuel oil leaked into the subsurface and subsequently discharged to the Little River. The New York State Department of Environmental Conservation (NYSDEC) was responsible for the site for over 20 years.

During this period, NYSDEC oversaw a number of site investigation efforts and the implementation of a number of remedial efforts, including:

- Spill mitigation,
- Recovery of oil and contaminated sediments from the river,
- Impermeable liner installation along the river bank,
- Installation of a network of monitoring wells, and
- Installation and operation of oil recovery trenches and pumps.

An estimated 300,000 gallons of fuel oil has been recovered from the site. A number of years ago, State funding ran out resulting in the termination of further oil recovery efforts at the site.

The south bank of the Little River runs along the northern extent of the site. The average elevation of the river bottom is approximately 1,393 feet above mean sea level (AMSL). The top of the river bank ranges from approximately 1,410 to 1,400 feet AMSL and averages approximately 1,404 feet AMSL. Oil seeps have been observed in a number of areas along the bank.

Site Physical Characteristics

The area where construction will occur is relatively flat. Cobbles and large boulders extend from ground surface up to 10 feet in some areas along the proposed trench line, as observed in a number of previous test pits and borings. However, the average thickness of the cobbles and boulders is generally 5 feet or less. Unconsolidated materials beneath the boulders consist of sandy mine tailings (up to around 10 feet) and fluvial sands (beneath 10 feet). The depth to groundwater is generally less than 10 feet, which typically resides beneath the boulder layer. Bedrock is assumed to occur at depths greater than 30 feet.

The primary contaminant of concern at the site is No. 2 fuel oil, which contains both semi-volatile and volatile organic compounds (SVOCs/VOCs).

3.0 SITE PREPARATION AND PRE-TRENCH EXCAVATION

A critical component of the trench construction will be pre-trench excavation. Pre-trench excavation will be necessary in order to remove all boulders and other obstructions along the alignment of the trench. For this operation, an excavator shall be used to remove the boulders, which will be segregated from the finer-grained spoils. The finer-grained spoils will be placed back into the cut in a controlled manner, and periodically compacted to densities similar to the surrounding undisturbed materials. Additional on-site or off-site fill will more than likely be required to bring the cut areas up to surrounding grade.

4.0 TRENCH CONSTRUCTION OPTIONS

The below technical specification includes the minimum requirements for a Free Product (Oil) Interceptor Trench as constructed by the Bio-Polymer Slurry (BPS) Method. This specification does not cover another viable alternative; namely, One-Pass Trenching Technology. Each method has their unique set of merits and disadvantages. For example, with the BPS method, a slurry must be used to keep the excavation open in order to install coarse backfill material. However, vertical collection wells can be installed at the same time as the trench is being constructed. With one-pass trenching, a slurry is not necessary but the collection wells must be installed after trench completion using specialized drilling rigs with large diameter tooling. Regardless of which method is used, trench construction shall incorporate the following design parameters:

- Length 1,300 feet (approximate)
- Width 24 inches (average)
- Depth 10 to 20 feet (depth varies with location). Average depth = 15 feet
- Wells 12-inch diameter, Schedule 80 PVC pipe and factory slotted screens (50 slot or 0.05-inch) with bottom plugs, spaced at 100-foot intervals (12 total)

A conceptual design illustration of the interceptor trench is shown in Figure 1.

5.0 TECHNICAL SPECIFICATION

A. SCOPE OF WORK

This specification includes the minimum requirements for a Free Product Interceptor Trench and related work as constructed by the BPS Method and as specified hereinafter. The subcontractor shall provide and furnish all labor, infrastructure, equipment, material, and expertise for performing all operations as required to construct the trench. The interceptor trench shall be constructed with essentially vertical trench walls which shall be supported by an engineered, biodegradable slurry. A gravel backfill, geomembrane barrier (optional), and six 12-inch diameter slotted extraction wells (spaced at approximate 200-foot intervals) shall be placed into the trench, through the slurry. The slurry shall be degraded or broken down by the subcontractor and the trench system fully developed to eliminate any residual effects of the slurry.

Qualifications of Subcontractor

The subcontractor shall submit evidence and references from at least five similar projects to document their successful use of the BPS technique. This evidence will ensure that the Subcontractor will have sufficient expertise, experienced personnel, proven methodologies, and equipment to carry out the work as specified. In particular, the qualifications of an in-house or subcontracted BPS specialist shall be submitted, and approved by the EPA's Representative to supervise the construction, slurry preparations, slurry degradation, and quality control.

Design Parameters for Interceptor Trench

The free product interceptor trench shall incorporate the following design parameters:

- Length 1,300 feet (approximate)
- Width 30 inches (average) 24 inches is acceptable
- Depth 10 to 20 feet (depth varies with location). Average depth = 15 feet
- Wells 12-inch diameter, Schedule 80 PVC pipe and factory slotted screen (12 total)

Descriptions of the overburden through which the trench is to be excavated are presented in the soil boring logs (SB7 through SB19, and SB23) attached in Appendix A. A plan view map of the site (showing the locations of profile lines) and two hydrogeologic cross sections (E lines) along the south bank of the Little River (proposed trench alignment) are attached in Appendix B.

B. SUBMITTALS

Qualifications

The subcontractor shall be a specialist in the construction of groundwater/oil interceptor trenches by the BPS Method. The subcontractor shall submit evidence and references from at least five similar projects. Project descriptions shall include depth, width, and length of the trench as well as a description of the permanent materials placed in the trench for groundwater and/or oil extraction. A brief history of each project shall include the type of slurry used, procedures for implementation, soil conditions, and any difficulties encountered in construction and trench development. Submit with the bid.

The BPS Specialist shall be knowledgeable and experienced in drainage trench construction using BPS Method. This experience shall include, but not necessarily be limited to: 1) the use and control of BPS in trench construction; 2) methods required to properly mix and degrade the BPS; 3) trench excavating and backfilling procedures; and 4) knowledge of construction equipment and materials testing as required for slurry trench construction. The specialist shall control the mixing, composition, placement, cleaning and maintenance of the BPS and backfill. The specialist shall supervise and ensure that the trench is continuous and freely-draining. The credentials of the trench specialist shall be submitted at least one week prior to starting trench construction.

Work Plan

The subcontractor shall submit a pre-construction work plan for approval by the EPA's Representative at least 14 days prior to the start of work. The work plan shall include the following items:

- Schedule: A schedule in sufficient detail to identify the major segments of the work. Starting and ending dates for all major work items shall be clearly identified.

- BPS Trench Construction Method: A detailed description of the methods of construction which shall include the excavation methods, slurry mixing and handling, material handling and placement, backfill placement, well/sump placement, optional geomembrane placement, etc.

- Equipment: A list of major equipment by type and capacity, which shall include excavator, slurry mixer, material handler, lifting equipment, and transport equipment.

Quality Control

The quality control plan shall be submitted along with the work plan. The plan shall include a list of test methods and minimum standards with which to gauge the quality of the work during construction, including slurry viscosity, depth measurements, control of well/sump verticality, etc.

The plan shall address the physical properties and manufacturer's stated properties for all permanent materials including manufacturer's certifications of quality, mill certificates, gradation test data, etc.

The plan shall state when all quality control data will be submitted to the EPA and the correction procedures to be employed in the case of substandard results.

C. MATERIALS REQUIREMENTS

Biodegradable Bio-Polymer

Biodegradable Bio-Polymer shall naturally degrade or be "broken down" to a non-toxic water solution once backfilling of the trench is complete. Degraded Bio-Polymer shall not materially reduce the trench wall transmissivity. The subcontractor shall submit the physical and chemical characteristics and properties of the Bio-Polymer with the quality control plan. Substances prohibited by local, state, or federal law shall not be contained in the Bio-Polymer. The biodegradable Bio-Polymer shall not form a filter cake on the trench walls which might decrease the transmissivity of the drainage trench/overburden interface. Unused Bio-Polymer slurry shall convert to water containing a small residual of non-toxic material once the drainage trench has been completed.

Water

The water used in preparing the Bio-Polymer slurry shall be fresh water. The water shall be free of excessive amounts of oil, acid, alkali, organic matter and other deleterious substances which could adversely affect the properties of the Bio-Polymer. Potential water sources shall be tested by the subcontractor prior to beginning trench excavation to assure that water of suitable characteristics for slurry preparation shall be used. Water used in preparing the Bio-Polymer slurry shall have the following minimum properties:

1. pH between 6 and 8
2. total dissolved solids less than 1,000 milligrams per liter (mg/L)
3. total hardness less than 250 mg/L

Slurry

The slurry for supporting the trench shall consist of a stable suspension of biodegradable Bio-Polymer in water. It is the responsibility of the subcontractor to insure that the slurry meets the necessary properties and monitor the slurry and the trench during excavation. The viscosity and pH of the slurry will additionally be monitored by the subcontractor to determine when breakdown of the slurry begins. The gel strength of the slurry shall be maintained at a high level so that hydrostatic pressure is transferred from the slurry to the trench walls.

Additives

Admixtures of softening agents, preservatives, or dispersants may be added to the slurry to permit efficient use of and proper workability of the slurry. The Bio-Polymer slurry may be modified as required for successful trench excavation. Any additives used must be biodegradable and broken down prior to completion of the trench cap. Chemical and physical properties and characteristics of any proposed additives shall be submitted with the quality control plan.

Geomembrane Barrier (optional)

High-density polyethylene (HDPE), 60 mil thickness (0.060 inch).

Backfill

Durable, clean, washed, and graded gravel shall be used to backfill the trench. Readily available, local materials should be used (e.g., #1A crushed gravel: 1/4-inch to 1/8-inch with a maximum size of 1/2-inch).

Vertical Wells

Vertical well materials shall be furnished and installed to accept extraction or skimming pumps and permit the free flow of oil and groundwater into the pumps. The well casings shall be constructed of 12-inch diameter, Schedule 80 PVC pipe. The casing shall be factory slotted or fitted with well screens with 0.05-inch slots (or roughly similar) and capped on the bottom. The casing shall be slotted from the trench bottom to approximately 3 feet below grade.

Manholes

Heavy-duty, flush-mount, square manholes with water-tight covers.

D. EQUIPMENT

General

The subcontractor shall furnish necessary mixing plant and equipment for trench construction. The equipment shall be of type and capacity to complete the work in an efficient manner, and shall be maintained in operable conditions at all times.

Trench Excavation

Equipment for excavating the slurry trench shall be approved earthmoving equipment such as an excavator and/or clamshell capable of performing the indicated work as specified herein. The equipment shall develop a live load surcharge that will produce no significant contribution to the instability of the trench. The equipment shall be capable of excavating to the required trench depth from the working platform. It shall be capable of excavating the required minimum width of the trench in a single pass of the excavating equipment (except where a wider excavation may be necessary to install the large diameter, vertical wells/sumps).

Slurry Mixing Plant

The subcontractor shall provide a slurry mixing plant containing the necessary equipment for preparing the Bio-Polymer slurry including a high-shear colloidal mixer capable of producing a stable suspension of Bio-Polymer in water. Pumps, valves, hoses, storage supply lines and other equipment shall be provided as required to adequately supply Bio-Polymer slurry to the trench. The slurry mixing plant shall be equipped with a high-speed/high-shear colloidal mixer (with a static agitator). Hydration ponds shall not be permitted.

E. EXECUTION OF THE WORK

General

The interceptor trench shall be constructed to the specified length, depths, and cross sections in accordance with these specifications, unless otherwise directed by the EPA's Representative.

Excavation

Trench excavation shall be maintained in an open condition by the BPS Method. Excavation shall be conducted in a manner which provides for a continuous, minimum width trench to the required depths along the centerline of excavation. The subcontractor shall excavate the trench immediately to the

minimum depth at the point where excavation is started. The EPA's Representative may direct the subcontractor to deepen a specific trench segment based on examination of spoils and shall approve the depth of each trench segment immediately after excavation. The trench shall be constructed without undue interruption until complete.

Mixing and Placing Slurry

The Bio-Polymer slurry shall be prepared by mixing water and biodegradable polymer. No slurry shall be made within the trench. The Bio-Polymer slurry shall be prepared in the mixing plant and hydrated in a tank with circulation until the resulting slurry appears homogeneous and meets quality control standards. Additives may be added to the slurry at the mixing plant. The slurry shall be constantly agitated until introduced into the trench. The slurry shall be supplied to the trench through pipelines which shall be extended as necessary to supply the excavation.

After the initial 3 feet of soil (overburden) has been excavated, the slurry shall then be introduced into the trench. Slurry in the open trench shall be maintained at a level sufficient to maintain trench stability and no more than 3 feet below the ground surface or less than 2 feet above the groundwater table until placement of vertical wells and backfill material is complete. The subcontractor shall have sufficient personnel, equipment, slurry storage equipment and stored slurry materials ready to raise the slurry level in the excavated trench during construction. Dilution of slurry by surface water shall be prevented. The quality of the slurry shall be maintained at all times, including periods of work stoppage.

Trench Stability

The subcontractor shall be responsible for maintaining the stability of the excavated trench for its full length and depth and shall be responsible for maintaining slurry densities and levels within specified limits. The subcontractor shall control surcharges from excavation and backfilling equipment, waste, berm construction, backfill stockpiles, and any other loading situations that may affect trench stability. It is the subcontractor's responsibility to ensure that any stockpiles do not affect the open trench stability and that open trench stability is maintained at all times. In the event of failure of the trench walls prior to completion of backfilling, the subcontractor shall, at their expense, re-excavate the trench and remove all material displaced into the trench and take corrective action to prevent further deterioration as directed by the EPA's Representative.

Geomembrane Barrier (optional)

As an option, a HDPE liner (60-mil thickness) can be installed on the downgradient side of the trench to restrict oil migration at shallow depths while allowing for unobstructed groundwater flow at greater depths. However, such a barrier is not an essential component of the design. In the case of a trench constructed in fine-grained native materials using a coarser-grained backfill, a *capillary barrier effect* will exist. Even without installation of an impermeable liner, the non-wetting oil will tend to be trapped in the trench due to the higher elevation of the capillary fringe in the formation on either side of the trench. As long as oil is periodically removed from the trench and not allowed to build up, oil migration downgradient of the trench would be precluded.

If installed, the bottom of the HDPE geomembrane shall extend to approximately 80% of the total trench depth, leaving an open interval at the bottom of the trench. The HDPE geomembrane shall be temporarily staked at ground surface on the downgradient side of the trench and lowered into the bio-polymer slurry (prior to trench backfilling) using weights attached to its bottom end to prevent it from floating in the bio-polymer slurry. The geomembrane panels shall be overlapped a minimum of 3 feet to create a continuous free product barrier. After installation, backfilling of the trench section being worked on can resume.

Backfilling

Backfilling of the trench shall commence as soon as practical and be continuous to minimize the area of trench supported only by slurry. The areas for the storage of backfill material shall be approved by the EPA's Representative and re-stored upon completion of work each day. The subcontractor shall backfill continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench.

The backfill shall be placed into the trench in a manner that avoids trapping pockets of slurry and segregation of the gravel. The backfill shall be installed in the trench, through the slurry, by equipment which minimizes segregation of the gravel and the creation of voids. Initial backfill shall be placed to bed and anchor vertical wells. All backfill placed around vertical wells shall be gently placed from the surface to ensure proper bedding of the structure. Subsequent backfill may be placed by filling continuously through the slurry until a backfill slope develops. Free dropping of backfill through the slurry will not be permitted, other than bedding of structures.

Slurry Breakdown and Activation

After completion of backfilling, the slurry shall be degraded to water and residual material. Slurry modifiers shall be added as necessary to destroy the viscosity and filtrate properties of the slurry. The broken down slurry shall be oxygenated and pH-adjusted to promote slurry degradation and drainage activation. Water shall be flushed through the trench backfill material in order to remove residual material and to insure satisfactory hydraulic conductivity through the trench media.

Trench Surface Cover

After the trench is developed, the top of the trench shall be covered and backfilled to grade. If a HDPE geomembrane was installed, then the excess material can be folded over the backfill, completely covering it. If not, then a separate layer of non-woven geotextile shall be placed over the backfill to separate the backfill from an overlaying soil layer. A minimum of 3 feet of suitable (clayey) native soils (e.g. from the trench spoils) shall be compacted over the geotextile to bring the trench up to surrounding grade.

Vaults

Vaults will be installed over each well location and anchored in place using a suitable concrete mix.

Site Restoration

Upon the completion of placing the surface cover, the site surface will be restored and blended into the surrounding areas.

F. QUALITY CONTROL

The subcontractor shall be responsible to ensure that all work is performed to the standards established herein, subject to review and inspection by the EPA. All quality control records, routine tests, observations, and measurements shall be available for inspection by the EPA's Representative. The subcontractor shall bear the cost of all specified tests.

Submittals

The subcontractor shall make timely submittals of all required information to the EPA's Representative. The EPA may review and approve these submittals. Approval of any submittal does not relieve the subcontractor of the duty to perform the work to the standards specified.

Materials

The subcontractor shall submit data, tests, manufacturer's certificates, etc., to document the compliance of all materials to these specifications.

- Bio-Polymer: The subcontractor shall submit Material Safety Data Sheets for the Bio-Polymer materials and additives, prior to delivery of these materials to the site. Test data shall be submitted to document the physical and chemical properties of the Bio-Polymer slurry and degraded slurry.

- Water: Test records for water will include pH, total dissolved solids, and total hardness.

- Gravel: The supplier shall provide test results documenting the "gradation" of the gravel prior to construction. The subcontractor shall perform one additional gradation test for each 500 tons of backfill placed into the trench.

- Wells: The supplier shall provide a letter of certification indicating that the material delivered to the site complies with the specified properties.

Bio-Polymer Slurry

The slurry used for trench construction shall be tested each shift to ensure the ability of the slurry to stabilize the trench. The following tests shall be performed at the indicated minimum frequencies:

- Viscosity 2 per shift
- Density 2 per shift
- pH 2 per shift

Samples of the slurry shall be obtained from both the trench and mixing plant for testing. Equipment and personnel for performing these tests shall be supplied by the subcontractor.

The degraded slurry and water in the trench shall be tested by the subcontractor to demonstrate the slurry has broken down. The subcontractor shall test and monitor the viscosity and pH of the slurry to verify degradation. In addition, the subcontractor shall pump and flush the trench until the pore volume of the trench has been circulated at least three (3) times.

Excavation

The subcontractor shall make measurements of the trench depth at least every 10 linear feet. All depth measurements shall be made from the working platform to the bottom of the trench. The subcontractor shall generate and maintain on site an as-built profile of the trench depth.

System Performance

The subcontractor shall verify the continuity of the system by pumping from a centrally located well/sump and observing an immediate drawdown in other wells/sumps in the system.

Records

Records shall be maintained by the subcontractor for all testing, measurements, observations, and inspections. Quality Control Reports shall be submitted to the EPA's Representative each day on a form acceptable to the EPA. These reports shall list all test results, measurements, and observations made of the work for that day.

Trench Contractors

Bio-polymer Slurry Trenches

Geo-solutions
http://www.geo-solutions.com/
1250 5th Avenue
New Kensington, PA 15068
724-335-7273

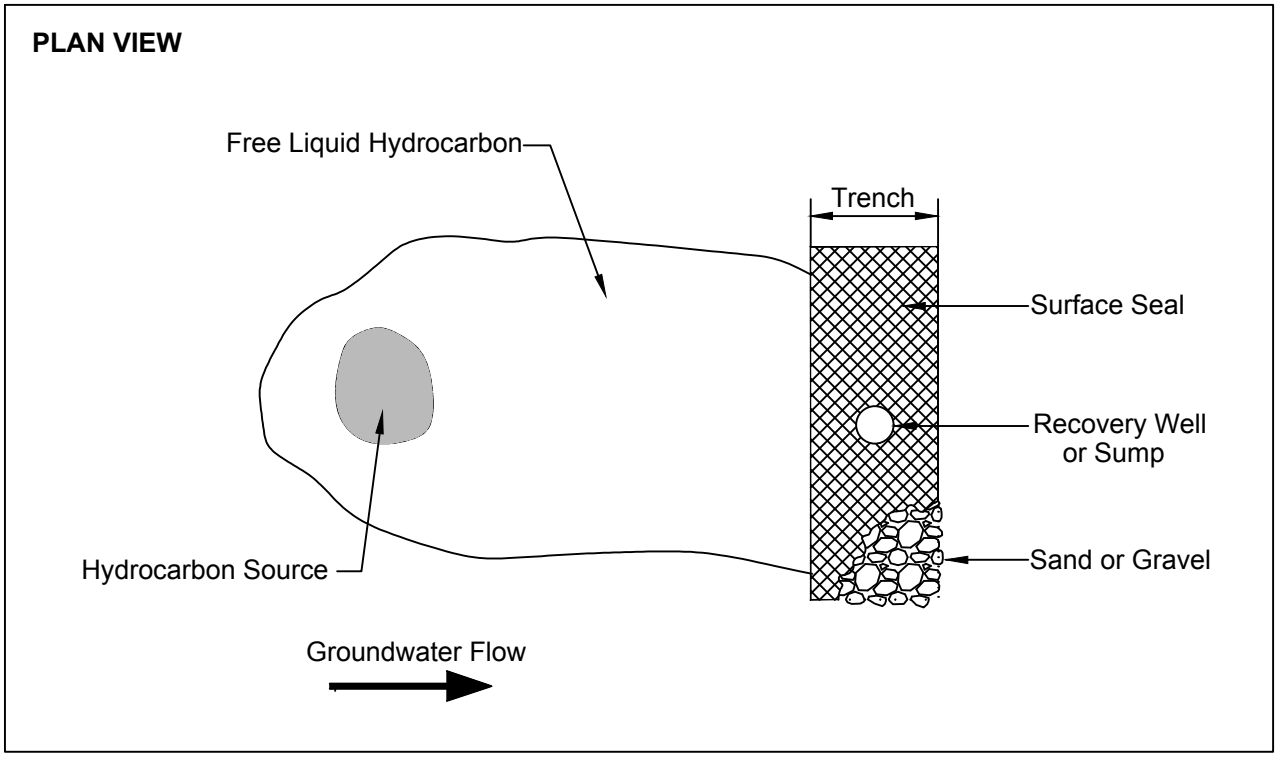
Remedial Construction Services (RECON)
http://www.reconservices.com/
950 West Valley Road, Suite 2802
Wayne, Pennsylvania 19087
484-367-5400

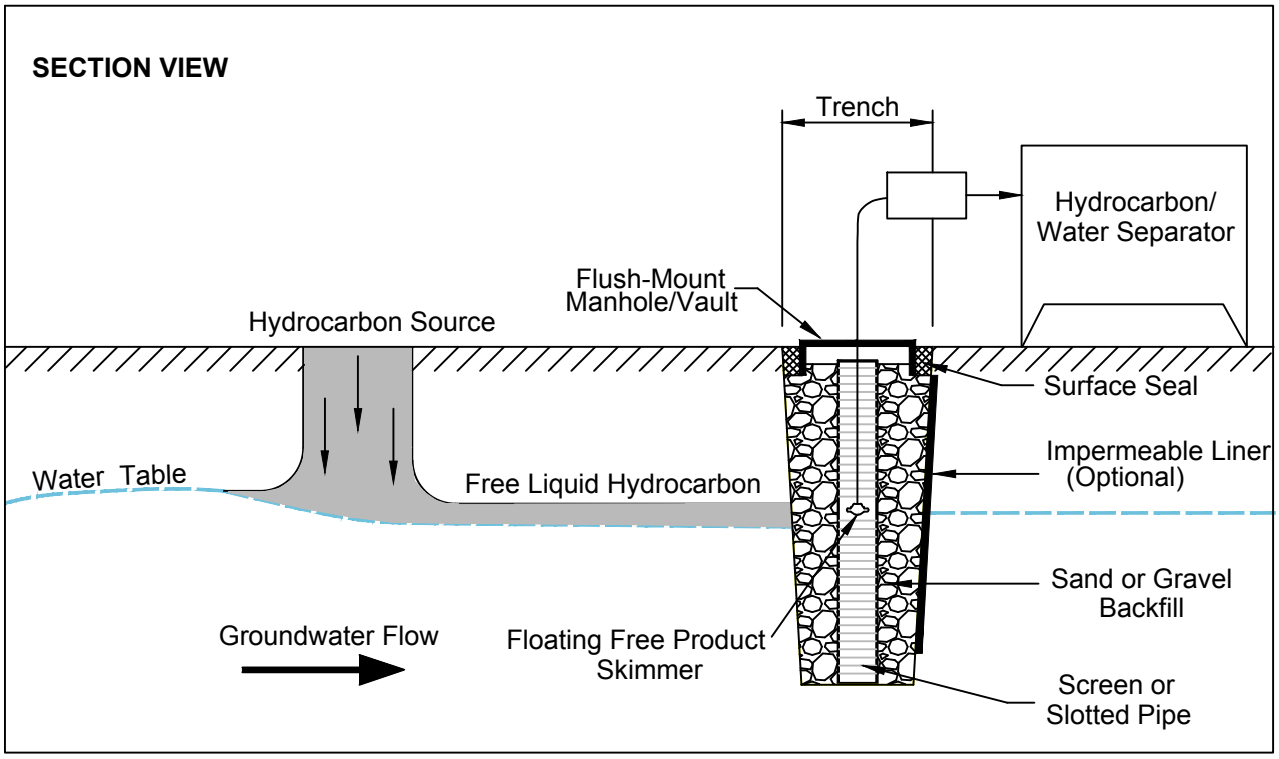
One-Pass Trenching Technology

Dewind
http://www.dewindonepasstrenching.com/
9150 96th Street
Zeeland, Michigan 49464
616-875-7580

Mersino
http://www.mersino.com/
673 National Pike W
Pittsburgh, PA 15417
866-637-7466

FIGURE





NOTE: Conceptual Design;
Not to Scale

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0 -**245**

Figure 1
Interceptor Trench with Skimming Equipment
J&L Steel/Fuel Oil Site
Town of Clifton, New York

00-245/245_Trench_f1.dwg 07/05/2016

Appendix A

Soil Boring Logs
J&L Steel/Fuel Oil Site
Town of Clifton, New York
Technical Memorandum
July 2016

Log of Borehole SB01

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944181.4
Easting: 361581.8
Elevation: 1408.36
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1408.4			
	FILL (Base) Bn/Lt Bn/Tn sc-sm: silt to fn sand, w/sparse subrnd to ang pebbles; well sorted; loose; dry	0.0			
		1406.6			
	Black Sand (Tailings) Bk sm: med grain (sand) tailings; magnetite and umafic tails; v. homogenous; loose; dry	1.8			
		1405.4			
		3.0	601	SS	
	Mixed Alluvium/Tailings 3.0-6.8' Bn sm w/ <cgl: fn sand w/ sparse subrnd-subang, pebbles (gneiss); sorted; loose; damp				
			602	SS	
	6.8-10.5' mottled Bk/Wh/Gy sm-cgl: pebbly fn-med sand, w/ subrnd-subang pebbles; sorted to poorly sorted; loose; moist-wet (**perched groundwater**)		603	SS	
			604	SS	
			605	SS	PW
		1397.9	606	SS	
		10.5			
	Green Sand (Tailings) Mottled Bk/Dk Gn sm-sc: reworked tailings and fn sand to silt w/ sparse ang pebbles; homogeneous; loose; saturated; **v. strong deisel odor; sheen**		607	SS	
			608	SS	
		1393.4			
		15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 9/29/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

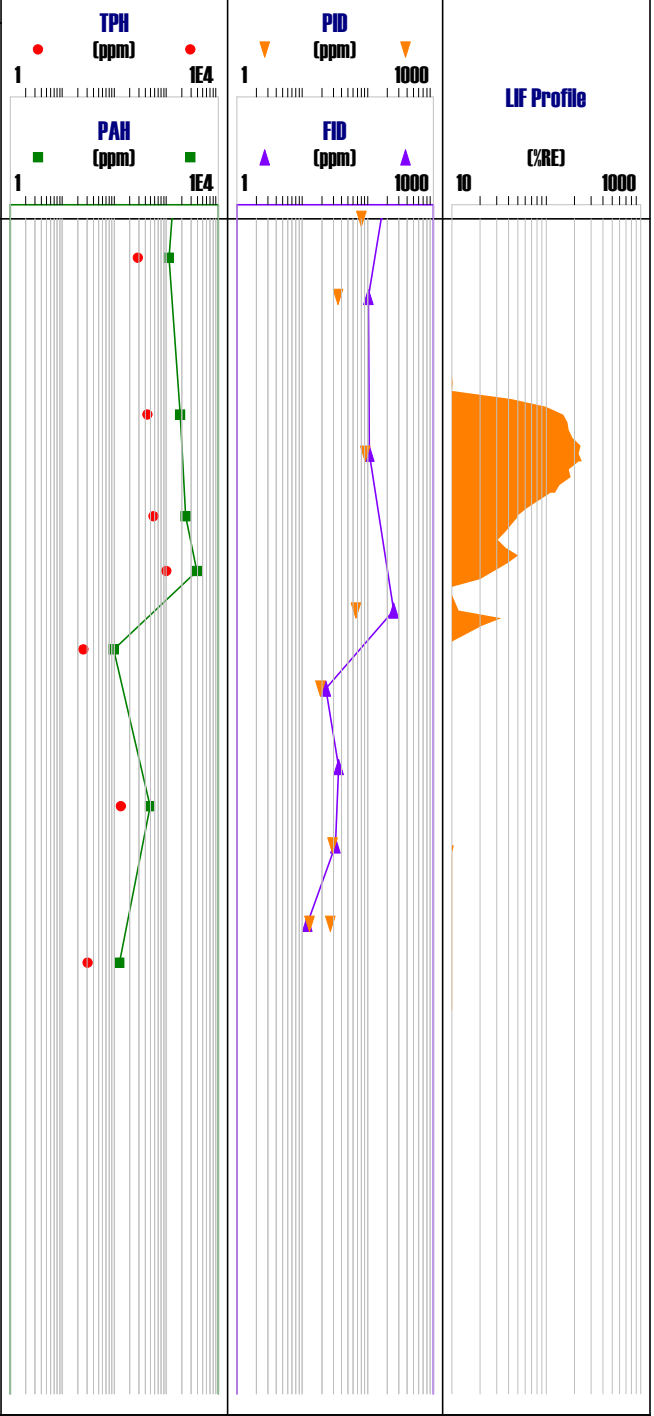
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB01

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944181.4
Easting: 361581.8
Elevation: 1408.36
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16		**Marsh Mat** Dk Bn/Bn Organic Mat: abundant roots, grass, reeds, branches, twigs, etc.		609	SS	
17			1391.4 17.0	610	SS	
18						WT
19		**Fluvial Sand** 17.0-19.2' mottled Bk/Wh/Gy sm-cgl: pebbly fn-med sand, w/ subrnd-subang pebbles; sorted to poorly sorted; loose; moist-wet (**water table**)		612	SS	
20				611	SS	
21		19.2-20.0' mottled Bn/Wh/Gy med sm-cgl: med sand w/ gravels; sorted; loose; washed; saturated		613	SS	
22						
23		20.0-25.0' mottled Bn/Wh/Gy sm: fn-med sand; well sorted; massive; loose; friable; saturated		614	SS	
24						
25			1383.4 25.0	615	SS	
		End of Borehole 25				
26						
27						
28						
29						
30						



Drill Method: Sonic
Drill Date: 9/29/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB02

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944318.7
Easting: 361509.7
Elevation: 1406.86
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	**Ground Surface**	1406.9			
	FILL (Base) Bn/Lt Bn/Tn sc-sm: silt to fn sand, w/sparse subrnd-ang pebbles; well sorted; loose; dry	0.0			
		1405.4			
		1.5			
	Black Sand (Tailings) Bk sm: med grain (sand) tailings; magnetite and umafic tails; v. homogenous; loose; dry		616	SS	
		1401.9			
		5.0			
	Mixed Alluvium/Tailings Dk Gy sm-cgl w/ oc-sc: clayey silt-fn sand w/ ang-subang pebbles/cobbles; poorly sorted; dense; moist-wet (**perched groundwater**)		617	SS	PW
		1396.9			
		10.0	618	SS	
	Green Sand (Tailings) Dk Gy/Dk Bn sc-sm-cgl: magnetite and umafic tails & cinder/ash that is reworked w/ clayey silt-fn sand w/ ang-subang pebbles/cobbles; poorly sorted; dense; wet		619	SS	
		1394.4			
		12.5			
	Marsh Mat Dk Bn/Bn Organic Mat: abundant roots, grass, reeds, branches, twigs, etc.		620	SS	
		1392.4			
		14.5			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 9/29/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

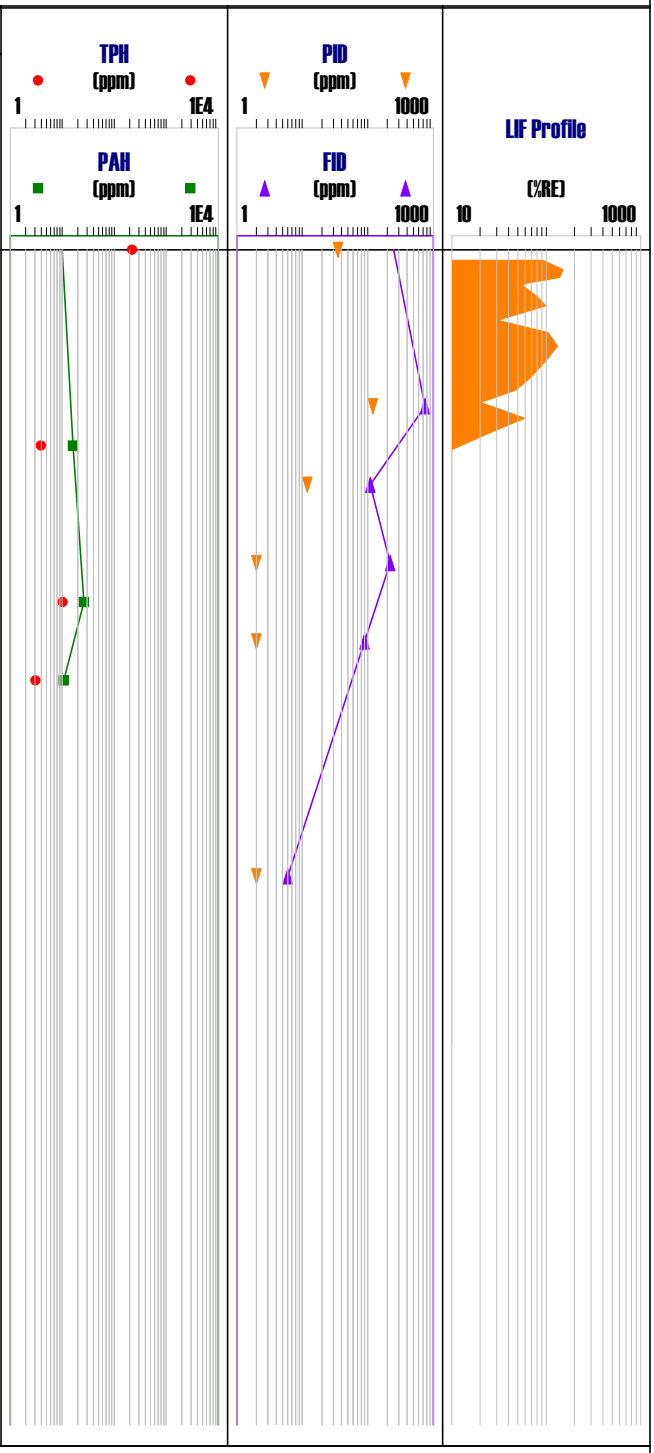
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB02

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944318.7
Easting: 361509.7
Elevation: 1406.86
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16		**Fluvial Sand** 14.5-16.5' mottled Lt Bn/Tn sm: fn-med sand w/ some cobbles; v. well sorted; loose; massive; washed; wet (**water table**); **deisel odor**		621	SS	WT
17						
18		16.5-18.0' mottled Wh/TnBn med sm: med sand; massive; v. well sorted; loose; washed; wet		622	SS	
19		18.0-20.0 mottled Bn/Wh/Or sm-cgl: med-crse sand w/ gravel; well sorted; bedded to weaky developed laminae; loose; friable; saturated		623	SS	
20			1386.9 20.0			
21				624	SS	
22		**Fluvial Gravels** Mottled Rd/Pk/Wh/Bn sm-cgl: crse sand & gravels w/ subang cobbles; poorly sorted; loose; saturated				
23						
24						
25			1381.9 25.0			
		End of Borehole 25				
26						
27						
28						
29						
30						



Drill Method: Sonic
Drill Date: 9/29/15
Hole Size: 6-inch

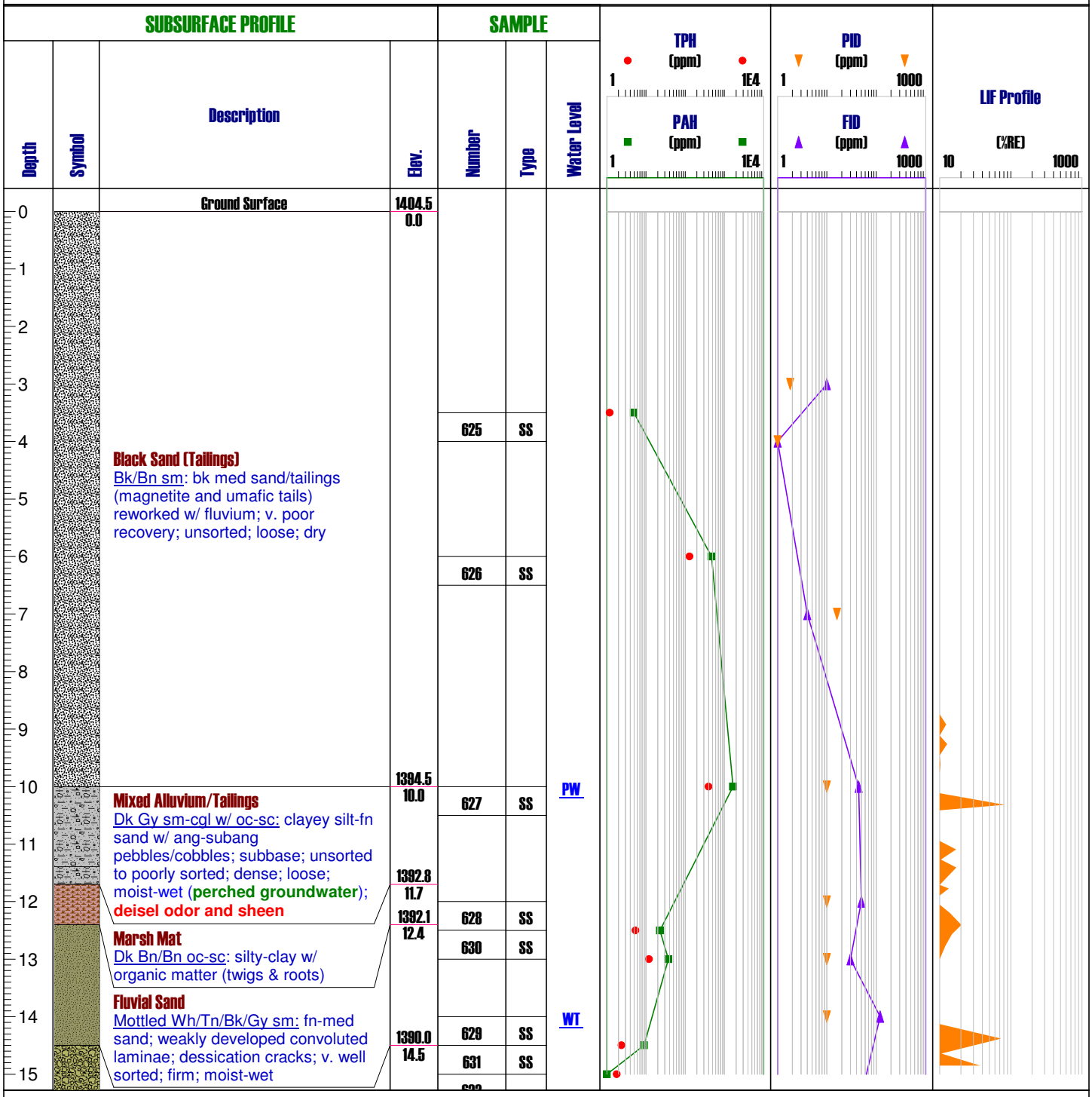
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB03

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944389
Easting: 361476.5
Elevation: 1404.46
Logged By: dge



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

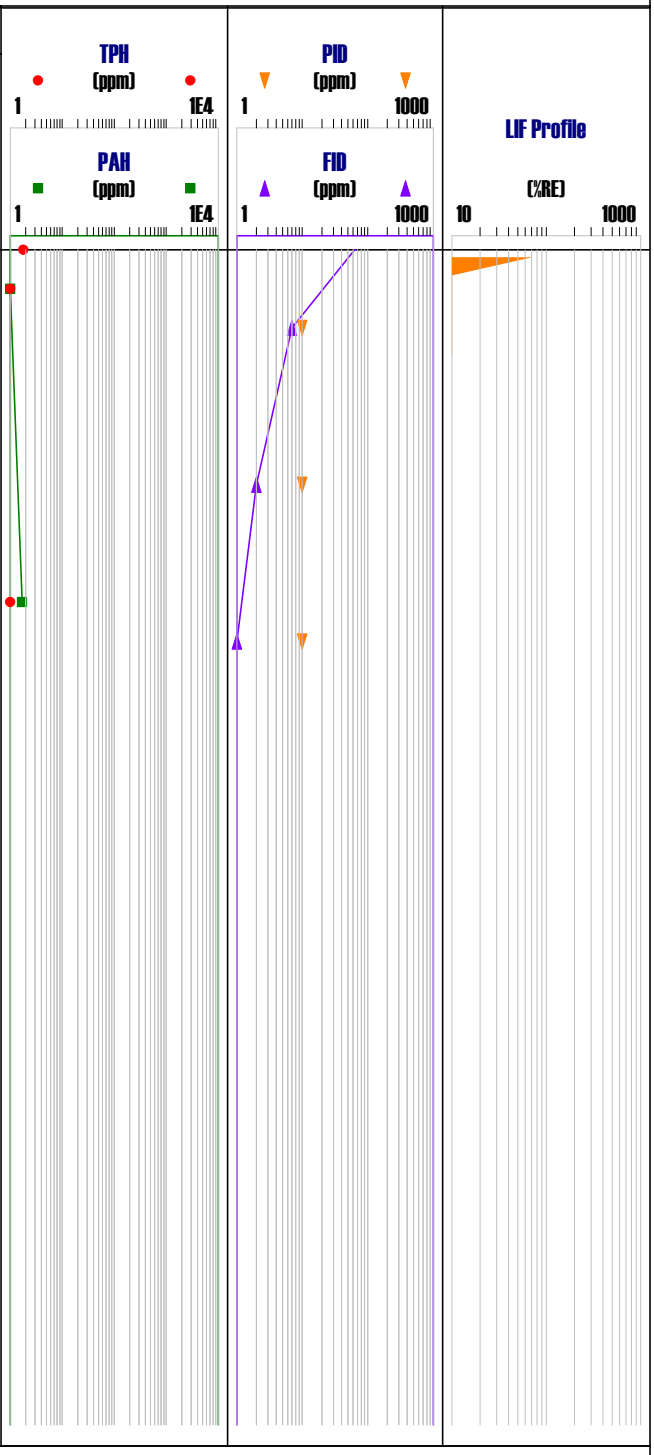
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB03

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944389
Easting: 361476.5
Elevation: 1404.46
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16		**Fluvial Gravel** Mottled Bk/Gy sm-cgl: crse sand & gravels w/ subrnd-subang cobbles; poorly to moderately sorted; washed; loose; saturated (**water table**)		632	SS	
17						
18			1386.5 18.0			
19		**Fluvial Sand** Mottled Lt Bn/Gy sm: fn-med sand; v. well sorted; loose; massive; washed; wet				
20			1384.5 20.0	633	SS	
21		End of Borehole 20				
22						
23						
24						
25						
26						
27						
28						
29						
30						



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

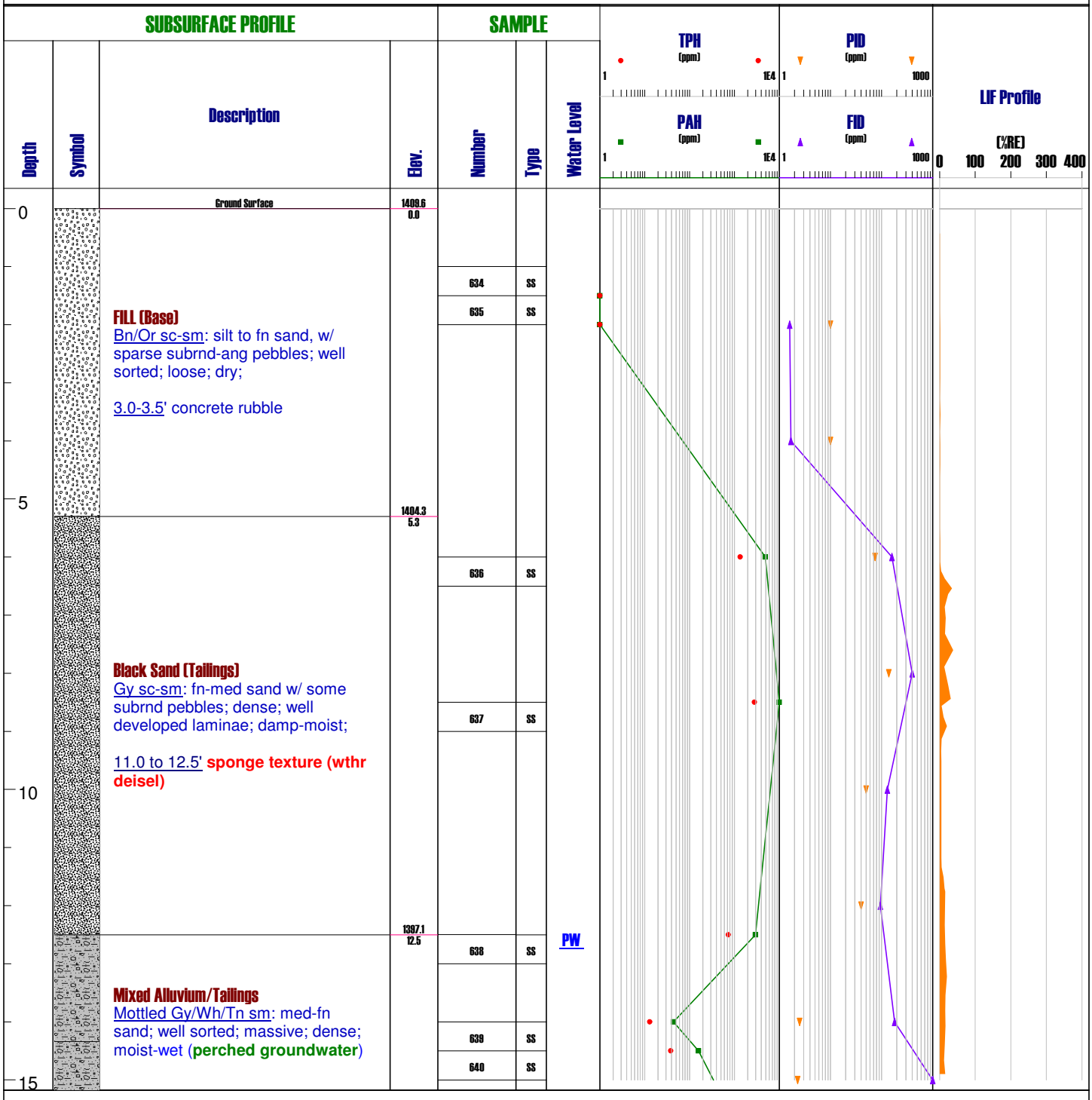
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB04

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.:
Location: Star Lake, NY

Northing: 1944310.7
Easting: 361750.3
Elevation: 1409.59
Logged By: dge



Drill Method: Sonic
Drill Date: 9/29/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB04

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.:
Location: Star Lake, NY

Northing: 1944310.7
Easting: 361750.3
Elevation: 1409.59
Logged By: dge

Depth	Symbol	Description	Elev.	Number	Type	Water Level
			1394.1	641	SS	
		Marsh Mat Dk Bn/Bn oc-sc w/ organics: clayey-silt w/ roots, grass, reeds, branches, twigs, etc.	15.5	642	SS	
			1390.1			
			18.5	643	SS	
20		**Fluvial Sand** 19.5-21.0' mottled Gy/Wh/Tn sc-sm: silt-fn sand w/ some cobbles; some roots; v. well sorted; loose; massive; washed; wet (**water table**)		644	SS	WT
		21.0-23.5' mottled Gy/Wh/Tn sm: med sand w/ sparse pebbles; massive; v. well sorted; loose; well washed; saturated		645	SS	
		23.5-25.0' mottled Gy/Wh/Bk sm: fn-med sand; v. well sorted; weakly developed laminae; dessication cracks; loose; friable; saturated		646	SS	
25		End of Borehole 25	1384.6 25.0			
30						

TPH (ppm) 1 – 1E4
PID (ppm) 1 – 1000
PAH (ppm) 1 – 1E4
FID (ppm) 1 – 1000
LIF Profile (%RE) 0 100 200 300 400

Drill Method: Sonic
Drill Date: 9/29/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

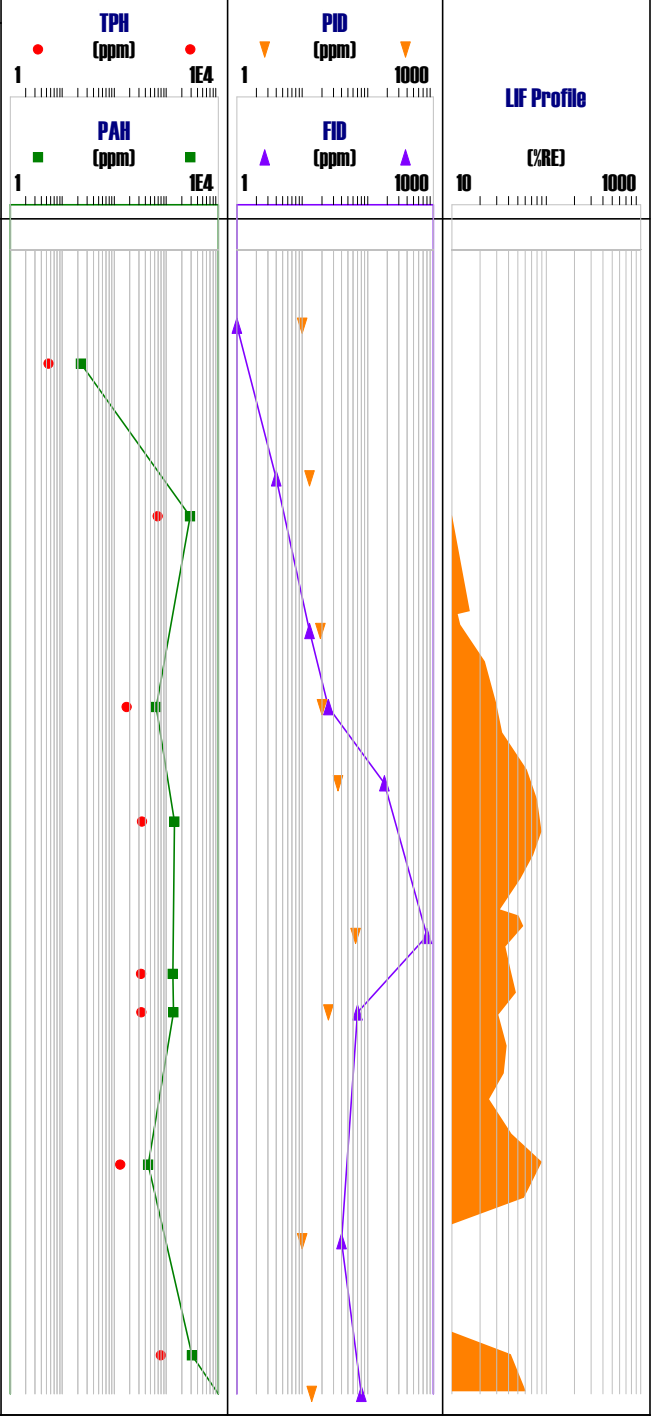
Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB05

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944237.7
Easting: 361672.7
Elevation: 1407.78
Logged By: dge

Depth	Description	Elev.	Number	Type	Water Level
	Ground Surface	1407.8			
0	**Black Sand (Tailings)** Bk/Bn sm: bk med sand/tailings (magnetite and umafic tails) reworked w/ fluvium; v. poor recovery; unsorted; loose; dry	0.0			
1			647	SS	
2		1405.5			
3	**Mixed Alluvium/Tailings** 2.3-6.0' Dk Gy sm-cgl w/ oc-sc: clayey silt-fn sand w/ ang-subang pebbles/ cobbles; subbase; unsorted to poorly sorted; dense; loose; moist-wet (**perched groundwater**); **deisel odor and sheen**	2.3	648	SS	
4					
5					
6			649	SS	
7	6.0-10.0' mottled Gy/Wh sm: med sand; massive; v. well sorted; firm; moist				PW
8			650	SS	
9			651	SS	
10		1397.8	652	SS	
11	**Marsh Mat** Dk Bn/Bn oc-sc: silty-clay w/ organic matter (twigs & roots)	10.0			
12			653	SS	
13	**Overbank (Clayey Silt)** Gy/Lt Bn sc-oc: clayey silt; welll developed convoluted laminae; roots; v. well sorted; firm; moist-wet				
14					
15			654	SS	WT



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

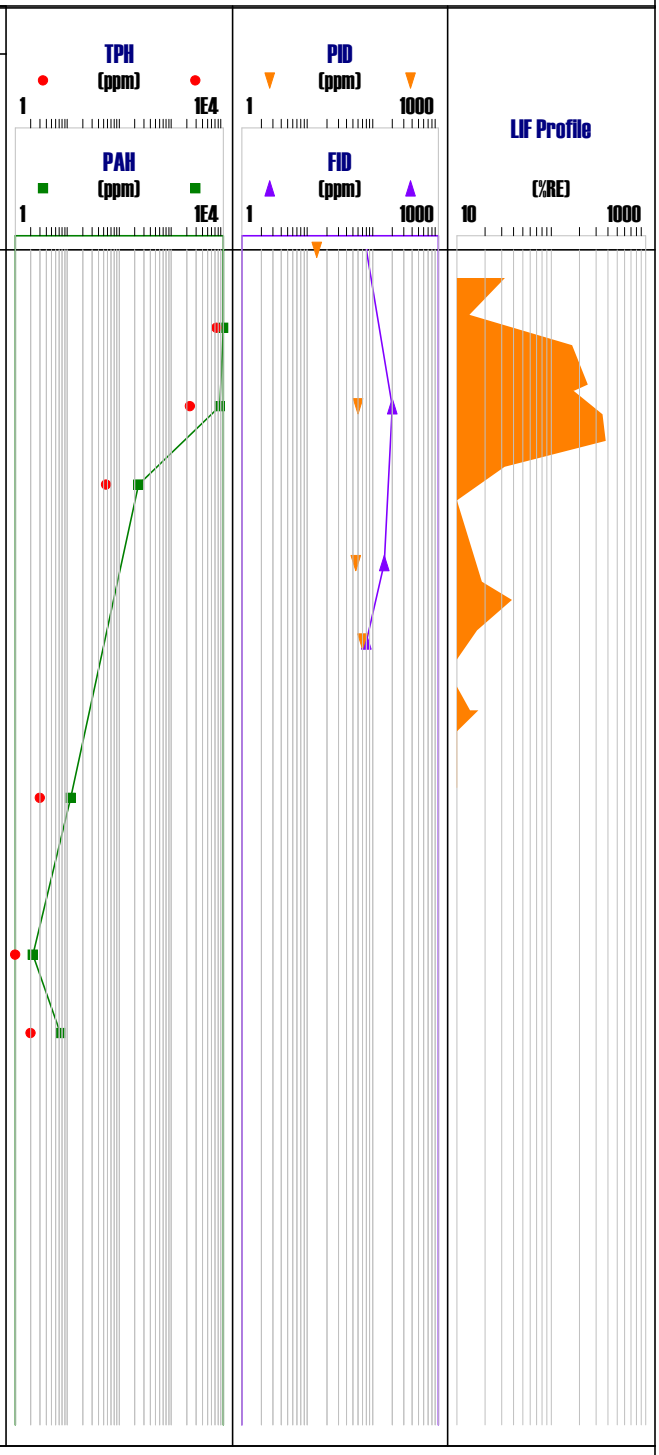
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB05

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944237.7
Easting: 361672.7
Elevation: 1407.78
Logged By: dge

Depth	Description	Elev.	Number	Type	Water Level
		1392.5			
		15.3			
16			655	SS	
17			656	SS	
18	**Fluvial Sand** 15.3-18.0' mottled Gy/Lt Gy/Wh sm: fn-med sand; convoluted laminae; v. well sorted; firm; moist-wet (**LNAPL 15.0 to 16.5' bgs**)		657	SS	
19					
20	18.0-21.0' mottled Lt Bn/Gy sm: fn-med sand; v. well sorted; loose; massive; washed; saturated (**water table**)				
21					
22	21.0-25.0' mottled Bk/Gy sm-cgl: crse sand & gravels w/ subrnd-subang cobbles; poorly to moderately sorted; washed; loose; saturated		658	SS	
23					
24			659	SS	
25	End of Borehole 25	1382.8 25.0	660	SS	
26					
27					
28					
29					
30					



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

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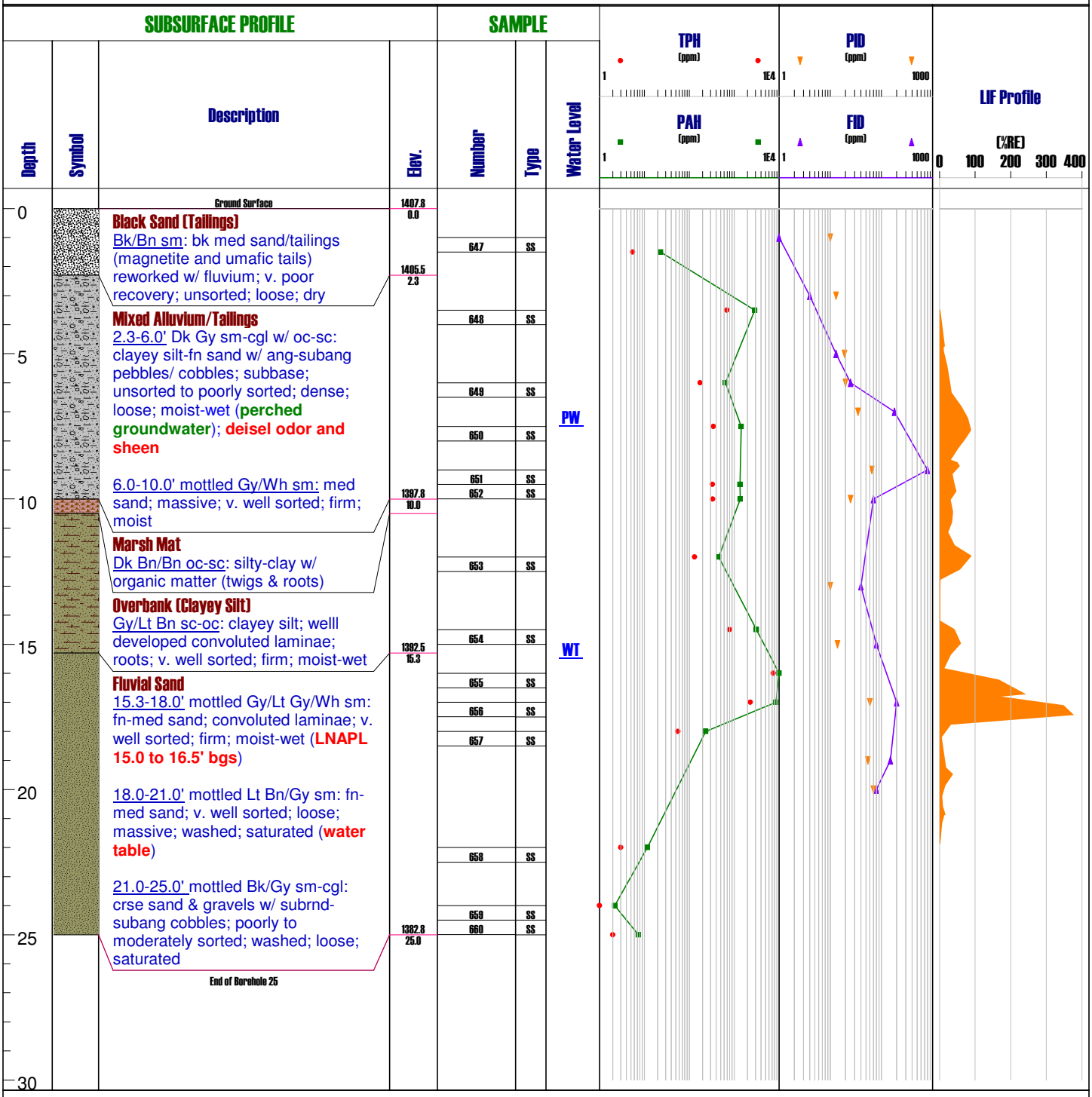
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB05_pp

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944237.7
Easting: 361672.7
Elevation: 1407.78
Logged By: dge



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

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Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 1

Log of Borehole SB06

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944316.69
Easting: 361867.43
Elevation: 1417.15
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1417.2			
	FILL (Base) Bn/Lt Bn/Tn sc-sm: silt to fn sand, w/sparse subrnd to ang pebbles; well sorted; loose; dry	0.0			
		1415.7			
		1.5			
4	**Black Sand (Tailings)** Bk sm: Bk med sand/tailings; magnetite and umafic tails; v. homogenous; loose; dry		661	SS	
7		1409.7	662	SS	
		7.5			
9	**Mixed Alluvium/Tailings** 7.5-10.0' Dk Gy sm-cgl w/ oc-sc: clayey silt-fn sand w/ ang-subang pebbles/ cobbles; subbase; unsorted to poorly sorted; dense; loose; moist-wet (**perched groundwater**); **deisel odor and sheen**		663	SS	
11			664	SS	
12	10.0-14.0' mottled Gy/Wh sm: med sand; massive; v. well sorted; firm; moist				
13			665	SS	PW
14		1403.2			
	Marsh Mat Dk Bn/Bn oc-sc: silty-clay w/ organic matter (twigs & roots)	14.0	666	SS	
15		1402.2	667	SS	
		15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

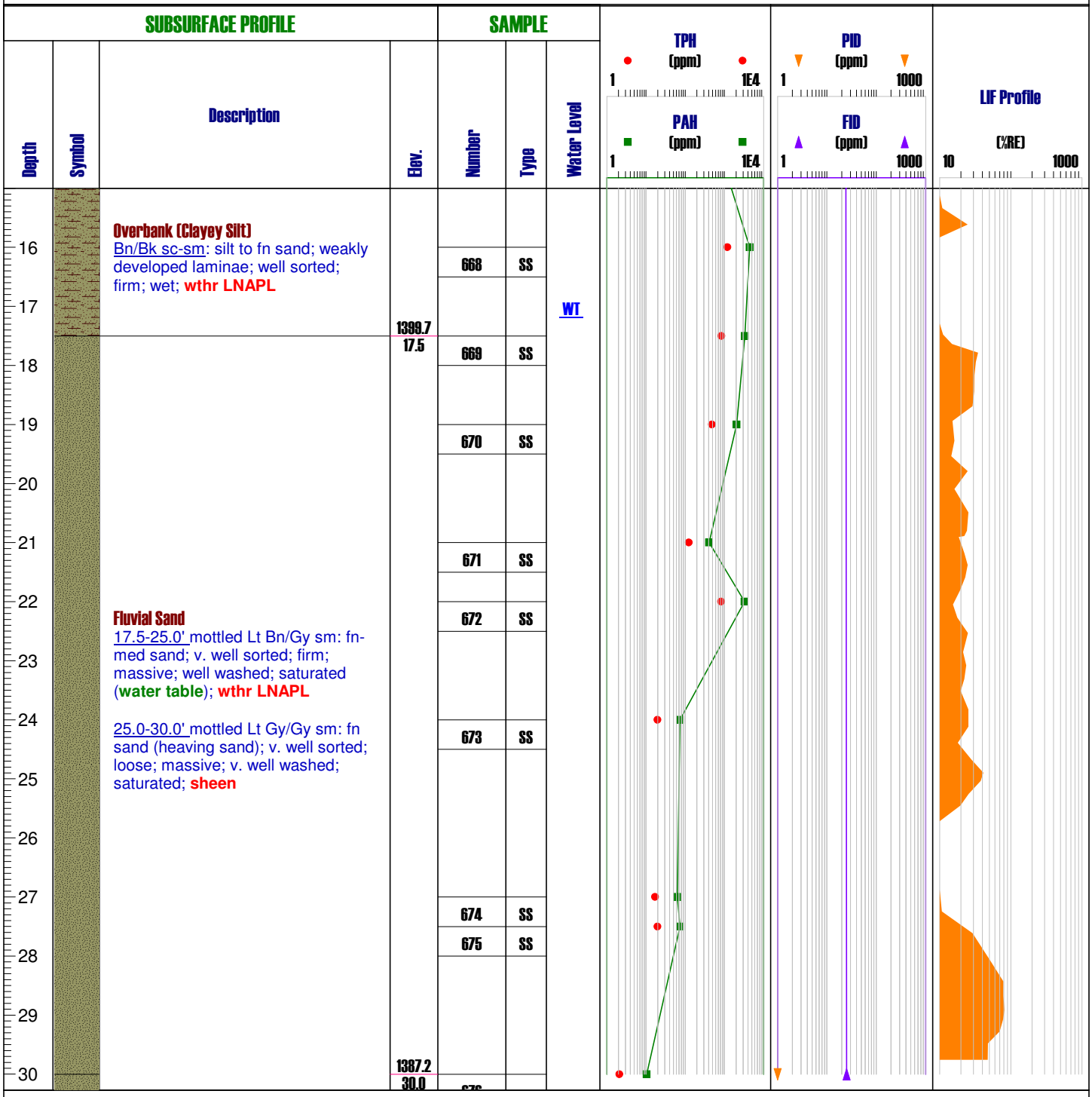
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 4

Log of Borehole SB06

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944316.69
Easting: 361867.43
Elevation: 1417.15
Logged By: dge



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

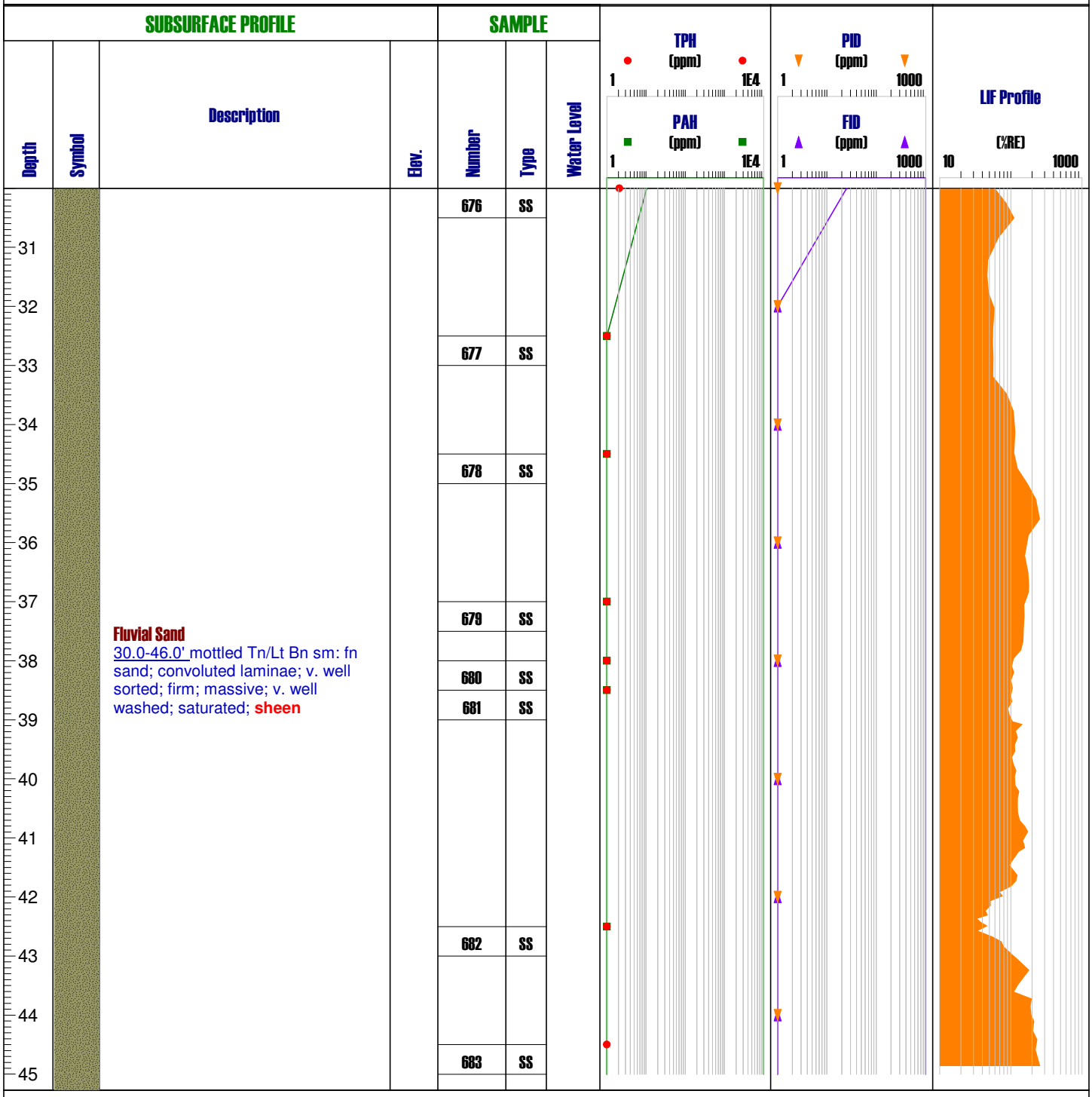
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 4

Log of Borehole SB06

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944316.69
Easting: 361867.43
Elevation: 1417.15
Logged By: dge



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

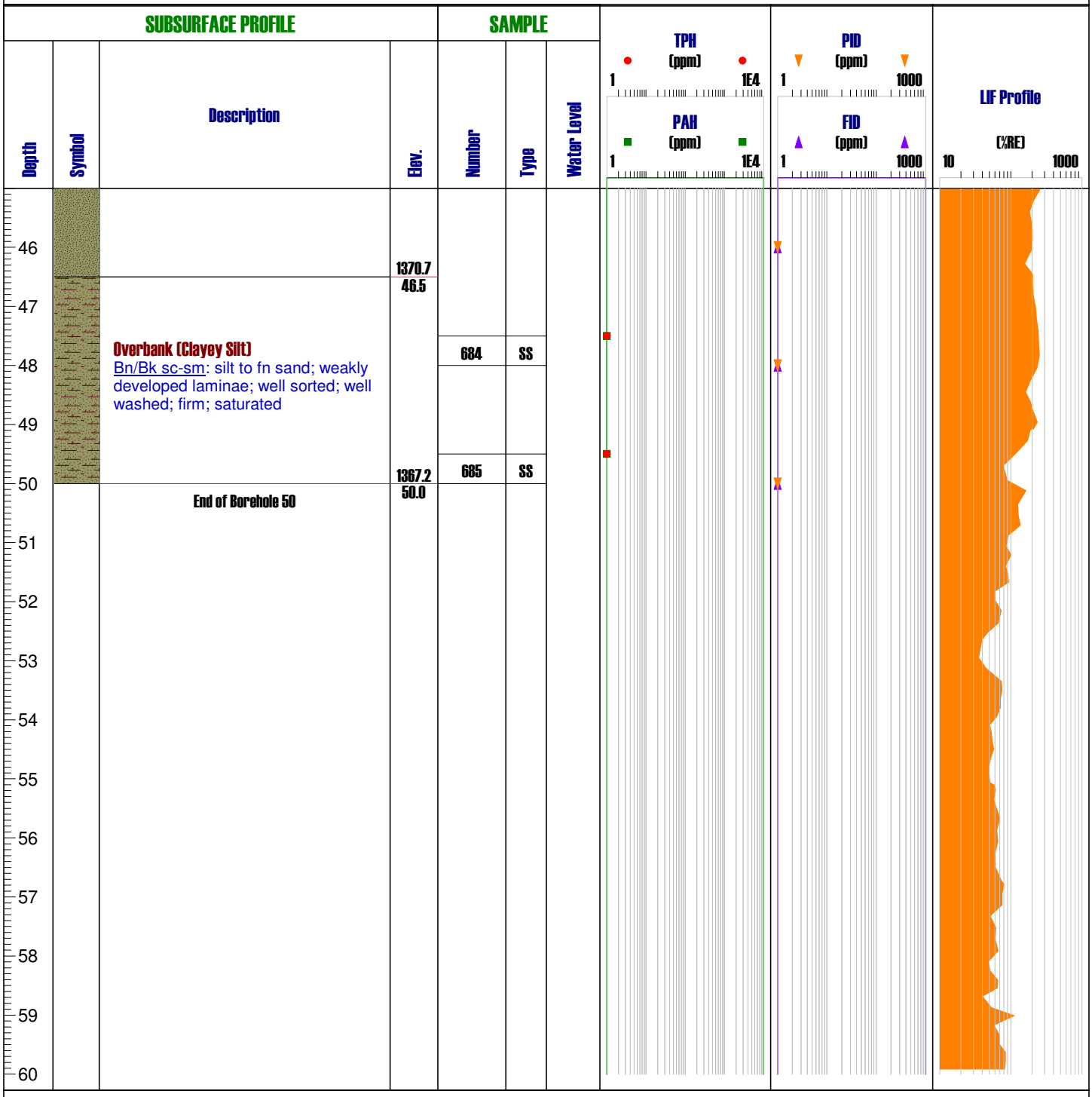
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 3 of 4

Log of Borehole SB06

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944316.69
Easting: 361867.43
Elevation: 1417.15
Logged By: dge



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 4 of 4

Log of Borehole SB06_pp

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944316.69
Easting: 361867.43
Elevation: 1417.15
Logged By: dge

SUBSURFACE PROFILE

Depth	Description	Elev.
0	Ground Surface	1417.2 / 0.0
	FILL (Base) Bn/Lt Bn/Tn sc-sm:	
5	**Black Sand (Tailings)** Bk sm: Bk med sand/tailings	
		1409.7 / 7.5
10	**Mixed Alluvium/Tailings** 7.5-10.0' Dk Gy sm-cgl w/ oc-sc: **deisel odor and sheen**	
		1403.2 / 14.0
15	**Marsh Mat** Dk Bn/Bn oc-sc:	
	Overbank (Clayey Silt) Bn/Bk sc-sm: **wthr LNAPL**	1399.7 / 17.5
20	**Fluvial Sand** 17.5-25.0' mottled Lt Bn/Gy s**wthr LNAPL**	
25	25.0-30.0' mottled Lt Gy/Gy sm: fn sand (heaving sand); v. well sorted; loose; massive; v. well washed; saturated; **sheen**	
		1387.2 / 30.0
30		
35	**Fluvial Sand** Mottled Tn/Lt Bn sm: fn sand; **sheen**	
40		
45		1370.7 / 46.5
	Overbank (Clayey Silt) Bn/Bk sc-sm: silt to fn sand	
50	End of Borehole 50	1367.2 / 50.0
55		
60		
65		

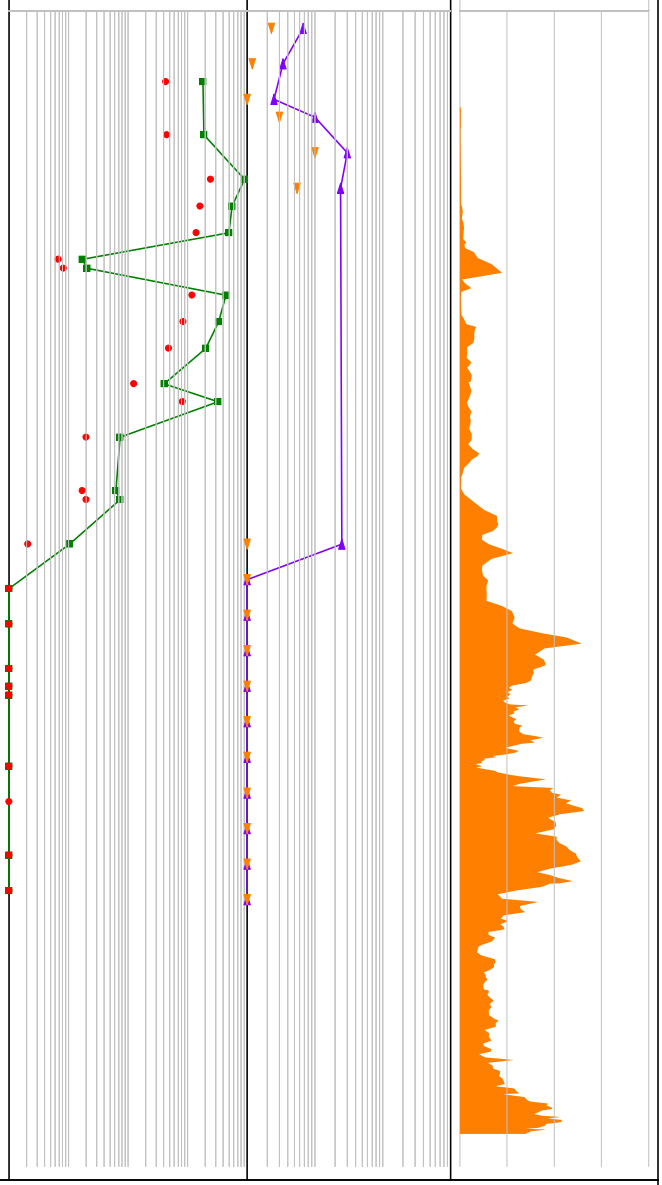
SAMPLE

Number | Type | Water Level

PW
WT

TPH (ppm) | PID (ppm) | PAH (ppm) | FID (ppm) | LIF Profile

TPH (ppm): 1 – 1E4
PID (ppm): 1 – 1000
PAH (ppm): 1 – 1E4
FID (ppm): 1 – 1000
LIF Profile (%RE): 0 100 200 300 400



Drill Method: Sonic
Drill Date: 9/30/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 1

Log of Borehole SB07

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944614.1
Easting: 361850.2
Elevation: 1402.17
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
0		Ground Surface	1402.2			
		FILL (Base) Rd/Or sc-oc: Clayey silt w/ <med sand; sorted; friable; dry	0.0			
			1399.7			
		Mixed Alluvium/Tailings Bn/Rd sm; med sand, loose; well sorted; dry	2.5			
4				686	SS	PW
			1395.7			
		Green Sand (Tailings) Gy/Gn sm; fn-med sand reworked tailings, weakly developed laminae, loose; v. well sorted; damp	6.5			
			1393.7			
		Mixed Alluvium/Tailings 8.5-11.8' Dk Gy/Gy sm: fn-med sand; weakly devleoped laminae, loose; well sorted; damp-moist	8.5	687	SS	
		11.8-12.5' Bn/Dk Gy sc-oc: Varved clay-silt; friable; moist-wet				
		12.5-13.2' mottled Bk/Gy sm-cgl: crse sand & gravel; wet (**perched groundwater**)		688	SS	
			1389.0			
		Marsh Mat Dk Bn/Bn oc-sc: silty-clay w/ organic matter (twigs & roots)	13.2			
			1388.2			WT
			14.0	689	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

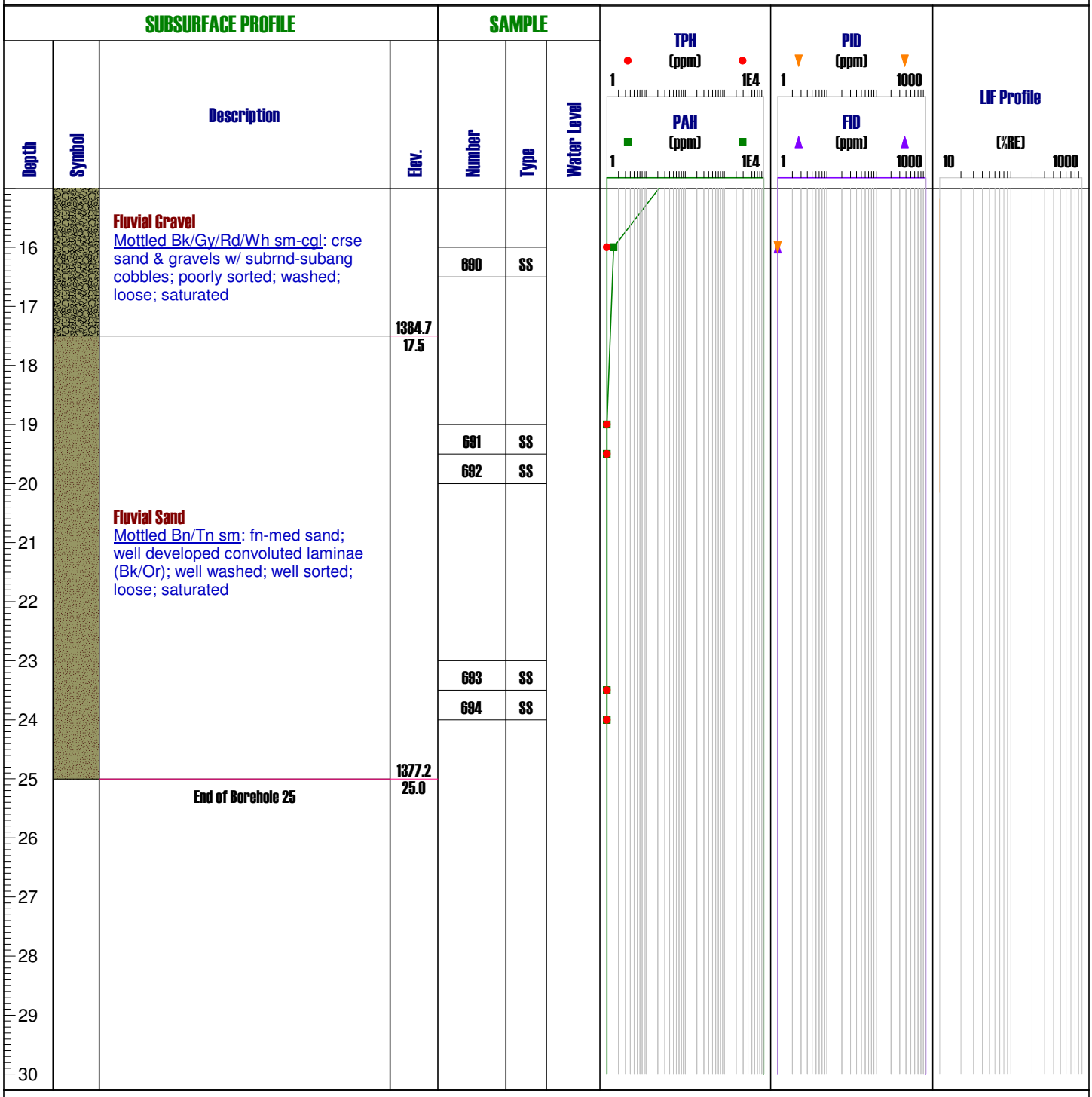
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB07

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944614.1
Easting: 361850.2
Elevation: 1402.17
Logged By: dge



Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB08

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944561.3
Easting: 361674.8
Elevation: 1402.9
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
0		Ground Surface	1402.9			
		FILL (Base) Rd/Or sc-oc: clayey silt w/ <med sand; sorted; friable; dry	0.0			
2			1400.9			
		Black Sand (Tailings) Bk sm: Bk med sand/tailings; magnetite and umafic tails; v. homogenous; loose; dry	2.0			
3			1399.5			
			3.4			
5				695	SS	
6		**Mixed Alluvium/Tailings** Gn/Bk sm: reworked tailings (magnetite & umafic) w/ coal cinder/ ash; some qtz-mgt cobbles/pebbles (over-size ore); massive; poorly sorted; wet				
10				696	SS	PW
11			1391.4			
			11.5			
13				697	SS	
14						WT
15				698	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB08

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944561.3
Easting: 361674.8
Elevation: 1402.9
Logged By: dge

SUBSURFACE PROFILE | **SAMPLE**

Depth	Symbol	Description	Elev.	Number	Type	Water Level
16						
17		**Fluvial Sand** Mottled Wh/Bn/Bk/Pnk sm: med sand; weakly developed bedding to massive; well washed; well sorted; loose; saturated;				
18						
19		13.0-13.5' **wthr LNAPL**				
20				699	SS	
21			1381.9 21.0			
22		**Overbank (Clayey Silt)** Mottled Gy/Lt Gy sm: fn-med sand; well sorted; well washed; loose; saturated				
23						
24				700	SS	
25		End of Borehole 25	1377.9 25.0			
26						
27						
28						
29						
30						

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4

PID (ppm) 1 – 1000; FID (ppm) 1 – 1000

LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

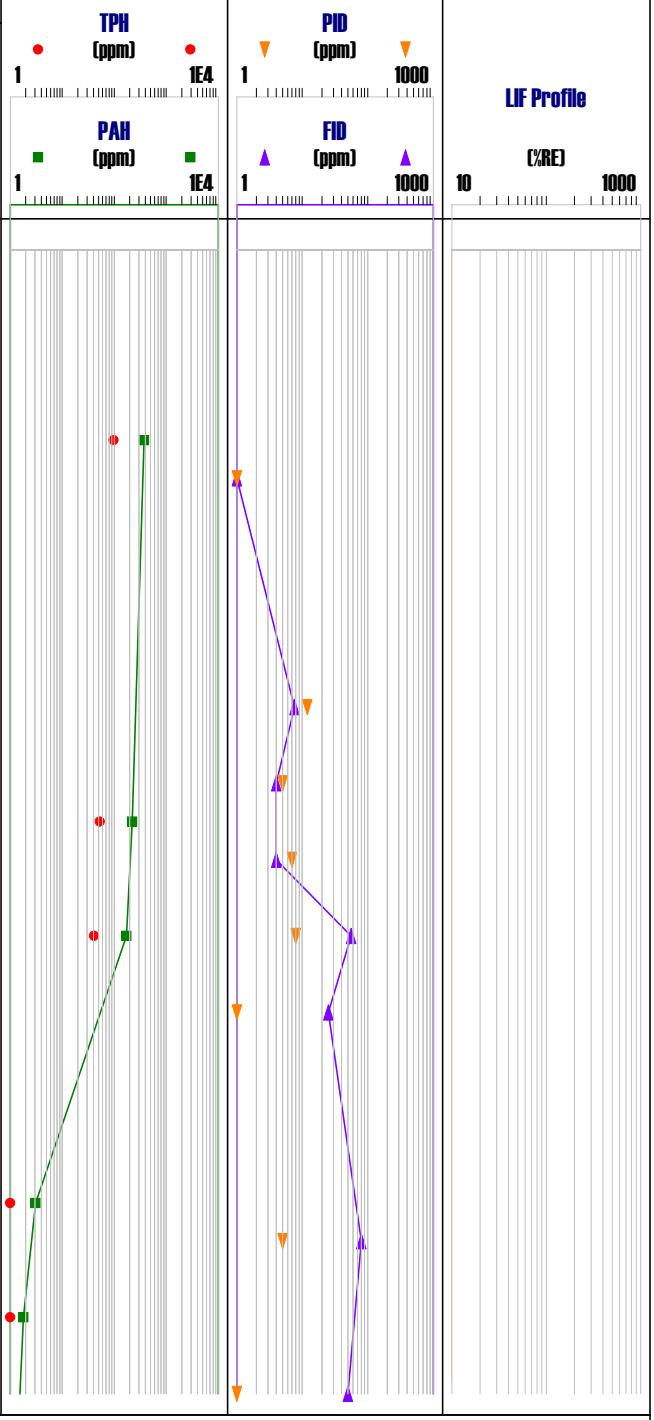
Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB09

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944514
Easting: 361481.9
Elevation: 1408.36
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	**Ground Surface**	1403.5			
	FILL (Base) Bn/Lt Bn/Tn sc-sm: silt to fn sand, w/sparse subrnd to ang pebbles; well sorted; loose; dry	0.0			
1		1401.8			
2	**Black Sand (Tailings)** Bk sm: Bk med sand/tailings; magnetite and umafic tails; v. homogenous; loose; dry	1.8			
3		1400.5	701	SS	
		3.0			
4	**Mixed Alluvium/Tailings** 3.0-6.8' Bn sm w/ <cgl: fn sand w/ sparse, subrnd-subang pebbles (gneiss); sorted; loose; damp				
5					PW
6	6.8-8.5' mottled Bk/Wh/Gy sm-cgl: pebbly fn-med sand, w/ subrnd-subang pebbles; sorted to poorly sorted; loose; moist-wet (**perched groundwater**)				
7					
			702	SS	
8		1395.0			
	Marsh Mat Dk Bn/Bn Organic Mat: abundant roots, grass, reeds, branches, twigs, etc.	8.5			
9			703	SS	
10		1393.5			
	Fluvial Gravel Mottled Bk/Wh/Gy sm-cgl: pebbly v. crse sand, w/ subrnd-subang pebbles (bt-qtz-gn); moderately to poorly sorted; loose; saturated (**water table**)	10.0			
11					WT
12		1392.0			
		11.5			
13	**Fluvial Sand** Mottled Gy/Wh/Bk/Rd sm-cgl: med sand; sorted to moderately; weakly developed laminae to massive; loose; washed; saturated		704	SS	
14			705	SS	
15					



Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

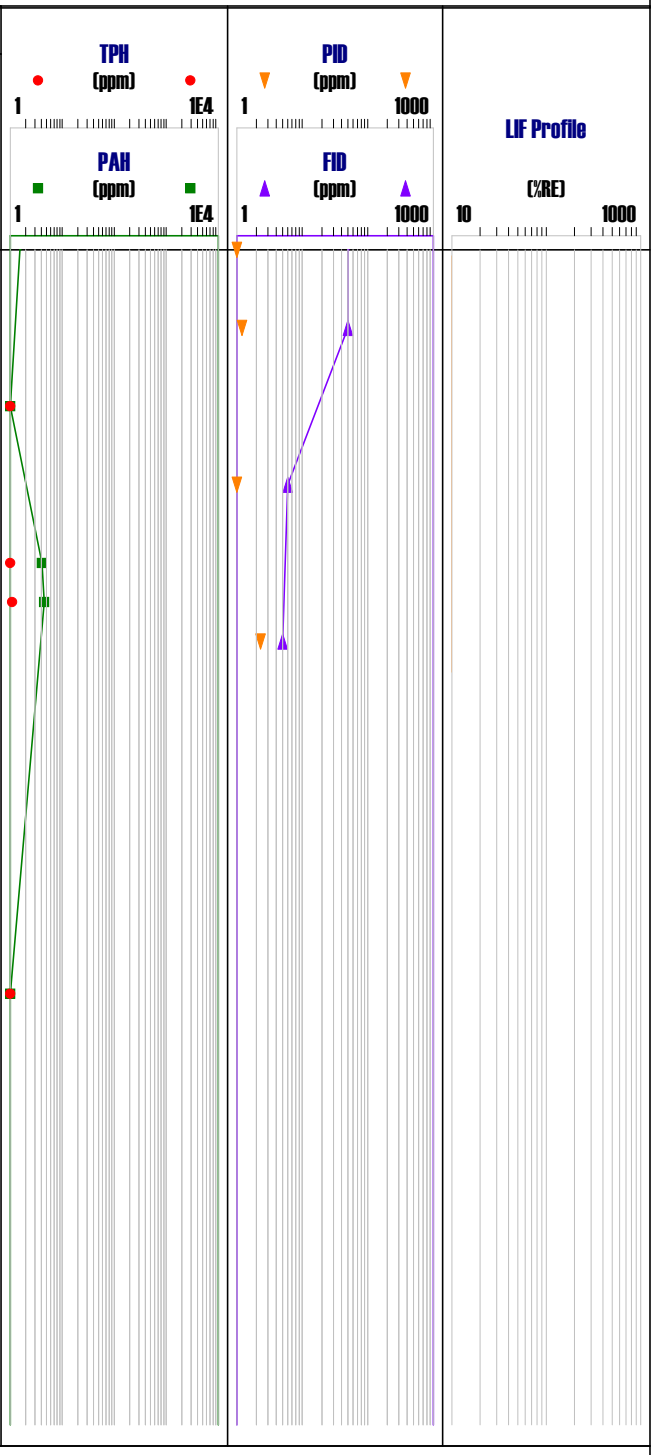
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB09

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944514
Easting: 361481.9
Elevation: 1408.36
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
			1388.0			
			15.5			
16		**Fluvial Gravel** Mottled Bk/Wh/Gy sm-cgl: pebbly v. crse sand, w/ subrnd-subang pebbles (bt-qtz-gn); moderately to poorly sorted; loose; saturated	1387.0			
			16.5			
17				706	SS	
18						
19				707	SS	
				708	SS	
20						
21		**Fluvial Sand** Mottled Bk/Tn/Bn sm-cgl: med sand; sorted to moderately; weakly to well developed convoluted laminae; loose; washed; saturated				
22						
23						
24						
			1378.5	709	SS	
25		End of Borehole 25	25.0			
26						
27						
28						
29						
30						



Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB10

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944447.8
Easting: 361291.8
Elevation: 1402.82
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1402.8			
	FILL (Base) Dk Bn/Dk Rd sc-oc: clayey silt w/ some cobbles; unsorted sorted; firm; friable; dry-moist	0.0			
2		1400.8 2.0			PW
4			710	SS	
6	**Green Sand (Tailings)** Gy/Gn sm; fn-med sand reworked tailings, weakly devleoped laminae, loose; v. well sorted; damp		711	SS	
10			712	SS	
11	**Marsh Mat** Dk Bn oc-sc: varved silty-clay w/ organic matter (twigs & roots)	1391.8 11.0			
12		1390.4 12.4	713	SS	
13			714	SS	
14					WT
15		1387.8 15.0	715	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB10

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944447.8
Easting: 361291.8
Elevation: 1402.82
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16		**Fluvial Sand** 12.4-13.8' mottled Bk/Wh/Gy sm: fn-med sand; well washed; well sorted; loose; saturated (**water table**)				
17		13.8-14.6' mottled Bk/Wh/Gy/Rd sm: crse sand; v. well washed; v. well sorted; loose; saturated				
18		**Fluvial Sand** 14.6-19.0' Gy sm-sc: fn sand to silt; well developed convoluted laminae; v. well washed; v. well sorted; loose; saturated				
19			1383.8 19.0			
20				716	SS	
21						
22		**Overbank (Clayey Silt)** Mottled Tn/Or sc: silt; well developed convoluted laminae; v. well washed; v. well sorted; loose; firm; saturated		717	SS	
23				718	SS	
24						
25		End of Borehole 25	1377.8 25.0			
26						
27						
28						
29						
30						

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

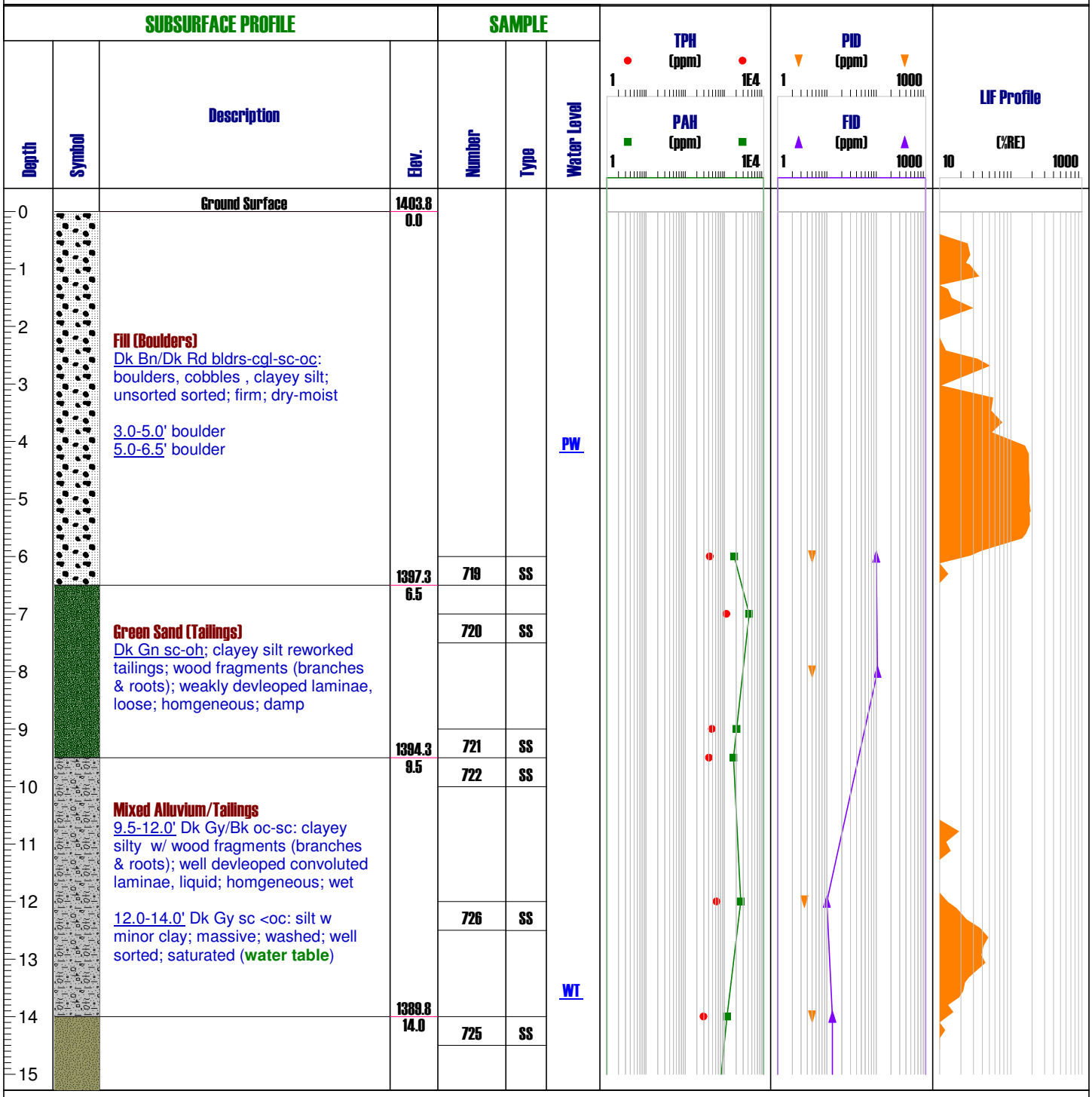
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB11

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944447.8
Easting: 361291.8
Elevation: 1403.79
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB11

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944447.8
Easting: 361291.8
Elevation: 1403.79
Logged By: dge

SUBSURFACE PROFILE				SAMPLE			TPH (ppm) 1 – 1E4 / PAH (ppm) 1 – 1E4	PID (ppm) 1 – 1000 / FID (ppm) 1 – 1000	LIF Profile (%RE) 10 – 1000
Depth	Symbol	Description	Elev.	Number	Type	Water Level			
16									
17		**Fluvial Sand** 14.0-17.0' mottled Gy/Bk/Rd sm: med-crse sand; massive; well washed; well sorted; loose; saturated							
18				724	SS				
19		17.0-19.0' mottled Lt Gy/Gy/Rd sm: v. crse sand w/ occassional pebble; well washed; sorted to well sorted; loose; saturated		723	SS				
20									
21		19.0-23.0' mottled Tn/Bn sm: fn-med sand; well developed laminae; v. well washed; v. well sorted; loose; saturated							
22									
23		23.0-25.0' mottled Lt Bn/Tn sm: fn sand; well developed convoluted laminae; washed; v. well sorted; firm; saturated							
24				727	SS				
25			1378.8 25.0						
		End of Borehole 25							
26									
27									
28									
29									
30									

Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

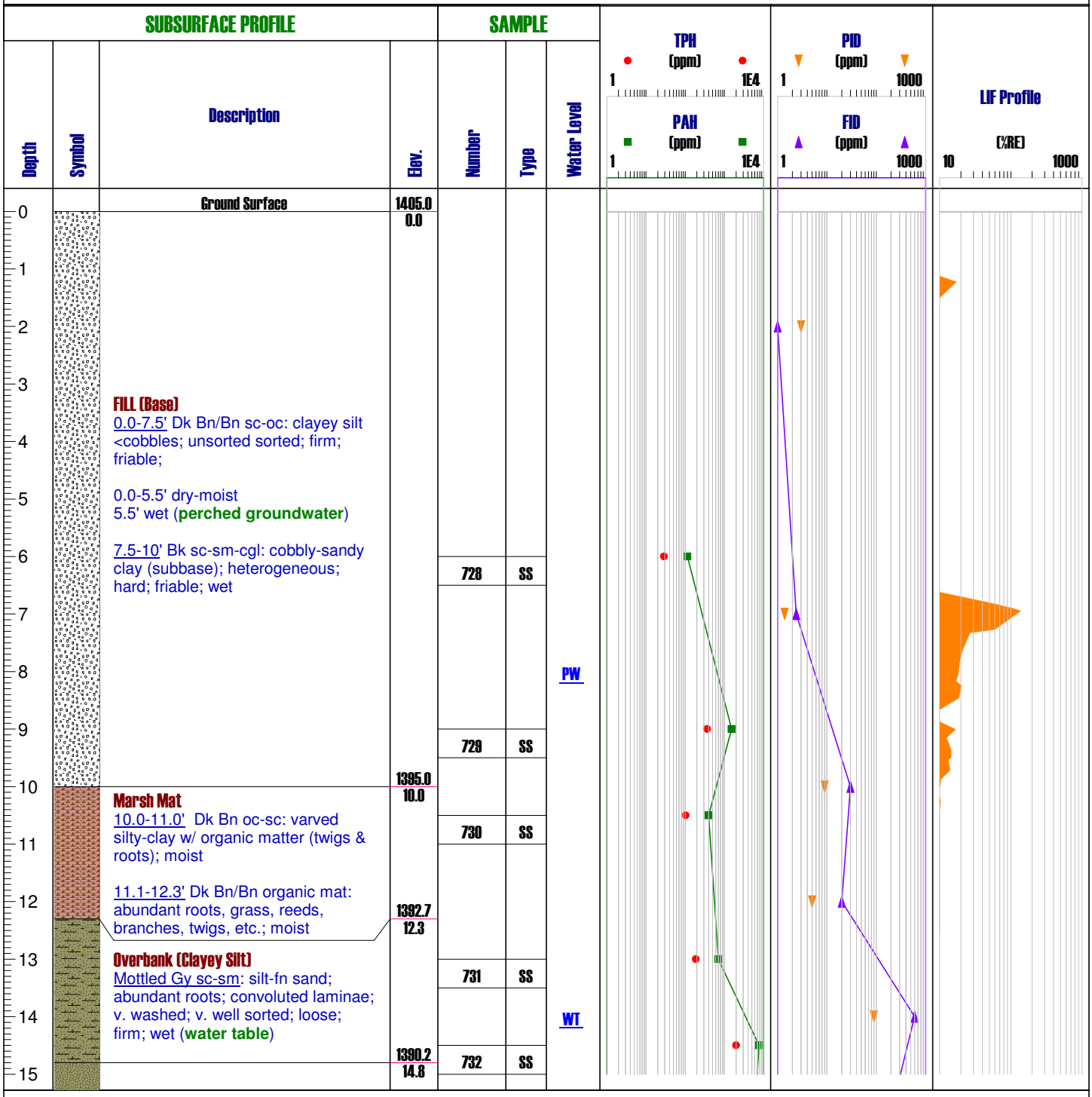
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB12

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944322.1
Easting: 360908.4
Elevation: 1405.03
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB12

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944322.1
Easting: 360908.4
Elevation: 1405.03
Logged By: dge

SUBSURFACE PROFILE				SAMPLE			TPH (ppm) 1 – 1E4 / PAH (ppm) 1 – 1E4	PID (ppm) 1 – 1000 / FID (ppm) 1 – 1000	LIF Profile (%RE) 10 – 1000
Depth	Symbol	Description	Elev.	Number	Type	Water Level			
16									
17									
18									
19				733	SS				
20		**Fluvial Sand** 14.8-17.0' mottled Bk/Wh/Gy sm: fn-med sand; abundant roots; vuggy; washed; well sorted; firm; saturated							
21		17.0-18.5' mottled Pnk/Bk/Gy sm: crse-med sand; weakly developed laminae; well washed; well sorted; loose; saturated							
22									
23		18.5-20.0' mottled Tn/Gy/Bk/Wh/Pnk sm: med sand; convoluted laminae; v. well washed; well sorted; loose; saturated							
24				734	SS				
25		20.0-30.0' mottled Bk/Tn/Bn sm: fn-med sand; well developed convoluted laminae; well washed; v. well sorted; loose; saturated							
26				735	SS				
27									
28				736	SS				
29				737	SS				
30			1375.0 30.0						

Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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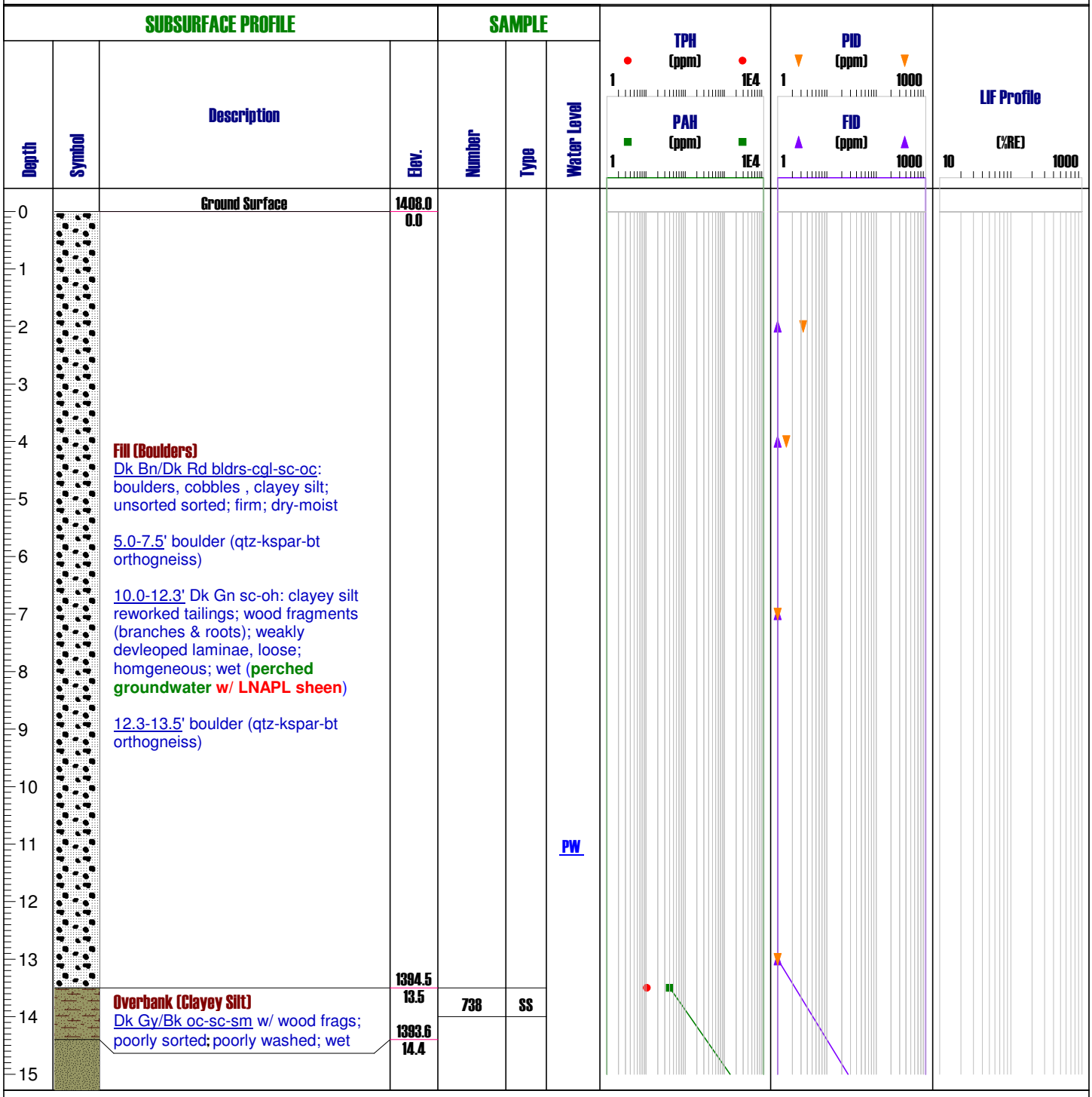
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB13

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944167.1
Easting: 360783.5
Elevation: 1407.99
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB13

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944167.1
Easting: 360783.5
Elevation: 1407.99
Logged By: dge

SUBSURFACE PROFILE				SAMPLE			TPH (ppm) 1 – 1E4 / PAH (ppm) 1 – 1E4	PID (ppm) 1 – 1000 / FID (ppm) 1 – 1000	LIF Profile (%RE) 10 – 1000
Depth	Symbol	Description	Elev.	Number	Type	Water Level			
16						WT			
17				739	SS				
18				740	SS				
19									
20		**Fluvial Sand** 14.4-15.0' mottled Gy/Bk/Lt Gy sm: med sand; well developed bedding (<0.5"); washed; well sorted; loose; saturated							
21									
22		15.0-16.0' mottled Rd/Gn sm-cgl: crse sand and gravels; ang-subrnd pebbles; massive; mod washed; sorted; loose; saturated		741	SS				
23									
24		16.0-30.0' mottled Tn/Wh/Gy/Or sm: fn sand w/ sparse rnd-subrnd pebbles; well developed convoluted laminae (Bk/Tn or Bk/Or); well washed; well sorted; loose; saturated							
25									
26									
27									
28				742	SS				
29				743	SS				
30			1378.0 30.0						

Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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Datum: NAD83/2011
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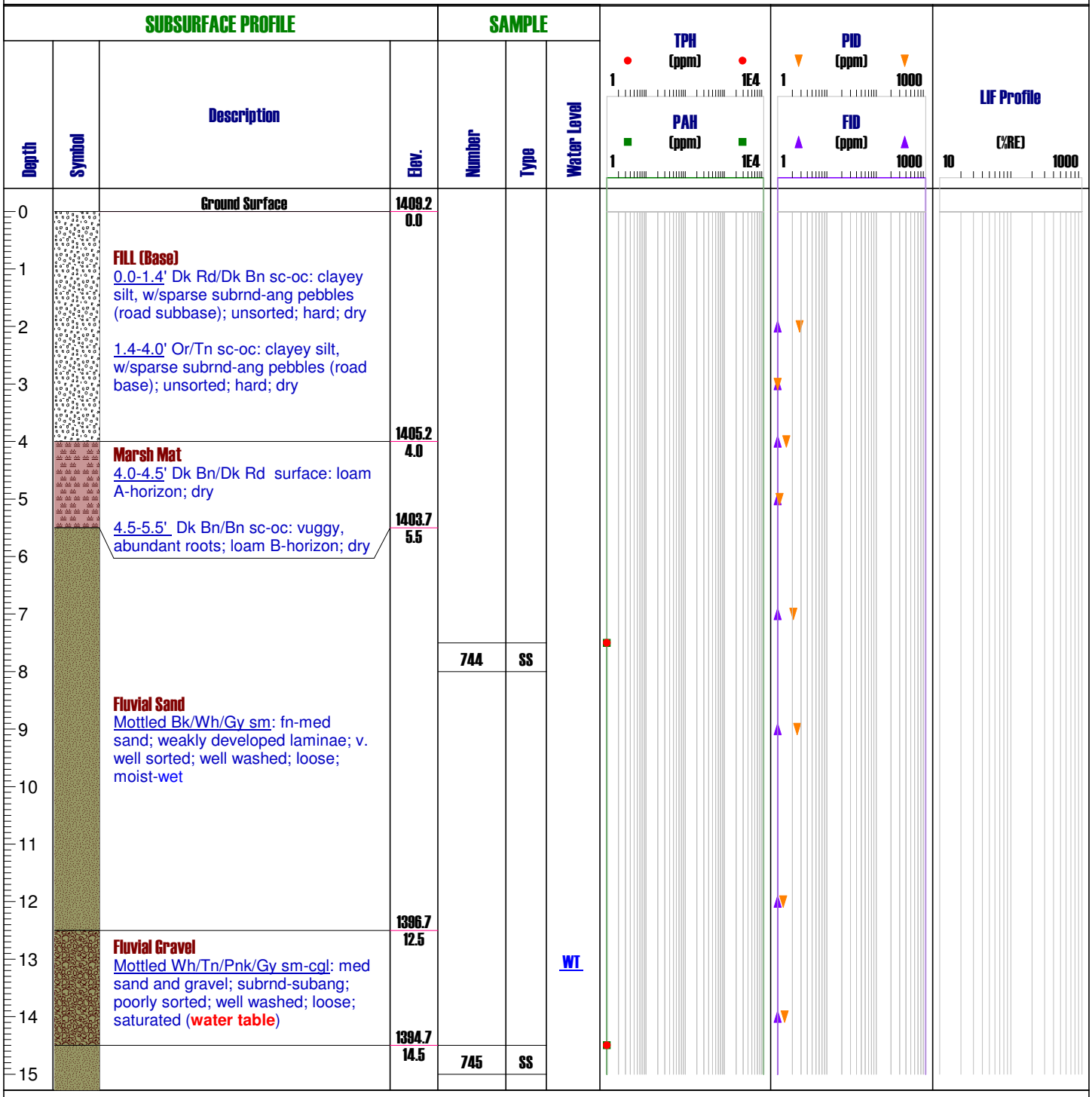
Sheet: 2 of 2

Log of Borehole SB14

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944104
Easting: 360749.3
Elevation: 1408.36
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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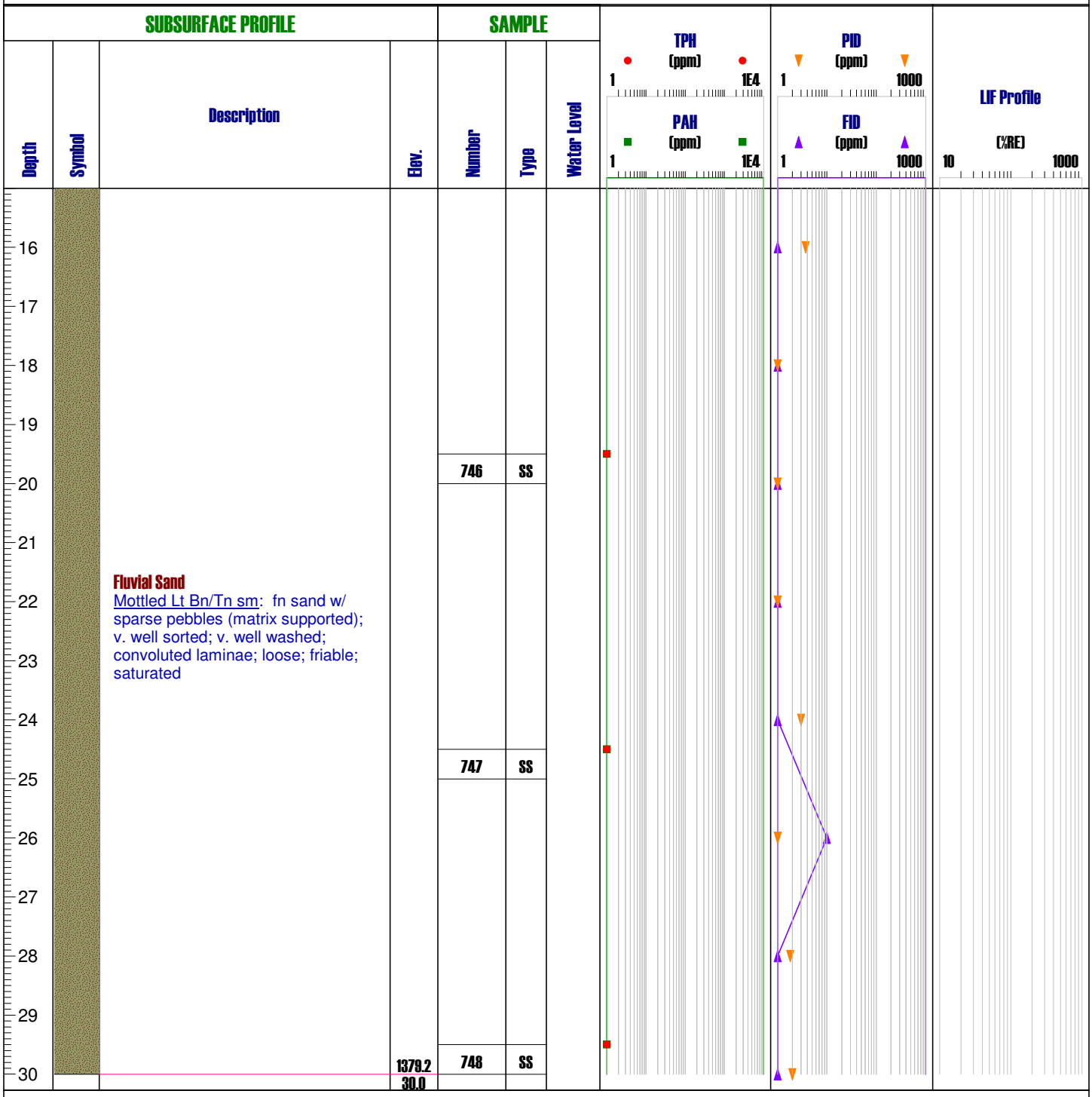
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB14

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944104
Easting: 360749.3
Elevation: 1408.36
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

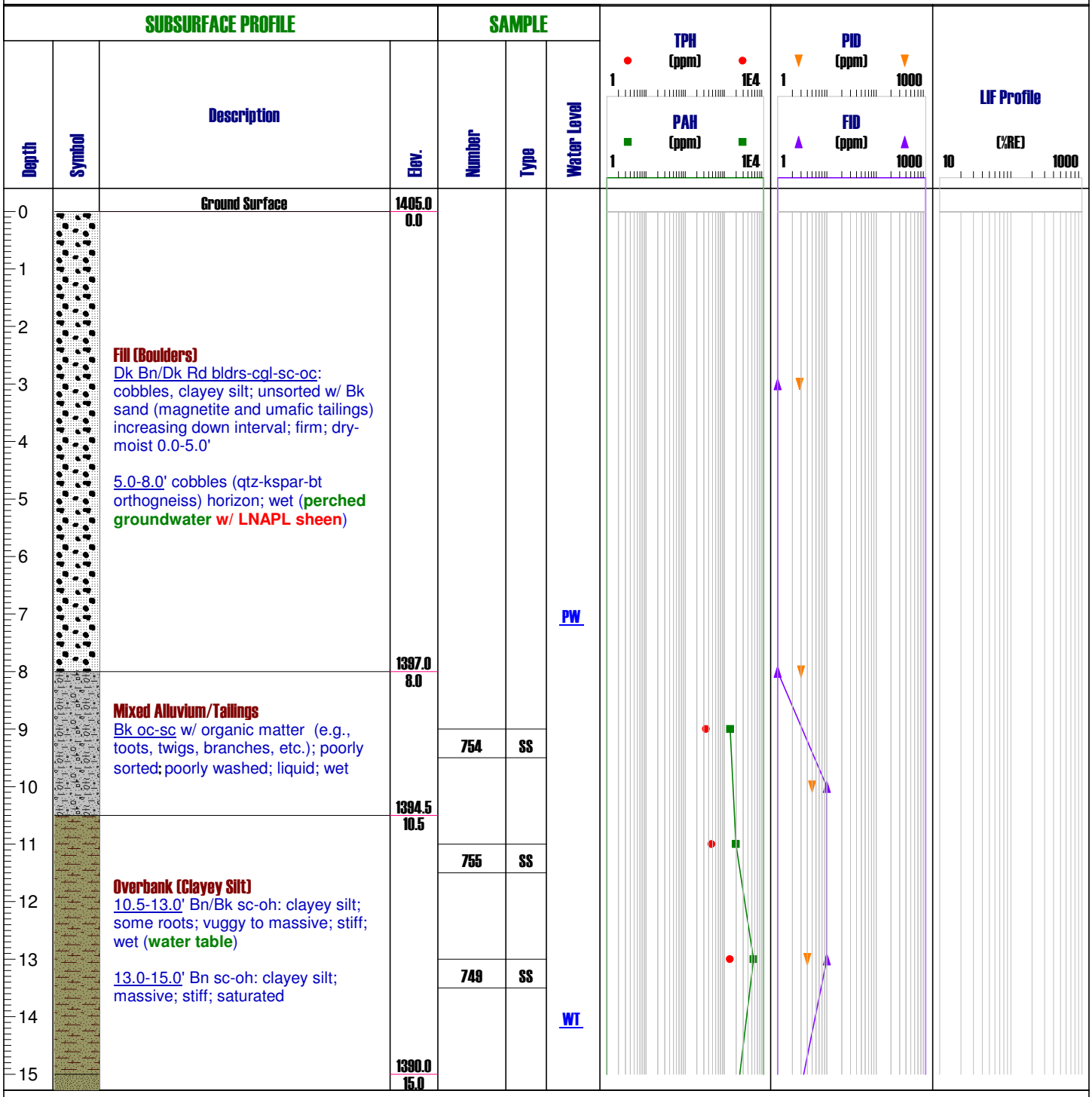
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB15

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944254.1
Easting: 360832.4
Elevation: 1405.03
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

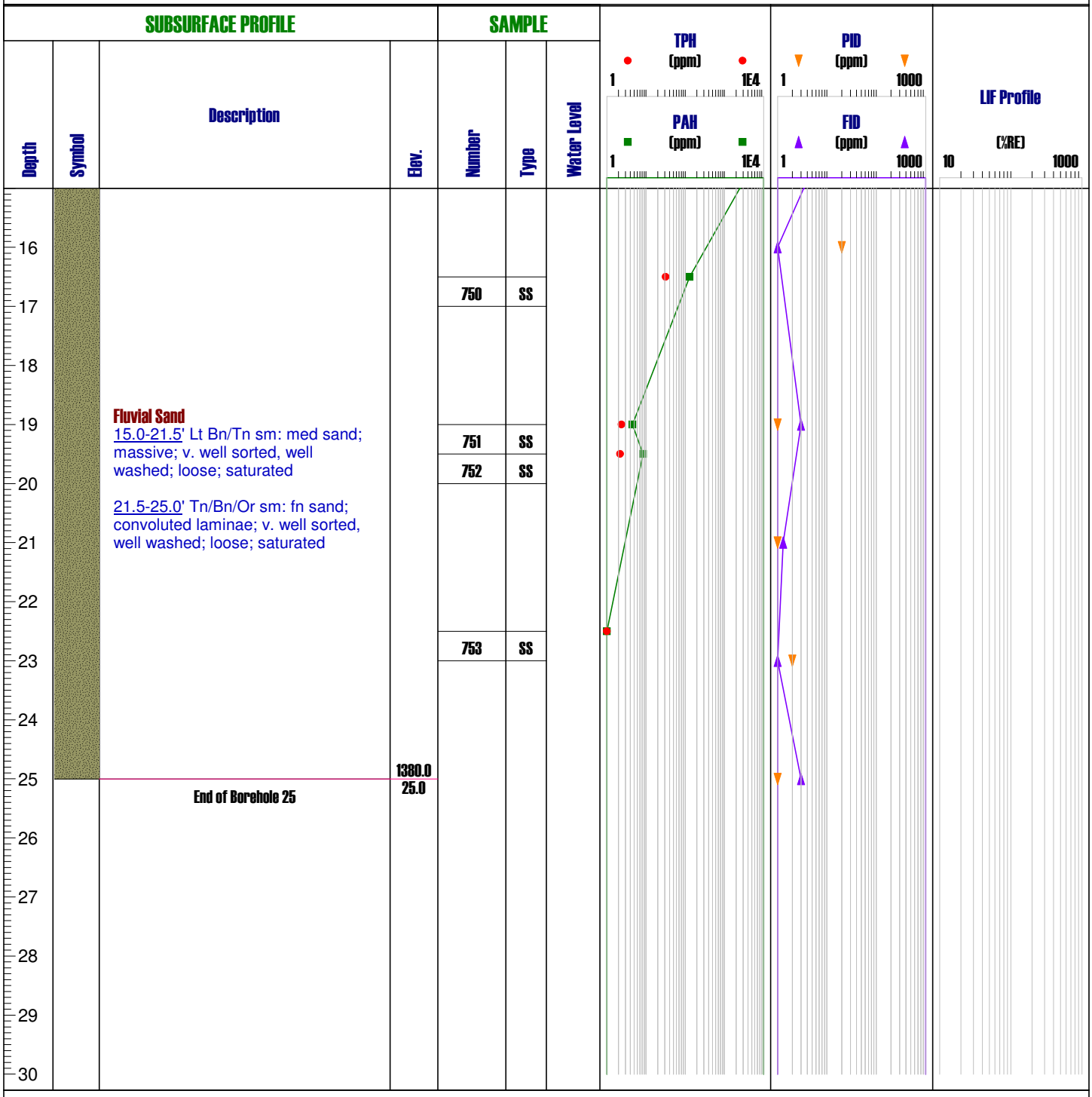
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB15

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944254.1
Easting: 360832.4
Elevation: 1405.03
Logged By: dge



Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB16

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944347
Easting: 361013.3
Elevation: 1403.33
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1403.3			
	Fill (Boulders) Dk Bn/Dk Rd sc-oc/oh w/ cgl/bldr: clayey silt w/ cobbles/boulders overlying original surface; unsorted; firm; friable; dry-moist	0.0			
6			756	SS	PW
	Marsh Mat Dk Bn/Bn oc/oh-sc: silty clay w/ abundant roots, grass, reeds, branches, twigs, etc.; moist	1396.3 7.0			
		1394.8 8.5	757	SS	
9	**Overbank (Clayey Silt)** Mottled Bn oh/oc-sc: silty clay; some roots; vuggy to massive; plastic; firm; moist				
10			758	SS	
		1392.8 10.5			
11			759	SS	
12	**Fluvial Sand** 10.5-15.5' mottled Gy/Dk Gy sm: fn-med sand; some roots; massive; washed; well sorted; firm; saturated (**water table**)				WT
13			760	SS	
14					
15		1388.3 15.0	761	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB16

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944347
Easting: 361013.3
Elevation: 1403.33
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16						
17						
18		**Fluvial Sand** 15.5-16.5' mottled Bk/Gy sm: crse sand; massive; v. well washed; v. well sorted; loose; saturated		762	SS	
19		16.5-17.0' Bn oc-sc; silty clay; abundant organic matter; massive; saturated				
20		17.0-18.5' mottled Bk/Gy/Wh/Pnk sm: crse sand; massive; v. well washed; v. well sorted; loose; saturated				
21						
22		18.5-25.0' mottled Tn/Gy/Bk/Wh/Pnk sm: med sand; convoluted laminae; v. well washed; well sorted; loose; saturated		763	SS	
23						
24						
25		End of Borehole 25	1378.3 25.0			
26						
27						
28						
29						
30						

Drill Method: Sonic
Drill Date: 10/2/15
Hole Size: 6-inch

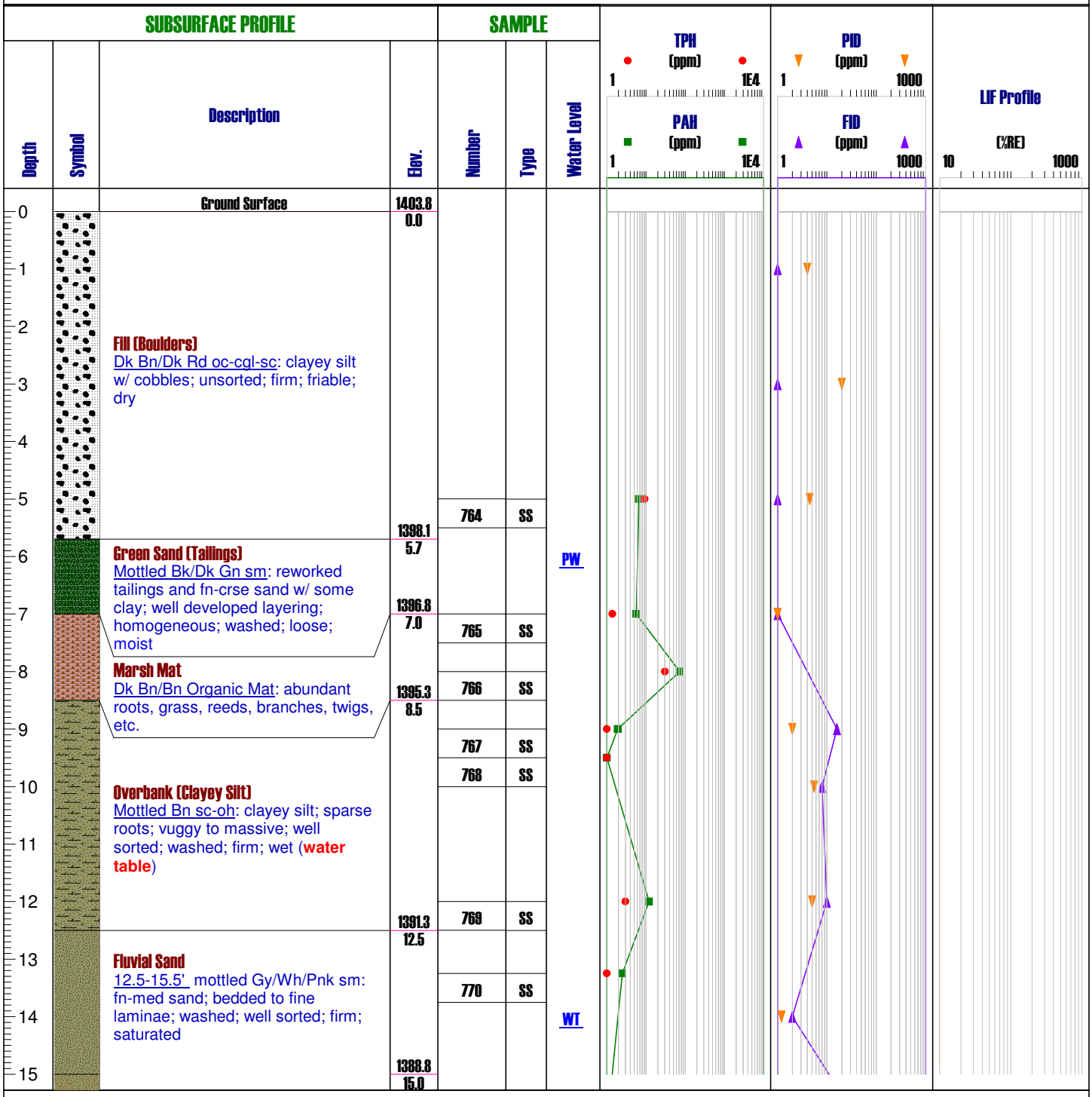
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB17

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944407.8
Easting: 361202
Elevation: 1403.77
Logged By: dge



Drill Method: Sonic
Drill Date: 10/3/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB17

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944407.8
Easting: 361202
Elevation: 1403.77
Logged By: dge

SUBSURFACE PROFILE				SAMPLE			TPH (ppm) 1 – 1E4 / PAH (ppm) 1 – 1E4	PID (ppm) 1 – 1000 / FID (ppm) 1 – 1000	LIF Profile (%RE) 10 – 1000
Depth	Symbol	Description	Elev.	Number	Type	Water Level			
16									
17				771	SS				
18									
19		**Fluvial Sand** 15.5-17.5' mottled Bk/Gy/Wh/Pnk sm: crse sand; massive; v. well washed; v. well sorted; loose; saturated							
20									
21		17.5-25.0' mottled Tn/Gy/Bk/Wh/Pnk sm: med sand; convoluted laminae; v. well washed; well sorted; loose; saturated							
22									
23				772	SS				
24									
25			1378.8 25.0						
		End of Borehole 25							
26									
27									
28									
29									
30									

Drill Method: Sonic
Drill Date: 10/3/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB18

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944484
Easting: 361386.1
Elevation: 1403
Logged By: dge

Depth	Description	Elev.	Number	Type	Water Level
0	Ground Surface	1403.0			
	Fill (Boulders) 0.0-1.5' Or/Bn oc-sc w/ cgl: clayey silt w/ cobbles; unsorted; firm; friable; dry	0.0			
2	1.5-2.5' Or/Tn oc-sc/sm: clayey silt-sand; massive; firm; friable; wet (perched groundwater)	1400.5	773	SS	
		2.5			PW
4	**Green Sand (Tailings)** 2.5-8.0' mottled Dk Gn/Bk sm: reworked tailings (fn-crse sand w/ some clay); weakly developed layering w/ sparse pebbles & clay balls; heterogeneous; poorly washed; loose; wet		774	SS	
7	8.0-9.0' Bk/Dk Gy sm-cgl: crse sand and cobble; subang-ang cobbles (mine waste); subbase fill; wet		775	SS	
9	**Marsh Mat** Bk Organic Layer (oc-oh): abundant roots, grass, reeds, branches, twigs, etc.	1394.0 9.0	776	SS	
10		1392.7 10.3			
11	**Overbank (Clayey Silt)** Mottled Lt Gy sc-oh: clayey silt; branch & root frags; massive; well sorted; moderately washed; firm; wet (**water table**)		778	SS	WT
13		1390.0 13.0	779	SS	
	Fluvial Sand 13.0-16.0' mottled Gn/Tn sm: med-crse sand; well washed; well sorted; loose; saturated		780	SS	
15		1388.0 15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/4/15
Hole Size: 6-inch

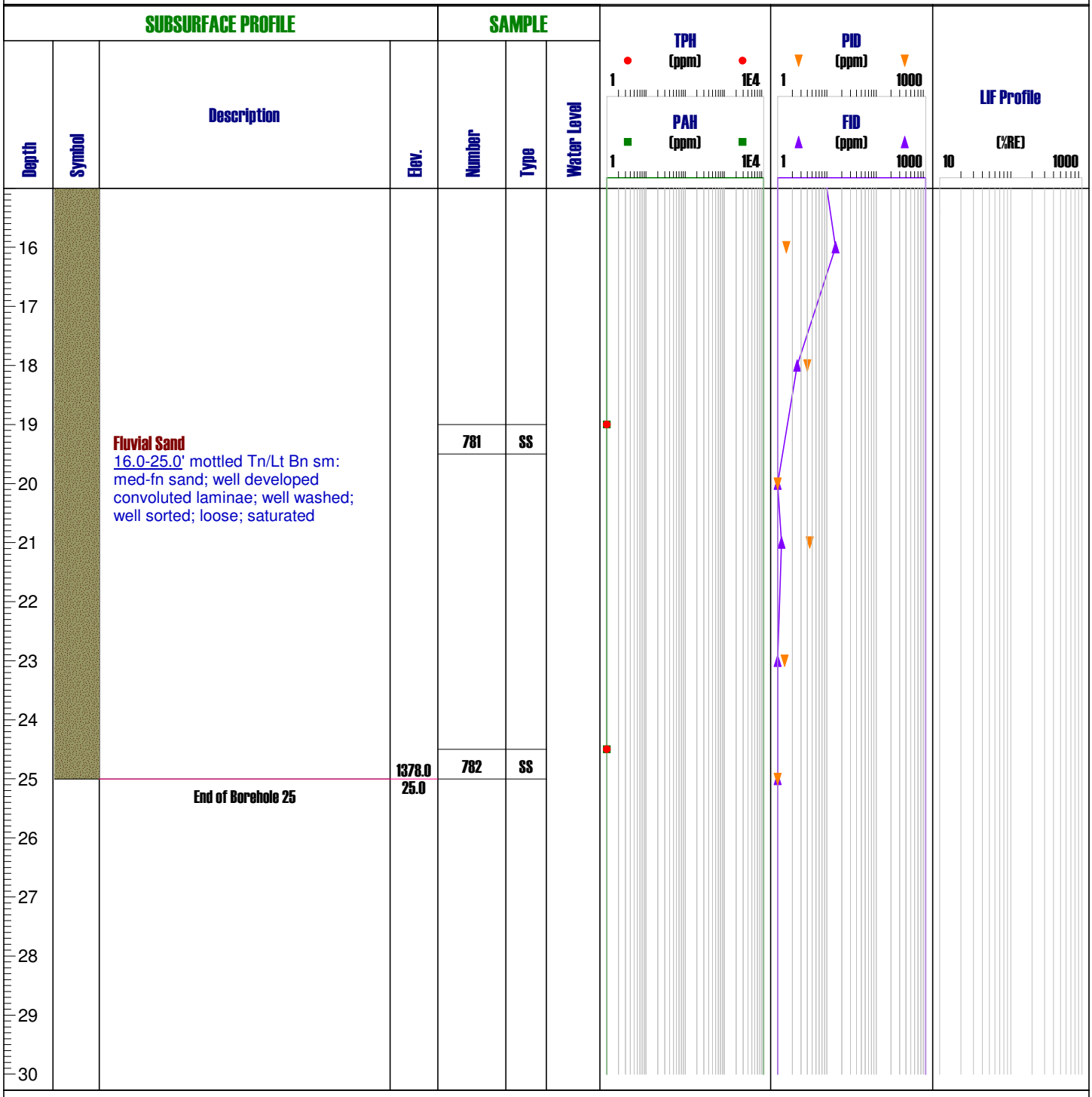
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB18

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944484
Easting: 361386.1
Elevation: 1403
Logged By: dge



Drill Method: Sonic
Drill Date: 10/4/15
Hole Size: 6-inch

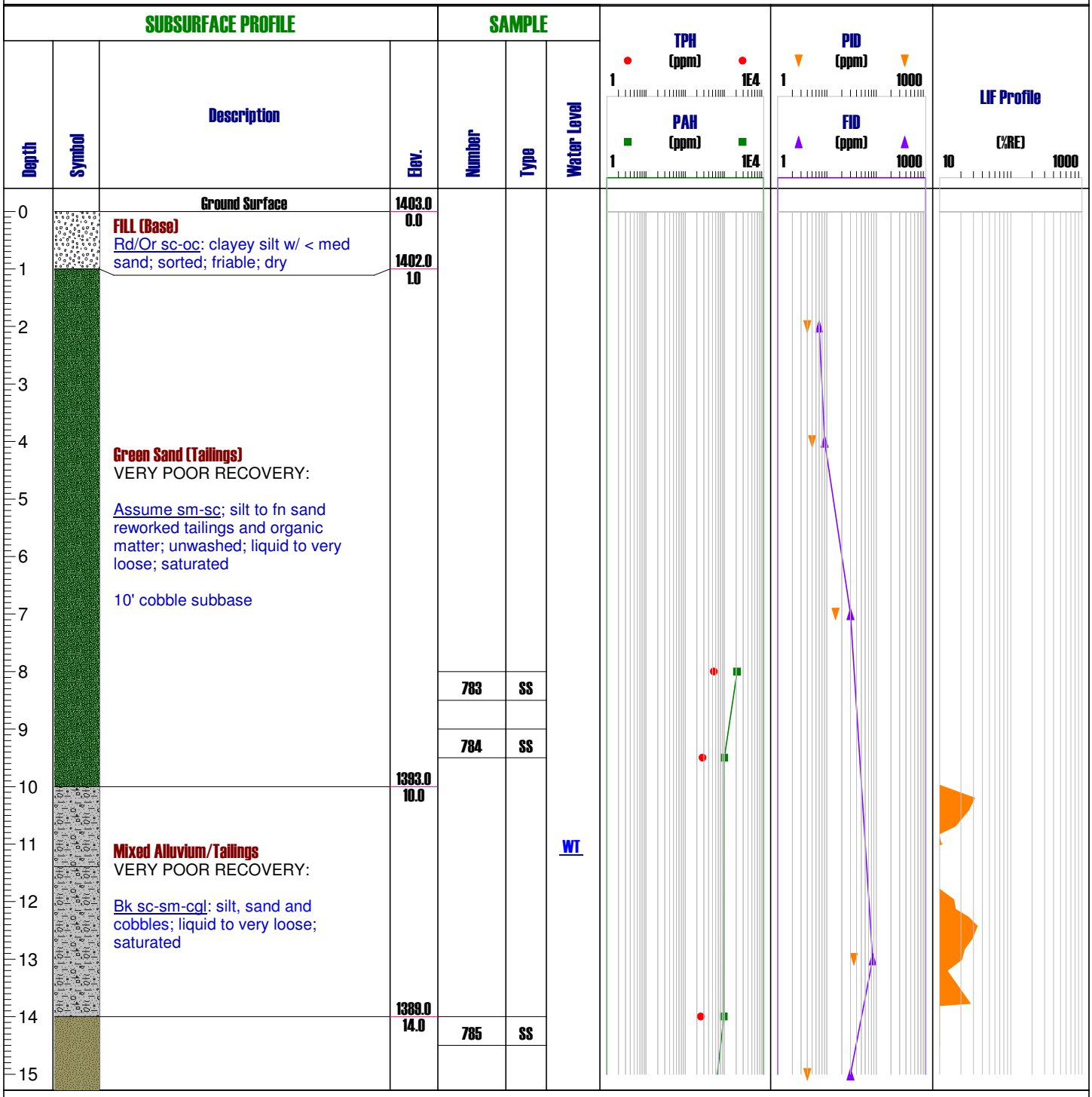
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB19

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944539.1
Easting: 361578.7
Elevation: 1403
Logged By: dge



Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

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Edison, NJ 08520

Datum: NAD83/2011
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Sheet: 1 of 2

Log of Borehole SB19

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944539.1
Easting: 361578.7
Elevation: 1403
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16						
17				786	SS	
18						
19				787	SS	
20				788	SS	
21		**Fluvial Sand** 14.0-23.0' mottled Bk/Or sm w/ cgl: crse-med sand w/ some subrnd-subang pebbles; well washed; well sorted; loose; saturated; **wthr** **LNAPL w/ deisel odor**				
22						
23		23.0-30.0' mottled Bk/Tn/Pnk sm: med sand; well washed; well sorted; loose; saturated				
24						
25						
26				789	SS	
27						
28						
29						
30			1373.0 30.0	790	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/1/15
Hole Size: 6-inch

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Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB20

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944486.3
Easting: 361620.3
Elevation: 1404.3
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1404.3			
		0.0			
	FILL (Base) Bn/Rd sm-sc-oc/oh: fn sand, silt & clay; heterogeneous; unsorted; firm; dry				
4			791	SS	
5			792	SS	
6		1398.3			
	Black Sand (Tailings) Bk sm: Med grain (sand) tailings; magnetite and umafic tails; v. homogenous; loose; dry	6.0			
7			793	SS	
		1396.8			
	Mixed Alluvium/Tailings	7.5			
8	7.5-8.5' Dk Gy sc-oh/oc: clayey silt w/ roots; well sorted; unwashed; v. soft; wet (**perched groundwater**)		794	SS	
					PW
9	8.5-10.5' Gy/Lt Gy sc-oh/oc: clayey silt; fine laminae; v. well sorted; unwashed; soft; wet		795	SS	
10		1393.8			
		10.5			
11			796	SS	
12	**Overbank (Clayey Silt)** 10.5-13.0' mottled Lt Gy/Gy sm-sc-oc: clayey-silty fn sand; weakly developed laminae; moderately sorted; moderately washed; wet (**water table**)				
13			797	SS	
14					WT
15		1389.3			
		15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/4/15
Hole Size: 6-inch

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Datum: NAD83/2011
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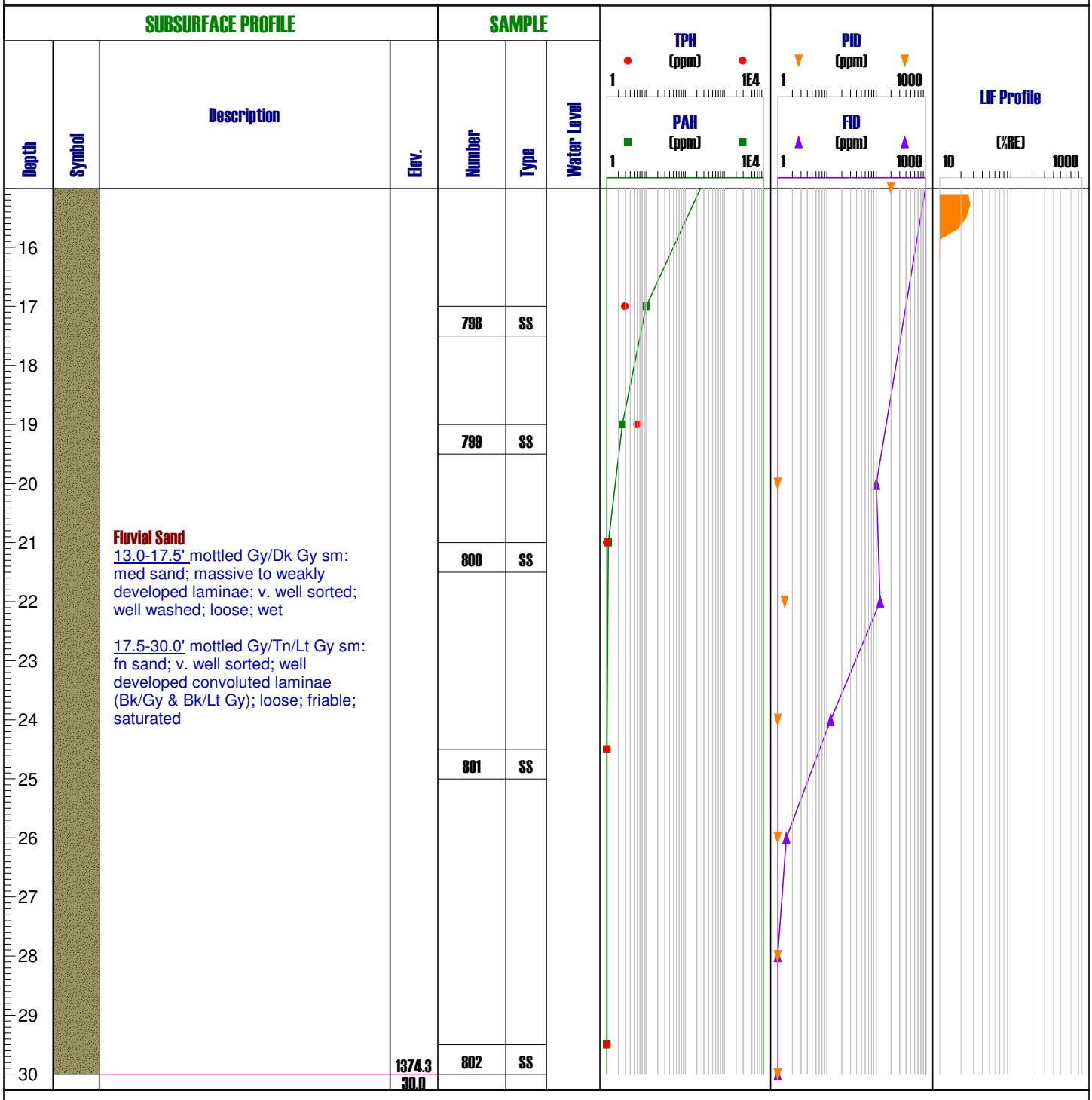
Sheet: 1 of 2

Log of Borehole SB20

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944486.3
Easting: 361620.3
Elevation: 1404.3
Logged By: dge



Drill Method: Sonic
Drill Date: 10/4/15
Hole Size: 6-inch

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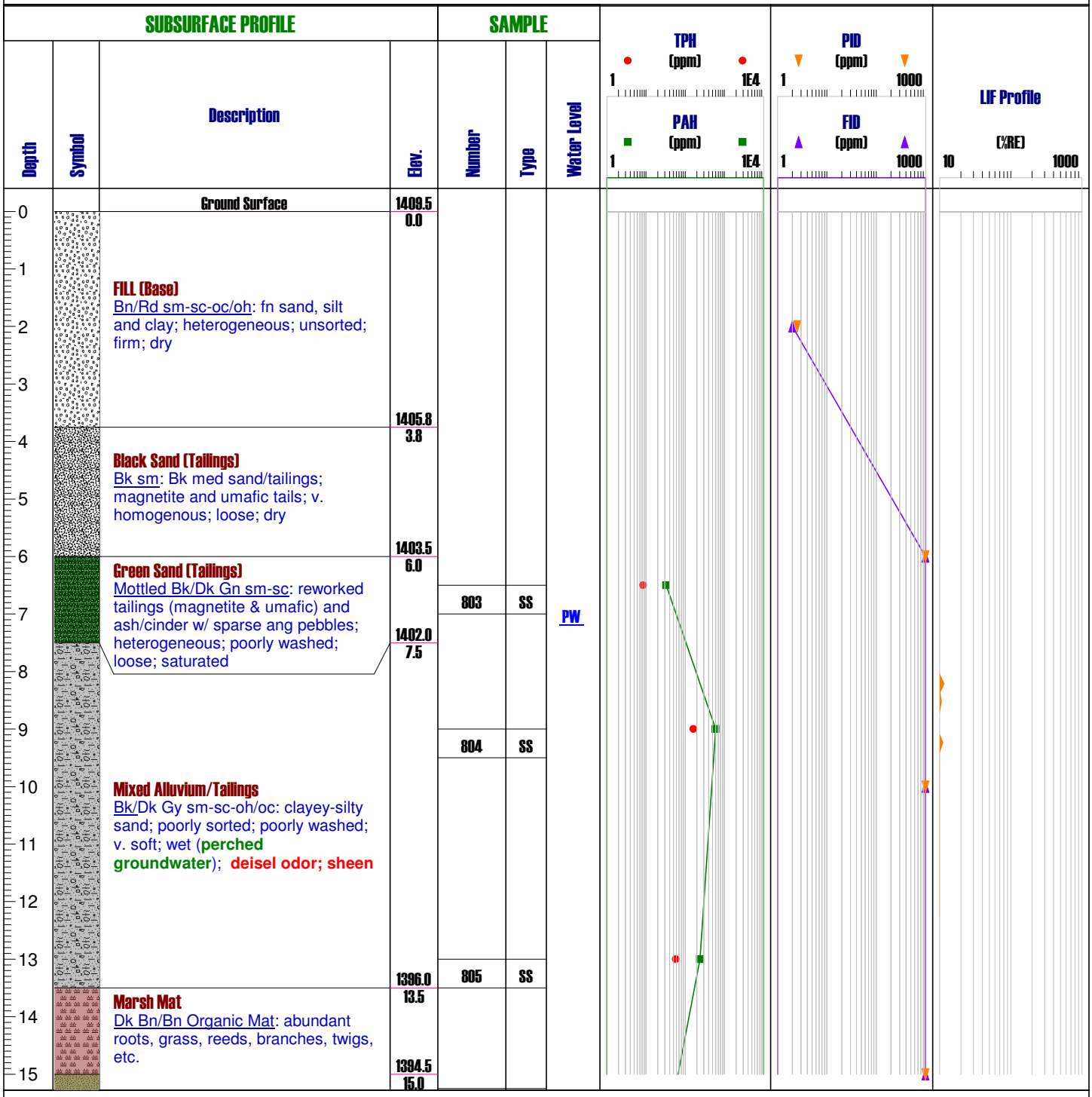
Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB21

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944424.4
Easting: 361700.6
Elevation: 1409.54
Logged By: dge



Drill Method: Sonic
Drill Date: 10/4/15
Hole Size: 6-inch

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Edison, NJ 08520

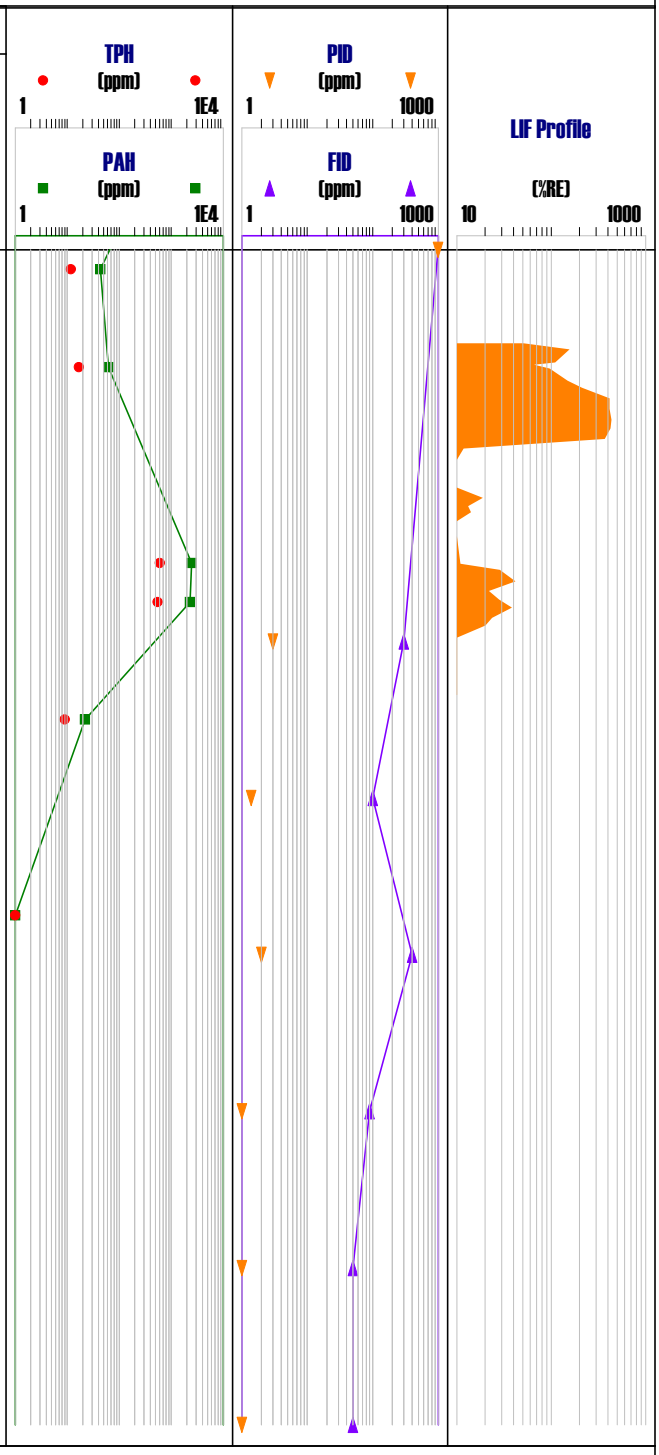
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB21

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944424.4
Easting: 361700.6
Elevation: 1409.54
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16				806	SS	WT
17				807	SS	
18						
19				808	SS	
				809	SS	
20						
21		**Fluvial Sand** 15.0-22.0' mottled Gy/Lt Gy/Bk/Wh sm: fn sand; massive to weakly developed laminae; moderately to well sorted; washed; loose; wet (**water table**)		810	SS	
22						
23		22.0-30.0' mottled Lt Gy/Tn/Pnk sm: fn sand; v. well sorted; well developed convoluted laminae (Bk/Tn & Gy/Tn); loose; friable; saturated				
24				811	SS	
25						
26						
27						
28						
29						
30			1379.5 30.0			



Drill Method: Sonic
Drill Date: 10/4/15
Hole Size: 6-inch

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Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB22

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944504.1
Easting: 361761.5
Elevation: 1406.36
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1406.4			
		0.0			
	FILL (Base) 0.0-7.5' Rd/Bn sm-sc-oc/oh: fn sand, silt and clay w/ ang cobbles; heterogeneous; unsorted; firm; dry; **wthr LNAPL** 7.5-9.0' Dk Gy/Or oc/oh-cgl: cobbly-silty clay (subbase); heterogeneous; unsorted; firm; wet (**perched groundwater**); **wthr LNAPL**				PW
7			813	SS	
8					
9	**Black Sand (Tailings)** Bk sm: Med grain (sand) tailings; magnetite and umafic tails; v. homogenous; loose; dry	1397.4 9.0	814	SS	
10		1395.9 10.5			
11			815	SS	
12	**Overbank (Clayey Silt)** Mottled Gy/Lt Gy oc/oh-sc: silty clay w/ organic matter (roots, twigs, etc.); well sorted; poorly washed; wet (**water table**)				
13					
14			816	SS	
15					

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/5/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

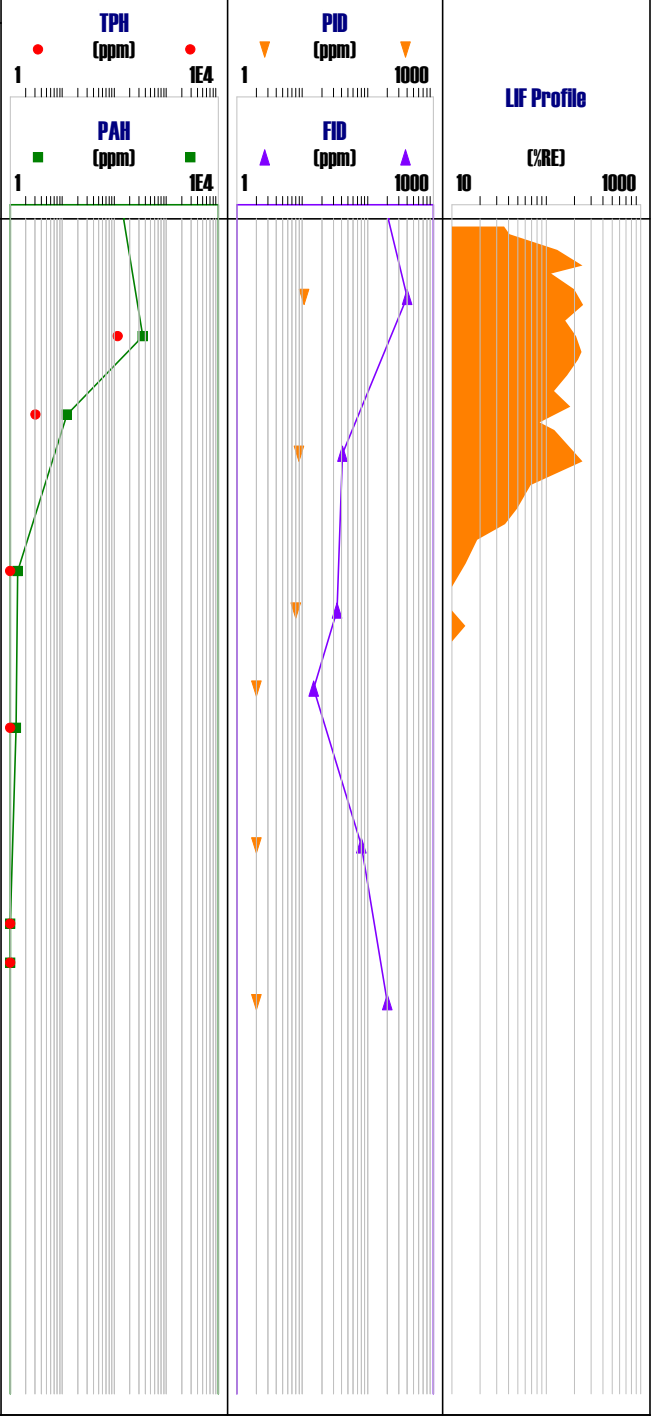
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB22

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944504.1
Easting: 361761.5
Elevation: 1406.36
Logged By: dge

Depth	Description	Elev.	Number	Type	Water Level
		1390.9			WT
		15.5			
16	**Fluvial Sand** 15.5-18.0' mottled Gy/Lt Gy/Bk/Wh sm: med-crse sand; thinly bedded to developed laminae; moderately sorted; well washed; loose; wet				
17			817	SS	
	18.0-19.5' Bk/Bn sc-oh/oc: clayey silt w/ organic matter (twigs, roots, etc); fine laminae; poorly washed; firm; moist				
18			818	SS	
19		1386.9			
	Fluvial Gravel Mottled Gn/Gy/Bk cgl-sm: sandy gravel; rnd-subang pebbles; moderately sorted; well washed; well drained; loose; saturated	19.5	819	SS	
20					
21		1385.4			
	Fluvial Sand Mottled Gy/Lt Gy sm: fn sand silt; v. well sorted; well washed; loose; saturated	21.0			
22			820	SS	
23					
24		1382.4			
	Fluvial Gravel Mottled Gn/Gy/Bk cgl-sm: sandy gravel; rnd-subang pebbles; moderately sorted; well washed; well drained; loose; saturated	24.0	821	SS	
		1381.4	822	SS	
25		25.0			
26	End of Borehole 25				
27					
28					
29					
30					



Drill Method: Sonic
Drill Date: 10/5/15
Hole Size: 6-inch

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Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole ERT3-D

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944579.9
Easting: 361775.3
Elevation: 1404.3
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1404.3			
		0.0			
	FILL (Base) 0.0-8.0' Or/Bn sm-sc-oc/oh: fn sand, silt and clay w/ ang cobbles; heterogeneous; unsorted; firm; dry 8.0-9.0' Dk Gy/Or oc/oh-cgl: cobbly-silty clay (subbase); heterogeneous; unsorted; firm; wet (perched groundwater); **wthr** **LNAPL**		823	SS	
					PW
		1395.3			
	Black Sand (Tailings) Bk sm: Bk med sand/tailings; magnetite and umafic tails; v. homogenous; loose; moist	9.0	824	SS	
		1393.8			
	Marsh Mat Mottled Gy/Lt Gy oc/oh-sc: clayey silt w/ organic matter (roots, twigs, grass, etc.); moist	10.5			
		1393.0	824	SS	
		11.3			
	Fluvial Sand 11.3-13.5' mottled Gy/Lt Gy/Bk/Pnk sm: med-crse sand; weakly developed laminae to bedded; well sorted; well washed; well drained; loose; wet (**water table**)				WT
			826	SS	
		1389.3			
15		15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/5/15
Hole Size: 6-inch

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Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole ERT3-D

Project No: 0-245
Project: J&L Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944579.9
Easting: 361775.3
Elevation: 1404.3
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
16						
17				827	SS	
18						
19				828	SS	
20				829	SS	
21		**Fluvial Sand** 13.5-18.0' Bk/Gy/Lt Gy/Pnk/Wh sm-cgl: pebbly, v. crse sand; subrnd-subang pebbles; well sorted; well washed; well drained; loose; saturated				
22						
23		18.0-30.0' mottled Lt Gy/Tn/Pnk sm: fn sand; v. well sorted; well developed convoluted laminae (Bk/Tn & Bk/Lt Bn); loose; friable; saturated				
24						
25				830	SS	
26						
27						
28						
29						
30			1374.3 30.0	831	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/5/15
Hole Size: 6-inch

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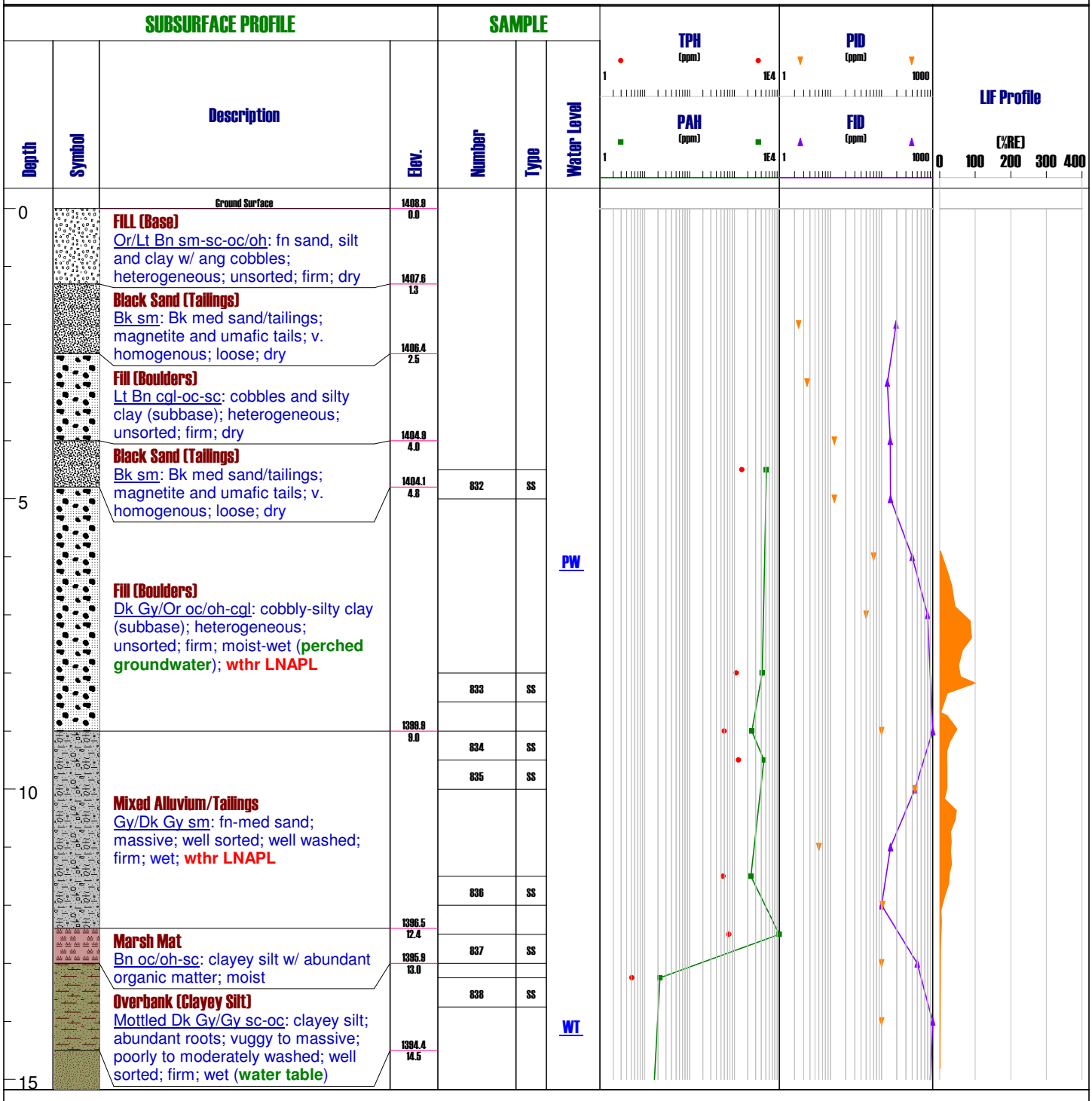
Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB24

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944469.7
Easting: 361894
Elevation: 1408.86
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

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Datum: NAD83/2011
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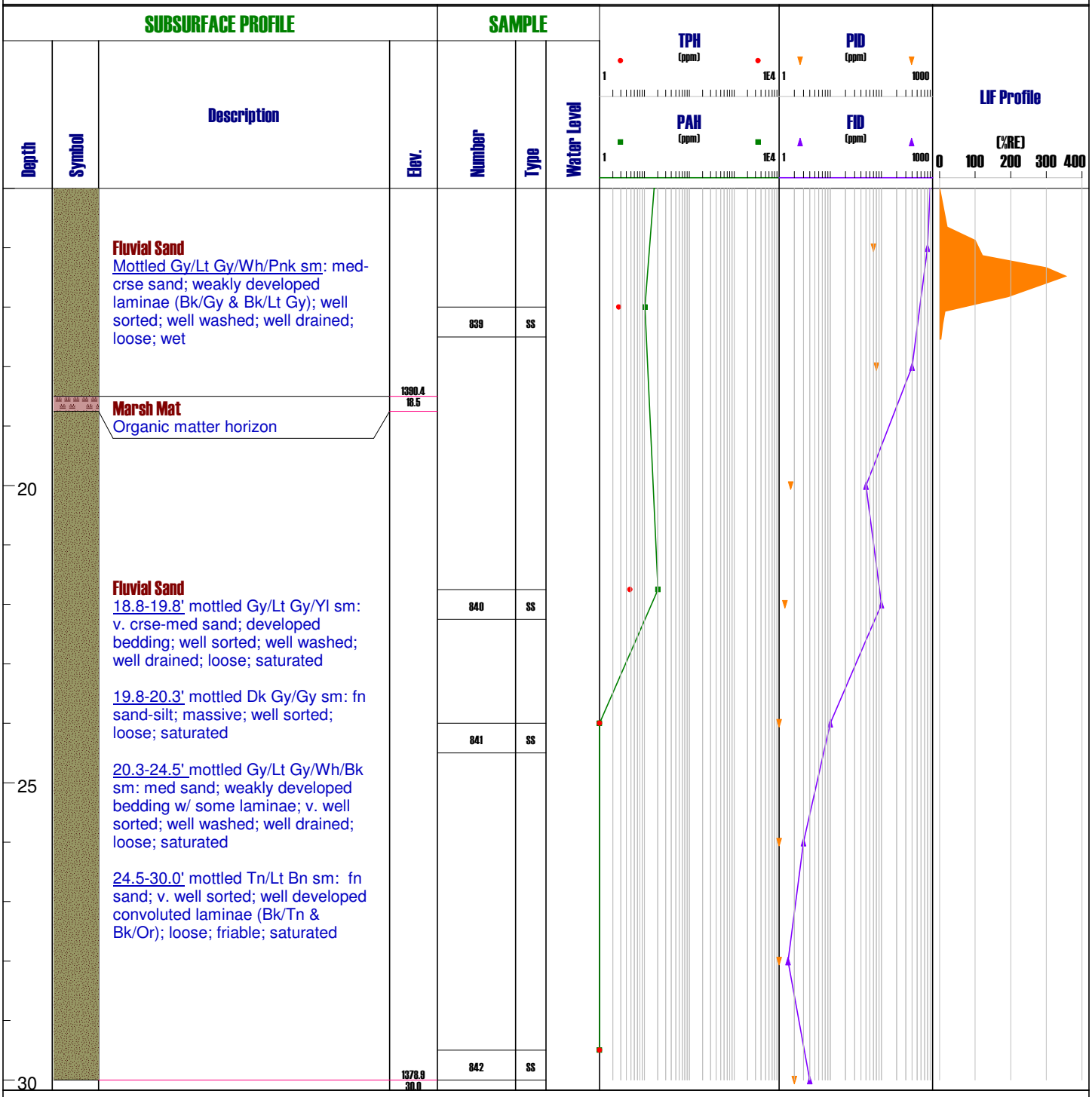
Sheet: 1 of 2

Log of Borehole SB24

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944469.7
Easting: 361894
Elevation: 1408.86
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

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Datum: NAD83/2011
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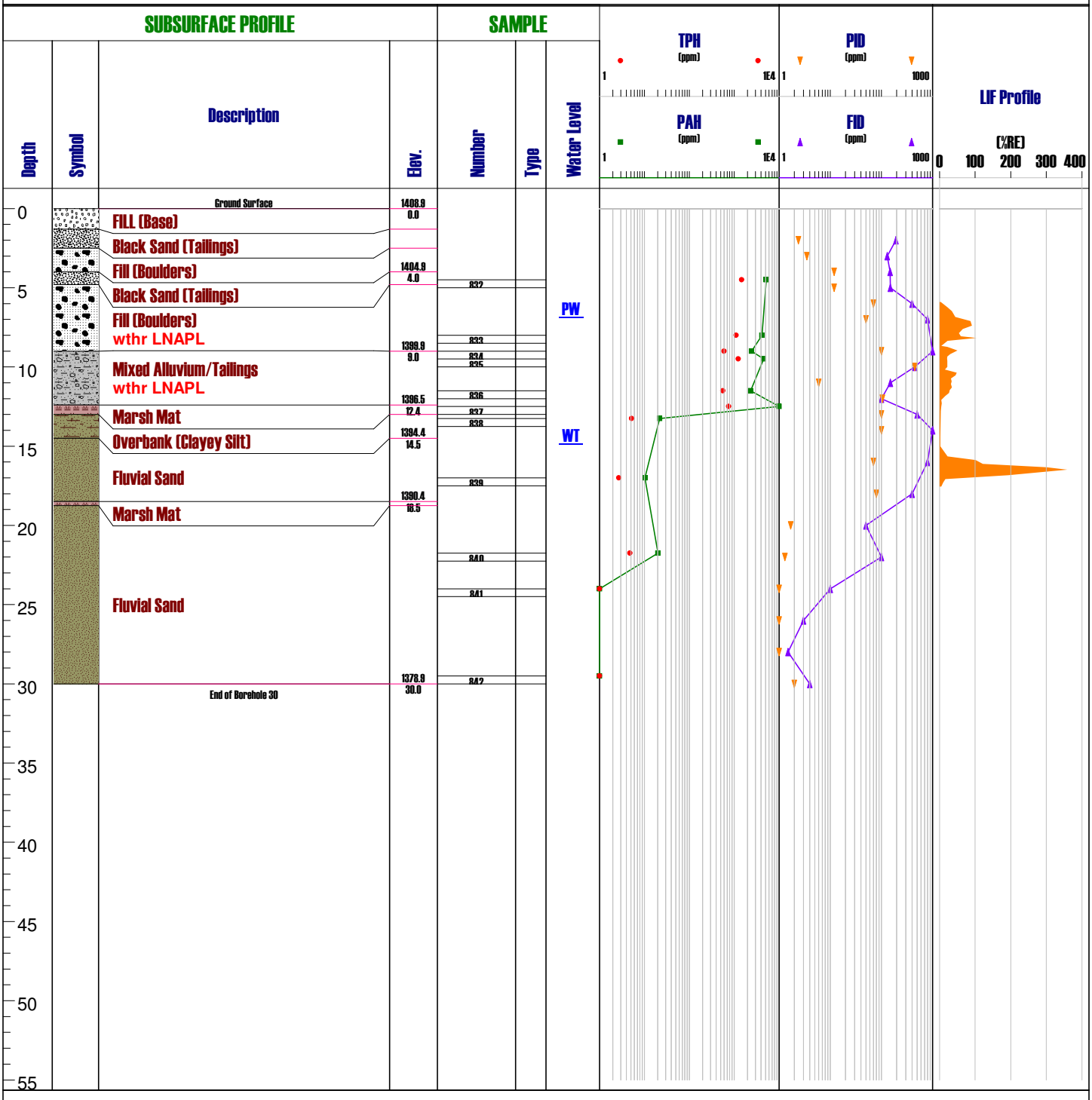
Sheet: 2 of 2

Log of Borehole SB24_pp

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944469.7
Easting: 361894
Elevation: 1408.86
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

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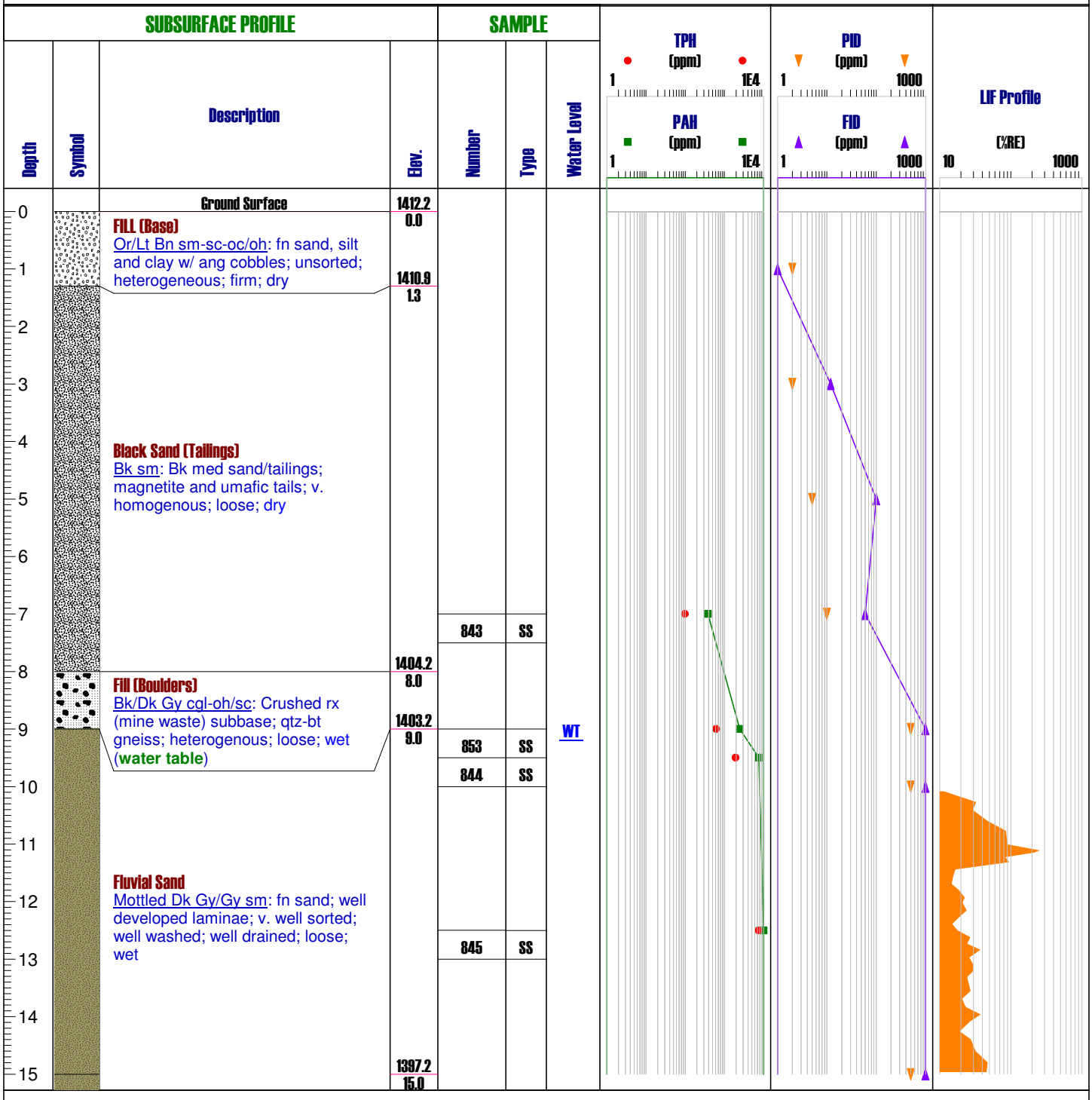
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 1

Log of Borehole SB25

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944288.6
Easting: 361853
Elevation: 1412.17
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

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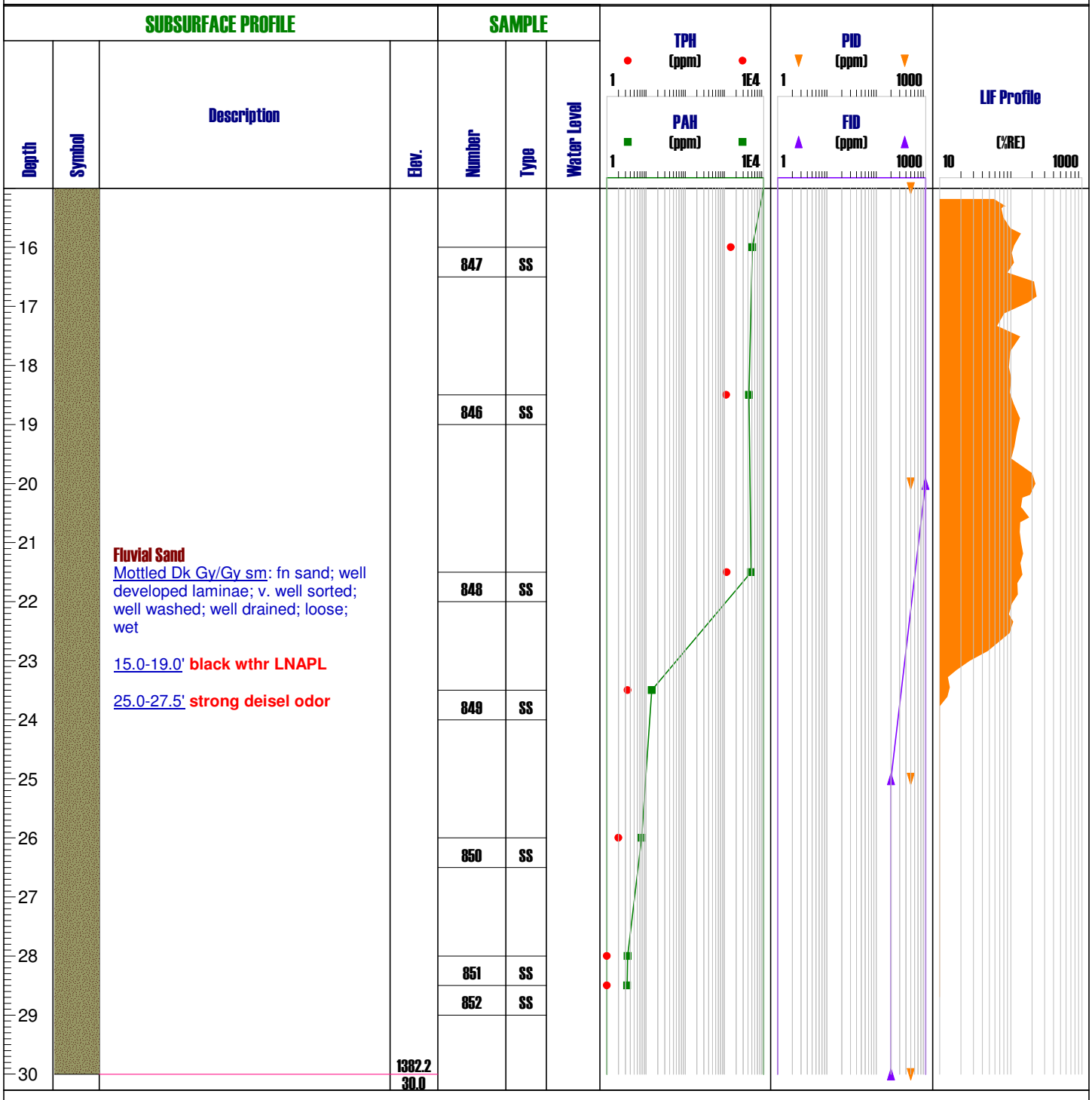
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB25

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944288.6
Easting: 361853
Elevation: 1412.17
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB26

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944260.2
Easting: 361727.8
Elevation: 1408.86
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
0	Ground Surface	1408.9 / 0.0			
	FILL (Base) 0.0-6.0' Bk/Or/Dk Bn sc-oc/oh: clayey silt mixed with black sand w/ wood frags; heterogeneous; unsorted; firm; damp 6.0-7.5' Dk Bn/Bn/Or/Rd sm-sc/oh: med sand and silty clay; homogeneous; friable; dry		854	SS	
7		1401.4 / 7.5	855	SS	
9	**Mixed Alluvium/Tailings** Dk Gy/Gy sm-sc: med-crse sand to w/ clayey silt; vuggy; weakly developed laminae to massive; sorted; moderately washed; firm; wet (**perched groundwater**); 8.0-10.7' **product (Fuel Oil #2)** 10.7-14.8' **wthr LNAPL**		866	SS	PW
11			857	SS	
12			858	SS	
13			866	SS	
14			867	SS	
15		1394.1 / 14.8	859	SS	

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

Lockheed Martin/SERAS
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Edison, NJ 08520

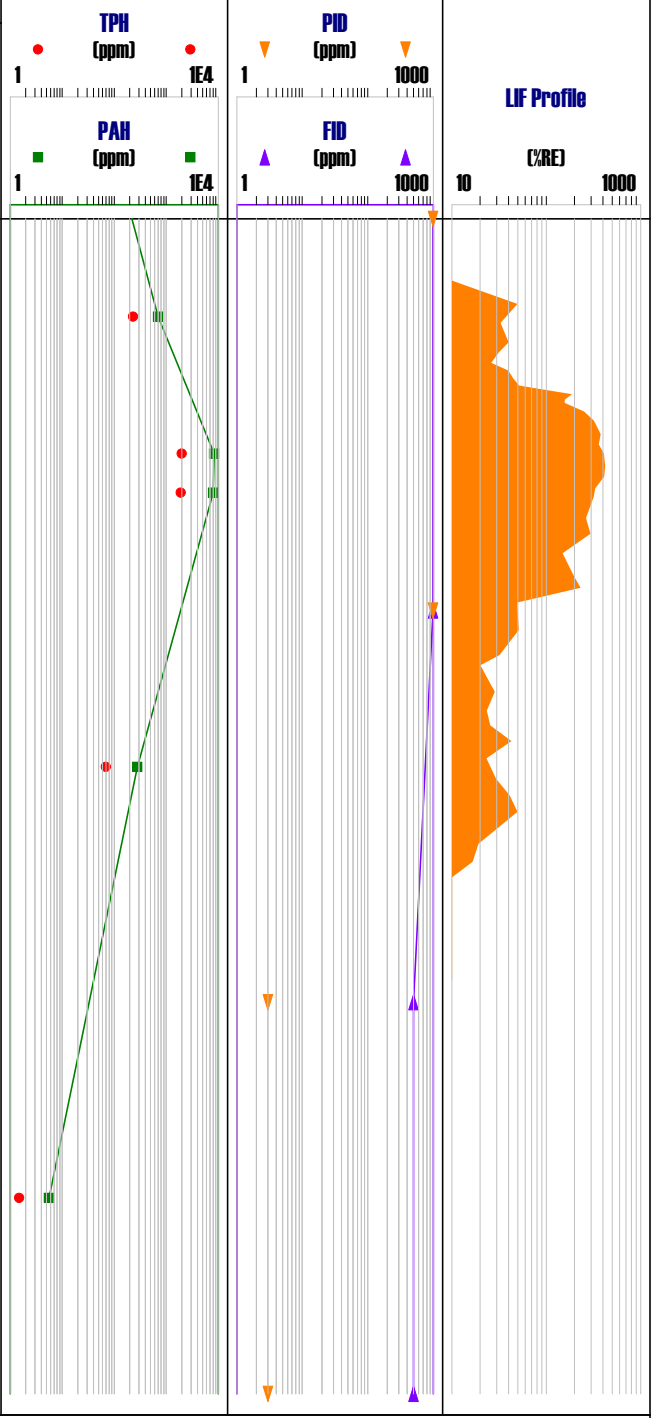
Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB26

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944260.2
Easting: 361727.8
Elevation: 1408.86
Logged By: dge

Depth	Description	Elev.	Sample Number	Sample Type	Water Level
15	**Marsh Mat** Bn oc/oh-sc: clayey silt w/ abundant organic matter; moist	1393.1 15.8			WT
16	**Overbank (Clayey Silt)** Dk Gy/Gy sc-oc: clayey silt; abundant roots; vuggy to massive; poorly to moderately washed; well sorted; firm; damp		860	SS	
17					
18		1390.9 18.0	861	SS	
19			862	SS	
20					
21					
22	**Fluvial Sand** 18.0-23.0' mottled Wh/Lt Gy/Gy sm: med-crse sand; developed bedding w/ some laminae; v. well sorted; v. well washed; well drained; loose; saturated (**water table**)		863	SS	
23					
24					
25	23.0-30.0' mottled Dk gy/Gy sm: fn sand; well developed convoluted laminae (Bk/Lt Gy & Bk/Gy); v. well sorted; well washed; well drained; loose; friable; saturated				
26					
27					
28			864	SS	
29					
30		1378.9 30.0			



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

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2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB27

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944265.7
Easting: 361551.8
Elevation: 1407.22
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
0		Ground Surface	1407.2			
		FILL (Base) Bk/Bn sc-oc/oh: clayey silt mixed w/ black sand (magnetite and umafic); heterogeneous; unsorted; firm; dry	0.0			
3			1404.2			
			3.0			
4				868	SS	
5		**Fill (Boulders)** 3.0-9.5' xldr-xgl: boulders/cobbles (qtz-bt gneiss & grph schist) subbase (mine waste); heterogeneous; dry-damp				
6				869	SS	
7		9.5-11.0' Bk/Gy sm-xgl; sand/cobbles (qtz-bt gneiss & grph schist) subbase (mine waste); heterogeneous; wet (**perched groundwater**); **sheen w/ traces of product (Fuel Oil #2)**				
8				870	SS	
9						
10						PW
11			1396.2			
		Marsh Mat Bn oc/oh-sc: clayey silt w/ abundant organic matter (roots, twigs, grass, etc.); dry	11.0	871	SS	
12			1394.7			
		Overbank (Clayey Silt) 12.5-14.5' Gy/Lt Gy sc-oc: clayey silt; abundant roots; vuggy to massive; poorly to moderately washed; well sorted; firm; moist	12.5			
13				872	SS	
14		14.5' grass horizon		873	SS	
15			1392.2			
			15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

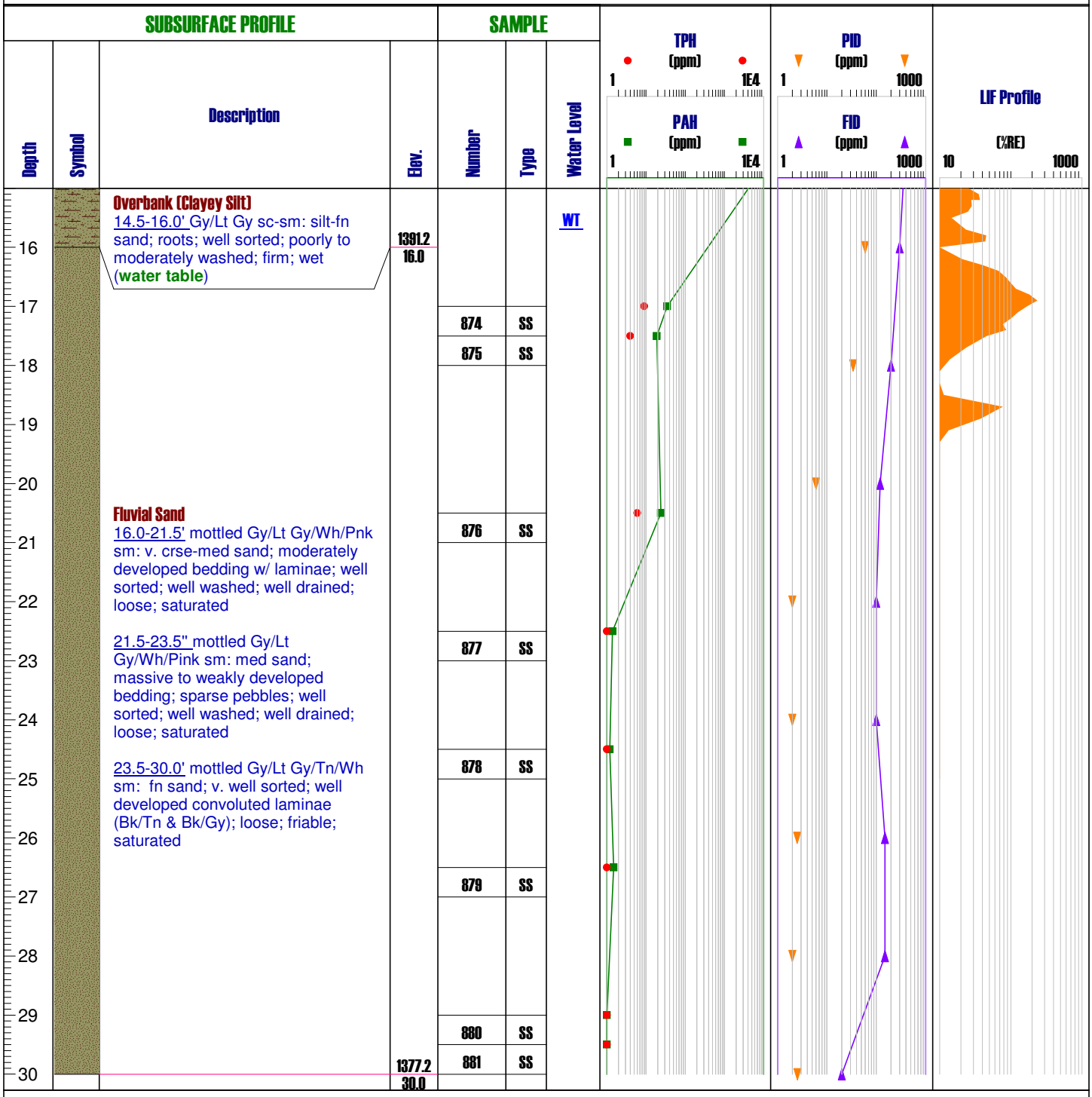
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB27

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944265.7
Easting: 361551.8
Elevation: 1407.22
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Log of Borehole SB28

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944096
Easting: 361624.2
Elevation: 1436.94
Logged By: dge

Depth	Symbol	Description	Elev.	Sample Number	Sample Type	Water Level
0		Ground Surface	1436.9			
			0.0			
1						
2						
3						
4						
5		**FILL (Base)** POOR RECOVERY: Assumed to be fill material				
6						
7						
8						
9						
10			1426.9			
			10.0	882	SS	
11		**Mixed Alluvium/Tailings** Mottled Tn/Lt Bn sm: fn sand; v. well sorted; well developed convoluted laminae (Bk/Tn & Bk/Gy); loose; friable; dry				
12						
13						
14				883	SS	
15			1421.9			
			15.0			

TPH (ppm) 1 – 1E4; PAH (ppm) 1 – 1E4; PID (ppm) 1 – 1000; FID (ppm) 1 – 1000; LIF Profile (%RE) 10 – 1000

Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

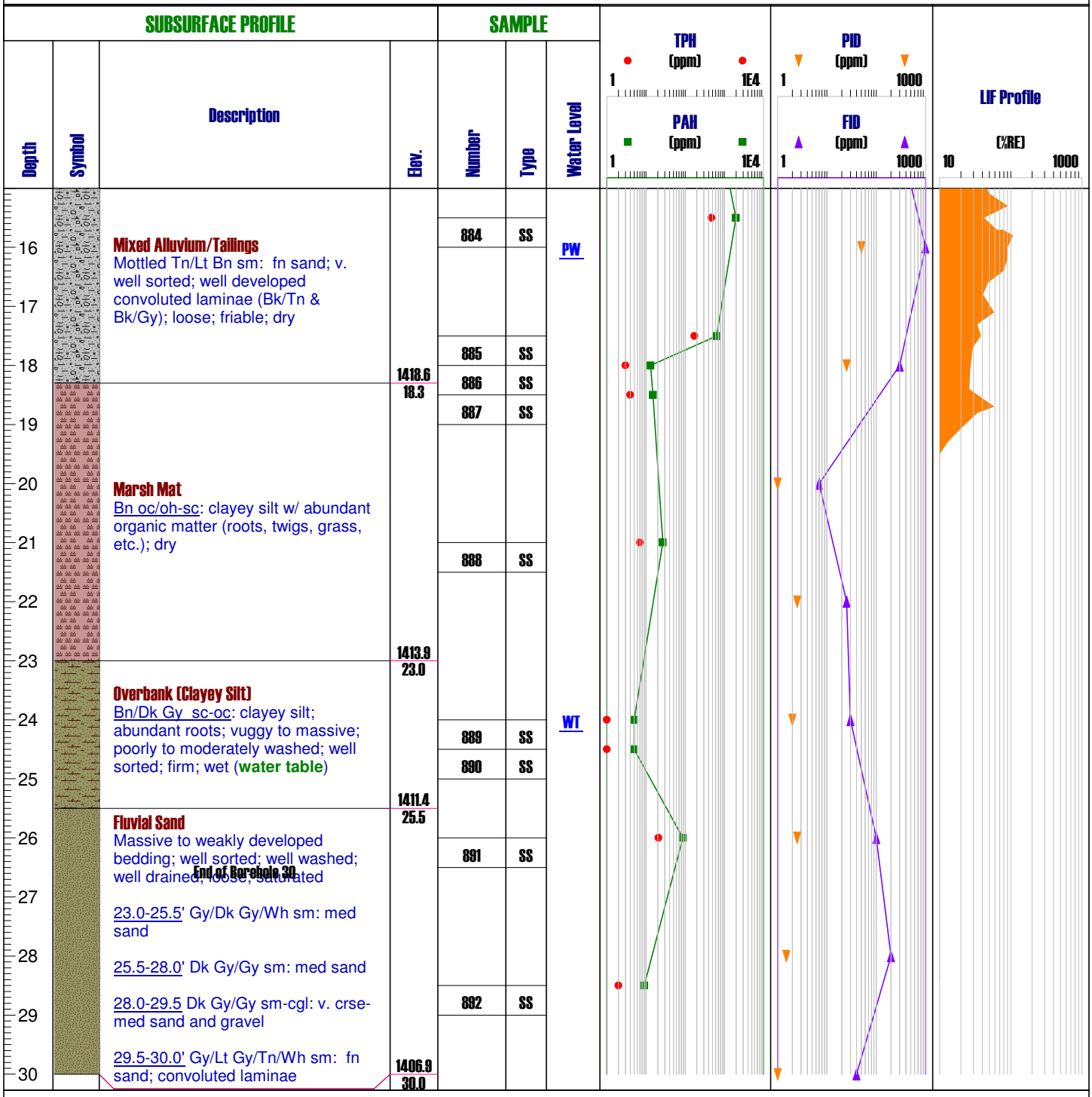
Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 1 of 2

Log of Borehole SB28

Project No: 0-245
Project: JCL Steel Fuel Oil Site
Client: EPA R2
Drilling Co.: Frontz Drilling
Location: Star Lake, NY

Northing: 1944096
Easting: 361624.2
Elevation: 1436.94
Logged By: dge



Drill Method: Sonic
Drill Date: 10/6/15
Hole Size: 6-inch

Lockheed Martin/SERAS
2890 Woodbridge Avenue
Edison, NJ 08520

Datum: NAD83/2011
Checked by: dge
Sheet: 2 of 2

Appendix B

Hydrogeological Cross Sections
J&L Steel/Fuel Oil Site
Town of Clifton, New York
Technical Memorandum
July 2016

Map created using high resolution imagery data from NY state, sampling data in 2015.

Map Creation Date: 06 April 2016

Coordinate system: State Plane New York East
FIPS: 3101
Datum: NAD83
Units: Feet

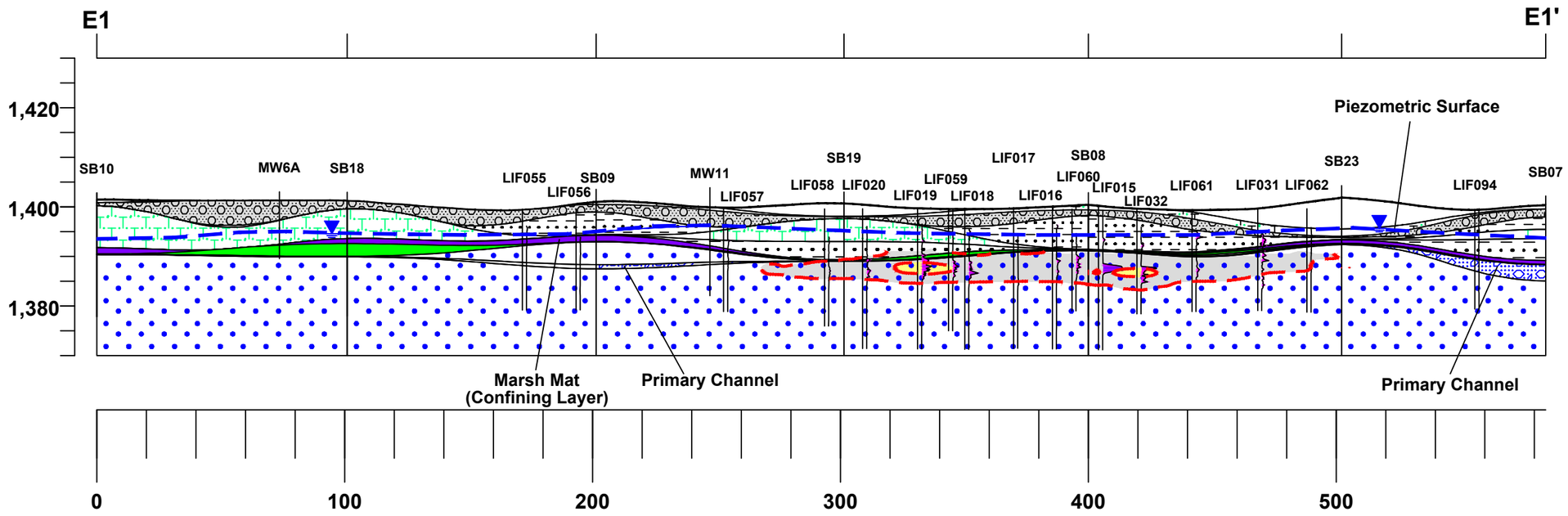
0 100 200 Feet

Data: g:\arcviewprojects\SERAS01\00-245
MXD file: g:\arcinfoprojects\SERAS01\SER00245_JnL_SteelFuelOilSite\Appendix/S\245_Profile_Lines_A-1.mxd

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-245

A-1
Schematic Profile Lines
J & L Steel Fuel Oil Site
Clifton, New York

Schematic Profile E1-E1'



Stratigraphy Index

- FILL (Base)
- Black Sand (Tailings)
- Fill (Boulders)
- Mixed Alluvium/Tailings
- Green Sand (Tailings)
- Mixed Alluvium/Tailings_2
- Marsh Mat
- Overbank (Clayey Silt)
- Fluvial Sand
- Fluvial Gravel
- Fluvial Sand_2

GRAPHIC SCALE

0 50 100

(IN FEET)

LIF %RE Soil Profile

LIF093

LIF %RE

- 10-30
- 30-60
- 60-80
- > 80

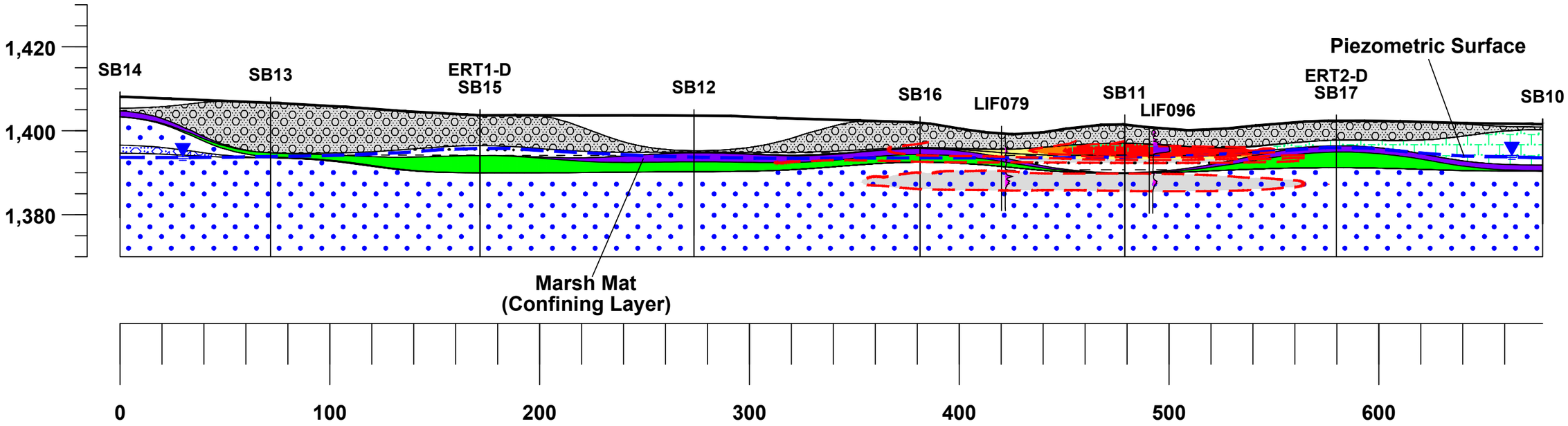
U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0 - 245

Figure A-2
Schematic Profile E1-E1'
J&L Steel Fuel Oil Site
Clifton, New York

04/06/2016

ACAD_2013/00-245/Appendix2016/245_Cross_Section_EE1_A-2.dwg

Schematic Profile E2-E2'



Stratigraphy Index

- FILL (Base)
- Black Sand (Tailings)
- Fill (Boulders)
- Mixed Alluvium/Tailings
- Green Sand (Tailings)
- Mixed Alluvium/Tailings_2
- Marsh Mat
- Overbank (Clayey Silt)
- Fluvial Sand
- Fluvial Gravel
- Fluvial Sand_2

GRAPHIC SCALE

0 50 100

(IN FEET)

LIF %RE Soil Profile

LIF093

LIF %RE

- 10-30
- 30-60
- 60-80
- > 80

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0 - 245

Figure A-3
Schematic Profile E2-E2'
J&L Steel Fuel Oil Site
Clifton, New York

04/07/2016

ACAD_2013/00-245/Appendix2016/245_Cross_Section_EE2_A-3.dwg