EnviroAnalytics
Group

October 9, 2015

Ms. Barbara Brown
Project Coordinator
Maryland Department of the Environment
1800 Washington Blvd.
Baltimore, MD 21230

Mr. Andrew Fan, PE
Project Coordinator
US EPA Region III, 3LC20
1650 Arch Street
Philadelphia, PA 19103-2029

Re: *SPARROWS POINT TERMINAL LLC*
DRAFT PRE-DESIGN INVESTIGATION REPORT
FORMER COKE OVEN AREA

Dear Ms. Brown and Mr. Fan:

On behalf of Sparrows Point Terminal, LLC, enclosed please find the Draft Pre-Design Investigation Report for the Former Coke Oven Area. This report is being submitted for approval in accordance with the requirements and schedule outlined in the Administrative Consent Order (ACO) between Sparrows Point Terminal, LLC and the Maryland Department of the Environment (effective September 12, 2014) and the Settlement Agreement and Covenant Not to Sue (PPA) between Sparrows Point Terminal, LLC and the United States Environmental Protection Agency (effective November 25, 2014).

The report describes the work completed, presents the results of the investigation, and provides conclusions and recommendations based on completion of the scope of work as specified in the MDE- and USEPA-approved work plan dated January 23, 2015. We appreciate the guidance and input you have provided in support of development of the pre-design investigation. Please contact me at rbecker@enviroanalyticsgroup.com should you have any questions and we look forward to your review of this information.

Sincerely,

Russell Becker
Vice President, Remediation

cc: Michael Pedone, Sparrows Point Terminal, LLC
Randall Lutz, Saul Ewing LLP
Doug Dorgan, Weaver Boos Consultants
Al Briggs, Key Environmental Inc.

DRAFT

PRE-DESIGN INVESTIGATION SUMMARY REPORT

FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL, LLC
BALTIMORE COUNTY, MARYLAND

Prepared for:

EnviroAnalytics Group, LLC

Prepared by:

Key Environmental, Inc.
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Carnegie, Pennsylvania 15106

October 9, 2015

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ABBREVIATIONS AND ACRONYMS

ACO	Administrative Consent Order
AS	Air sparge
Benzol	Benzene and Light Oil
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene and xylenes
Decree	Consent Decree
DNAPL	Dense non-aqueous phase liquid
DO	Dissolved oxygen
GPS	Global positioning system
IM	Interim measure
KEY	Key Environmental, Inc.
LNAPL	Light non-aqueous phase liquid
MDE	Maryland Department of the Environment
msl	Mean sea level
NAPL	Non-aqueous phase liquid
ORP	Oxidation/Reduction Potential
PDI	Pre-Design Investigation
PID	Photo-Ionization Detector
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
SA	Settlement Agreement
SCCP	Site Conceptual Cleanup Plan
SPLLC	Sparrows Point LLC
SPT	Sparrows Point Terminal
SVE	Soil Vapor Extraction
SVOC	Semi-volatile organic compound
VCP	Voluntary Cleanup Program
VOC	Volatile organic compound

1.0 INTRODUCTION

This Pre-Design Investigation (PDI) Report for the Former Coke Oven Area at the Sparrows Point Terminal, LLC property has been prepared by Key Environmental, Inc. (KEY) on behalf of EnviroAnalytics Group, LLC. This report presents relevant historical information for the property and surrounding areas (as relevant), a description of the field activities that were completed to gather pre-design information, a summary of the results of the investigation, and a summary of the implications of these data with respect to the ultimate design and implementation of a cost-effective site remedy that complies with the requirements of the Resource Conservation and Recovery Act (RCRA) and the Maryland Voluntary Cleanup Program (VCP). The PDI was completed pursuant to a work plan approved by the Maryland Department of the Environment and United States Environmental Protection Agency (KEY, January 2015).

1.1 OBJECTIVES OF THE PRE-DESIGN INVESTIGATION

Various Interim Measures (IMs) have been implemented at the Former Coke Oven Area to address dissolved and non-aqueous phase groundwater impacts. The general objective of the pre-design investigation was to provide additional information to support development and implementation of additional or supplemental IMs and a final remedy for the Former Coke Oven Area that is protective of both human health and the environment. Various alternative approaches, or combinations thereof, are under consideration as summarized in the Site Conceptual Cleanup Plan (SCCP; EAG, August 2014a). Evaluation of the potential effectiveness and implementability of various responses/approaches required that additional data be collected. The work plan identified the additional data needs and discussed the procedures that would be employed to satisfy the data needs. In several cases, the data collection effort was geared toward a proof-of-concept approach. For example, preliminary investigation was completed to assess the potential viability of a containment option using a slurry wall. Additional data (e.g., slurry wall alignment borings) will be obtained as part of the detailed design phase as appropriate and necessary.

In addition to the aforementioned general objective, specific objectives have been identified on an IM Cell-specific or area-wide basis and are as follows:

IM Cell-Specific Objectives:

- Delineate the lateral extent of LNAPL in Cell 6
- Delineate the lateral extent of LNAPL in the eastern portion of Cell 2
- Assess potential communication of LNAPL between Cell 6 and Cell 2
- Assess the recoverability of LNAPL via vacuum extraction for Cell 2 and Cell 6
- Assess potential preferential LNAPL migration pathways for Cell6
- Assess viability of containment options for Cells 1, 2, and 6

- Assess viability of bioremediation for intermediate groundwater (Cells 1, 2 and 6)
- Investigate potential sources and dissolved phase concentrations in Cell 3
- Investigate and evaluate effectiveness of Cell 1 and Cell 3 treatment systems
- Delineate the lateral and vertical extent of DNAPL in Cell 4/5
- Assess the recoverability of DNAPL in Cell 4/5 (gravity separation and collection)

Area-Wide Objectives:

- Define Area-Wide groundwater elevations, flow directions, and gradients (shallow and Intermediate Zones)
- Define Area-Wide dissolved phase constituent concentrations (shallow and Intermediate Zones)

The preceding objectives were satisfied via the consideration of historical data, including results of previous investigations and data generated as a result of operation of the IMs, and via the collection of supplemental data during the pre-design investigation. Routine groundwater monitoring is conducted for the various Cells. The most recent analytical data generated as a result of the ongoing monitoring programs (June 2015) was supplemented as necessary during the pre-design investigation to address the Area-Wide objectives.

1.2 SITE DESCRIPTION

The Sparrows Point Terminal, LLC property is located on Sparrows Point in Baltimore County, Maryland as depicted in Figure 1-1 which was prepared from the United States Geological Survey Curtis Bay and Sparrows Point 7.5 minute quadrangles. Between 1916 and 1929, four blast furnaces, three Bessemer converters, three open hearth furnaces, plate mills, a tin mill, a blooming mill and continuous bar mill, a rod and wire mill and a pipe mill were constructed at Sparrows Point. The facility expanded during the 1940s and 1950s to become the largest integrated steelmaking facility in the United States by 1958.

The focus of this investigation, the Former Coke Oven Area, comprises approximately 180 acres and was historically the location of the integrated mill's coke ovens and coal chemical byproduct plants. The historical configuration of the coking operations at the mill is shown on Figure 1-2 which depicts the coal conveyors, the coke batteries, and various byproduct processing areas including the benzene/light oil recovery plant and biological wastewater treatment plant. Figure 1-3 depicts various former subsurface utilities which still may exist in the area, specifically the alignments of storm sewers, sanitary sewers, former process water lines, potable water lines, and natural gas lines (possibly above ground); the backfill envelopes (assumed to be permeable gravel or slag) for these lines were considered to be potential preferred migration pathways for dissolved phase constituents and/or LNAPL.

Descriptions of the coking operations and the coal chemicals byproduct operations are provided in the Final Phase II RCRA Facility Assessment (RFA) Report dated August 12, 1993 (ATK, August 1993). Coking operations began in 1930 and ceased at the site in 1991. The Benzol (Benzene and Light Oil) Processing Plant began operations in the late 1940s and ceased in 1986. The coke ovens and the byproduct plant have been demolished and few surface structures associated with the former operations remain. As shown on Figure 1-4 (Current Site Arrangement), very few structures remain in the Former Coke Oven Area and none of these were related to coke production or byproduct processing.

Figure 1-4 also depicts the boundaries of the six areas of interest (i.e., Cells) that are the focus of this report as well as the type of IM present. Additional details regarding the IMs depicted on Figure 1-4 are discussed in Section 1.5.

1.3 SITE OWNERSHIP HISTORY

Bethlehem Steel Corporation operated an integrated steelmaking facility at the site from approximately 1916 through 2003. As a result of multiple market factors, Bethlehem Steel declared bankruptcy in 2001 and the facility was subsequently operated by a succession of owners, the last of which (RG Steel Sparrows Point, LLC) filed for bankruptcy in 2012. The site was subsequently purchased by Sparrows Point, LLC (SPLLC) at a bankruptcy sale on August 7, 2012. Sparrows Point Terminal, LLC (SPT) purchased the real property on September 18, 2014 subject to the provisions of a Purchase and Sale Agreement wherein SPLLC and SPT have allocated various environmental responsibilities, liabilities, and obligations among themselves.

1.4 REGULATORY HISTORY

Environmental responses for the Former Coke Oven Area and for the site in general, are being implemented pursuant to the following:

- Multi-media Consent Decree (Decree) between Bethlehem Steel Corporation, the United States Environmental Protection Agency, and the Maryland Department of the Environment (effective October 8, 1997); this Decree has been modified in accordance with a stipulated order entered into by Sparrows Point LLC and the respective agencies effective July 28, 2014;

- Administrative Consent Order (ACO) between Sparrows Point Terminal, LLC and the Maryland Department of the Environment (effective September 12, 2014); and,

- Settlement Agreement and Covenant Not to Sue (SA) between Sparrows Point Terminal, LLC and the United States Environmental Protection Agency (effective November 25, 2014).

The original Consent Decree for the Sparrows Point facility dealt with many issues associated with ongoing iron-making, steel-making, coking, byproduct, plating, and finishing operations. To the extent that these operations are no longer conducted, and the associated facilities no longer exist, many specific requirements of the Decree are no longer applicable and have been removed in accordance with the stipulated order implementing modifications to the Decree. Nonetheless, the aforementioned ACO and SA incorporate the relevant aspects of the Decree by reference.

1.5 EXISTING INTERIM MEASURES

Interim measures (IMs) are in place for each of the Cells in the Former Coke Oven Area, as described in the following subsections. In order to provide consistency on well designations for the Former Coke Oven Area, well numbers were changed to a numerical system with a "CO" prefix for the purposes of the pre-design investigation and reporting. Appendix A contains a list of former and current well numbers as a cross-reference to historical documents.

1.5.1 Cell 1 – Air Sparging/Soil Vapor Extraction System

Cell 1 is located at the western edge of the former Benzol processing area of the byproduct coke plant. The IM for this area was installed and placed on line in 2010 and consists of an air sparging and soil vapor extraction (AS/SVE) system to address dissolved phase constituents in groundwater (primarily benzene from the Benzol plant, but also other constituents typically associated with light oil recovered from coke oven gas – toluene, ethylbenzene, and xylenes, collectively known as BTEX). The general configuration of the Cell 1 IM is depicted on Figure 1- 5. As shown, a total of 16 air sparge wells surrounded by a recovery trench equipped with approximately 1,100 feet of perforated pipe and 15 vertical risers (soil vapor extraction points). Based on performance monitoring information, system operation has been optimized and eight air sparging wells (Shallow Zone) and associated recovery trenches are currently operated in the Cell 1 area.

The soil vapor collected via the vacuum system is thermally treated via catalytic oxidation using a mobile treatment unit located adjacent to the sparge/vapor recovery well field and is discharged to the atmosphere in accordance with an air permit. As of the 1st quarterly report for 2015 (EAG, April 2015), it is estimated that a total of 12,449 pounds of volatile organic hydrocarbons have been recovered and destroyed in the Cell 1 area to date with an estimated 3.9 pounds recovered and destroyed during the most recent reported quarter. The AS/SVE system at Cell 1 was initially operated on a continuous basis. Currently, the system is operated on an intermittent basis wherein the system is run for approximately one day and is idled for two to three days to allow for rebound.

The pulsed operation has been determined to be more effective for hydrocarbon recovery than continuous operation.

The primary component in the recovered vapor is benzene which was measured at an air phase concentration of 302.4 mg/m^3 in June 2014 and 282.2 mg/m^3 in September 2014. In the most recent quarter (1st quarter 2015), the air phase concentration of benzene had reduced to 29.7 mg/m^3. The average benzene concentration for the most recent groundwater samples (April 2015) from the Cell 1 area (as measured for monitoring wells CO02-PZM006, CO18-PZM006, and CO93-PZM) was approximately 148 mg/L. This concentration is higher than the values reported in mid to late 2014 (130 mg/L in June and 83.5 mg/L in September).

Historically, the benzene concentration for samples from these three wells averaged approximately 568 mg/L as demonstrated by samples obtained in July, August, and September 2010 (URS, October 2010). Consequently, it is apparent that a significant reduction in benzene concentrations has been realized in the Cell 1 Area between 2010 and 2014 although concentrations still fluctuate. Additional discussion of the results for monitoring well CO93-PZM is provided in the Cell 6 discussion as this well is downgradient of Cell 6.

1.5.2 Cell 2 – AS/SVE System and Groundwater Pump and Treat

Cell 2 is located within a former coal storage area adjacent to a surface water inlet historically used for the offloading of raw materials. Installation of various components of an IM for Cell 2 was completed in September 2014, and the system began operation in October 2014. The IM consists of a combination of an Air Sparge/Soil Vapor Extraction (AS/SVE) system for the Shallow Zone groundwater and groundwater pumping and treatment for the Intermediate Zone groundwater.

The AS/SVE system consists of eight air sparge points and a recovery trench equipped with 500 feet of perforated pipe and five vertical risers (soil vapor extraction points). The Intermediate Zone system consists of six groundwater pumping wells. The general arrangement of the IM for Cell 2 is depicted on Figure 1-6.

Soil vapor recovered via the SVE system is currently treated via catalytic oxidizer and is discharged to the atmosphere in accordance with the requirements of an air permit. Groundwater is treated via stripping in a shallow tray, low-profile air stripper and is discharged to an infiltration well field consisting of six wells screened in the Shallow Zone as is depicted on Figure 1-6, in accordance with the requirements of Maryland Department of the Environment (MDE) State Discharge Permit. The air stream from the stripper is treated in the catalytic oxidizer. Since the AS/SVE system began operation, a total of 219 pounds of volatile organic hydrocarbons have been recovered, with approximately 50 pounds recovered in the first quarter of 2015.

Historically, concentrations of the primary dissolved phase constituent (benzene) in Cell 2 area groundwater samples ranged as high as 42 mg/L in the Shallow Zone and 390 mg/L in the Intermediate Zone as evidenced by samples obtained in the summer of 2004 from a well cluster (CO27-PZM012 and CO27-PZM046) located immediately downgradient of the current location of the Cell 2 treatment zone (URS, January 2005). As part of the IM for Cell 2, additional Shallow and Intermediate Zone groundwater monitoring wells were installed to support monitoring of the effectiveness of the IM. These wells have been sampled since installation as part of performance monitoring.

Benzene concentrations measured in March 2015 samples collected from the new wells ranged as high as 98.6 mg/L in the Shallow Zone (CO41-PZM001), which is 11 percent less than the 111 mg/L reported in November 2014. The highest concentration of benzene in the intermediate well samples (428 mg/L in CO41-PZM036) is about 2 percent less than the 437 mg/L reported in November 2014. The benzene concentration measured in the March 2015 sample from CO27-PZM012 was 8.28 mg/L, which is a significant reduction from the 22.6 mg/L reported in November 2014. This result may be indicative of a relatively rapid reduction as a result of air sparging (versus the 2005 result of 42 mg/L) or may simply be attributable to temporal variability associated with seasonal fluctuations. While a small quantity of LNAPL accumulation (2 inches or ~0.03 gallons in a 2-inch well) was observed in new Shallow Zone well (CO37-PZM003) during the November 2014 sampling event, the well was bailed weekly during the first quarter of 2015, recovering a total of 5 gallons of product. No LNAPL was observed during the most recent well gauging event (June 2015).

In the first quarter of 2015, approximately 770,000 gallons of water from the Intermediate Zone were extracted and treated, at an average pumping rate of 8 gallons/minute. During the last quarter, 1541 pounds of benzene, toluene, ethylbenzene and xylenes (BTEX) and 12 pounds of naphthalene were removed and treated, bringing the total to 4,989 pounds since the system began operation in late 2014.

1.5.3 Cell 3 – AS/SVE System

Cell 3 is located in the southwestern portion of the Former Coke Oven Area in a location historically referred to as the "Cove" area. A surface water "inlet" exists immediately south of Cell 3. The inlet is not a natural inlet but rather is an area where slag fill was not placed during expansion of the Coke Point area. Installation of an AS/SVE system in the Cell 3 area was completed in 2010 to address dissolved phase groundwater impacts in the Shallow Zone. The AS/SVE system consist of 14 air sparge points on 40-foot centers and a recovery trench equipped with approximately 600 feet of perforated pipe and five vertical risers (soil vapor extraction points). The general arrangement of the IM for Cell 3 is depicted on Figure 1-7. The system was placed in operation in August of 2010.

Soil vapor recovered via the SVE system is currently treated via vapor phase carbon and is discharged to the atmosphere in accordance with the requirements of an air permit. The system operates on a pulsing schedule with one day of operation followed by two or three idle days to allow for rebound and improved hydrocarbon recovery. As summarized in the most recent IM progress report (EAG, April 2015), it is estimated that 1,464 pounds of hydrocarbons have been destroyed via operation of the Cell 3 AS/SVE system with a total of 18.8 pounds destroyed during the most recent reported quarter. The primary component in the recovered vapor is benzene which was measured at inflow air phase concentrations of approximately 79.5 mg/m^3 in March 2015.

Four shallow monitoring wells were also installed as part of the IM implementation. Groundwater samples were obtained from these wells, as well as from two other pre-existing monitoring well locations (CO32-PZM004 and CO30-PZM15) in March 2015. Historical analytical results for wells located in the Cell 3 area were summarized in the design report for the Cell 3 AS/SVE system (URS, March 2011).

In March 2015, benzene concentrations in samples from four of the wells in this area (CO101-PZM, CO102-PZM, CO103-PZM, and CO30PZM015) ranged from 2.24 mg/L to 79.5 mg/L with an average concentration of 36.6 mg/L, which is below the peaks reported in September 2014 (90.15 mg/L) and slightly higher than the average reported in June 2014 (29.75 mg/L). The westernmost monitoring well (CO104-PZM) yielded a sample with a benzene concentration of 0.055 mg/L (compared to 1.5 mg/L in 2014) indicating that it is located near the western edge of the Cell 3 benzene plume. Overall, there was a general increase in benzene concentrations in samples from wells CO30-PZM015 and CO103-PZM, with more stable or slightly decreasing concentrations reported in samples from wells CO101 and CO102 (EAG, April 2015).

To provide an historical perspective, benzene concentrations measured in samples from the four wells with the consistently highest results obtained in September 2014 ranged from 18 mg/L to 237 mg/L with an average of approximately 92 mg/L. A significant increase was noted for monitoring well CO103-PZM which increased from 14 mg/L in June to 237 mg/L in September. It is possible that the observed increase for this well was a delayed response to significant rainfall in the month of April 2014 which came within 1/10th of an inch of setting a record for Baltimore (4.3 inches of rain fell on April 29 and April 30, 2014). Another round of sampling was completed for Cell 3 in November 2014. Concentrations ranged from 17.7 mg/L to 73.7 mg/L and averaged approximately 41 mg/L. By March 2015, the concentrations in these four wells ranged from 2.24 to 79.5 mg/L, and averaged 36.6 mg/L. The benzene concentration detected in the sample from CO103-PZM declined to 47.3 mg/L (from 237 mg/L in September 2014). Overall, the data represent a 60% reduction in benzene concentrations since September 2014.

Although the benzene concentrations in the Cell 3 area shallow groundwater have generally been lower than those in the Cell 1 area, the Cell 3 AS/SVE system does not appear to be performing as well as the Cell 1 system. While some reductions are evident for monitoring wells CO101-PZM and CO102-PZM, concentrations for a downgradient well sample (CO30-PZM015) have remained fairly consistent over time (~80 mg/L). Furthermore, substantial fluctuations have been observed for samples from monitoring well CO103-PZM.

1.5.4 Cell 4/5 – Dual Phase Extraction

Cell 4/5 is located in the southeastern corner of the Former Coke Oven Area in the vicinity of the former coal tar recovery operations. Historically, an attempt to address dissolved phase impacts (primarily benzene, toluene, and naphthalene) via bioaugmentation (nutrient addition) was conducted for the Cell 4 area. This attempt proved to be ineffective, likely as a result of the elevated pH of the groundwater, and was discontinued.

In October 2014, a dual phase extraction system was installed and started up as an alternative remedial approach. Cell 4/ 5 is being addressed as one operable unit for this approach. A total of 12 dual phase (vapor and groundwater) extraction wells were installed. The recovered vapors and groundwater are treated via a combination of air stripping and carbon absorption. Vapor and the air stream from the stripper are treated using vapor phase carbon subject to the requirements of an air permit. Treated groundwater is returned to the subsurface via a reinjection well field subject to the requirements of a State Discharge Permit. The general configuration of the Cell 4/5 IM is depicted on Figure 1-8.

In the first quarter of 2015, approximately 51 pounds of BTEX and naphthalene were removed and treated. The dual phase extraction system appears to be effective in removing volatile hydrocarbons from the shallow groundwater, with 100% removal of BTEX and 95% removal of naphthalene from the influent.

Historically, concentrations of dissolved phase constituents in the Cell 4/5 area have been on the order of 5.3 mg/L (benzene), 4.0 mg/L (toluene), and 22 mg/L (naphthalene). These concentrations were reported for a sample from a well located in the center of the Cell 4 area [AS-2 (CO112-PZM)]. Bioaugmentation was historically attempted for this area and a sample obtained from this well after bioaugmentation yielded concentrations of 5.65 mg/L (benzene), 3.38 mg/L (toluene), and 245 mg/L (naphthalene). These results are indicative of the ineffectiveness of the bioaugmentation approach for Cell 4. Further, it should be noted that the recent reported naphthalene concentration exceeds its pure component solubility limit (30 mg/L). This result indicates that it is likely that DNAPL droplets were entrained in the sample.

1.5.5 Cell 6 – LNAPL Recovery

Cell 6 is located in the former benzene and light oil (Benzol) processing portion of the Former Coke Oven Area byproduct plant. Cell 6 constitutes a primary source area for dissolved phase groundwater impacts in the Former Coke Oven Area as a result of the presence of a Light Non-Aqueous Phase Liquid (LNAPL) body at the capillary fringe above the water table. An IM has been implemented in the Cell 6 area to recover LNAPL. The IM was initiated in July 2010 and consists of LNAPL skimming from monitoring and recovery wells located in the Cell 6 area. As of the most recent quarterly report (EAG, April 2015), a cumulative total of 90,198 pounds of LNAPL had been recovered via skimming operations, with 1,550 pounds of that occurring in the first quarter of 2015. The general arrangement of the Cell 6 area is depicted on Figure 1-9. A summary of LNAPL apparent thicknesses measured during first quarter 2015 is as follows:

- CO96-PZM 0.15 feet
- CO97-PZM 0.07 feet
- CO92-PZM 3.70 feet
- CO89-PZM 1.30 feet
- CO98-PZM 1.30 feet
- CO99-PZM 2.11 feet
- CO95-PZM 4.15 feet

LNAPL was not observed in wells CO100-PZM, CO91-PZM, CO90-PZM, CO93-PZM, or CO19-PZM004 during the first quarter of 2015. The LNAPL thicknesses reported above do not provide a direct indication of the thickness of the actual LNAPL body in the Cell 6 area. LNAPL typically exists above the water table and will enter the screens of partially-penetrating wells and depress the water level in the well as LNAPL accumulates. Some evidence of the effect of the skimming operations is offered by the analytical results for monitoring well CO93-PZM, which is downgradient of Cell 6 and upgradient of Cell 1. Well CO93-PZM is subjected to quarterly groundwater monitoring as the upgradient well for Cell 1. The benzene concentration in samples from this well ranged from 204 mg/L to 239 mg/L in three samples obtained in July, August, and September of 2010 (URS, October 2010). The benzene concentration reported for this well as of the most recent quarterly report was 95.8 mg/L. The apparent decrease in concentration may be a result of the effect of LNAPL recovery in Cell 6.

2.0 SCOPE OF THE INVESTIGATION ACTIVITIES

The investigation activities performed in 2015 were conducted in accordance with a Site Conceptual Cleanup Plan (EAG, August 2014b), the USEPA- and MDE-approved Work Plan, and in view of comments and suggestions provided by USEPA and MDE representatives during a scoping meeting held in November 2014. The Pre-Design Investigation Work Plan (KEY, January 2015) specified the tasks to be performed. This section presents the scope of investigation activities conducted at the Former Coke Oven Area.

2.1 SOIL BORINGS

Fifty-two soil borings (CO126-SB036 through CO187-SB016) were completed during April and May 2015 to evaluate subsurface conditions in or near various cells at the Former Coke Oven Area. As discussed with the MDE and USEPA during project scoping, borings beyond those originally proposed in the Work Plan were completed to define site conditions. Although the numbering/naming of the borings was consecutive, a few borings were not completed as a result of access difficulty (CO144-SB, CO145-SB, and CO184-SB), refusal (CO175-SB at 7 feet) or voids (CO179-SB at approximately 2 feet - possible basement or vault). The delineation borings ranged in depth from 16 to 36 feet below ground surface (feet-bgs). Geotechnical borings were completed to depths ranging up to 87 feet and are discussed in Section 2.2. Boring logs are provided as Appendix B. General boring locations and depths and completion dates are summarized in Table 2-1. Figure 2-1 presents the locations of all the soil borings discussed in this section.

All of the soil borings (with the exception of four geotechnical borings discussed in Section 2.2) were completed through the fill and underlying unconsolidated materials using rotosonic methods. This methodology was implemented by driving telescoping 5- and 6-inch outside diameter steel casing with sonic vibrations. Continuous samples were collected ahead of the outer casing and were recovered in plastic sleeves for logging purposes. Soil logging was completed as described in the Work Plan and included observations of NAPL, photoionization detector (PID) readings, and descriptions of soil sample colors and textures. The cores were photographed.

These boreholes were abandoned by delivering a Type I/II Portland cement grout under pressure to the base of the borehole through a tremie pipe. Each borehole was filled with cement grout to ground surface while collecting any displaced fluids during this process. The locations of all soil borings were staked and surveyed with a hand-held GPS unit.

Soil samples were not collected for chemical analysis during this investigation. Widespread impacts with organic compounds in the soil/fill and groundwater are well documented. As stated previously, the soil borings were primarily completed to delineate the extent of non-aqueous phase liquids in the Former Coke Oven Area. The scope of the soil boring investigation for the various Cells is discussed in more detail in the remainder of this section.

2.1.1 Cells 1 and 6

No soil borings were drilled in the Cell 1 area, as the investigation of Cell 1 focused on the performance of the existing AS/SVE system and the extent of LNAPL. One boring was completed proximate to Cell 1 to the southwest but this boring was completed to assess potential migration toward Cell 3 and hence is subsequently discussed in that context. Several of the borings installed in the Cell 6 area are located close to the eastern side of Cell 1.

The soil investigation of Cell 6, according to the Work Plan, was to consist of 19 shallow soil borings to define the extent of LNAPL. Two historical wells located on the eastern/northeastern side of the Cell 6 area had contained LNAPL. Ultimately, 26 borings were completed as part of the LNAPL delineation effort; all borings were 16 feet deep. Three of these borings were subsequently completed as shallow monitoring wells. A list of the borings completed in the Cell 6 area, including the completion dates and depths is provided in Table 2-1.

Several of the borings located around Cell 6 that presented visual evidence of the presence of NAPL were left open for up to two weeks during the investigation. Boreholes typically remained open as a result of the nature of the cemented slag matrix that constituted much of the fill in the area. This investigation was added to the scope of work as part of an effort to delineate the extent of potentially mobile and recoverable LNAPL in Cell 6 and also to accommodate the installation of monitoring wells (as appropriate) in this area once all of the boring data were evaluated. Observations regarding accumulated LNAPL in open boreholes in Cell 6 are discussed in Section 3.1.

Finally, an inspection of the Cell 1 IM was completed to determine if opportunities exist for enhancement of the effectiveness of the Cell 1 IM. The inspection did not include any direct investigation or measurement activities but, nonetheless, opportunities for enhancement were identified as is discussed later in this report (Section 4.2.2).

2.1.2 Cell 2

The Work Plan called for the completion of five borings including four geotechnical test borings and the installation of two monitoring wells/piezometers (one of the geotechnical test borings was to be converted into one of the proposed monitoring wells/piezometers) in Cell 2. Geotechnical logging (blow counts) and sampling to investigate the feasibility of installing a slurry wall (see Section 2.3) was planned for four of these locations. The planned monitoring well boring that was

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to coincide with one of these borings was ultimately offset from the geotechnical boring location in an effort to preserve the well in the event that a slurry wall is ultimately installed.

Additionally, the field investigation was designed to be flexible based on discussions with the USEPA and MDE. Ultimately, a total of 16 additional borings were drilled and logged in the Cell 2 area to investigate the potential presence of source materials and to determine if a possible relationship exists between Cell 2 and Cell 1/6. Furthermore, the additional borings were completed to provide information to support determination of an appropriate length for the potential barrier wall. The geotechnical test borings ranged in depth from 72 to 87 feet and the supplemental test borings (i.e., borings installed for source material investigation) ranged in depth from 16 to 36 feet. A list of the borings completed in the Cell 2 area, including the completion dates and depths is provided in Table 2-1.

2.1.3 Cell 3

Five borings were completed in or near Cell 3 to investigate the potential presence of source materials in the Cell 3 area and for the purpose of collecting depth-specific isoflow groundwater samples from the open boreholes. One of the borings (CO130-SB036) was specifically installed to investigate the possible relationship between the impacts at the Cell 3 area and the Cell 1 and Cell 6 areas. All borings were completed to a depth of 36 feet below ground surface. The borings were designated as CO126-SB036 through CO130-SB036. A list of the borings completed in the Cell 3 area, including the completion dates and depths is provided in Table 2-1. Isoflow groundwater sampling and analysis is discussed in more detail in Section 2.7.

2.1.4 Cell 4/5

The soil investigation of Cell 4/5 was designed to investigate the presence, extent and potential recoverability of DNAPL. Six soil borings were intended to be completed in the Cell 4 (potential DNAPL source) area. A total of eight borings were ultimately completed, three of which were converted to monitoring/recovery wells. Borings were completed to depths ranging from 26 to 36 feet. The borings were designated as CO166-SB036 through CO173-SB036. A list of the borings completed in the Cell 4/5 area, including the completion dates and depths is provided in Table 2-1. Borings CO166-SB036 through CO168-SB036 were completed as 6-inch monitoring wells with 10-foot DNAPL collection sumps (potential DNAPL recovery wells). The wells were assigned well numbers CO123-PZM through CO125-PZM.

In addition, information generated as a result of the Cell 4/5 investigation was provided to a thermal technology vendor that has developed a smoldering technology. Smoldering is currently under consideration as potential final corrective measure for the Cell 4/5 area. The vendor has prepared a report regarding the potential applicability of this technology. The report is provided as Appendix C of this report. Further evaluation of the smoldering technology will be undertaken while IM improvements and additional design activities are completed.

2.2 GEOTECHNICAL BORINGS

As previously indicated, four geotechnical borings (CO121-SB075, CO123-SB072, CO124-SB073 and CO125-SB087) were advanced to depths of 72 to 87 feet in May and June 2015. The purpose of these borings was to investigate subsurface conditions along two potential slurry wall alignments in the vicinity of Cell 2. Specifically, they were completed to determine if a clay layer is present at a reasonable depth that could form a competent confining layer for the installation of a barrier wall. One alignment was along the sea wall north of Cell 2, and the second alignment to be evaluated was located between Cells 1/6 and 2. Information regarding these borings (completion dates and depths) is included under Cell 2 in Table 2-1.

All drilling was completed using mud rotary methods by augering ahead with drilling mud in the borehole to control heaving sands. A split-spoon sampler was advanced two feet ahead of the casing through the use of a 140-lb hammer with a 30 inch drop. The Standard Penetration Test values were recorded during logging. Representative undisturbed (i.e., Shelby tube) samples were collected from a potential confining unit. Soil logging was completed as described in the scope of work and included observations of NAPL, PID readings, and descriptions of soil sample colors and textures.

The locations of the geotechnical borings (CO121-SB075, CO123-SB072, CO124-SB073 and CO125-SB087) are shown in Figure 2-1. The CO121 boring was originally planned to be converted to a shallow piezometer but a separate boring was completed near this location for that purpose to preserve the well in the event that the barrier is ultimately installed. Samples were collected from each of the borings for a variety of laboratory tests contingent upon the type of sample (i.e., Shelby Tube versus split spoon sample). Testing consisted of soil classification, moisture content, sieve and hydrometer analyses, Atterberg Limits, and permeability. A total of seven Shelby tubes and eight split spoon samples were analyzed.

The Shelby Tubes were shipped to a geotechnical laboratory for analysis and the split spoon samples were retained for subsequent supplemental analysis as necessary. As a result of consideration of the depth to clay at the CO125-SB087 location and in view of the results of the soil boring program and groundwater study in the Cell 2 area, the southernmost potential barrier wall alignment was no longer considered appropriate. Consequently, no additional geotechnical analyses were completed using the split spoon samples from CO125-SB087. However, a total of eight split spoon samples from locations CO121-SB075, CO123-SB072 and CO124-SB073 were subjected to supplemental testing. These tests were performed to verify the consistency of the stratigraphic layers between boreholes.

All boreholes were sealed using a Type I/II Portland cement grout, which was delivered to the base of the boreholes through a tremie pipe. Each borehole was filled with cement grout to ground surface, and displaced fluids were collected for management by EAG.

2.3 WELL SEARCH

Prior to beginning the groundwater investigation tasks specified in the Work Plan, an effort was made to locate and assess the condition of all existing wells and piezometers in the Former Coke Oven Area. Twelve wells could not be located for a variety of reasons, including burial or possible destruction, given that heavy equipment use and earthmoving activities are still occurring at the site. The wells which could not be located were as follows:

CO06-PZM008	CO11-PZM007	CO106-PZM	SW14-PZM004
CO06-PZM039	CO12-PZM008	TS05-PDM004	SW17-PZM007
CO10-PZM029	CO17-PZM005	TS05-PPM007	SW17-PZM038

Two additional wells (SW13-PZM003 and CO07-PZM050) were located but were either damaged (bent casing) or destroyed and could not be used for monitoring purposes. None of the "missing" or damaged wells were considered crucial to the Former Coke Oven Area area-wide groundwater investigation for the following reasons:

- The historic samples were clean or exhibited very low concentrations of dissolved constituents (i.e., CO06-PZM008, CO06-PZM039, CO07-PZM050, CO11-PZM007, SW13-PZM003, and SW14-PZM004);

- Other wells existed nearby, new wells were installed in the general vicinity, and/or soil borings were drilled and logged nearby that provided delineation information for dissolved phase constituents and NAPL (i.e., CO12-PZM008, CO106-PZM, TS05-PPM007 and TS05-PDM004);

- The wells were located upgradient of the Former Coke Oven Area (i.e., CO10-PZM029; SW14-PZM004, SW13-PZM003); or

- The measured concentrations of primary constituents (BTEX and naphthalene) exhibited a 40 to 50 percent decline between 2001 and 2004 (i.e., SW17-PZM007, SW17-PZM038, and CO17-PZM005) and alternate sampling points were located nearby.

Based on these observations of current and historical analytical results and boring logs, there are adequate data points to define the extent of dissolved phase constituents and possible free phases in both the Shallow and Intermediate Zones. All other wells in the Former Coke Oven Area were located and subsequently gauged and sampled. Given the existence of multiple borings and wells in the study areas, it was determined that the missing/damaged wells would not be critical to the pre-design investigation.

2.4 WELL INSTALLATION

As specified in the Work Plan, eight groundwater monitoring wells/piezometers were installed in May 2015 (two in Cell 2, three in Cell 6, and three in Cell 4/5). The boring and well construction logs for these borings/wells are provided in Appendix B. A summary of well construction information is provided as Table 2-2. Upon completion of well construction, each well was developed using a surge block and disposable twister pumps. Development ceased when field parameters (pH, dissolved oxygen, conductivity) stabilized. Details regarding well installation and completion for the cells of interest are provided in the remainder of this section.

2.4.1 Cell 2

Two shallow monitoring wells were installed in the Cell 2 area to support the evaluation of LNAPL extent and recoverability. CO121-PZM was completed at a depth of 14 feet-bgs and was constructed near one of the geotechnical borings drilled proximate to Cell 2. This well was located near an existing well (CO37-PZM003) which contained LNAPL, and was intended to provide lateral delineation of LNAPL in Cell 2. Well CO122-PZM was completed at a depth of 22 feet-bgs south-southeast of CO37-PZM003.

Each of the wells was constructed with two-inch diameter, schedule 40 polyvinyl chloride (PVC) risers with ten-foot, 10-slot screens. The sand packs were brought above the screens and a minimum two-foot-thick bentonite seal was placed on top of the sand pack and hydrated before the wells were completed with stick-ups, protective steel covers and concrete pads.

2.4.2 Cell 4/5

Three DNAPL recovery wells were installed in the Cell 4/5 area. Two of those recovery wells were co-located with planned soil boring locations and the third was installed in a boring completed specifically for the well installation. These three wells were installed for a proof-of-concept DNAPL gravity separation and collection program.

CO123-PZM was completed to a depth of 35.7 feet-bgs, CO124-PZM was completed to a depth of 38 feet bgs, and CO125-PZM was completed to a depth of 36 feet-bgs. All wells were constructed of six-inch diameter stainless steel. Ten-foot stainless steel sumps were installed beneath ten-foot, 10-slot stainless screens and risers (stainless steel and in one case PVC) were installed to the ground surface. Well CO124-PZM was completed with a PVC riser from eight feet-bgs to the ground surface as there was a shortage of stainless steel sections; the use of PVC at the top of this well is not significant as this is a DNAPL recovery well with the top of the screened interval located eight feet below the PVC. Hence degradation of the PVC as a result of contact with DNAPL will not occur.

The sand packs in each well were brought to a depth of approximately two feet above the screens and a minimum two and a half foot bentonite seal was placed on top of the sand pack and hydrated before the wells were completed with stick-ups, protective steel covers, and concrete wells pads.

2.4.3 Cell 6

Three wells were installed in the Cell 6 area. Two of the wells were installed in delineation borings and one was installed in a boring completed specifically for well installation. Two of these wells were installed for a pilot LNAPL vacuum extraction recovery test and the third was installed between, and in proximity to one of the other two wells to be used for monitoring the radius of influence during the pilot testing.

CO126-PZM was completed at a depth of 14 feet bgs, CO127-PZM was completed at a depth of 16 feet bgs, and CO128-PZM was completed at a depth of 16 feet bgs. All wells were constructed of four inch diameter schedule 40 PVC with ten-foot long, 10-slot screens and risers. The sand packs in each well were brought above the screens and a minimum two foot thick bentonite seal was placed on top of the sand pack and hydrated before the wells were completed with stick-ups, steel protective covers, and completion pads.

2.5 SURVEYING

EAG issued a separate contract to complete surveying activities as part of the Former Coke Oven Area PDI. The location (Maryland State Plane NAD 1983), casing elevation and the adjacent ground surface elevation (NAVD 1988) were surveyed for all newly installed wells. In addition, multiple wells that had not previously been surveyed were also included in this effort. The locations of the four geotechnical borings installed to assess the viability of containment using a slurry wall (Cell 2) were also surveyed for location and elevation. Recent survey results are provided in Appendix D. Surveyed coordinates and measuring point elevations for the existing Former Coke Oven Area wells are provided in the well cross reference table provided as Appendix A.

Four wells were inadvertently missed during the surveying activities, including one of the newly installed wells (CO34-PZM048, CO79-PZM, CO108-PZM, and CO128-PZM). These wells will be surveyed at a later date if necessary to further define site conditions although the elevations and locations of these well are not critical to an understanding of the site. Note that the location of CO128-PZM (one of the newly installed monitoring wells) was surveyed using a field Global Positioning System (GPS) instrument during installation and multiple other wells exist in the Cell 6 area to define water table elevations. As previously indicated, all soil boring locations were surveyed using the GPS field instrumentation at the time of completion.

2.6 GROUNDWATER GAUGING AND SAMPLING/ANALYSIS

The locations of all new and existing monitoring wells used in the gauging effort and/or the groundwater sampling and analysis program are depicted on Figure 2-2. The results of the gauging and groundwater sampling/analysis efforts, including the results of isoflow sampling performed in Cell 3, are discussed in Section 3.5 through 3.9 of this report. Gauging is discussed is Section 3.5 (Geology and Hydrogeology), analytical results are discussed in Sections 3.6 through 3.9 (Shallow Groundwater Analytical Results, Intermediate Groundwater Analytical Results, Isoflow Groundwater Sample Analytical Results, and Indicator Parameter Analysis, respectively). Potentiometric surface contours for the shallow and intermediate groundwater are discussed in Section 3.5. Isoconcentration contour maps for the shallow and intermediate groundwater are discussed in Sections 3.6 and 3.7.

Prior to the collection of groundwater samples, water levels and total well depth were measured and an interface probe was used to investigate the potential presence of both LNAPL and DNAPL. If a well was found to contain LNAPL or DNAPL, no groundwater sample was collected from that well. Instead, apparent thicknesses were measured and the well was re-locked.

Each well was purged to ensure that fresh formation water was collected. Groundwater samples were obtained from Shallow and Intermediate Zone monitoring wells using either a dedicated peristaltic pump or non-dedicated bladder pump with dedicated Teflon-lined tubing. Sample containers were filled directly from the tubing and sent to Pace Analytical Services laboratory in Greensburg, Pennsylvania for chemical analysis.

For many wells, several field parameters were measured at the time of sample collection. These parameters were pH, Oxidation-Reduction Potential (ORP), specific conductance, dissolved oxygen, turbidity and temperature. These measurements were recorded in the field logbook and on sample collection sheets.

In June 2015, 60 groundwater samples and 5 duplicate samples were collected from the Shallow and Intermediate Zone wells to support delineation efforts regarding the nature and extent of dissolved phase constituents. Samples were sent to a laboratory for analysis of volatile and semi-volatile organic compounds (VOCs and SVOCs, respectively) via USEPA Methods 8260B and

8270C, respectively. In addition, the laboratory also performed analysis of sulfate and chloride via USEPA Method 300.

This comprehensive round of groundwater sampling included wells located in and around individual cells, as well as several wells located some distance from the cells or at the perimeter of the Former Coke Oven Area. Water level data and analytical data for the Coke Point Landfill Area to the south of the Former Coke Oven Area were obtained from EAG and these results were also evaluated. As discussed, the chemical analytical results were used to prepare isoconcentration contour maps for particular constituents of interest (benzene, BTEX [i.e., benzene, toluene, ethylbenzene, and xylenes], and naphthalene).

2.7 CELL 3 ISOFLOW GROUNDWATER SAMPLING

Groundwater samples were collected from five soil borings at three depth intervals using isoflow technology during advancement of the borings. The samples were collected at the water table (approximately 15 feet below ground surface), at 25 feet-bgs, and at 35 feet-bgs. The samples were collected as grab samples pumped directly from the formation. Field parameters (pH, dissolved oxygen, etc.) were measured and the samples were immediately placed on ice and transported to the on-Site laboratory for pick up by the analytical laboratory courier. The samples were sent to Pace Analytical Services, Inc. in Greensburg, Pennsylvania where analysis of VOCs plus naphthalene and SVOCs was performed.

2.8 CELL 2 AND CELL 6 HIGH-VACUUM RECOVERY TESTING

On June 15, 2015, KEY mobilized a trailer-mounted “Hi-Vac” unit to conduct an assessment of the effectiveness of vacuum-enhanced LNAPL recovery at Cell 2 and Cell 6. Prior to initiating recovery efforts, wells in the area were gauged to measure water levels and product thicknesses; well gauging was also completed after individual wells were subjected to testing. Vacuum-enhanced LNAPL recovery was conducted at wells that contained greater than a trace thickness of LNAPL. A total of 12 events were conducted at 8 separate locations during the week.

Based on the results of the June 2015 vacuum testing, another round of vacuum-enhanced recovery testing was completed approximately 6 weeks later (July 29 through July 31, 2015). This work was completed for three wells which demonstrated positive results during the June 2015 study (CO89-PZM, CO92-PZM, and CO99-PZM). In addition, monitoring well CO04-PZM004, which is located some distance to the east of Cell 6 was also studied in July 2015 given that a thin layer (on the order of one foot) of LNAPL has been observed in this well historically and was also observed during the site-wide groundwater study.

A uniform vacuum, typically between 11 to 12 inches of mercury (~ 0.4 bar), was applied to each tested well. Vacuum field propagation to nearby wells was monitored using a magnahelic gauge and the quantity of LNAPL recovered was measured by allowing the recovered LNAPL and water to separate in 55-gallon drums (typically overnight), then gauging the LNAPL thicknesses with an interface probe. The results of this investigation are discussed in the results for Cells 2 and 6 in Sections 3.1 (Cells 1 and 6) and 3.2 (Cell 2) of this report.

2.9 CELL 4/5 DNAPL RECOVERY INVESTIGATION

As previously indicated, three DNAPL recovery wells were installed in the Cell 4/5 area to facilitate proof-of-concept testing of potential DNAPL recovery. One of the wells (CO123-PZM) accumulated a significant quantity of DNAPL and this well was subjected to recovery testing. DNAPL was pumped from the well at a sustained rate until the sump was fully evacuated of DNAPL. The thickness of DNAPL was measured as a function of time during the pumping process. The DNAPL was containerized in a DOT-approved 55-gallon drum. The total DNAPL recovered was then determined by measuring the volume of accumulated DNAPL in the drum. Subsequently, an additional DNAPL measurement was obtained from this well to determine if additional DNAPL had entered the well. The results of the DNAPL recovery testing are discussed in Section 3.4.

2.10 CELL 3 ANEMOMETER AND PID INVESTIGATION

Although relatively high concentrations of byproduct coke plant-related constituents have been detected in groundwater at Cell 3 (monitoring well groundwater samples and isoflow discrete downhole groundwater samples as specified in the work plan), the mass recovered via operation of the Cell 3 AS/SVE system has been less than expected. Consequently, historical information regarding the system configuration was reviewed and an investigation of the system was conducted during the week of August 24, 2015. Two weeks prior to the investigation, the air sparge and soil vapor extraction wells were tapped (and fitted with apertures) to accommodate air flow and vapor phase concentration measurement in the system. Anemometers were used to measure air velocity (and temperature) in each of the 15 air sparge points. A flow-equalized vacuum pump was used to draw air samples from each of the 5 vapor extraction risers to accommodate real time total volatile organic compound concentration measurements using a Photo-Ionization Detector. The results of this investigatory work are discussed in Section 3.3.

2.11 DISPOSAL OF INVESTIGATION-DERIVED WASTES

All soil cuttings, drilling fluids, development fluids, and decontamination fluids generated during the drilling and sampling program were drummed in DOT-approved 55-gallon drums and moved onto pallets in a staging area located at Cell 2. In addition, disposable personnel protective equipment and disposable sampling equipment were also drummed. The contents of each drum were documented on a drum inventory form and the drums were labeled for off-site disposal by EAG.

3.0 RESULTS OF THE INVESTIGATION

This section presents a discussion of the results of the field activities described in Section 2. The first portions of this section focus on the individual cells (Sections 3.1 through 3.4) with emphasis on LNAPL and DNAPL delineation and recovery evaluations, IM assessments, and general water quality information (indicator parameters). A discussion of Coke Oven Area-wide considerations consisting of geology, hydrogeology, and Shallow and Intermediate Zone groundwater analytical results is provided in Sections 3.5 through 3.7 and 3.9. Groundwater analytical results for the Cell 3 isoflow samples are discussed separately in Section 3.8 given that these samples were obtained from boreholes and not from traditional monitoring wells. A discussion of the results of the geotechnical investigation completed to assess the potential applicability of a slurry wall to effect containment for dissolved phase constituents associated with Cells 1, 2, and 6 is provided in Section 3.10. Finally, the results of LNAPL and DNAPL physical testing (density, viscosity, and interfacial tension) are discussed in Section 3.11.

3.1 CELLS 1 AND 6

LNAPL Investigation – Cells 1 and 6

LNAPL was observed in several wells in the Cell 6 area but was not identified in wells in the Cell 1 area to the west of Cell 6. Although a large diameter storm sewer (72”) exists between Cell 6 and Cell 1 (see Figures 1-3 storm sewer inset) there is no evidence to suggest that LNAPL has entered the envelope surrounding the storm sewer. NAPL was also identified in multiple soil borings completed in this Cell 6 area although, in most cases, the NAPL appeared to be residual in nature. Several borings displayed the potential presence of recoverable NAPL although it is apparent that this potentially recoverable NAPL likely has a density similar to that of water. Where such NAPL was encountered, it was generally found to be present in seams of coarser slag material at depths below the water table but at depths less than 16 feet below ground surface (i.e., the completion depths of the various borings). Based on consideration of the historical development at the Coke Oven Area, it is considered likely that organic impacts at depths below the water table are likely a result of the placement of fill materials over previously impacted areas. Observed NAPL in the Cell 6 area did not exhibit a coal tar odor, and therefore it is likely that this NAPL is an intermediate fraction that is not as rich in benzene, toluene, ethylbenzene, and xylene as is typical byproduct recovery plant light oil.

Figure 3-1 presents a graphical depiction of the wells in which LNAPL was measured and observations regarding the boring locations and depths at which the aforementioned NAPL was encountered. The figure also includes those boring and well locations where no observations of LNAPL/potentially recoverable NAPL occurred. As is shown on Figure 3-1, potentially recoverable NAPL was found to extend beyond the limits of the area historically designated as Cell 6.

Potentially recoverable NAPL was encountered in borings to the north and was identified as far as north as boring CO185-SB016 where potentially recoverable NAPL was encountered at a depth of 11 to 12.9 feet. This boring is located approximately 500 feet to the north of Cell 6. The depth to water in this area is expected to be on the order of 5 to 6 feet below ground surface based on water level measurements for monitoring wells in the surrounding area. NAPL was also identified at depth in borings CO152-SB016 (14.1 to 16 feet) and CO153-SB016 (10.4 to 16 feet) located approximately 250 feet and 100 feet north of Cell 6, respectively. The NAPL encountered in boring CO185-SB016 is at a higher elevation than that at CO152-SB016 and CO153-SB016 which indicates that the two observed areas of NAPL are likely unrelated.

Potentially recoverable NAPL was also encountered to the southwest at the perimeter of Cell 6 (from 9.2 to 12.9 feet in Boring CO151-SB016) and to the east of Cell 6 in borings CO159-SB016 (10 to 14.2 feet) and CO160-SB016 (12.8 to 15.6 feet). The eastern borings, as well as several others to the east and southeast were installed in an attempt to establish a possible connection (or lack thereof) between LNAPL observed in monitoring well CO04-PZM004 (1.19 feet during the June 2015 monitoring well gauging round) and Cell 6. No such connection was identified as a result of the boring program; recoverable LNAPL was not identified in borings located between Cell 6 and CO04-PZM004 and LNAPL did not accumulate in borings which were left open between these locations. As subsequently discussed, the physical properties of the LNAPL in the CO04-PZM004 area are different than those in the Cell 6 area. Consequently it has been concluded that the LNAPL observed at well CO04-PZM004 is associated with an isolated source.

In addition to direct observation of the potential presence of NAPL in the boring cores, a supplemental study (not specified in the Work Plan) was also completed in the Cell 6 area. Specifically, a number of boreholes were left open during the study to facilitate subsequent installation of monitoring wells once the field information was reviewed. This procedure afforded the opportunity to complete direct measurements of potential LNAPL and DNAPL presence. The borings where this was completed and the results are summarized in Table 3-1. In addition, the "open borehole" monitoring locations are depicted on Figure 3-1.

Importantly, although potentially recoverable NAPL was observed in CO152-SB016 to the north of Cell 6, no NAPL accumulated in this borehole. Of the fourteen borings subjected to such testing, NAPL was found to have accumulated (as LNAPL) in two of the borings (CO150-SB016 and CO154-SB016). A trace of LNAPL was encountered in three others (CO152-SB016, CO159-SB016, and CO176-SB016). As a result of the detection of LNAPL in CO150-SB016 and CO154-SB016, both of these borings were ultimately converted to monitoring wells. It is also important to consider the fact that, similar to the observation for CO152-SB016, two other borings which displayed the presence of potentially recoverable NAPL yielded no NAPL pursuant to the "open borehole" measurement program. Specifically, while potentially recoverable NAPL was detected in borings CO151-SB016 (9.2 to 12.9 feet) located at the southern perimeter of Cell 6 and CO159-SB016 (10 to 14.2 feet) located immediately east of Cell 6, no NAPL accumulated in either of these boreholes.

In conclusion, the LNAPL present in the Cell 6 area does not appear to have migrated significantly from the Cell 6 area as historically delineated. The potentially recoverable LNAPL does not extend to the north, east, south or west of the Cell 6 area. However, widespread organic impacts are present at depth throughout the area and observations of potentially recoverable free product were noted below the water table in some transmissive seams in the slag fill at the site. Such seams, which appear to contain material with a density similar to that of water, are not widespread and did not demonstrate recoverable or mobile NAPL characteristics based on consideration of the open borehole study. Of the fourteen boreholes that remained open during the study, only those within the limits of the Cell 6 area as defined accumulated LNAPL. Importantly, it does not appear that the presence of large diameter storm sewers to the north and west of Cell 6 have acted as preferential migration pathways for free phase material; the available data suggested that the LNAPL has not reached the envelopes of such storm sewers. Nonetheless, the LNAPL in the Cell 6 area is considered a potential long term source of dissolved phase constituents and evaluation of possible means to reduce the mass of such LNAPL is considered appropriate.

<u>High-Vacuum Study – Cell 6</u>

Six wells in the Cell 6 area (CO89-PZM, CO92-PZM, CO95-PZM, CO98-PZM, CO99-PZM, CO127-PZM) and a well located to the east of Cell 6 (CO04-PZM004) were investigated during the high-vacuum recovery study. The purpose of this study was to evaluate the potential for accelerated recovery of LNAPL using vacuum to draw NAPL into the well, as well as to evaluate the potential radius of influence possible with such a process. The location of these wells is depicted on Figure 3-2 which graphically depicts the results of LNAPL and DNAPL recovery studies. The wells for the high vacuum study were selected based on consideration of LNAPL measurements completed during the June 8, 2015 groundwater gauging and monitoring program. The results of the high vacuum study for these wells are summarized in the following paragraphs.

Given the demonstrated presence of an LNAPL body in this area, the six wells in the Cell 6 area were investigated via high vacuum recovery during the initial phase of the study. Well CO04-PZM004 was added to the program at a later date to assess the potential for recovery in the area to the east of Cell 6. The initial vacuum study for Cell 6 was completed from June 15 through June 17, 2015. A round of LNAPL gauging was completed for each of the six wells prior to initiation of the vacuum study.

LNAPL thicknesses ranged from 0.02 feet (CO127-PZM) to 3.1 feet (CO99-PZM) in a pre- and post-vacuum gauging table (Table 3-2). Vacuum (12" of mercury) was applied at the well heads. At the completion of the vacuum study, only a trace of LNAPL remained in each of the wells studied as is summarized in Table 3-2. Slight propagation of the vacuum was measured in nearby monitoring wells using a magnahelic gauge as is summarized in Table 3-3. Consequently, it is apparent that vacuum can be propagated although the formation is not particularly pneumatically conductive, likely as a result of the presence of cemented slag.

The water/LNAPL recovered during the vacuum study was decanted into steel drums. The calculated LNAPL volume for these wells is summarized in Table 3-4. After the first phase of the vacuum study for Cell 6, LNAPL thicknesses ranging from a trace amount to 0.6 feet. The upper bound of this range was measured for well CO89-PZM and the 0.6 foot thickness corresponded to approximately 13 gallons of LNAPL in a standard 55-gallon drum (1.78 gallons per inch). This LNAPL was recovered in an elapsed time of 10 minutes which equates to a recovery rate of approximately 1.3 gpm. Two additional wells (CO92-PZM and CO99-PZM) also yielded significant quantities of LNAPL during the initial study although 120 minutes was required to recover approximately 10 gallons of LNAPL from CO99-PZM. CO95-PZM, CO98-PZM, and CO127-PZM yielded only a trace amount of LNAPL.

As a result of this initial study, CO95-PZM, CO98-PZM, and CO127-PZM were dropped from the high vacuum study. The remaining three wells were subjected to additional vacuum testing and CO04-PZM004 was added to the program as a result of the detection on the order of one foot of LNAPL at that location. Additional LNAPL gauging results for the wells studied during the high vacuum assessment are summarized in Table 3-5.

CO89-PZM was tested four additional times. CO92-PZM and CO99-PZM were tested two more times and CO04-PZM004 was tested twice. Recovery rates fluctuated during the different vacuum events but it was determined that CO89-PZM and CO92-PZM were potentially productive wells over a longer term. CO04-PZM004 yielded approximately 2 gallons of LNAPL both times it was tested.

The results of the vacuum study and LNAPL measurement for Cell 6 indicate that high vacuum recovery has the potential to accelerate LNAPL removal significantly. Based on these findings, it is considered appropriate that simulation efforts be completed to determine if the technology is indeed viable on a large scale and to support determination of spacing, possible duty cycles, fluids management assessment, etc. during design if appropriate.

3.2 CELL 2

LNAPL Assessment

The field data indicated a much more limited extent of LNAPL in Cell 2 than in Cell 6, as is depicted in Figure 3-1. Clean wells surrounding those that contained LNAPL provide confirmation that the extent of LNAPL is limited. The LNAPL in Cell 2 does not appear to be associated with the LNAPL body in the Cell 6 area given observations regarding different physical properties (i.e., viscosity) and the absence of LNAPL in intervening monitoring wells. It is considered likely that the LNAPL observed in the Cell 2 area is present as a result of the placement of byproduct coke oven wastes in the area prior to the advent of the Resource Conservation and Recovery Act.

High-Vacuum Study – Cell 2

Two wells in the Cell 2 area (CO122-PZM and CO37-PZM003) were investigated during the high-vacuum recovery study. The location of these wells is depicted on Figure 3-2 which graphically depicts the results of LNAPL and DNAPL recovery studies. The results of the high vacuum study for these two wells are summarized in the following paragraphs.

A viscous, weathered LNAPL was encountered in well CO122-PZM which made determination of the thickness of LNAPL difficult. The LNAPL apparently occluded the interface probe tip and resulted in a false signal. Consequently, during the first LNAPL measurement for this well (completed as part of the site-wide groundwater study subsequently discussed), almost 7 feet of LNAPL was reported to be present. Subsequent measurement was completed using a "bottom up" approach where the interface probe was lowered into the water column until a sustained aqueous phase response was obtained. The probe was then raised until the water/LNAPL and LNAPL/air interface were encountered to determine LNAPL thickness. This procedure yielded repeatable measurements of approximately 0.1 feet of LNAPL for this well location. An in-well LNAPL thickness of 0.51 feet was measured for well CO37-PZM003 during the site-wide groundwater study (June 8, 2015).

Given the potential presence of a LNAPL body in this area, these two wells were subjected to the high-vacuum study. On the day that the vacuum study was completed (June 18, 2015), 0.3 feet of LNAPL was present in well CO122-PZM as is summarized in a pre- and post-vacuum gauging table (Table 3-2). A total of 2.55 feet was measured for well CO37-PZM003 on the day of the vacuum study (June 18, 2015). Vacuum (12" of mercury) was applied at the well heads. A trace of LNAPL was measured in both wells at the completion of the study as is summarized in Table 3-2. Slight propagation of the vacuum was measured in nearby monitoring wells using a magnahelic gauge as is summarized in Table 3-3. Consistent with the findings for Cell 6, it is apparent that vacuum can be propagated although the formation is not particularly pneumatically conductive, likely as a result of the presence of cemented slag.

The water/LNAPL recovered during the vacuum study was decanted into steel drums. The following day, an LNAPL thickness of 0.3 feet was measured in the CO122-PZM drum which equates to approximately 6.4 gallons of LNAPL in a standard 55-gallon drum (1.78 gallons per inch). Only a trace of LNAPL was measured for the well CO37-PZM003 drum which was estimated to be 0.10 gallons of LNAPL.

The calculated LNAPL volume for these wells, and the other wells subjected to testing in the Cell 6 area are summarized in Table 3-4. As is shown in Table 3-4, the duration of the vacuum study for well CO122-PZM was 25 minutes and the duration for well CO37-PZM003 was 120 minutes. Consequently, LNAPL recovery rates of 0.26 gpm and 0.0008 gpm were achieved for wells CO122-PZM and CO37-PZM003, respectively.

Subsequently, additional high vacuum LNAPL recovery events were completed at the site. However, gauging of the LNAPL thicknesses in wells CO122-PZM and CO37-PZM003 indicated that LNAPL had not re-entered the wells. The wells were gauged for LNAPL presence on July 30, 2015 and August 26, 2015. No measurable thickness of LNAPL was encountered although a trace amount was present. Additional LNAPL gauging results for the wells studied during the high vacuum assessment are summarized in Table 3-5.

The results of the vacuum study and LNAPL measurement for Cell 2 indicate that small pockets of localized LNAPL likely exist and that the LNAPL may be very viscous in nature. Although some LNAPL was recovered as a result of the vacuum study, the fact that LNAPL had not re-accumulated in the wells more than two months later suggests that limited free-phase source material exists in the Cell 2 area. High vacuum recovery of LNAPL from the Cell 2 area is not considered likely to produce significant returns.

3.3 CELL 3

NAPL Assessment

Boring logs and photographs of the cores for the four Cell 3 borings that were proximate to the cell were reviewed to determine if source materials exist in the area. Several borings were completed in the general vicinity of locations where high concentrations of VOCs have been detected in groundwater. Some indications of a potential source zone consisting of clear oil were noted in the boring logs (specifically for borings CO127-SB036 and CO128-SB036). A thin seam of this clear oil (confirmed to be present with Sudan IV dye) was observed from 9.5 feet to 10 feet in boring CO127-SB036 near the downgradient western end of Cell 3.

Clear oil (22.3 to 26 feet) was also identified in boring CO128-SB036 which is located upgradient and near the center of the Cell 3 AS/SVE system. PID readings were as high as 377 ppm in this zone and an aromatic odor was reported. The oil was located below the water table. An isoflow groundwater sample obtained at this depth yielded a benzene concentration similar to that for well CO103-PZM. NAPL has never been noted in well CO103-PZM (or in any other well in the Cell 3 Area for that matter). Consequently, it is evident that recoverable free product does not exist in the Cell 3 area.

Anemometer and PID Study

Cell 3 is located adjacent to an inlet from the tidally-influenced Patapsco River approximately 1,600 feet to the southwest of the former benzol plant. As previously discussed, an AS/SVE system consisting of 15 sparge points and 5 soil vapor extraction points is in operation at Cell 3. Although high concentrations of dissolved phase constituents (e.g., benzene on the order of 75 mg/L) have been detected in groundwater samples obtained from the Cell 3 area, mass removal via operation of the IM has been less than expected and is essentially ineffective. Approximately 1,463 pounds of volatile organics have reportedly been removed from Cell 3 via operation of the AS/SVE system.

As a result of the relatively poor performance of the Cell 3 IM (versus the performance of the IMs at Cells 1 and 2) investigation of a possible explanation was initiated. Multiple possible explanations were hypothesized to explain the performance of the Cell 3 IM although other explanations might be postulated:

1) Short circuiting of air from the atmosphere to the SVE system results in inability to capture the outgassing volatile organic constituents;
2) The impacted dissolved phase groundwater zone is located at a deeper elevation than the sparge points;
3) Scaling as a result of geochemical reactions resulted in occlusions in the subsurface which impeded delivery of air beyond the immediate vicinity of the sparge points (i.e., limited delivery or short circuiting is occurring);
4) The AS side installation method wherein slag was ripped along the AS alignment to a depth equivalent to the approximate elevation of the sparge points resulted in pneumatically-transmissive vertical conduits to the SVE zone (short circuiting);
5) High variability in grain sizes and pore space interconnection exists along the AS trench such that air is delivered preferentially to sparge points located in areas of lower concentration (i.e., at the ends of the trench);
6) The sparge points are not located at optimal locations in the horizontal direction or are too widely spaced; and/or,

7) The sparge points are not deep enough to result is good lateral dispersion through the overlying impacted groundwater.

Review of historical information regarding installation and operation of the system indicates that hypothesis number 1 is unlikely. If poor performance of the SVE system were responsible, it would be expected that a decline in groundwater concentrations would occur regardless. This has not been observed; concentrations, particularly those in samples from monitoring well CO30-PZM015 have remained fairly consistent over time. Similarly, the air sparge points appear to have been installed in the same horizon as the impacted groundwater as evidenced via comparison of the depth of the sparge points relative to the depth of impacted groundwater as determined from depth-specific isoflow groundwater sampling.

Available historical data were insufficient to assess the other possible explanations for the relatively poor performance. Consequently, initial investigatory activities were undertaken to assess the system. As discussed in Section 2, ports were installed on the piping to the various air sparge points and on the SVE risers to accommodate measurement of air velocities (AS side) and vapor phase concentrations (SVE side). An anemometer was used to measure the air velocities and a Photo-Ionization Detector (PID) was used to measure off-gas volatile organic compound concentrations. The PID measurements were obtained by using a vacuum pump to draw air from the SVE system at a rate approximately equivalent to the air flow rate through the SVE risers.

The results of the velocity and vapor phase concentration study are summarized in Table 3-6. As is shown in Table 3-6, it is evident that a potentially significant imbalance exists for the AS side of the Cell 3 IM. The PID measurements for the 5 SVE risers also provide some significant information with respect to performance. While the central SVE riser (C3V3) yielded a 14.5 ppm measurement on the PID, the second highest PID result was approximately an order of magnitude lower (1.9 ppm for C3S1) and the remaining three risers yielded 0.2, 0.2 and 0.9 ppm.

It is important that the results of the air velocity and PID measurements be viewed in the context of the spatial distribution of dissolved phase constituents in the Cell 3 area. Several issues are significant with respect to spatial distribution.

The most significant BTEX concentration (primarily benzene) appears to exist in the central portion of Cell 3 as indicated by the analytical results for samples from monitoring wells CO30-PZM015 and CO103-PZM and isoflow sample CO128-WS25 (total BTEX concentrations ranging from approximately 55 to 75 mg/L). In addition, possible source material (clear oil) was identified in the CO128-SB036 soil boring. Concentrations at the eastern end of the AS system are somewhat lower as evidenced by the results for monitoring wells CO101-PZM and CO102-PZM (17.2 and 24.9 mg/L). Significantly, BTEX concentrations are substantially lower at the western end of the AS network. Furthermore, it is apparent that the area where the highest groundwater concentrations of BTEX are present (i.e., CO30-PZM015) is likely located beyond the influence of the sparge wells given the depth of installation and possible vertical short circuiting.

Rudimentary calculations based on the air velocity measurements indicates that approximately 27% of the total air is delivered to the subsurface at point AS-1 on the easternmost end of the network whereas 6.7% would be delivered if the system were equally balanced. Air sparge points AS-8 through AS-11 are considered potentially optimum locations for delivery of air (as the system is currently configured) based on the measured BTEX concentrations in proximate monitoring well and isoflow samples, yet only 13% of the air delivered reaches these points.

It should be apparent that re-balancing of the system will likely improve the performance of the Cell 3 IM. In fact, preliminary rebalancing was accomplished at the completion of the study and potential improvements have already been realized. Prior to rebalancing, the average PID concentration in the SVE risers was 3.5 ppm. After preliminary balancing, the average PID concentration in the risers increased to 9.3 ppm. It is apparent that a potentially significant increase in removal was achieved.

3.4 CELL 4/ 5

DNAPL Assessment

As previously discussed, eight borings were completed in the Cell 4/5 area to define the extent of DNAPL. Three of the borings were converted to monitoring/recovery wells. In addition, all of the existing wells in the Cell 4/5 area were gauged for the presence of DNAPL. The results of the DNAPL gauging for the monitoring wells and the boring program for the Cell 4/5 area are depicted on Figure 3-1.

As shown, limited DNAPL was found in the existing wells. During the initial gauging round completed on June 8, 2008, the maximum thickness of DNAPL encountered was 2.35 feet in newly installed well CO123-PZM. Traces of DNAPL were found in six Cell 4/5 area wells, and thicknesses ranging from 0.1 to 1.4 feet were measured in five other wells. A trace of DNAPL was identified in well CO20-PZM004 which is located approximately 900 feet to the north of the Cell 4/5 area. No other indications of the presence of DNAPL have been identified in this northern area and the trace amount measured is not considered grounds for further assessment.

Observations regarding the presence of potentially recoverable DNAPL in the eight borings installed in the Cell 4/5 area are also depicted on Figure 3-1. Three borings were completed within the previously established limits of Cell 4 (CO166-SB36, CO167-SB36, and CO168-SB36). These borings were completed inside the limits of Cell 4/5 given that it was desired that potentially productive monitoring/recovery wells be installed. DNAPL was encountered in all three of these interior borings, all of which were subsequently converted to monitoring wells. A seam of DNAPL was identified in boring CO166-SB36 from 16 to 19.5 feet. Boring CO167-SB031 was reportedly saturated with DNAPL from a depth of 16 to 18.1 feet. Potentially recoverable DNAPL was encountered in boring CO168-SB31 from a depth of 16.5 to 19 feet. It is apparent that an approximate three foot thick seam of DNAPL exists within the Cell 4 area.

Five additional borings were completed around the perimeter of the Cell 4 area in a general star-shaped pattern, two to the north, one to the east, one to the south, and one to the west. The DNAPL thickness thinned to between 0.3 to 0.4 feet to the north (borings CO170-SB026 and CO169-SB36, respectively) and is likely a result of horizontal movement of DNAPL from the main DNAPL body believed to exist within the Cell 4 area as historically defined. Only bands of residual DNAPL were encountered in boring CO173-SB36 which was completed at the western perimeter of the Cell 4 area. No indications of DNAPL presence were observed in boring CO172-SB031 which was installed approximately 75 feet south of the southern perimeter of the Cell 4 area. DNAPL was identified in boring CO171-SB036 at a depth of 16 to 17.75 feet. This boring was located approximately 60 feet to the east of the Cell 4 area. The presence of DNAPL at this location should be recognized if an aggressive DNAPL recovery program is to be implemented.

As indicated, three of the borings located within the limits of the Cell 4 area as historically defined were completed as monitoring/recovery wells. During initial gauging on June 8, 2015, the DNAPL thicknesses in these wells were 2.35 feet (CO123-PZM), trace (CO124-PZM), and trace (CO125-PZM). Additional gauging of each of these wells was completed on July 29 and 30, 2015, July 31, 2015, and August 26, 2015 as is summarized in Table 3-7. DNAPL was recovered from one of these wells (CO123-PZM) during the July 29 and 30, 2015 gauging and a follow-up DNAPL measurement was made on July 31, 2015. A DNAPL recovery study was conducted for this well during the July gauging (subsequently discussed). A summary of DNAPL thicknesses as measured in each of the three wells is as follows:

Recovery Well	DNAPL Thickness (Feet)			
	07/29-30/2015	07/31/2015	08/05/2015	08/26/2015
CO123-PZM(1)	14.5	1.6	3.41	10.6
CO124-PZM	3.0	3.05	2.79	4.3
CO125-PZM	0.7	0.7	0.47	0.8

1. CO123-PZM was purged of DNAPL during the first measurement event listed above.

As shown, CO123-PZM appears to be a potentially highly productive well, CO124-PZM appears to be somewhat productive, and CO125-PZM is of limited productivity. One general inference from this is that, while DNAPL can be recovered from the Cell 4 area via physical removal, the recoverable DNAPL does not appear to be an extensive body (at least in the context of the size of the Former Coke Oven Area). The three wells listed above are along a line approximately 100 feet in length and although DNAPL was identified during boring completion for each of the wells, only one of the wells appears to be producing a copious quantity of DNAPL.

As is shown 14.5 feet of DNAPL accumulated in CO123-PZM (a six-inch diameter well) over approximately seven weeks. After the well was purged of DNAPL, another 1.6 feet accumulated within days and 10.6 feet had accumulated after another three to four weeks. The 14.5 foot and 10.6 foot accumulations indicate that the DNAPL had filled the ten foot sump on two occasions and had extended up into screened portion of the well. However, it should be noted that future performance may vary from recent observations. For example, it is distinctly possible that this well will cease to produce over time as the viscous DNAPL approaches residual saturation. Similarly, when originally gauged, well CO124-PZM exhibited a trace of DNAPL (June 8, 2015) but approximately 3 to 4 feet subsequently accumulated, likely as a result of delayed entry associated with wetting of the sand pack. Wells CO123-PZM and CO124-PZM have been outfitted with dedicated DNAPL recovery pumps to remove DNAPL from the area and to assess longer-term DNAPL recovery performance.

<u>DNAPL Recovery Study</u>

During the removal of DNAPL from well CO123-PZM, routine DNAPL thickness measurements were made to determine if DNAPL was actively entering the well. The DNAPL thicknesses versus time are summarized in Table 3-7. Given the viscous nature of the DNAPL, it took approximately 8.5 hours to remove the DNAPL.

As indicated, a total of 14.5 feet of DNAPL were removed from well CO123-PZM over the course of approximately 8.5 hours. In a six inch well, this equates to approximately 21.3 gallons of DNAPL. A measurement of the quantity of DNAPL in the drum into which the DNAPL was containerized (for subsequent management by EAG), was also made and approximately 25 gallons of DNAPL had accumulated.

Gauging of this well was conducted on three separate occasions after the DNAPL recovery study was completed (July 31, 2015, August 5, 2015, and August 26, 2015. Data for these gauging efforts are summarized in Table 3-5. An estimate of the short term recharge rate for this well may be made based on the subsequent gauging rounds, as follows:

- (3.94-1.6 feet) x π x 0.25^2 ft^2 x 7.48 gal/ft^3 / 5 days = 0.70 gallons per day.
- (10.6-3.94 feet) x π x 0.25^2 ft^2 x 7.48 gal/ft^3 / 21 days = 0.46 gallons per day.
- (10.6-1.6 feet) x π x 0.25^2 ft^2 x 7.48 gal/ft^3 / 26 days = 0.51 gallons per day.

The recovery estimates are relatively consistent as a function of time although some decline in the rate appears to occur as the well sump fills.

3.5 GEOLOGY AND HYDROGEOLOGY

The Former Coke Oven Area is relatively flat, owing its existence to man-made fill and extensive, long-term industrial activity. Average ground surface elevations at the site range from sea level at the shoreline to approximately 16 feet-msl. This section presents information on the general geology and hydrogeology of the Site. Information presented in this section was compiled from boring logs as well as historical reports prepared for various portions the Sparrows Point facility. Water levels and LNAPL thickness measurements (which depress the water table) obtained in June 2015 (or compiled from historical data for the Coke Point Landfill Area) were used in the preparation of potentiometric surface maps.

3.5.1 Geology

The geology beneath the Former Coke Oven Area consists of fill material composed primarily of slag overlying interbedded and unconsolidated sand, silt, and clay fluvial and estuarine Quaternary deposits (historically referred to as the Talbot Formation by the Maryland Geological Survey [MGS, 1906] and in previous Site specific reports), which unconformably overlies interbedded dense sand and silt, and hard clay fluvial channel and flood plain deposits of the Cretaceous Period Patapsco Formation. Interconnected and laterally extensive coarse textured water bearing zones within these deposits have been divided into three hydrostratigraphic zones: (1) the shallow unconfined zone; (2) the intermediate semi-confined zone; and (3) the deep confined zone.

The slag and fill deposits are present at surface across the entire Site with thicknesses that range from near 0 feet to approximately 50 feet. These slag and fill materials were likely placed to increase ground surface elevation to alleviate flooding concerns across the Site and emplaced at the western and southern shoreline of the Site to expand the usable footprint of the former industrial facility. These fill deposits are typically welded together and difficult to penetrate with a drilling rig. However, these materials exhibit a relatively high permeability with historical data from URS (2005) indicating a measured hydraulic conductivity value of 48 feet per day (ft/day) for this layer. These fill deposits were placed on top of recent fine sandy and silty river bottom sediments that are laterally discontinuous and overlie fine grained clayey marsh deposits associated with the Talbot Formation. These fine grained deposits beneath the fill materials act to attenuate vertical groundwater flow thus minimizing hydraulic connection with deeper water bearing zones. When these fine grained deposits are present at relatively high elevations, their effectiveness at minimizing vertical flow results in localized perched groundwater water conditions. Anomalous groundwater elevations in the historical data indicate perched groundwater conditions may be present at piezometers CO04-PZM004, CO03-PZM005, SW12-PZM001, and SW14-PZM004. Average hydraulic conductivity values of these clayey marsh deposits are approximately $1.3x10^{-3}$ ft/day.

The Quaternary Talbot Formation is the uppermost naturally-occurring geologic unit in most areas of the Site and underlies recent fill deposits. The Talbot Formation ranges in thickness from approximately 50 to 110 feet beneath the Site with an average thickness of 90 feet. The Talbot Formation consists of eroded and reworked materials from itself, the Patapsco Formation, and similar coastal formations. These eroded materials were then deposited in an interbedded fresh water fluvial channel, flood plain, and a marine estuary environment. The formation's source material and depositional environment result in a complex stratigraphy where lateral correlations are challenging.

The Talbot Formation has been locally divided into an upper and lower Talbot Channel deposits that are separated by a continuous clay layer referred to as the Talbot Aquitard. The upper Talbot Channel deposit contains the semi-confined intermediate water bearing zone and the lower Talbot Channel deposit contains the upper portion of the deep water bearing zone. The upper Talbot Channel deposit is composed of two or more interconnected sand layers separated by discontinuous clay layers. Most of the piezometers designated as "intermediate wells" are generally screened within this intermediate semi-confined water bearing zone. The individual sand lenses within the upper Talbot Channel deposit tend to be 5 to 10 feet thick, but some lenses are as much as 30 feet thick. These sand layers of the upper Talbot Channel deposit exhibit a downward coarsening texture as demonstrated by the average historical hydraulic conductivity values that range from 0.6 ft/day at the top to 5.7 ft/day in the center to 9.2 ft/day at the base (URS, 2005).

A discontinuous clay layer separates the upper Talbot Channel deposit from the overlying slag and fill material. Discontinuities where this clay layer thins or is absent are believed to be localized areas and may represent locations where the overlying slag and fill deposits are hydraulically connected to the semi-confined intermediate water bearing zone. This overlying clay layer has an interpolated average thickness of 14 feet.

The Talbot Aquitard separates the upper Talbot Channel deposits from the lower Talbot Channel deposits. The Talbot Aquitard has an interpolated thickness of up to approximately 26 feet and separates the intermediate semi-confined water bearing zone from the deep confined water bearing zone. The historical data indicate that the Talbot Aquitard has an average hydraulic conductivity of 7.1×10^{-4} ft/day.

The sandy layers within the lower Talbot Channel deposit comprise part of the deep confined water bearing zone. A discontinuous clay layer with an average hydraulic conductivity of 6.9×10^{-4} ft/day is present at the base of the Talbot Formation. This discontinuous basal clay layer results in a hydraulic connection between the sandy layers from the lower Talbot Channel deposit and the sandy layers from the Upper Cretaceous Patapsco Formation. These hydraulically connected sandy layers comprise the deep confined water bearing zone. Several of the historical piezometers designated as "lower" piezometers are screened within the deep confined water bearing unit. Historical data indicate that the sand layers of the deep confined water bearing zone have an average hydraulic conductivity of 2.8 ft/day (URS, 2005).

The Cretaceous Patapsco Formation is composed of dense sand and hard clay layers. This hydrostratigraphic unit is divided into the upper and lower Patapsco Sand units that are separated by the middle Patapsco Clay Aquitard. The sand layers within the upper Patapsco Sand are composed of semi-continuous sand and sandy clay lenses and form the basal portion of the deep confined aquifer. The Upper Patapsco Sand is approximately 40 to 150 feet thick.

Figure 3-3 presents a location map of the geologic cross sections provided to illustrate the general geologic conditions beneath the Former Coke Oven Area. The geologic units described above are shown in cross section in Figures 3-4 and 3-5. The cross sections were developed using interpolation between both historical and recent boring logs and have been simplified to show the multiple layers of interbedded sands, silts and clays. As shown in historical cross sections (URS, 2005), there are areas where the fill material is in direct contact with the underlying Upper Talbot Unit.

3.5.2 Hydrogeology

Water level measurements obtained on June 8, 2015 are summarized in Table 3-8. These water level results were used to prepare potentiometric surface maps for the water horizons historically designated as the Shallow and Intermediate Zones. Table 3-8 also provides information on the extent of NAPL at the site. Water levels were corrected to account for the density of LNAPL if it was present in the well (assumed specific gravity of 0.9).

For wells in the Coke Point Landfill Area, concurrent water level measurements were not obtained, therefore results obtained over the last 5 years were averaged for the purposes of contouring. An extensive number of shallow wells exist in the Cell 6 and Cell 4/5 areas. Water levels in wells in these areas were quite variable and consequently the water levels for these closely-spaced (in the context of the size of the Former Coke Oven Area) were averaged for contouring purposes. In addition, it is believed that both wells at the CO02 cluster were replaced and that survey data are not available for the new wells at this location. Consequently the water elevations for these wells were not considered during contouring. In all cases, the most recent elevation survey data were used to determine water level elevations.

The potentiometric surface of the Slag-Fill Unit is relatively flat over the entire site, with elevations ranging from 5.68 to -2.71 feet-msl. Figure 3-6 is a graphical representation of the potentiometric surface of the shallow unconfined zone as of June 2015. Perched water may be encountered occasionally. In instances where perched water was believed to be present, the water levels were not used for contouring purposes (i.e. CO03-PZM005 with a water level elevation of 8.94 feet).

Groundwater in the shallow unconfined zone flows from the northeast of the peninsula in a general southwest direction, then radially toward the turning basin, Coke Point and the Patapsco River. The hydraulic gradient in the northeastern portion of the Former Coke Oven Area is relatively steep (approximately 0.011foot/foot) compared to that across the remainder of the Former Coke Oven Area and the Coke Point Landfill Area (approximately 0.001 foot/foot).

A depression in the potentiometric surface in the shallow aquifer is observed in the vicinity of Cells 4/5. This condition was not observed historically. It is considered possible that this depression may reflect the effect of operation of the dual-phase extraction system installed in the Cell 4/5 area. Although other shallow wells in this general area (e.g., CO55-PZM000 and CO56-PZP001) do not exhibit a similar influence, evaluation of available boring logs for this area indicates that the slag fill is thicker at such locations but thins towards the wells where the depression is evident. The unaffected wells are completed in slag whereas the affected wells likely intersect the underlying sands.

The potentiometric surface elevations in the Intermediate Zone (i.e., semi-confined zone) ranged from 0.89 to -1.57 feet-msl, as shown in Figure 3-7. Water in the Intermediate Zone appears to flow radially from the site toward the turning basin, the southern portions of Coke Point, and the Patapsco River. A slight depression in the potentiometric surface is located in the northcentral portion of the Former Coke Oven Area in the general vicinity of Cell 1. This depression may be attributable to the intermittent operation of the soil vapor extraction system or possible to the effects of pumping at the graving dock to the north. Several of the wells in the Coke Point Landfill area exhibit high variation in water level measurements, which may be attributable to rainfall, tidal or seasonal influences.

Based on the observed head difference between the two units and the relative impermeability of discontinuous clay layer present at the top of the Talbot Formation, there appears to be little hydraulic connection between the shallow unconfined zone and the Upper Talbot Channel Unit across much of the Former Coke Oven Area. The boring logs indicate that the clay layer that separates the Shallow and Intermediate Zones has a variable thickness of up to 14 feet but is non-existent in some areas. Communication between the two units is considered likely in the areas where the clay is nonexistent, particularly if affected by pumping of the Intermediate Zone Groundwater. The Talbot Clay aquitard is reported as having a hydraulic conductivity of 10^{-6} to 10^{-9} cm/sec (URS, January 2005).

3.6 SHALLOW GROUNDWATER ANALYTICAL RESULTS

This section provides a discussion of the analytical results for the groundwater samples collected from wells and borings at the Former Coke Oven Area in 2015. The 2015 sampling and analysis results are also compared in general terms to historical data from 2002 and 2005 to give an indication of temporal trends in the concentrations of the primary soluble constituents and hence to give an idea of the effectiveness of the current IMs in place at the various cells.

3.6.1 Current Conditions

In June 2015, groundwater samples were collected from 43 individual monitoring wells screened in the shallow aquifer using the techniques described in the Work Plan (KEY, January 2015) and summarized in Section 2 of this report. In addition, four duplicate samples were collected. The chemical analytical results for these groundwater samples are summarized in Table 3-9.

As was indicated in prior sampling events, the most prevalent organic constituents in groundwater (i.e., most widespread and found at the highest concentrations) were benzene, toluene, ethylbenzene, xylenes and naphthalene. In addition to naphthalene, lower solubility Polycyclic Aromatic Hydrocarbons (PAHs) were also detected in the groundwater samples albeit at markedly lower concentrations given their limited solubility and high sorption potential.

Summaries of the most recent (2015) analytical results were compiled in a series of figures depicting isoconcentration contours for the primary constituents of interest. The contours were derived from the measured concentrations and use orders of magnitude to simplify the presentation. The groundwater data were supplemented with information gained from the isoflow samples (which were groundwater samples collected from discrete intervals in an open borehole as compared to results from screened monitoring wells) as well as nearby soil borings that were drilled and logged in an effort to define the lateral extent of NAPL impacts.

Figure 3-8 presents isoconcentration contours for benzene in the shallow groundwater. Figure 3-9 presents groundwater isoconcentration contours for BTEX, which closely mimic those for benzene. The figures suggest the presence of five separate sources in the Former Coke Oven Area, particularly when considered in concert with the Intermediate Zone groundwater results and observations during the soil boring program and LNAPL and DNAPL measurements. These five sources consist of an isolated source in the Cell 3 area, an isolated source at the Cell 4/5 area, two sources (Cell 1/6 and Cell 2 areas) which appear to be superimposed to some extent, and a separate source in the Coke Point Landfill Area.

In the Cell 3 area, the highest concentration of benzene reported was 67.9 mg/L, with non-detected values east and west of the cell. North of this area, concentrations declined rapidly, to 12.4 mg/L

200 feet north, and finally to 0.137 mg/L in a shallow isoflow sample collected 300 feet northeast of the AS/SVE system (i.e., in the direction of Cell 1 and Cell 6). The results for this isoflow sample provide a direct indication that the affected groundwater in the Cell 3 area is separate and distinct from that in other portions of the Former Coke Oven Area (specifically the Cell 1/6 source area).

Another source of benzene is evident in the Cell 4/5 area. The highest concentrations of benzene in this area are one to two orders of magnitude lower than those in the Cell 3 and Cells 1, 2 and 6 areas, respectively. This source area is primarily associated with coal tar DNAPL with light oil artifacts and consequently the dissolved phase benzene concentrations are lower than those observed elsewhere.

Benzene concentrations in the Cell 1 and 6 areas were as high as 169 mg/L, with the highest concentrations reported for samples obtained in the vicinity of Cell 1. However, as shown on Figures 3-8 and 3-9, the contours are drawn around Cell 6 because of the presence of LNAPL in several Monitoring wells at Cell 6 (as previously discussed) which precluded collection of groundwater samples for chemical analysis. As is shown on Figure 3-8, concentrations in samples obtained from the Cell 1 area are relatively consistent and it was considered possible that the aforementioned large diameter storm sewer could be affecting the localized distribution of dissolved phase constituents near Cell 1.

As a specific example, the benzene concentrations in samples from four wells located along a line roughly parallel to the storm sewer centerline were 119 mg/L, 166 mg/L, 168 mg/L, and 169 mg/L (wells CO16-PZM006, CO88-PZM, CO02-PZM006, and CO15-PZM005, respectively). However, considering the location of the storm sewer relative to Cell 1, one would expect higher concentrations samples from other wells such as CO79-PZM006 (1.38 mg/L of benzene) which is almost adjacent to the storm sewer if the storm sewer were controlling dissolved phase plume migration. Based on this, it is considered more likely that the distribution of constituents in the Cell 1 area is attributable to the effects of operation of the AS/SVE system itself which appears to have equilibrated the concentrations to a great extent along the Cell 1 centerline.

The dissolved phase benzene in the Cell 1 and Cell 6 areas appears to be superimposed with benzene impacts in the Cell 2 area. Benzene and BTEX concentrations jump at several locations in Cell 2 and this behavior is atypical for a dissolved phase plume from a single source. The highest benzene concentration encountered in the Cell 2 area was 27.3 mg/L. It is considered likely that the source in this area is directly influenced by the dewatering operations at the graving dock located to the north and it is also possible that the effects of the graving dock pumping extend to the Cell 1 and 6 areas.

Finally, an isolated source of benzene and BTEX exists in the vicinity of Coke Point Landfill Area well CP08-PZM008. The benzene concentration detected in a sample from this well was 24.1 mg/L. Concentrations in other groundwater samples obtained in the Coke Point Landfill Area are markedly lower than those detected elsewhere and suggest that the source materials are localized in the vicinity of CP08-PZM008.

Concentrations of naphthalene in the shallow groundwater are depicted on Figure 3-10. Naphthalene concentrations are not continuous throughout the site, and are clearly separated into separate source areas defined by the individual cells. The cell sources of dissolved naphthalene in the shallow groundwater are delimited by the highest concentrations focused on the various cells, with lower concentrations or non-detectable values between cells. Two small, isolated source areas of naphthalene are located north of Cells 4/5 and east of Cell 6, and on the western shoreline northwest of Cell 3. Additionally, the concentrations of naphthalene in the Coke Point Landfill Area do not appear to be connected to those in the Former Coke Oven Area.

3.6.2 Temporal Trends

Historical benzene and naphthalene concentrations were evaluated to determine if any trends are evident in the dissolved phase groundwater concentrations. CH2MHill prepared a "Site-Wide Investigation Release Site Characterization Study" in 2002. The CH2MHill Report characterized benzene and naphthalene concentrations, groundwater geochemistry, groundwater flow, and local geology. URS prepared a thorough site investigation in 2005, titled "Site Wide Investigation: Report of Nature & Extent of Releases to Groundwater from the Special Study Areas," which expanded on the CH2MHill Report. URS generated isoconcentration maps of benzene and naphthalene in the Shallow and Intermediate Zones in 2006 as a response to USEPA Comments. Quarterly monitoring began in 2010 for Cell 1, 2011 for Cell 2, and 2010 for Cell 4. Most concentration data used to determine trends was collected by URS and EnviroAnalytics during quarterly monitoring from 2010-2014.

Previous depictions of isoconcentration contours for benzene and naphthalene (URS, 2005) indicated that the entire Former Coke Oven Area and Coke Point Area were impacted, with source areas centered near Cells 1/6, Cells 4/5 and the Coke Point Landfill. The concentrations of constituents of interest have declined in most locations as indicated by the most recent round of groundwater sample analysis. Furthermore, the completion of various borings (which identified other discrete source areas), isoflow groundwater sampling and analysis between the Cell 1/6 and Cell 3 areas, and the latest round of groundwater sampling and analysis indicates that, while dissolved phase impacts are widespread across the Former Coke Oven Area (and to a lesser extent across the Coke Point Landfill Area), the impacts are not continuous in nature. The extent of the dissolved phase impacts was discussed in some detail in the preceding sections. This section provides a discussion of trends in dissolved phase groundwater concentrations to provide an indication of attenuation (primarily via physical mechanisms such as sorption and dispersion) and the effects of remedial efforts initiated as Interim Measures.

Cell 1

Three wells (CO93-PZM, CO02-PZM006, and CO18-PZM006) have been monitored regularly in the Cell 1 area from 2010-2015. Additional sampling events occurred in 2002, 2004, and 2015. All three wells monitored showed declines in benzene concentrations since 2002. Wells CO02 and CO18 showed more substantial declines in concentration than CO93. Well CO02 contained 1,600 mg/L benzene in 2002, which had declined to168 mg/L by 2014. Well CO18 contained 1,300 mg/L benzene in 2002, which had declined to 13.2 mg/L by 2014. Well CO93 shows a subtle decline in benzene concentration, but the data is scattered and there are frequent increases and decreases from 2010-2014.

Only three sampling events included analysis for naphthalene in Cell 1. The three sampling events occurred in 2002, 2004, and 2014. Well CO02 showed an increase in naphthalene concentration from 2002 to 2011, while C093 and CO18 showed no change in naphthalene concentration. Naphthalene concentrations were much lower than benzene concentrations. Naphthalene concentrations vary between 33.8 µg/L for well CO18 and 1,880 µg/L for well CO02. Naphthalene concentration increased in the most downgradient well monitored in Cell1, CO02.

Cell 2

Limited benzene and naphthalene data are available for Cell 2. Only two sampling events in well CO27-PZM012 were identified for historical trend analysis. Newer wells (CO121, CO36-PZM008, and CO39-PZM007) in and around Cell 2 show similar concentrations to CO27-PZM012. Well CO27-PZM012 benzene decreased from 25 mg/L in 2002 to 8.34 mg/L in 2014. Naphthalene decreased from 710 mg/L in 2002 to less than 391 mg/L in 2014. CO36-PZM008 contained 27.3 mg/L benzene, which is greater than the benzene concentration reported for well CO27-PZM012 in 2002.

Cell 3

Four wells (CO30, CO101, CO102, and CO103) were regularly monitored in Cell 3 from 2011 to 2014. Additional sampling events occurred in 2004 and 2015. Combined Cell 3 data showed a minor increase in benzene concentration from 2004 to 2015. CO30, CO101, and CO103 showed increases in benzene from 2011 to 2014. CO102 showed no change in benzene from 2011 to 2014. CO102 is located farthest from the shoreline compared to the other monitoring wells in Cell 3. Only two sampling events measured naphthalene in the four wells. There are not enough naphthalene measurements to evaluate historical trends. Based on the isoflow groundwater data it is apparent that a potentially significant source of naphthalene exists at the western end of Cell 3. From the limited data, it appears that naphthalene has not declined from 2004 to 2011.

<u>Cell 4/5</u>

Eleven wells were regularly monitored from 2010-2014. Combined Cell 4/5 data showed a slight increase in benzene and naphthalene concentrations from 2010-2014. Time series data for individual wells within Cell 4/5 are similar to combined trends. Some individual wells (CO119 and CO116) showed slight decreases in benzene.

<u>Cell 6</u>

Given the presence of LNAPL in the Cell 6 area, extensive sampling and analysis of wells in the immediate area has not been conducted over time. However, one well (CO19-PZM004) was sampled in 2002 and again in 2015. The benzene concentration measured in groundwater samples from this well decreased from 12 mg/L in 2002 to 0.409 mg/L in 2015. The naphthalene concentration decreased from 4.4 mg/L in 2002 to less than 0.001 mg/L in 2015 (i.e., not detected with a detection limit of 0.19 ug/L). It appears that the constituent concentrations in the dissolved phase are attenuating in the vicinity of Cell 6. Physical attenuation coupled with source (i.e., LNAPL) removal appears to have had a marked affect for Cell 6. Nonetheless, the presence of LNAPL in this area, as measured in static wells and wells subjected to vacuum recovery, indicates that source material remains.

In conclusion, the temporal trend analysis for the shallow groundwater indicates that concentrations in the Cell 1/6 area are declining, that the concentrations in the Cell 2 area are likely declining (and are expected to respond to the recently installed AS/SVE and recovery well network), but are relatively stable at Cell 3 and Cell 4/5 and the Coke Point Landfill Area.

3.7 INTERMEDIATE GROUNDWATER ANALYTICAL RESULTS

As was discussed for the Shallow Zone groundwater results in Section 3.6, the current conditions discussion is based on the June 2015 analytical results. Previous reports and older quarterly monitoring reports were consulted for the evaluation of temporal trends.

3.7.1 Current Conditions

In 2015, 17 Intermediate Zone wells were sampled and the groundwater samples were analyzed for volatile and semi-volatile organic compounds. One duplicate sample was also collected. The wells selected for sampling and analysis were denoted in the Work Plan for this investigation (KEY, January 2015). The complete analytical results are summarized in Table 3-10.

As shown on Figure 3-11, benzene concentrations in the Intermediate Zone wells are one to three orders of magnitude lower than in the Shallow Zone across large portions of the Former Coke Oven Area. A similar pattern of lesser groundwater impacts in the Intermediate Zone is depicted on Figures 3-12 (BTEX) and 3-13 (naphthalene). This is likely a result of the fact that the Intermediate Zone exists under semi-confined conditions and communication between the unconfined (Shallow Zone) and semi-confined (i.e., Intermediate Zone) groundwater is poor.

However, the opposite condition is observed for Cell 2 and the area immediately upgradient of Cell 2, where the concentrations of benzene, BTEX and naphthalene are approximately an order of magnitude higher in the Intermediate Zone than in the Shallow Zone. For example, a sample from well CO41-PZM036, which is located to the northwest of Cell 1, yielded a benzene concentration of 616 mg/L and a total BTEX concentration of 758 mg/L. The shallow well at this location yielded a benzene concentration of 76.2 mg/L and a total BTEX concentration of 136 mg/L. This phenomenon is likely attributable to the operation of the underdrain pumping system at the graving dock to the north of Cell 2, which appears to pull contamination from the Shallow zone into the Intermediate zone.

3.7.2 Temporal Trends

Unlike the Shallow Zone, the Intermediate Zone has not been monitored quarterly in the vicinity of the various Cells with the exception of Cell 2. Intermediate Zone data were collected by CH2MHill in 2001-2002, URS in 2004, and EnviroAnalytics in 2011 and 2014. Data have not been collected for all cells. Where data are available for the various cells, brief discussions of temporal trends are provided in the paragraphs that follow.

Cells 1 and 2

Only two sampling events for well CO02-PZM041 were identified for temporal trend analysis in Cell 1. Benzene concentrations increased from less than 0.001 mg/L in 2001 to 0.036 mg/L in 2015. It appears that benzene has migrated into this zone. Naphthalene concentrations decreased from 1.1 mg/L in 2001 to 0.114 mg/L in 2011. Naphthalene was present in the Intermediate Zone in 2002, but had declined by an order of magnitude by 2011. Two sampling events for Cell 2 well CO27-PZM046 were evaluated. Benzene slightly increased from 390 mg/L in 2004 to 413 mg/L in 2015. Naphthalene also increased from 0.86 mg/L in 2004 to 3.23 mg/L in 2015.

Cell 4/5

Historically, two Intermediate Zone wells have been subjected to sampling/analysis for Cell 4/5. Well CO13-PZM030 is located in the center of Cell 4 and well CO26-PZM032 is located on the eastern edge of Cell 5. Well CO13-PZM030 benzene concentration decreased from less than 0.18

mg/L in 2002 to 0.0017 mg/L in 2015. The concentration of benzene in groundwater from well CO26-PZM030 decreased from 0.0025 mg/L in 2004 to less than 0.001 mg/L in 2015. The concentration of benzene in the Intermediate Zone appears to have attenuated over time.

The concentration of naphthalene in groundwater from well CO13-PZM030 decreased from less than 3.1 mg/L in 2002 to 0.0019 mg/L in 2015. Well CO26-PZM030 naphthalene concentration decreased from 0.031 mg/L in 2004 to less than 0.001 mg/L in 2015. The Intermediate Zone naphthalene appears to be attenuating over time.

Coke Point Landfill

In 2014, benzene was only detected in samples from CP05-PZM028 and CP16-PZM035: the other six wells in the Coke Point Landfill area exhibited benzene concentrations below a detection limit of 0.005 mg/L. The concentration of benzene in well CP16-PZM035 increased slightly from 0.26 mg/L in 2003 to 0.281 mg/L in 2014. Well CP05-PZM028 decreased in benzene concentration from 0.12 in 2002 to 0.0599 in 2014.

3.8 ISOFLOW GROUNDWATER ANALYTICAL RESULTS

Several additional groundwater samples were collected as grab samples pumped directly from the formation during this activity. These sample results were used in the development of the isoconcentration contour maps discussed in Sections 3.6 and 3.7. Field parameters were measured where possible (depending on turbidity) and the samples were sent to the laboratory for analysis of volatile and semi-volatile organic compounds. The analytical results for these samples are summarized in Table 3-11. These results were used in the development of the isoconcentration contours presented in Figures 3-8 through 3-13 (the results of the 25’ depth were used for contouring purposes).

It should be recognized that isoflow samples are obtained from a borehole that is undeveloped and consequently the water samples obtained in this manner are not truly representative of groundwater quality. Nonetheless, as depicted on Figure 3-8 through 3-13, the Cell 3 isoflow results are generally consistent with the results obtained from monitoring wells installed in the area. The results serve to demonstrate that the impacted groundwater zone exists at a depth of approximately 25 feet below grade. Significantly lower concentrations were encountered in the shallow (15 foot) and deeper (36 foot) samples. The results for isoflow samples obtained from boring location CO130 located to the northeast of Cell 3 area are particularly useful given that they indicate an absence of a connection between Cell 3 and the Cell 1/6 area.

3.9 INDICATOR PARAMETER ANALYSIS

Various indicator parameters were measured in the field or in fixed-base laboratories during the groundwater gauging and sampling/analysis event. The overall chemical-analytical results of the groundwater study (volatile and semivolatile organics) were discussed on an area-wide basis in Sections 3.6 and 3.7. However, the results for the indicator parameters are discussed herein separately since they could have a direct bearing on potential remedial technologies. The results of the indicator parameter measurements are summarized for the Shallow and Intermediate Zones in Tables 3-12 and 3-13, respectively. Table 3-14 presents chloride and sulfate analytical results for Intermediate Zone wells. The sulfate and chloride data were obtained to support an evaluation of potential bioremediation (sulfate-reducing bacteria) and to provide an indication of potential saltwater intrusion in the Intermediate Zone (chloride). Significant findings based on review of the indicator parameter results may be summarized as follows:

- Dissolved oxygen concentrations across much of the Former Coke Oven Area are depleted, indicating that aerobic respiration by native microorganisms is likely occurring. Groundwater dissolved oxygen (DO) concentrations in the Shallow Zone ranged from 0.29 to 1.98.

- Oxidation-Reduction Potentials (ORP) were highly variable across the site indicating that strongly reducing conditions to slightly oxidizing conditions exist. Groundwater typically exists under reducing conditions which could favor manganese, iron, or sulfate reduction and anaerobic degradation of organics.

- The pH of groundwater across the Former Coke Oven Area was also found to be highly variable. In areas where significant thicknesses of slag exist, the groundwater pH is typically elevated. Measurement of pH for groundwater samples obtained from the Cell 3 and Cell 4/5 areas ranged to over 12 standard units. The elevated pH at these locations will be inhibitory with respect to microbial activity. In general, groundwater in the Cell 1, 2 and 6 areas is more neutral although localized areas of elevated pH are evident.

- Based on review of historical (2002) sulfate data and recent (2015) sulfate data for the Intermediate Zone, it is apparent that sulfate reduction may be occurring in areas where microbial activity is not inhibited by elevated pH or organic compound concentrations.

To facilitate consideration of the indicator parameter results, six figures depicting selected results for the Shallow and Intermediate Zones were prepared. These figures are provided in Appendix E and are as follows:

- Figure E-1 Shallow Zone Groundwater pH
- Figure E-2 Intermediate Zone Groundwater pH
- Figure E-3 Shallow Zone Groundwater ORP and DO
- Figure E-4 Intermediate Zone Groundwater ORP and DO
- Figure E-5 Shallow Zone Groundwater Sulfate
- Figure E-6 Intermediate Zone Groundwater Sulfate

In conclusion, several regions of the Former Coke Oven Area Shallow and Intermediate Zone groundwater exhibit pH values that will inhibit microbial activity, primarily Cell 3, Cell 4/5, and portions of Cell 2 adjacent to the seawall. Dissolved oxygen concentrations are depleted in virtually all areas suggesting that aerobic respiration has occurred but is likely rate limited by the absence of oxygen. The introduction of oxygen via air sparing in the Cell 1 and Cell 2 areas could result in some acceleration of aerobic respiration. Opportunities for introduction of sulfate as calcium sulfate, magnesium sulfate, or preferably sodium sulfate could possibly result in increased anaerobic respiration, a condition that has been observed at other integrated steel making or coal tar processing facilities.

Finally, chloride analysis of samples of groundwater from selected Intermediate Zone monitoring wells was completed to provide additional information regarding the general water quality of semi-confined groundwater. Chloride concentrations ranged from 143 to 830 mg/L and averaged 380 mg/L in the eight samples subjected to analysis. The chloride concentrations in the Intermediate Zone groundwater exceed the chronic Ambient Water Quality Criteria for protection of freshwater aquatic life (230 mg/L) but are substantially below the concentrations in sea water (approximately 2%). Given that the chloride concentrations are above the freshwater standard it is likely that some degree of saltwater intrusion has occurred at the site.

3.10 GEOTECHNICAL INVESTIGATION

Four proof-of-concept geotechnical soil borings were completed in the vicinity of Cell 2 at the locations depicted on Figure 2-1, to determine whether a slurry wall would be an effective contaminant containment measure. Split spoon samples were obtained at selected intervals. In addition, undisturbed (Shelby Tube) samples were also collected. The geotechnical parameter analytical results are summarized in Table 3-15.

In general, granular fill material was found in all borings from the ground surface to depths ranging from 21 to 55 feet below ground surface (bgs). Below the fill, interbedded layers of silt that graded to fine-to-medium sand extended to depths ranging from 60 to 80 feet bgs. Dense, stiff clay was found at depths ranging from 60 feet to 80 feet. In one boring, CO125-SB087, dense, stiff clay lenses interbedded with fine to medium sand extended from depths of 41 to 80 feet-bgs. Shelby Tube samples from the clay units were tested for moisture content, grain size, plasticity (Atterberg limits) and permeability. The permeability of the low plasticity clay and silt soils ranged from 2.29 to 8.66 x 10^{-8}cm/sec and is considered to be suitable as the lower confining unit for slurry wall installation. In addition, consistent results were obtained for soil samples collected at multiple locations along the proposed barrier wall alignment, further demonstrating the continuity of the confining unit.

The geotechnical borings and samples collected on two potential barrier wall alignments indicated that installation of a barrier wall is feasible for the northwestern portion of the Former Coke Oven Area. A thick, competent potential confining layer was encountered at a depth of approximately 65 feet along the potential northern barrier wall alignment and yielded permeabilities ranging from 2.29 to 2.62 x 10^{-8} cm/sec. The potential southern barrier wall alignment was eliminated from further consideration given the depth of the clay (greater than 80 feet) and the presence of dissolved and sorbed constituents and residual and residual free product to the north of the southern alignment. Additional discussion of the viability of a slurry wall is provided in Section 4.1 of this report.

3.11 LNAPL AND DNAPL PHYSICAL PROPERTIES

To support assessment of NAPL recovery via analytical or numerical modeling techniques, samples of NAPL were obtained from selected wells for physical property analysis. Samples of LNAPL were obtained from four monitoring wells in the Cell 6 area (CO089-PZM, CO092-PZM, CO95-PZM, and CO99-PZM) and from a well located to the east of Cell 6 (CO04-PZM004). Samples of LNAPL from the Cell 2 area could not be obtained given that an insufficient quantity of LNAPL was present in wells expected to contain LNAPL (i.e., CO121-PZM and CO37-PZM003). Only a trace of LNAPL was found in these wells on multiple occasions after the completion of the high vacuum study. A sample of DNAPL was obtained from well CO123-PZM located in the center of the Cell 4 area.

Samples of NAPL were analyzed for density, viscosity, and interfacial tension in oil-water, oil-air, and water-air interfaces. Measurements were completed using instrumentation maintained by Key in its Carnegie, PA office. The results of the physical testing are summarized in Table 3-16.

As expected, the density (as specific gravity) of the LNAPL samples was found to be less than unity (1.0) while the density of the DNAPL sample was found to be greater than unity. A wide range of densities were measured for the LNAPL samples even though most were obtained from monitoring wells located close to one another (i.e., in Cell 6). This suggests that the LNAPL has been subjected to various degrees of weathering or is attributable to the inadvertent release of various cuts of byproducts. The densities of the samples from the Cell 6 area ranged from 0.874 to 0.955 g/cm^3. The sample from CO04-PZM004 yielded the lowest density (0.856 g/cm^3). Coupled with the fact that no apparent connection between the Cell 6 and CO04-PZM004 LNAPL was identified in various soil borings, this phenomenon is likely to indicate a separate, localized LNAPL source in the vicinity of CO04-PZM004 that may not consist of light oil.

The primary components of byproduct plant light oil (benzene, toluene, ethylbenzene, and xylenes) have densities ranging from 0.86 to 0.88 at 20 degrees centigrade (reference temperature). Consequently, it is evident that the LNAPL encountered in monitoring wells CO92-PZM and CO95-PZM, and to some extent CO99-PZM likely contain some "heavier" components. The LNAPL encountered at CO04-PZM004 could conceivably consist of m- and p- xylenes which have densities similar to that measured for the CO04-PZM004 sample. The observed density of the coal tar DNAPL sample (approximately 1.1 g/cm^3) is typical for coal tar DNAPL.

A wide range of kinematic viscosities were also measured for the LNAPL samples obtained from the Former Coke Oven Area. Kinematic viscosities ranged from 16.2 centistokes to 78.3 centistokes. For comparative purposes the kinematic viscosity of water at 20C is approximately 1 centistoke while that of honey at 100F (37.4C) is approximately 74 centistokes. It is therefore evident that the LNAPL is somewhat viscous which affects its potential mobility as well as recoverability. As expected, the coal tar DNAPL samples obtained from the Cell 4 area exhibited high kinematic viscosities (up to 212 censtistokes). The viscosity of the coal tar DNAPL serves to impede migration which explains why the Cell 4 DNAPL is localized and also why almost 9 hours were required to evacuate the 25 gallons of DNAPL from well CO123-PZM.

Table 3-16 also summarizes interfacial tensions. The interfacial tensions (oil-water) of the LNAPL samples ranged from approximately 12 to 16 dynes/cm (excluding one aberrant sample) which are considered reasonable given that the pure component interfacial tensions of benzene and toluene (for example) with water are on the order of 35 dynes/cm. The interfacial tension of the DNAPL for an oil/water interface is approximately 16 dynes/cm which is on the low side for coal tar DNAPL which typically ranges from 20 – 25 dynes/cm. However, the oil-water viscosity testing was completed with site groundwater which exhibits pH values on the order of 11 or more in the vicinity of Cell 4. The measured interfacial tension is actually relatively high given the pH of the groundwater in the Cell 4 area. The interfacial tensions of the LNAPL and DNAPL are important considerations for simulation purposes and are useful for assessing contact angles and wettability.

The physical property data were obtained to provide a general indication of the types of nonaqueous phase materials present in the Former Coke Oven Area and to support simulation efforts as necessary for the design of recovery system. The LNAPL physical data is expected to be particularly useful for evaluation and possible design of a high vacuum recovery system for Cell 6.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The major conclusions reached as a result of the Pre-Design Investigation are summarized in this section. Multiple conclusions have been developed based on implementation of the scope of work as specified in the Work plan and through the completion of additional activities that were conducted to further understanding of site conditions. It is believed that the objectives of the predesign investigation as specified in the USEPA- and MDE-approved Work Plan as enumerated in Section 1.1 of this PDI Report were achieved through the completion of the scope of work as specified in the Work Plan.

Cell 1 IM Evaluation

- Inspection of Cell 1 indicated that substantial opportunities exist for improvements to the system. New piping runs, a new configuration, appropriate ports for performance monitoring and balancing purposes, are considered "low hanging fruit".
- The Cell 1 AS/SVE system will likely continue to remove significant mass of volatile constituents, especially if the refurbishment and monitoring improvements are implemented

Cell 2 and Cell 6 LNAPL Investigation

- LNAPL in Cell 2 and Cell 6 varies considerably in viscosity, and measurement of the apparent thickness in wells can be difficult and lead to erroneous data. The “bottom-up” measurement technique is more accurate than conventional depth to LNAPL / depth to groundwater measurement techniques for areas with highly viscous LNAPL.
- The LNAPL extent in Cell 2 appears to be limited based on the consideration of boring logs, photographs, monitoring well LNAPL measurements, and minimal returns during vacuum testing (traces only). Organic impacts in the subsurface are widespread however.
- The LNAPL extent in Cell 6 appears to be limited to the confines of the cell as historically defined. Some possible free product is present below the water table beyond the limits of Cell 6 but is unlikely to be recoverable based on the results of the open borehole study.
- Vacuum can be propagated through the slag. Several wells, specifically monitoring wells CO89-PZM and CO92-PZM in Cell 6, yielded significant quantities of LNAPL

via high vacuum recovery. LNAPL volume versus groundwater volume indicates reasonable cuts.

- Although the slag is not exceptionally pneumatically conductive, the LNAPL high vacuum recovery testing indicates that vacuum recovery is a viable mechanism for removal of free product in the Cell 6 area.

- Several wells were subjected to high vacuum LNAPL recovery testing on multiple occasions and continued to yield LNAPL although a recovery period appeared to be necessary and a pilot or full scale operation might be best operated on an intermittent or pulsed basis.

- Given the fact that only traces of LNAPL were recovered during high vacuum testing in Cell 2, given the viscosity of the LNAPL encountered, and given the limited amounts encountered, using the more robust "bottom up" gauging method, high vacuum recovery is not considered appropriate for Cell 2.

- LNAPL at various locations was found to exhibit different physical properties indicating that not all of the LNAPL observed is associated with the same source. The LNAPL encountered at location CO04-PZM004 is significantly different in density than that in Cell 6.

- Delineation of the potential presence of recoverable LNAPL to the east of Cell 6 (i.e., towards well CO04-PZM004) provides further evidence that the LNAPL at the CO04-PZM004 location is not associated with releases at the former benzol plant.

- High vacuum recovery testing was conducted for CO04-PZM004 on two occasions and yielded only 2 gallons of LNAPL each time. LNAPL reentered the well after vacuuming. The LNAPL thickness in this well the last time it was measured was 0. 75 feet (0.13 gallons).

- The LNAPL in the vicinity of CO04-PZM004 can be recovered via high vacuum. It is unclear how extensive this LNAPL is and additional delineation is warranted given the recoverability of the LNAPL.

Cell 3 NAPL and IM Evaluation

- A zone of potential free product (colorless oil) was identified upgradient of the central portion of the Cell 3 AS/SVE system. A localized source exists in the vicinity of Cell 3 and impacts at Cell 3 are not directly related to impacts in Cells 1 and 6.

- Testing of Cell 3 via air velocity and PID measurements indicated less than optimum air delivery and organics recovery. Several possible reasons were postulated.

Modification of the system to improve performance is warranted, followed by a reassessment of effectiveness. An initial step of re-balancing airflow to the air sparging wells did increase removal efficiency in the short term.

Cell 4/5 DNAPL Investigation

- The extent of DNAPL in the Cell 4 area was defined. The DNAPL thins to the north and east and was not found near the perimeter of the cell to the south and west. The recoverability of DNAPL within Cell 4 is highly variable.

- Three DNAPL recovery wells (10-ft sumps) were installed in Cell 4. One produced significant DNAPL, a second yielded a moderate amount, and the third yield was minimal. All were installed where it was expected that DNAPL could be recovered (likely free product).

- The potential exists that the dynamics of these new recovery wells could change contingent upon wettability considerations and the quantity of DNAPL present. The unproductive well could become productive and the productive well could become unproductive.

- EAG is in the process of deploying DNAPL recovery pumps in two of the three new recovery wells installed in the Cell 4 area. Additional useful recovery information will become available over time as the pumps are operated.

- Information regarding the nature and extent of DNAPL has been provided to a thermal treatment technology vendor and samples of subsurface materials impacted with DNAPL were provided to the vendor for treatability testing.

General Groundwater Quality in the Former Coke Oven Area

- Five primary distinct significant sources of groundwater impacts are present in the areas considered during the course of the investigation. Four source areas are located in Former Coke Oven Area and one is located in the Coke Point Landfill Area.

- Shallow groundwater is impacted by each of the five sources. Four separate plumes exist in the shallow groundwater, one at Cell 3, one at Cell 4/5, one at the Coke Point Landfill area, and two that appear to be superimposed (Cell 1/6 and Cell 2).

- Intermediate groundwater is also impacted but to a substantially lesser degree than the shallow groundwater except in the northwestern part of the Former Coke Oven Area where Intermediate Zone concentrations are greater than those in the Shallow Zone by approximately an order of magnitude.

- Cell 2 is the only location where impacts in the Intermediate Zone exceed those in the Shallow Zone. The likely explanation for this is the pumping of the graving dock to the north which has likely exacerbated the mobility of the dissolved phase plume horizontally and vertically.

- Several large-diameter storm sewers and other subsurface utilities are present throughout the site. These structures and utilities are generally located above the water table, but in some instances may affect local groundwater and constituent movements and patterns. No significant migration pathways (NAPL or dissolved phases) have been directly associated with subsurface structures.

- As a result of the presence of slag across much of the Former Coke Oven Area, the groundwater pH is elevated. This is particularly relevant for Cell 3 and for Cell 4/5. High pH has, and will, continue to inhibit microbial degradation of organics at these cells.

- Some evidence of natural attenuation via aerobic and anaerobic respiration is evident for the Former Coke Oven Area. Dissolved oxygen is depleted across virtually all areas of the Former Coke Oven Area. Sulfate concentrations are highly variable.

- Additional assessment of potential degradation by sulfate reducing bacteria is warranted. More detailed assessment of the relationship between constituent concentrations, sulfate concentrations, and pH is warranted.

Potential Barrier Wall Investigation

- As noted above, groundwater quality data provided compelling evidence that groundwater pumping associated with the graving dock operations continues to induce constituent movement into and through the Intermediate Zone

- The geotechnical investigation indicated that a competent confining layer exists at the northern perimeter of the Former Coke Oven Area. The clay layer is thick, is located approximately 65 feet below ground surface, and has a permeability that is on the order of 10^{-8} cm/sec.

- The potential southern alignment for a barrier wall was eliminated from consideration based on the depth to the clay (85 feet or more) and the presence of source materials and significant groundwater impacts to the north of the potential southern alignment.

- Additional evaluation of barrier wall options is warranted to evaluate the cost-effectiveness of such a containment option. Simulation of groundwater movement and a fate and transport evaluation may be suitable in this respect.

4.2 RECOMMENDATIONS

A series of recommendations have been developed based on evaluation of the data obtained during the area wide groundwater monitoring and pre-design investigative activities. Recommendations are provided in this section and address the following specific issues:

- Accelerated LNAPL and DNAPL Removal
- Enhanced Dissolved Phase Plume Management
- Development of Remedial Action Objectives
- Finalization of Corrective Action Approach

Each of the preceding issues is discussed in some detail in the subsections 4.2.1 through 4.2.4.

4.2.1 Accelerated LNAPL and DNAPL Recovery

Based on observations during the Cell 6 high vacuum LNAPL and Cell 4 DNAPL recovery studies, it is evident that removal of source materials from these two areas can be achieved. Removal of free product (to the extent possible) is considered a necessary component of overall corrective action for the Former Coke Oven Area. Accelerated recovery of recoverable free product for Cells 6 and 4 is discussed in the remainder of this subsection.

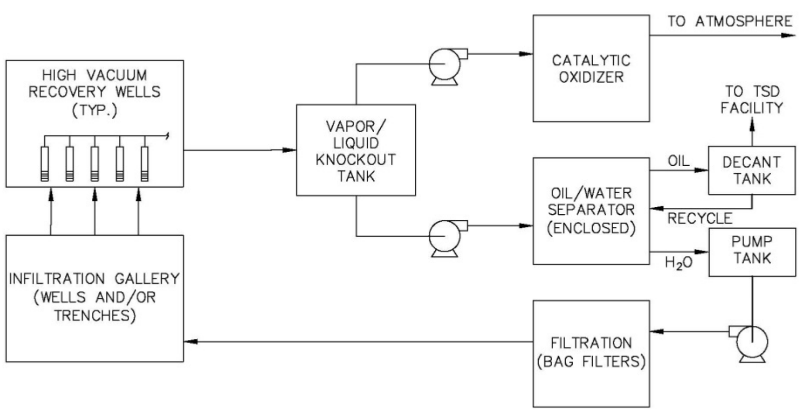
LNAPL Recovery

The proof-of-concept high vacuum study for Cell 6 demonstrated that LNAPL is recoverable via application of vacuum to the existing recovery and monitoring wells in the Cell 6 area. Recovery of LNAPL from this source area using a dedicated on-site high vacuum system is recommended. The design, installation and operation of the system, including the associated network of recovery wells that should rely on existing and new wells, can be supported through the simulation of LNAPL recovery using API software. The following are major considerations for design purposes beyond those developed as a result of the proof-of-concept study:

- Existing recovery wells and monitoring wells as well as newly installed recovery wells should be used for the high vacuum recovery efforts.
- The high vacuum system should be configured to accommodate flexibility in its operation.
- The recovery well network should be configured with closer well spacing in potential high LNAPL recovery areas and greater spacing in expected lower return, perimeter locations.
- Tight clusters of recovery wells around existing wells CO89 and CO95 are appropriate.

- An LNAPL and water knockout tank should be employed to separate the vapor phase and liquid phases.
- LNAPL should be decanted to a tank for additional separation and aqueous phase recycling. LNAPL should be pumped out as needed and should be managed in accordance with applicable State and Federal regulations.
- The vapor phase from the recovery operations should be directed to a catalytic oxidizer (i.e., the existing Cell 1 oxidizer; a new, larger Cell 1 oxidizer, or a new Cell 6 oxidizer).
- An appropriate cycling frequency and duration should be developed for each recovery well location to optimize LNAPL recovery and to minimize drawdown.
- The cycling frequency and duration should be refined during the operation of the system using user interfaces on the PLC.
- Vacuum lines from each of the individual wells heads should be “home runs” to a header system in the treatment trailer.
- Appurtenances for monitoring of individual recovery well operation (PID measurements flow rates, and LNAPL productivity) should be installed.
- Water recovered during the high vacuum process should be treated via oil/water separation and filtration and re-injected directly in the source area via a series of centralized infiltration galleries to maintain water levels and minimize LNAPL smearing.
- Records of the volume of LNAPL recovered via operation of the high vacuum system should be maintained to monitor productivity over time.
- The quantity of LNAPL recovered from Cell 6 should be reported in the quarterly monitoring reports, preferably in tabular and graphical form.
- Operation of the high vacuum system should be discontinued once the recovery rates approach an asymptotic endpoint.

The major components of the high vacuum system proposed for LNAPL recovery including flow patterns and associated disposal/treatment/re-injection of LNAPL, air and water are identified in the following concept diagram.



In addition to the Cell 6 area, additional delineation of the extent of LNAPL in the vicinity of monitoring well CO04-PZM005 is recommended. The PDI demonstrated that this LNAPL area is distinct and isolated from that at Cell 6. However, it is evident that a laterally extensive source of LNAPL may exist in this area based on the fact that LNAPL re-accumulated in this well after application of high vacuum over multiple rounds. Consequently it is recommended that additional focused LNAPL delineation be conducted in this area via a series of shallow borings.

DNAPL Recovery

Accelerated recovery of DNAPL in the Cell 4 area is recommended to supplement the ongoing dual phase extraction well IM system in the Cell 4/5 area. Successful DNAPL accumulation and recovery was demonstrated from the three DNAPL recovery wells with 10 foot sumps installed in the Cell 4 area. Two of the wells have produced DNAPL to date and the third may produce DNAPL in the future. In support of these findings, it is understood that EAG has recently installed DNAPL skimmer pumps in recovery wells CO123 and CO124 and has begun active DNAPL recovery operations. The following additional actions are recommended:

- Active pumping of the two productive recovery wells (i.e., CO123 and CO124) should be continued using the DNAPL recovery pumps recently installed.
- DNAPL should be accumulated in a double-walled tank and should be managed in accordance with applicable State and Federal regulations.
- Incidental water generated as a result of DNAPL recovery operations should be treated onsite via metering into the existing dual phase extraction system if possible.
- Gauging of the recovery wells should be completed on a routine basis and recovery well CO125 should be placed on line if DNAPL accumulated in the well sump.
- Records of the volume of DNAPL recovered via operation of the recovery wells should be maintained to monitor the productivity of the wells over time.
- The quantity of DNAPL recovered from each of the Cell 4 recovery wells should be reported in the quarterly monitoring reports, preferably in tabular and graphical form.
- The quarterly and cumulative DNAPL volume recovered from the individual wells should be reported in the quarterly reports.
- Pumping of the wells should be discontinued once the recovery rates approach an asymptotic endpoint.

4.2.2 Enhanced Dissolved Phase Plume Management

Data collected to date indicate that the operation of the various IMs in the Former Coke Oven Area are recovering and destroying hydrocarbons and having a noticeable effect on the dissolved phase plumes at the site although the response in the Cell 3 area is less than expected. It is recommended that operation of the IMs be continued although opportunities for improvements have been identified for the IMs. Recommended modifications and refurbishment for specific cells to facilitate management of the dissolved phase plumes are provided in the remainder of this subsection.

Cell 1 IM Rehabilitation

As a prototype system, the AS/SVE system installation in Cell 1 was of a semi-permanent design. Below-grade features consisting of sparge wells and vapor extraction piping were installed as permanent infrastructure, whereas above-grade plumbing was more temporary in nature. Operations were initiated in August 2010. After more than five years of operation, replacement of the above-grade system piping is warranted. It is recommended that the above-ground piping be upgraded with materials more suitable for long-term use, and that additional modifications be made to improve system performance and monitoring capability.

Operational issues have been noted as a result of condensation in the above-grade piping networks. To minimize water entrapment, it is recommended that new piping be installed to slope towards the sparge wells. A strut framework similar to that used for the Cell 3 IM is recommended. To accommodate improved monitoring capability, it is recommended that the air sparging well network be configured with a centralized manifold system and individual piping runs to each sparge well. Throttle valves, pressure monitoring gauges and air flow measurement ports (to allow access for a thermo-anemometer air velocity probe or pitot tube) are recommended for each individual air sparge piping run.

It is also recommended that the vapor extraction points be modified to include a velocity monitoring/sample collection port. A portable vacuum pump system to allow sample collection while the vacuum extraction system is in operation is recommended. Monitoring of the recovered vapor at each extraction point would allow for system optimization.

The AS/SVE treatment system is in good condition and it is recommended that routine maintenance be continued. No significant modifications of this system are proposed other than retrofitting to accommodate the catalytic oxidation of the vapor from the Cell 6 high vacuum system recovery efforts.

It is also recommended that, upon completion of the proposed modifications, the AS/SVE system be re-started and that a series of evaluations be conducted. It is recommended that the air sparging system be balanced to assure that approximately equal air flow rates are provided to each well. Use of a PID is recommended to determine the relative concentrations of constituents in the off-gas collected in each vapor extraction point. It is recommended that the system then be optimized by increasing air flow to sparge wells in areas with greater concentrations in the extraction points.

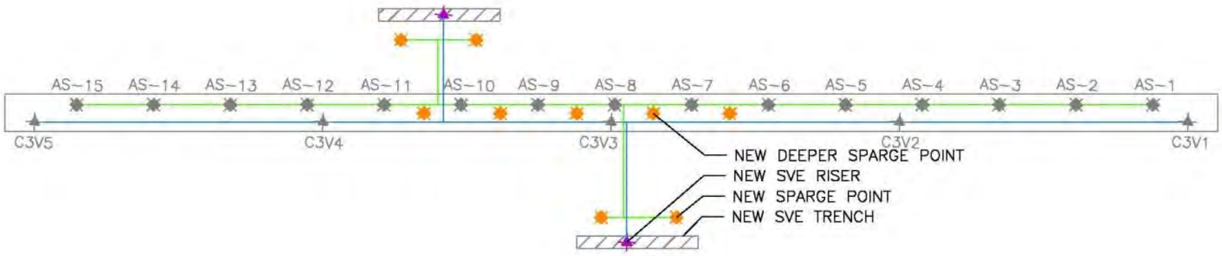
Cell 3 IM Improvements

The AS/SVE system installation in Cell 3 incorporates several improvements over the prototype system in Cell 1. A steel strut assembly provides structural stability to the above ground conveyance piping, eliminating issues with condensate build-up. Materials of construction are appropriate for long-term use. Performance of the system has been marginal, however, with relatively high groundwater concentrations persisting in the areas adjacent to the AS/SVE treatment zone, and a substantially lower mass of target constituents recovered over time versus other AS/SVE IMs in the Former Coke Oven Area. Specifically, samples from monitoring wells CO103 and CO30 have not shown significant declines in BTEX and naphthalene concentrations over time.

It is recommended that the AS/SVE system in the Cell 3 area be modified through the addition of new air sparging points targeting areas lateral to the existing system. Operation of these additional sparge wells using the existing AS/SVE system would require re-balancing of the system flows. An optimization approach would be used to identify which existing and proposed wells generate the greatest constituent removal rate via a program of measurement of VOC removal rates for each extraction point while sparge rates to various wells are varied. It is anticipated that some sparge wells will prove less effective and will not be operated, or will be operated intermittently. Based on recent measurement of the depth of the sparge wells, it is also considered likely that the existing sparge wells are too shallow. It is recommended that the existing sparge wells be replaced with well that are slightly deeper and introduce air at the top of the clay layer underlying the fill material.

As noted in the Cell 3 design (URS, March 1, 2011), the upper 10 feet of the geographic strata consists of densely compacted slag which is essentially impermeable to air flow, whereas the deeper saturated zone is more permeable, allowing horizontal movement of air. The Cell 3 design incorporated ripping of the slag along the alignment of the AS/SVE system to allow vertical air flow from the sparge wells to the vapor extraction piping in the vadose zone. It is recommended that new SVE recovery zones be established for the new lateral lines. This will entail ripping the slag to approximately 10 feet, the installation of perforated horizontal recovery lines in the trenches, and subsurface hard piping of the recovery lines to the existing SVE header. It is recommended that the hard piping be sloped toward the recovery trenches to drain condensate from the SVE lines.

Implementing the recommended additional sparge well approach will require additional supporting strut system, piping modifications and trenching. The additional components would match the existing Cell 3 system components, except for the addition of pressure and velocity measurement ports. A preliminary plan view of the recommended layout of the Cell 3 AS/SVE system depicting the new laterals is as follows:



Bioaugmentation Study

While much of the Shallow Zone groundwater at the Former Coke Oven Area is high in pH as a result of the presence of slag fill, some areas exhibit pH values that are more neutral. The Intermediate Zone groundwater typically exhibits pH results below 9. Given that sulfate reducing bacteria have been shown to degrade aromatic compounds such as those present in the Former Coke Oven Area, it is recommended that several proof-of-concept well locations be identified and that they be dosed with sodium sulfate to assess the potential effectiveness of anaerobic degradation by sulfate reducing bacteria. Wells located in areas of moderate pH and (relatively) low concentrations of constituents that may inhibit microbial activity should be selected for such a study.

4.2.3 Development of Corrective Action Objectives

As a result of review of historical data and additional data generated during the PDI, it is evident that, while accelerated removal of recoverable free product can likely be achieved in the near term, restoration of groundwater (i.e., attainment of MCLs) will not be achievable even over a very long time period. Given the BTEX, naphthalene, and other dissolved phase concentrations that exist in the Shallow and Intermediate Zones, the lateral extent of the impacts in the two zones, and in view of consideration of operating experience for extensive dissolved phase plumes at other sites, restoration of groundwater to MCLs is considered technically impracticable. Consequently, it is recommended that a concerted effort be initiated to develop realistic, attainable Corrective Action Objectives (CAOs) for groundwater in the Former Coke Oven Area.

Given that groundwater at the site is not used as a potable water source under current conditions and that use for such purposes in the future will be prevented via the establishment of appropriate institutional controls, it is considered reasonable that protection of proximate surface water bodies be the driving force for the establishment of groundwater CAOs. Establishment of groundwater CAOs would require that additional work be completed for the Former Coke Oven Area and it is recommended that such work be initiated in the near term as part of the overall corrective action process. First, it is recommended that a numerical groundwater flow and fate and transport model be developed such that discharge to surface water bodies can be simulated. Second, it is recommended that risk assessment activities be initiated to identify target surface water concentrations that are protective of ecological and human receptors. It is anticipated that some additional data collection activities may be necessary to facilitate the ultimate development of the CAOs, including the following:

- It is recommended that simulation of groundwater discharge to receiving surface water bodies be completed to facilitate development of CAOs for the dissolved phase plumes in the Former Coke Oven Area. Information regarding the construction details for the seawall and traveling crane foundation to the north of Cell 2 is currently unavailable. It is recommended that an extensive review of file information be completed to located as-built drawings, or that visual inspection and appropriate geophysical investigation be completed to determine the thickness, depth, and possible permeability (or lack thereof) of this physical feature. This is an important consideration for groundwater simulation in this area.

- In addition, it has been determined (via review of historical site plans) that the inverts of the various large diameter storm sewers in the Former Coke Oven Area (i.e., the 60-inch, 72-inch, and 84-inch storm sewers) are likely below the water table. Additional investigation of the storm sewer alignments, specifically with respect to the permeability and depth of the backfill envelopes surrounding the storm sewers, is recommended. As for the aforementioned seawall, this is an important consideration for groundwater simulation to develop CAOs.

4.2.4 Finalization of the Corrective Action Approach

Development of CAOs for the dissolved phase plumes in the former Coke Oven Area is considered crucial to the development of a final corrective action approach. In addition, it is likely that additional administrative issues must be addressed including the completion of a focused feasibility study/corrective measure study which evaluates viable alternatives, including appropriate institutional controls. Work towards resolution of various regulatory requirements (i.e., a focused feasibility study/corrective measures study, a technical impracticability demonstration if appropriate, etc.) is recommended to clearly define the regulatory path forward and to support the development of the corrective action approach. The approach can be integrated with near-term accelerated free product removal activities (and enhanced dissolved phase plume response, particularly for the areas located adjacent to surface waters [i.e., Cell 2 and Cell 3]) in accordance with the applicable regulatory framework as specified in the Administrative Consent Order and Settlement Agreement.

5.0 REFERENCES

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MONITORING WELL CROSS REFERENCE TABLE (INCLUDING COORDINATES AND ELEVATIONS)

APPENDIX B

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS
2015 PRE-DESIGN INVESTIGATION

APPENDIX C

SMOLDERING TECHNOLOGY REPORT

APPENDIX D

SURVEY DOCUMENTATION

APPENDIX E

INDICATOR PARAMETER MAPS

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TABLE 2-1
SOIL BORING SUMMARY
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Boring Identification	Drilling Date	Total Depth (feet-bgs)[(1)]
2	CO121-SB075	5/24-6/8/2015	75
	CO123-SB072	6/9/2015	72
	CO124-SB073	6/10/2015	73.5
	CO125-SB087	6/2-4/2015	87
	CO131-SB017	4/23/2015	17
	CO132-SB016	4/23/2015	16
	CO133-SB026	4/23/2015	26
	CO134-SB017	4/23/2015	17
	CO135-SB016	4/24/2015	16
	CO136-SB027	4/24/2015	27
	CO137-SB036	4/25/2015	36
	CO142-SB027	4/26/2015	27
	CO138-SB016	4/26/2015	16
	CO139-SB016	4/26/2015	16
	CO140-SB017	4/26/2015	17
	CO143-SB016	4/27/2015	16
	CO141-SB016	4/27/2015	16
	CO165-SB016	5/11/2015	16
	CO185-SB016	5/18/2015	16
	CO186-SB016	5/18/2015	16
3	CO126-SB036	4/27/2015	36
	CO127-SB036	4/28/2015	36
	CO128-SB036	5/4/2015	36
	CO129-SB036	5/4/2015	36
	CO130-SB036	5/5/2015	36
4/5	CO166-SB036*	5/21/2015	36
	CO167-SB0XX*	5/20/2015	38
	CO168-SB0XX*	5/20/2015	36.5
	CO169-SB036	5/9/2015	36
	CO170-SB026	5/9/2015	26
	CO171-SB031	5/9/2015	31
	CO172-SB031	5/10/2015	31
	CO173-SB036	5/10/2015	36

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TABLE 2-1
SOIL BORING SUMMARY
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Boring Identification	Drilling Date	Total Depth (feet-bgs)[(1)]
6	CO146-SB016	5/6/2015	16
	CO147-SB016	5/12/2015	16
	CO148-SB016	5/11/2015	16
	CO149-SB016	5/11/2015	16
	CO150-SB0XX*	5/19/2015	16
	CO151-SB016	5/6/2015	16
	CO152-SB016	5/6/2015	16
	CO153-SB016	5/11/2015	16
	CO154-SB0XX*	5/19/2015	16
	CO155-SB016	5/6/2015	16
	CO156-SB016	5/6/2015	16
	CO157-SB016	5/7/2015	16
	CO158-SB016	5/6/2015	16
	CO159-SB016	5/6/2015	16
	CO160-SB016	5/7/2015	16
	CO161-SB016	5/7/2015	16
	CO162-SB016	5/7/2015	16
	CO163-SB016	5/7/2015	16
	CO164-SB016	5/7/2015	16
	CO174-SB016	5/11/2015	16
	CO176-SB016	5/12/2015	16
	CO177-SB016	5/12/2015	16
	CO178-SB016	5/12/2015	16
	CO180-SB016	5/12/2015	16
	CO181-SB016	5/18/2015	16
	CO182-SB016	5/18/2015	16
	CO183-SB016	5/18/2015	16
	CO187-SB016	5/18/2015	16
	CO188-SB0XX*	5/19/2015	16

Notes:
1. feet-bgs - Feet below ground surface
* Boring converted to a monitoring well - See Table 2-2.

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TABLE 2-2
WELL CONSTRUCTION SUMMARY
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Nunber	Well Identification	Original Boring Identification [1]	Northing	Easting	Top of Casing Elevation [2]	Ground Surface Elevation [2]	Total Well Depth - 6/8/2015 (feet)	Casing Diameter (inches) and Well Construction Materials [3]	As-Built Total Well Depth (feet-bgs) [4]	As-Built Screen Interval (feet-bgs) [4]	As-Built Sand Pack Interval (feet-bgs)[4]	As-Built Sump Interval (feet-bgs)[4]
2	CO121-PZM [5]	--	563301.93	1455356.12	11.87	8.93	16.57	2 - PVC	14	4-14	3-14.5	None
	CO122-PZM	--	563185.36	1455250.14	19.42	16.42	25.20	2 - PVC	22	12-22	9.5-23	None
4/5	CO123-PZM	CO166-SB036	561584.33	1457395.77	15.06	12.01	38.80	6 - SS	35.7	15.7-25.7	14-26.8	25.7-35.7
	CO124-PZM	CO167-SB031	561592.12	1457446.48	14.83	11.74	40.98	6 - SS/PVC	38	18-28	16-28.5	28-38
	CO125-PZM	CO168-SB031	561587.03	1457359.84	14.98	11.98	39.02	6 - SS	36	16-26	14-27	26-36
6	CO126-PZM	CO150-SB016	562750.98	1455962.01	14.65	11.54	17.44	4 - PVC	14	4-14	3.5-14.5	None
	CO127-PZM	CO154-SB016	562807.24	1456091.19	14.55	11.58	18.94	4 - PVC	16	6-16	5-16	None
	CO128-PZM	CO188-SB016	NA	NA	NA	NA	18.73	4 -PVC	16	6-16	5-17	None

Notes:
1. Soil boring converted to well.
2. North American Vertical Datum 1988 (NAVD 1988) feet above mean sea level
3. SS - Stainless Steel PVC = Polyvinyl chloride
4. feet-bgs = feet below ground surface
5. Well was installed in Boring CO121-SB075.
NA - Not available. Well to be surveyed at a later date.

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TABLE 3-1
OPEN BOREHOLE WATER LEVEL AND PRODUCT MEASUREMENTS - CELL 6 AREA
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Boring Number	Date Drilled	Date Checked for Product	Depth to Accumulated Water (feet-bgs)	Depth to Accumulated Product (feet-bgs)	Apparent Product Thickness (feet)
Cell 6 Borings					
CO150-SB016[(1)]	5/12/2015	5/18/2015	5.48	5.35	0.13
CO150-SB016	--	5/19/2015	5.28	5.25	0.03
CO154-SB016[(2)]	5/6/2015	5/18/2015	9.70	8.7	1.00
CO155-SB016	5/6/2015	5/18/2015	9.28	--	--
Additional Near Field Borings					
CO146-SB016	5/6/2015	5/19/2015	8.70	--	--
CO147-SB016	5/12/2015	5/19/2015	7.90	--	--
CO149-SB016	5/11/2015	5/19/2015	8.50	--	--
CO151-SB016	5/6/2015	5/19/2015	0.00	--	--
CO158-SB016	5/6/2015	5/19/2015	6.90	--	--
CO159-SB016	5/6/2015	5/18/2015	4.40	--	--
CO159-SB016	--	5/19/2015	3.80	Trace on Probe	Trace
Additional Remote Borings					
CO148-SB016	5/11/2015	5/19/2015	NA[(3)]	NA	NA
CO152-SB016	5/6/2015	5/19/2015	8.80	8.8	Trace
CO176-SB016	5/12/2015	5/19/2015	4.30	Trace	Trace
CO177-SB016	5/12/2015	5/19/2015	6.50	--	--
Additional Northern/Southern Borings					
CO186-SB016	5/18/2015	5/19/2015	8.10	--	--

1. Boring CO150-SB016 was drilled on 5/12 and completed as monitoring well CO126-PZM on 5/19.
2. Boring CO154-SB016 was drilled on 5/6 and completed as montoring well CO127-PZM on 5/19.

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO127-PZM				**Start:**	16:45
Date:	6/15/2015				**Stop:**	17:15
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
Pre-Vacuum Well Gauging						
CO127-PZM	4	11.40	11.38	0.02	--	--
CO128-PZM	4	11.12	11.12	Trace	--	--
CO126-PZM	4	11.26	11.26	Trace	--	--
CO94-PZM	2	8.00	8.00	Trace	--	--
CO95-PZM	2	12.50	12.30	0.20	--	--
Post-Vacuum Well Gauging						
CO127-PZM	4	11.45	11.45	Trace	-0.05	-0.02
CO128-PZM	4	11.15	11.15	Trace	-0.03	0.00
CO126-PZM	4	11.15	11.15	Trace	0.11	0.00
CO94-PZM	2	7.50	7.50	Trace	0.50	0.00
CO95-PZM	2	12.72	12.15	0.57	-0.22	0.37

Vacuum Well:	CO92-PZM				**Start:**	9:50
Date:	6/16/2015				**Stop:**	2:10
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
Pre-Vacuum Well Gauging						
CO92-PZM	2	12.08	11.60	0.48	--	--
CO89-PZM	2	11.80	10.48	1.32	--	--
CO99-PZM	4	11.60	8.50	3.10	--	--
CO91-PZM	2	10.50	10.50	Trace	--	--
CO97-PZM	4	11.00	11.00	Trace	--	--
CO100-PZM	4	9.02	NP	NP	--	--
CO98-PZM	4	9.00	8.90	0.10	--	--
CO90-PZM	2	9.68	NP	NP	--	--
CO96-PZM	4	10.85	10.85	Trace	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	11.70	11.70	Trace	0.38	-0.48
CO89-PZM	2	11.80	10.45	1.35	0.00	0.03
CO99-PZM	4	11.70	8.70	3.00	-0.10	-0.10
CO91-PZM	2	10.40	10.40	Trace	0.10	0.00
CO97-PZM	4	11.08	11.08	Trace	-0.08	0.00
CO100-PZM	4	9.08	NP	NP	-0.06	0.00
CO98-PZM	4	9.00	8.90	0.10	0.00	0.00
CO90-PZM	2	9.70	NP	NP	-0.02	0.00
CO96-PZM	4	10.90	10.90	Trace	--	--

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO98-PZM				**Start:**	11:05
Date:	6/16/2015				**Stop:**	11:15
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO92-PZM	2	11.70	11.70	Trace	--	--
CO97-PZM	4	11.08	11.08	Trace	--	--
CO91-PZM	2	10.40	10.40	Trace	--	--
CO100-PZM	4	9.08	NP	NP	--	--
CO98-PZM	4	9.00	8.90	0.10	--	--
CO89-PZM	2	11.80	10.45	1.35	--	--
CO90-PZM	2	9.70	NP	NP	--	--
CO99-PZM	4	11.70	8.70	3.00	--	--
CO96-PZM	4	10.90	10.90	Trace	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	11.70	11.70	Trace	0.00	0.00
CO97-PZM	4	11.00	11.00	Trace	0.08	0.00
CO91-PZM	2	10.42	10.42	Trace	-0.02	0.00
CO100-PZM	4	9.00	NP	NP	0.08	0.00
CO98-PZM	4	8.80	8.80	Trace	0.20	-0.10
CO89-PZM	2	11.80	10.60	1.20	0.00	-0.15
CO90-PZM	2	9.68	NP	NP	0.02	0.00
CO99-PZM	4	11.70	8.60	3.10	0.00	0.10
CO96-PZM	4	10.90	10.90	Trace	0.00	0.00

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO89-PZM				**Start:**	12:55
Date:	6/16/2015				**Stop:**	13:05
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO92-PZM	2	11.70	11.70	Trace	--	--
CO97-PZM	4	11.00	NP	NP	--	--
CO91-PZM	2	10.42	10.42	Trace	--	--
CO100-PZM	4	9.00	NP	NP	--	--
CO98-PZM	4	8.80	8.80	Trace	--	--
CO89-PZM	2	11.80	10.60	1.20	--	--
CO90-PZM	2	9.68	NP	NP	--	--
CO99-PZM	4	11.70	8.60	3.10	--	--
CO96-PZM	4	10.90	10.90	Trace	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	11.70	11.70	Trace	0.00	0.00
CO97-PZM	4	11.10	NP	NP	-0.10	0.00
CO91-PZM	2	10.50	10.50	Trace	-0.08	0.00
CO100-PZM	4	9.10	NP	NP	-0.10	0.00
CO98-PZM	4	8.70	8.70	Trace	0.10	0.00
CO89-PZM	2	11.75	10.50	1.25	0.05	0.05
CO90-PZM	2	9.68	NP	NP	0.00	0.00
CO99-PZM	4	11.70	8.60	3.10	0.00	0.00
CO96-PZM	4	10.90	10.90	Trace	0.00	0.00

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO99-PZM				Start:	13:55
Date:	6/16/2015				Stop:	15:55
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO92-PZM	2	11.70	11.70	Trace	--	--
CO97-PZM	4	11.10	NP	NP	--	--
CO91-PZM	2	10.50	10.50	Trace	--	--
CO100-PZM	4	9.10	NP	NP	--	--
CO98-PZM	4	8.70	8.70	Trace	--	--
CO89-PZM	2	11.75	10.50	1.25	--	--
CO90-PZM	2	9.68	NP	NP	--	--
CO99-PZM	4	11.70	8.60	3.10	--	--
CO96-PZM	4	10.90	10.90	Trace	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	11.80	11.55	0.25	-0.10	0.25
CO97-PZM	4	10.90	10.90	Trace	0.20	0.00
CO91-PZM	2	10.40	10.40	Trace	0.10	0.00
CO100-PZM	4	9.20	NP	NP	-0.10	0.00
CO98-PZM	4	8.80	NP	NP	-0.10	0.00
CO89-PZM	2	11.80	10.50	1.30	-0.05	0.05
CO90-PZM	2	9.70	NP	NP	-0.02	0.00
CO99-PZM	4	9.25	9.25	Trace	2.45	-3.10
CO96-PZM	4	10.90	10.90	Trace	0.00	0.00

Vacuum Well:	CO95-PZM				Start:	10:00
Date:	6/17/2015				Stop:	12:00
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO94-PZM	2	14.35	12.15	2.20	--	--
CO95-PZM	2	7.58	7.58	Trace	--	--
CO126-PZM	4	11.38	11.38	Trace	--	--
CO127-PZM	4	11.50	11.50	Trace	--	--
CO128-PZM	4	11.28	11.28	Trace	--	--
Post-Vacuum Well Gauging						
CO94-PZM	2	7.60	7.60	Trace	6.75	-2.20
CO95-PZM	2	12.20	12.20	Trace	-4.62	0.00
CO126-PZM	4	11.40	11.40	Trace	-0.02	0.00
CO127-PZM	4	11.35	11.35	Trace	0.15	0.00
CO128-PZM	4	11.20	11.20	Trace	0.08	0.00

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacumm Well:	CO89-PZM				**Start:**	14:15
Date:	6/17/2015				**Stop:**	14:25
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO92-PZM	2	12.00	11.60	0.40	--	--
CO97-PZM	4	11.00	11.00	Trace	--	--
CO99-PZM	4	8.90	8.90	Trace	--	--
CO96-PZM	4	11.95	11.95	Trace	--	--
CO100-PZM	4	9.10	NP	NP	--	--
CO98-PZM	4	8.70	8.70	Trace	--	--
CO89-PZM	2	11.80	10.50	1.30	--	--
CO91-PZM	2	10.50	10.50	Trace	--	--
CO90-PZM	2	9.80	9.80	Trace	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	12.05	11.60	0.45	-0.05	0.05
CO97-PZM	4	10.95	10.95	Trace	0.05	0.00
CO99-PZM	4	9.40	9.00	0.40	-0.50	0.40
CO96-PZM	4	10.95	10.95	Trace	1.00	0.00
CO100-PZM	4	9.10	NP	NP	0.00	0.00
CO98-PZM	4	8.80	8.80	Trace	-0.10	0.00
CO89-PZM	2	11.00	10.41	0.59	0.80	-0.71
CO91-PZM	2	10.50	10.50	Trace	0.00	0.00
CO90-PZM	2	9.80	NP	NP	0.00	0.00

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO37-PZM003				**Start:**	10:40
Date:	6/18/2015				**Stop:**	12:40
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO121-PZM	2	10.38	NP	NP	--	--
CO122-PZM	2	17.35	17.35	Trace	--	--
CO37-PZM038	2	12.10	NP	NP	--	--
CO37-PZM003	2	13.40	10.85	2.55	--	--
CO39-PZM007	2	6.00	NP	NP	--	--
CO39-PZM042	2	8.00	NP	NP	--	--
Post-Vacuum Well Gauging						
CO121-PZM	2	10.55	NP	NP	-0.17	0.00
CO122-PZM	2	17.28	17.28	Trace	0.07	0.00
CO37-PZM038	2	12.20	NP	NP	-0.10	0.00
CO37-PZM003	2	10.90	10.90	Trace	2.50	-2.55
CO39-PZM007	2	8.00	NP	NP	-2.00	0.00
CO39-PZM042	2	5.55	NP	NP	2.45	0.00

Vacuum Well:	CO122-PZM				**Start:**	9:10
Date:	6/18/2015				**Stop:**	9:35
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO121-PZM	2	10.62	NP	NP	--	--
CO122-PZM	2	17.40	17.10	0.30	--	--
CO37-PZM038	2	12.10	NP	NP	--	--
CO37-PZM003	2	12.00	10.80	1.20	--	--
CO39-PZM007	2	6.00	NP	NP	--	--
CO39-PZM042	2	8.00	NP	NP	--	--
Post-Vacuum Well Gauging						
CO121-PZM	2	10.38	NP	NP	0.24	0
CO122-PZM	2	17.35	17.35	Trace	0.05	-0.3
CO37-PZM038	2	12.10	NP	NP	0.00	0
CO37-PZM 003	2	13.40	10.85	2.55	-1.40	1.35
CO39-PZM007	2	6.00	NP	NP	0.00	0
CO39-PZM042	2	8.00	NP	NP	0.00	0

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO89-PZM				**Start:**	7:40
Date:	6/19/2015				**Stop:**	7:50
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO89-PZM	2	11.80	10.50	1.30	--	--
Post-Vacuum Well Gauging						
CO89-PZM	2	10.50	10.50	Trace	1.30	-1.30

Vacuum Well:	CO99-PZM				**Start:**	8:20
Date:	6/19/2015				**Stop:**	10:20
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO99-PZM	4	9.90	8.90	1.00	--	--
Post-Vacuum Well Gauging						
CO99-PZM	4	9.00	9.00	Trace	0.90	-1.00

Vacuum Well:	CO92-PZM				**Start:**	7:15
Date:	6/19/2015				**Stop:**	7:20
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO92-PZM	2	12.40	11.50	0.90	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	11.70	11.70	Trace	0.70	-0.90

Vacuum Well:	CO04-PZM004				**Start:**	10:42
Date:	7/29/2015				**Stop:**	11:03
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO04-PZM	2	8.74	7.74	1.00	--	--
Post-Vacuum Well Gauging (1)						
CO04-PZM	2	8.15	8.15	Trace	0.59	-1.00
CO04-PZM	2	7.85	7.30	0.55	0.30	0.55
CO04-PZM	2	7.90	7.45	0.45	-0.05	-0.01
CO04-PZM	2	7.90	7.45	0.45	0.00	0.00

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO92-PZM				**Start:**	14:45
Date:	7/29/2015				**Stop:**	14:52
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO92-PZM	2	12.85	11.85	1.00	--	--
Post-Vacuum Well Gauging						
CO92-PZM	2	12.00	11.95	0.05	0.85	-0.95

Vacuum Well:	CO89-PZM				**Start:**	15:14
Date:	7/29/2015				**Stop:**	15:28
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO89-PZM	2	11.90	10.82	1.08	--	--
Post-Vacuum Well Gauging						
CO89-PZM	2	11.40	10.80	0.60	0.50	-0.48

Vacuum Well:	CO04-PZM004				**Start:**	10:36
Date:	7/31/2015				**Stop:**	10:58
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO04-PZM	2	7.50	8.00	0.50	--	--
Post-Vacuum Well Gauging (1)						
CO04-PZM	2	8.00	Trace	Trace	-0.50	-0.50

Vacuum Well:	CO99-PZM				**Start:**	11:56
Date:	7/31/2015				**Stop:**	13:26
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO99-PZM	4	10.20	9.20	1.00	--	--
Post-Vacuum Well Gauging						
CO99-PZM	4	8.90	7.35	0.05	1.30	-0.95

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TABLE 3-2
LNAPL VACUUM STUDY - WELL GAUGING MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	CO89-PZM				**Start:**	11:18
Date:	7/31/2015				**Stop:**	11:30
Pre-Vacuum Well Gauging						
Well Identification	**Well Diameter**	**Depth to Water (ft)**	**Depth to Product (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
CO89-PZM	2	11.85	10.85	1.00	--	--
Post-Vacuum Well Gauging						
CO89-PZM	2	11.90	11.70	0.20	-0.05	-0.80

Notes
1. Post vacuum well gauging conducted in 2 hour increments from stop time.

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TABLE 3-3
LNAPL VACUUM STUDY - VACUUM MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	**CO127-PZM**		**Start:**	16:45
Date:	6/15/2015		**Stop:**	17:15
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO128-PZM**	**CO126-PZM**	**CO94-PZM**	**CO95-PZM**
10	0.04	0.01	0.005	0.00

Vacuum Well:	**CO92-PZM**		**Start:**	9:50
Date:	6/16/2015		**Stop:**	10:07
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO89-PZM**	**CO99-PZM**	**CO91-PZM**	**CO97-PZM**
0	NM	NM	NM	-0.02
10	0.60	0.12	0.04	-0.06
15	0.00	0.03	0.01	0.02

Vacuum Well:	**CO98-PZM**		**Start:**	11:05
Date:	6/16/2015		**Stop:**	11:15
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO89-PZM**	**CO96-PZM**	**CO97-PZM**	**CO99-PZM**
0	0.03	0.07	0.01	0.2
10	0.02	0.02	NM	NM
Elapsed Time (min)	**CO90-PZM**	**CO91-PZM**	**CO92-PZM**	**CO126-PZM**
0	0.00	0.11	0.02	0.01
10	NM	NM	NM	NM

Vacuum Well:	**CO89-PZM**		**Start:**	12:55
Date:	6/16/2015		**Stop:**	13:06
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO98-PZM**	**CO91-PZM**	**CO96-PZM**	**CO97-PZM**
0	0.05	0.11	0.25	0.04
5	0.03	0.12	0.02	0.01
Elapsed Time (min)	**CO92-PZM**	**CO99-PZM**	**CO90-PZM**	
0	0.02	0.12	0.02	
5	0.03	0.12	0.02	

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TABLE 3-3
LNAPL VACUUM STUDY - VACUUM MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	**CO99-PZM**		**Start:**	13:35
Date:	6/16/2015		**Stop:**	15:55
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO98-PZM**	**CO91-PZM**	**CO96-PZM**	**CO97-PZM**
5	0.02	0.03	0.02	-0.03
20	0.03	0.01	0.04	0.03
30	0.03	0.03	0.04	0.02
40	0.02	0.02	0.02	0.00
50	0.01	0.01	0.00	-0.01
120	0.01	0.00	0.00	0.00
Elapsed Time (min)	**CO92-PZM**	**CO90-PZM**	**CO89-PZM**	
5	0.02	0.00	-0.01	
20	0.02	0.00	0.01	
30	0.02	-0.01	0.01	
40	0.02	-0.03	0.00	
50	0.02	0.00	0.00	
120	0.03	0.00	0.00	

Vacuum Well:	**CO95-PZM**		**Start:**	10:00
Date:	6/17/2015		**Stop:**	12:00
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO94-PZM**	**CO126-PZM**	**CO127-PZM**	**CO128-PZM**
10	0.10	0.00	0.00	0.10
15	0.00	0.00	0.00	0.10
30	0.10	0.20	0.10	0.30
45	0.00	0.00	0.00	0.20
60	0.00	0.20	0.00	0.30
90	0.00	0.00	0.00	0.10
120	0.00	0.10	0.00	0.10

Vacuum Well:	**CO89-PZM**		**Start:**	14:15
Date:	6/17/2015		**Stop:**	14:25
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO92-PZM**	**CO97-PZM**	**CO99-PZM**	**CO90-PZM**
0	0.02	0.01	0.05	0.04
10	0.03	0.01	0.05	0.05
Elapsed Time (min)	**CO96-PZM**	**CO98-PZM**	**CO91-PZM**	
0	0.10	0.04	0.2	
10	0.02	0.02	0.05	

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TABLE 3-3
LNAPL VACUUM STUDY - VACUUM MEASUREMENTS - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Vacuum Well:	**CO122-PZM**		**Start:**	9:10
Date:	6/18/2015		**Stop:**	9:35
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO121-PZM**	**CO37-PZM038**	**CO37-PZM003**	**CO39-PZM007**
0	0.02	0.09	0.01	0.01
10	0.01	0.01	0.01	0.02
20	0.01	0.01	0.00	0.00
Elapsed Time (min)	**CO39-PZM042**			
0	0.02			
10	0.03			
20	0.00			

Vacuum Well:	**CO37-PZM003**		**Start:**	10:40
Date:	6/18/2015		**Stop:**	12:40
Vacuum Measurements (Inches of Water)				
Elapsed Time (min)	**CO121-PZM**	**CO122-PZM**	**CO37-PZM038**	**CO39-PZM007**
0	0.00	0.00	0.10	0.20
10	0.00	0.00	0.30	0.30
20	0.00	0.00	0.30	0.40
40	0.00	0.00	0.30	0.40
100	0.00	0.00	0.30	0.30
Elapsed Time (min)	**CO39-PZM042**			
0	0.20			
10	0.20			
20	0.40			
40	0.40			
100	0.30			

1. 12 in Hg vacuum applied at all pumped well head locations.
2 Elapsed times are approximated based on the time required to traverse the well field.

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TABLE 3-4
LNAPL VACUUM STUDY - LNAPL RECOVERY - CELLS 2 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well Number	Date	Thickness of Product in Drum (feet)	Volume of Product in Drum (gallon)	Vacuum Duration (minutes)	Product Flow Rate (gpm)
Cell 2					
CO37-PZM003	6/19/2015	Trace	0.10	120	0.0008
CO122-PZM	6/18/2015	0.30	6.41	25	0.26
Cell 6					
CO89-PZM	6/16/2015	0.60	12.82	10	1.28
	6/18/2015	0.60	12.82	10	1.28
	6/19/2015	0.55	11.75	10	1.17
	7/29/2015	0.65	13.88	14	0.99
	7/31/2015	0.10	2.14	12	0.18
CO92-PZM	6/16/2015	0.40	8.54	20	0.43
	6/19/2015	0.35	7.48	5	1.50
	7/29/2015	0.15	3.20	7	0.46
CO95-PZM	6/17/2015	Trace	0.1	120	0.001
CO98-PZM	6/16/2015	Trace	0.10	10	0.01
CO99-PZM	6/16/2015	0.50	10.68	120	0.09
	6/19/2015	0.47	10.04	120	0.08
	7/31/2015	0.40	8.54	90	0.09
CO127-PZM	6/15/2015	Trace	0.10	30	0.0033
East of Cell 6					
CO04-PZM004	7/29/2015	0.10	2.14	400	0.01
	7/31/2015	0.10	2.14	22	0.10

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TABLE 3-5
LNAPL AND DNAPL WELL GAUGING MEASUREMENTS
FORMER COKE OVEN AREA- CELLS 2, 4/5 AND 6
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well ID	Measurement (1)	7/29-30/2015	7/31/2015	8/5/2015	8/26/2015
Cell 6 (LNAPL)					
CO89-PZM	DTW	11.90	11.85	11.89	12.20
	DTP	10.82	10.85	11.00	11.20
	PT	1.08	1.00	0.89	1.00
CO90-PZM	DTW	10.15	10.10	NM	9.95
	DTP	NP	NP	NM	NP
	PT	NP	NP	NM	NP
CO91-PZM	DTW	10.20	10.75	NM	11.20
	DTP	10.20	10.75	NM	11.15
	PT	Trace	Trace	NM	0.05
CO92-PZM	DTW	12.85	12.70	12.84	13.00
	DTP	11.85	11.90	12.01	12.00
	PT	1.00	0.80	0.83	1.00
CO94-PZM	DTW	8.10	8.20	NM	8.80
	DTP	8.10	8.20	NM	8.60
	PT	Trace	Trace	NM	0.20
CO95-PZM	DTW	NM	NM	13.23	NM
	DTP	NM	NM	12.71	NM
	PT	NM	NM	0.52	NM
CO96-PZM	DTW	11.20	11.25	NM	11.65
	DTP	11.05	11.25	NM	11.55
	PT	0.15	Trace	NM	0.10
CO97-PZM	DTW	10.85	11.55	NM	11.80
	DTP	10.80	11.50	NM	11.80
	PT	0.05	0.05	NM	Trace
CO98-PZM	DTW	9.00	9.05	9.25	9.45
	DTP	9.00	9.05	9.20	9.35
	PT	Trace	Trace	0.05	0.10
CO99-PZM	DTW	9.95	10.20	10.25	10.50
	DTP	9.15	9.20	9.81	9.60
	PT	0.80	1.00	0.44	0.90
CO100-PZM	DTW	9.90	9.90	NM	10.10
	DTP	NP	NP	NM	NP
	PT	NP	NP	NM	NP
CO126-PZM	DTW	11.75	11.8	NM	12.35
	DTP	11.75	11.8	NM	12.35
	PT	Trace	Trace	NM	Trace
CO127-PZM	DTW	11.70	11.70	12.21	12.25
	DTP	11.70	11.70	11.84	12.25
	PT	Trace	Trace	0.37	Trace
CO128-PZM	DTW	11.58	11.65	NM	12.10
	DTP	11.58	11.65	NM	12.00
	PT	Trace	Trace	NM	0.10

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TABLE 3-5
LNAPL AND DNAPL WELL GAUGING MEASUREMENTS
FORMER COKE OVEN AREA- CELLS 2, 4/5 AND 6
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well ID	Measurement [1]	7/29-30/2015	7/31/2015	8/5/2015	8/26/2015
East of Cell 6 (LNAPL)					
CO04-PZM004 [2]	DTW	8.74	7.50	8.09	8.90
	DTP	7.74	8.00	7.67	8.15
	PT	1.00	0.50	0.42	0.75
CO04-PZM048	DTW	NM	NM	12.43	NM
	DTP	NM	NM	NP	NM
	PT	NM	NM	NP	NM
Cell 2 (LNAPL)					
CO037-PZM003	DTW	10.00	NM	10.09	10.15
	DTP	10.00	NM	NP	10.15
	PT	Trace	NM	NP	Trace
CO037-PZM038	DTW	NM	NM	12.61	NM
	DTP	NM	NM	NP	NM
	PT	NM	NM	NP	NM
CO122-PZM	DTW	17.60	NM	18.00	17.90
	DTP	17.60	NM	14.34	17.90
	PT	Trace	NM	3.66	Trace
Cell 4/5 (DNAPL)					
CO123-PZM [3]	TD	38.90	38.90	38.90	38.90
	DTP	24.40	37.30	34.96	28.30
	PT	14.50	1.60	3.94	10.60
CO124-PZM	TD	40.60	40.60	40.60	40.60
	DTP	37.60	37.55	37.15	36.30
	PT	3.00	3.05	3.45	4.30
CO125-PZM	TD	39.20	39.20	39.20	39.20
	DTP	38.50	38.50	38.42	38.40
	PT	0.70	0.70	0.78	0.80

1. Abbreviations are as follows: DTW - Depth to Water; DTP - Depth to Product; PT - Product Thickness; NP - No Product; TD - Total Well Depth; NM - Not Measured.

2. LNAPL was vacuumed from well CO04-PZM004 on 7/29/15. Product thickness after pumping was minimal.

3. DNAPL was pumped from well CO123-SB072 on 7/30/15. Product thickness after pumping was minimal.

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TABLE 3-6
AIR SPARGING/SOIL VAPOR EXTRACTION WELL EVALUATION - CELL 3
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

SPARGE POINT PIPING AIR VELOCITY MEASUREMENTS			
Air Sparge Well Identification	**Velocity (ft/min)**	**Temperature (^oF)**	**Valve Position**
Initial Measurement			
AS-1	2,370	107.3	open
AS-2	350	108.2	open
AS-3	660	105.3	1/2 open
AS-4	88	104.2	1/2 open
AS-5	111	100.4	1/2 open
AS-6	740	103.4	open
AS-7	1,000	99.4	1/2 open
AS-8	428	97.8	open
AS-9	551	97.4	open
AS-10	104	98.0	1/2 open
AS-11	66	101.0	open
AS-12	806	104.6	1/2 open
AS-13	515	105.3	1/2 open
AS-14	624	104.0	1/2 open
AS-15	365	102.6	1/2 open

SVE RISER PHOTOIONIZATION DETECTOR (PID) MEASUREMENTS			
SVE Point Identification	**Purge Time (min)**	**PID Reading (ppm)**	**Comment**
C3V1	2	1.9	None
C3V2	5	0.9	Water vapor present during initial purge
C3V3	5	14.5	Water vapor present during initial purge
C3V4	5	0.2	Water vapor present during initial purge
C3V5	2	0.2	None

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TABLE 3-7
DNAPL RECOVERY STUDY - CELLS 4/5
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Recovery Well:	**CO123-PZM**				**Start:**	9:45
Date:	7/30/2015				**Stop:**	18:13
Time	**Depth to Water (ft)**	**Depth to Product (ft)**	**Total Depth (ft)**	**Product Thickness (ft)**	**Water Level Change (ft)**	**Product Change (ft)**
Initial	13.95	24.40	38.90	14.50	--	--
10:15	13.98	26.00	38.90	12.90	0.03	-1.60
10:35	14.00	27.40	38.90	11.50	0.02	-1.40
11:45	14.00	29.00	38.90	9.90	0.00	-1.60
12:45	14.00	30.00	38.90	8.90	0.00	-1.00
13:45	14.00	32.00	38.90	6.90	0.00	-2.00
14:45	14.00	34.50	38.90	4.40	0.00	-2.50
15:45	14.05	35.00	38.90	3.90	0.05	-0.50
16:45	14.20	36.30	38.90	2.60	0.15	-1.30
17:45	14.20	38.00	38.90	0.90	0.00	-1.70
18:13	14.00	38.90	38.90	Trace	-0.20	-0.90

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TABLE 3-8
WATER LEVEL, LNAPL, AND DNAPL MEASUREMENT RESULTS (JUNE 2015)
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well	Measuring Point Elevation (ft NAVD 1988) (top of casing)	Date	Time	Depth to Ground Water (ft)	Total Depth (ft)	Depth to LNAPL (ft)	LNAPL Thickness (ft)	Depth to DNAPL (ft)	DNAPL Thickness (ft)	PID Reading (ppm)	Potentiometric Surface Elevation (ft NAVD 1988)	Notes
Coke Oven Area Pre-Design Investigation Monitoring Well Measurement Data												
CO02-PZM006	13.89	06/08/15	10:25	13.96	18.84	NP	N/A	NP	N/A	1500	-0.07	
CO02-PZM041	13.88	06/08/15	10:21	15.01	51.81	NP	N/A	NP	N/A	0.3	-1.13	
CO03-PZM005	13.53	06/08/15	13:15	4.59	16.59	NP	N/A	NP	N/A	5.8	8.94	
CO04-PZM004	12.30	06/08/15	15:26	7.69	15.65	6.5	1.19	NM	N/A	0.1	5.68	
CO04-PZM048	12.27	06/08/15	13:56	12.12	59.26	NP	N/A	NP	N/A	0	0.15	
CO05-PZM006	11.01	06/08/15	13:35	7.23	17.51	NP	N/A	NP	N/A	0	3.78	confirmed TD
CO07-PZM008	13.74	06/08/15	16:12	11.98	19.29	NP	N/A	NP	N/A	2.6	1.76	
CO07-PZM050	13.48	06/08/15	16:18	NM	NM	NM	NM	NM	NM	NM	NM	well destroyed
CO08-PZM005	11.68	06/09/15	14:00	8.44	14.79	NP	N/A	NP	N/A	0	3.24	well located following day
CO08-PZM036	11.53	06/11/15	8:30	13.1	48.52	NP	N/A	NP	N/A	0	-1.57	well located three days later
CO09-PZM007	11.15	06/08/15	16:53	9.5	15.67	NP	N/A	NP	N/A	0	1.65	
CO10-PZM006	11.42	06/08/15	17:19	11.59	20.15	NP	N/A	NP	N/A	0	-0.17	
CO13-PZM008	12.01	06/08/15	11:02	10.51	19.58	NP	N/A	18.65	0.93	0	1.50	
CO13-PZM030	12.15	06/08/15	11:07	11.63	42.31	NP	N/A	NP	N/A	0	0.52	
CO15-PZM005	12.33	06/08/15	10:40	10.85	17.83	NP	N/A	NP	N/A	0.2	1.48	soft bottom
CO16-PZM006	12.88	06/08/15	10:01	11.15	18.12	NP	N/A	NP	N/A	4700	1.73	
CO18-PZM006	13.57	06/08/15	10:37	11.75	20	NP	N/A	NP	N/A	17	1.82	
CO19-PZM004	13.27	06/08/15	16:50	9.51	14.92	NP	N/A	NP	N/A	0	3.76	confirmed TD
CO20-PZM004	12.75	06/08/15	13:49	10.29	14.99	NP	N/A	14.99	Trace	0	2.46	confirmed TD; trace on probe tip
CO24-PZM007	12.02	06/08/15	10:06	14.03	22.08	NP	N/A	NP	N/A	0	-2.01	confirmed TD
CO25-PZM008	12.03	06/08/15	10:24	14.74	23.79	NP	N/A	NP	N/A	0	-2.71	confirmed TD
CO26-PZM007	12.76	06/08/15	10:42	11.33	19.29	NP	N/A	NP	N/A	0	1.43	confirmed TD
CO26-PZM032	14.99	06/08/15	10:37	14.12	47.1	NP	N/A	NP	N/A	0	0.87	
CO27-PZM012	5.12	06/08/15	11:39	3.61	17.54	NP	N/A	NP	N/A	11.1	1.51	
CO27-PZM046	5.17	06/08/15	11:36	6.51	51.39	NP	N/A	NP	N/A	1230.2	-1.34	
CO28-PZM010	12.34	06/08/15	11:03	11.32	22.09	NP	N/A	NP	N/A	61.7	1.02	
CO28-PZM048	12.69	06/08/15	10:55	11.92	56.22	NP	N/A	NP	N/A	61.7	0.77	
CO29-PZM010	14.86	06/08/15	13:23	13.8	24.75	NP	N/A	NP	N/A	4.8	1.06	
CO29-PZM051	13.48	06/08/15	13:28	12.59	64.2	NP	N/A	NP	N/A	1.4	0.89	
CO30-PZM015	12.35	06/08/15	13:43	11.26	27.56	NP	N/A	NP	N/A	70.9	1.09	
CO30-PZM060	13.36	06/08/15	13:41	12.89	73.01	NP	N/A	NP	N/A	0	0.47	
CO32-PZM004	13.73	06/08/15	13:57	11.91	17.74	NP	N/A	NP	N/A	0.1	1.82	
CO32-PZM041	13.15	06/08/15	13:59	12.8	54.55	NP	N/A	NP	N/A	0	0.35	

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TABLE 3-8
WATER LEVEL, LNAPL, AND DNAPL MEASUREMENT RESULTS (JUNE 2015)
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well	Measuring Point Elevation (ft NAVD 1988) (top of casing)	Date	Time	Depth to Ground Water (ft)	Total Depth (ft)	Depth to LNAPL (ft)	LNAPL Thickness (ft)	Depth to DNAPL (ft)	DNAPL Thickness (ft)	PID Reading (ppm)	Potentiometric Surface Elevation (ft NAVD 1988)	Notes
CO34-PZM048	Unknown	06/08/15	10:01	14.76	63.54	NP	N/A	NP	N/A	0.9	Unknown	
CO35-PZM013	11.06	06/08/15	18:19	9.86	24.48	NP	N/A	NP	N/A	0.4	1.20	
CO35-PZM056	11.26	06/08/15	19:21	10.66	65.24	NP	N/A	NP	N/A	0.5	0.60	
CO36-PZM008	6.94	06/08/15	11:28	6.23	14.22	NP	N/A	NP	N/A	0.5	0.71	
CO36-PZM043	6.92	06/08/15	11:12	6.95	51.96	NP	N/A	NP	N/A	12.3	-0.03	
CO37-PZM003	12.34	06/08/15	12:05	10.59	18.44	10.08	0.51	NP	N/A	457.6	2.21	
CO37-PZM038	12.12	06/08/15	12:02	11.71	50.16	NP	N/A	NP	N/A	103.4	0.41	
CO38-PZM006	6.75	06/08/15	11:32	5.94	16	NP	N/A	NP	N/A	1.6	0.81	
CO38-PZM043	6.65	06/08/15	11:30	6.71	50	NP	N/A	NP	N/A	0.7	-0.06	
CO39-PZM007	7.75	06/08/15	11:47	5.69	17.92	NP	N/A	NP	N/A	116.6	2.06	
CO39-PZM042	7.91	06/08/15	11:49	7.52	48.48	NP	N/A	NP	N/A	10.5	0.39	
CO40-PZM008	7.47	06/08/15	11:58	5.79	17.97	NP	N/A	NP	N/A	15.7	1.68	
CO41-PZM001	13.57	06/08/15	10:46	11.81	16	NP	N/A	NP	N/A	0	1.76	
CO41-PZM036	13.60	06/08/15	10:49	13.07	51.2	NP	N/A	NP	N/A	3732	0.53	soft bottom
CO42-PZM004	10.83	06/08/15	12:55	6.44	16.35	NP	N/A	NP	N/A	5.3	4.39	
CO55-PZM000	15.10	06/08/15	12:30	13.74	17.03	NP	N/A	NP	N/A	0.2	1.36	confirmed TD; soft bottom
CO56-PZP001	15.92	06/08/15	10:52	14.6	19.09	NP	N/A	NP	N/A	0	1.32	confirmed TD
CO57-PZP002	16.59	06/08/15	12:42	14.67	17.88	NP	N/A	NP	N/A	0.1	1.92	confirmed TD
CO58-PZM001	14.31	06/08/15	12:36	13.04	19.23	NP	N/A	NP	N/A	0.1	1.27	confirmed TD
CO59-PZP002	16.75	06/08/15	12:23	15.41	19.01	NP	N/A	NP	N/A	5.6	1.34	confirmed TD
CO60-PZP001	15.83	06/08/15	10:28	14.53	18.88	NP	N/A	NP	N/A	0	1.30	confirmed TD
CO79-PZM	Unknown	06/08/15	10:29	12.59	16.93	NP	N/A	NP	N/A	3	Unknown	
CO88-PZM	14.07	06/08/15	10:10	12.4	28.59	NP	N/A	NP	N/A	2500	1.67	double check td
CO89-PZM	13.46	06/08/15	16:27	10.98	13.27	10.14	0.84	NP	N/A	1481	3.24	confirmed TD
CO90-PZM	13.32	06/08/15	16:23	9.6	17.97	9.60	Trace	NP	N/A	2.5	3.72	
CO91-PZM	13.21	06/08/15	16:35	10.01	17.88	10.0	0.01	NP	N/A	135.6	3.21	
CO92-PZM	14.69	06/08/15	16:07	11.38	17.81	11.24	0.14	NP	N/A	2000	3.44	recovery pump removed to gauge
CO93-PZM	12.12	06/08/15	16:46	9.75	19.64	NP	N/A	NP	N/A	0.7	2.37	confirmed TD
CO94-PZM	14.32	06/08/15	16:00	7	15.7	7.00	Trace	NP	N/A	3.6	7.32	
CO95-PZM	15.60	06/08/15	15:50	11.75	17.99	11.20	0.55	NP	N/A	0.2	4.35	recovery pump removed to gauge
CO96-PZM	13.64	06/08/15	16:25	10.41	16.96	10.36	0.05	NP	N/A	1547	3.28	confirmed TD
CO97-PZM	14.11	06/08/15	16:13	9.11	17.45	9.01	0.1	NP	N/A	8.3	5.09	confirmed TD
CO98-PZM	11.49	06/08/15	16:31	8.54	15.88	8.50	0.04	NP	N/A	77.1	2.99	removed recovery pump to gauge
CO99-PZM	11.80	06/08/15	16:19	11.45	16.64	8.24	3.21	NP	N/A	21.5	3.24	confirmed TD

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TABLE 3-8
WATER LEVEL, LNAPL, AND DNAPL MEASUREMENT RESULTS (JUNE 2015)
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well	Measuring Point Elevation (ft NAVD 1988) (top of casing)	Date	Time	Depth to Ground Water (ft)	Total Depth (ft)	Depth to LNAPL (ft)	LNAPL Thickness (ft)	Depth to DNAPL (ft)	DNAPL Thickness (ft)	PID Reading (ppm)	Potentiometric Surface Elevation (ft NAVD 1988)	Notes
CO100-PZM	12.27	06/08/15	16:42	8.69	17.16	NP	N/A	NP	NM	0.3	3.58	confirmed TD
CO101-PZM	12.66	06/08/15	13:46	11.27	20.29	NP	N/A	NP	N/A	2.8	1.39	
CO102-PZM	13.09	06/08/15	13:50	11.78	19.24	NP	N/A	NP	N/A	12.2	1.31	
CO103-PZM	13.69	06/08/15	13:37	12.43	20.54	NP	N/A	NP	N/A	1.1	1.26	
CO104-PZM	13.48	06/08/15	13:33	12.22	19.17	NP	N/A	NP	N/A	0.2	1.26	
CO105-PZM	14.90	06/08/15	11:14	13.49	24.4	13.1	0.39	23.98	0.42	87.5	1.76	
CO108-PZM	Unknown	06/08/15	11:48	13.54	23.37	NP	N/A	NP	N/A	0	Unknown	confirmed TD
CO109-PZM	14.94	06/08/15	13:06	13.54	22.3	NP	N/A	NP	N/A	0	1.40	confirmed TD; soft bottom
CO110-PZM	15.43	06/08/15	11:55	14.05	23.72	NP	N/A	22.64	1.08	9.8	1.38	confirmed TD
CO111-PZM006	18.28	06/08/15	12:12	13.73	22.08	NP	N/A	NP	N/A	0	4.55	confirmed TD
CO112-PZM	14.94	06/08/15	13:01	13.54	21.91	NP	N/A	21.91	Trace	3.4	1.40	confirmed TD; trace on probe tip
CO113-PZM004	17.69	06/08/15	12:16	14.07	21.07	NP	N/A	NP	N/A	0	3.62	confirmed TD; soft bottom
CO114-PZM002	18.83	06/08/15	12:08	14.07	24.22	NP	N/A	NP	N/A	0.1	4.76	confirmed TD
CO115-PZM006	15.04	06/08/15	11:23	13.3	21.78	NP	N/A	21.78	Trace	0	1.74	soft bottom trace tip of probe
CO116-PZM003	18.48	06/08/15	11:31	13.05	21.72	NP	N/A	21.72	Trace	3.2	5.43	soft bottom trace on probe tip
CO117-PZM003	18.03	06/08/15	12:00	13.84	25.58	NP	N/A	25.48	0.1	0.4	4.19	confirmed TD
CO118-PZM007	14.48	06/08/15	11:36	12.88	23.1	NP	N/A	21.7	1.4	4.7	1.60	
CO119-PZM009	14.61	06/08/15	11:41	12.98	22.05	NP	N/A	NP	N/A	1.3	1.63	confirmed TD
CO120-PZM009	15.16	06/08/15	11:51	13.56	22.03	NP	N/A	22.03	Trace	0.4	1.60	confirmed TD; trace on probe tip
CO121-PZM	11.87	06/08/15	13:11	10.21	16.57	NP	N/A	NP	N/A	1.6	1.66	
CO122-PZM	19.42	06/08/15	13:13	23.02	25.2	16.15	6.87	NP	N/A	127.6	2.58	Viscous LNAPL; See Note No. 3
CO123-PZM	15.06	06/08/15	13:08	13.67	38.8	NP	N/A	36.45	2.35	6.5	1.39	
CO124-PZM	14.83	06/08/15	13:15	13.46	40.98	NP	N/A	40.98	Trace	17.1	1.37	trace on probe
CO125-PZM	14.98	06/08/15	13:25	13.61	39.02	NP	N/A	39.02	Trace	0.6	1.37	
CO126-PZM	14.65	06/08/15	14:52	10.9	17.44	10.86	0.04	NP	N/A	218.8	3.79	
CO127-PZM	14.55	06/08/15	15:02	10.94	18.94	10.9	0.04	NP	N/A	49.1	3.65	
CO128-PZM	Unknown	06/08/15	15:11	10.65	18.73	10.65	Trace	NP	N/A	3.5	Unknown	
SW13-PZM003	12.87	06/08/15	17:52	NM	NM	NM	NM	NM	NM	NM	NM	inner casing bent, cannot gauge
TS06-PPM008	13.21	06/09/15	9:53	12.4	19.52	NP	N/A	NP	N/A	0.3	0.81	

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TABLE 3-8
WATER LEVEL, LNAPL, AND DNAPL MEASUREMENT RESULTS (JUNE 2015)
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Well	Measuring Point Elevation (ft NAVD 1988) (top of casing)	Date	Time	Depth to Ground Water (ft)	Total Depth (ft)	Depth to LNAPL (ft)	LNAPL Thickness (ft)	Depth to DNAPL (ft)	DNAPL Thickness (ft)	PID Reading (ppm)	Potentiometric Surface Elevation (ft NAVD 1988)	Notes
Supplemental Monitoring Well Measurement Data - Coke Point Landfill Monitoring Wells												
CP02-PZM007	27.12	See Coke Point Landfill water level table for period of record (Table 2; EAG, April 10, 2015). Elevations are averages over approximate 4 year period.									1.10	
CP02-PZM026	27.31										1.30	
CP05-PZM008	9.75										0.04	
CP05-PZM019	10.48										-0.69	
CP05-PZM028	7.07										-1.43	
CP07-PZM006	14.00										0.37	
CP08-PZM008	24.64										0.37	
CP08-PZM034	25.47										-0.14	
CP09-PZM010	7.63										0.36	
CP09-PZM047	7.39										0.35	
CP10-PZM008	36.16										2.18	
CP11-PZM010	8.43										0.08	
CP12-PZM012	5.35										0.25	
CP12-PZM052	4.71										3.15	
CP14-PZM009	13.06										-1.74	
CP14-PZM062	13.67										-0.72	
CP15-PZM020	7.08										0.13	
CP15-PZM042	7.98										-0.14	
CP16-PZM035	20.01										0.28	

1. Water levels corrected if LNAPL present based on assumed LNAPL density. MP Elevation - Depth to Water + (Thickness of LNAPL x Density of LNAPL). Density = 0.9
2. Best effort made to located all wells identified in the Coke Oven Area Pre-Design Investigation Work Plan dated January 23, 2015. The following wells could not be located:

CO06-PZM008	CO11-PZM007	CO106-PZMXXX	SW14-PZM004
CO06-PZM039	CO12-PZM008	TS05-PDM004	SW17-PZM007
CO10-PZM029	CO17-PZM005	TS05-PPM007	SW17-PZM038

In addition, the inner casing on well SW13-PZM003 was bent and measurements could not be obtained. Well CO07-PZM050 was located but was destroyed.

3. Viscous LNAPL interfered with probe and response. Result considered suspect. Well regauged multiple times on July 17, 2015 during high vacuum study. Alternate LNAPL measurement method employed. As a result of regauging it was determined that 0.1 feet or less of LNAPL was present at this location.

TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
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Analyte	Units	CO02-PZM006 6/10/2015		CO03-PZM005 6/10/2015*		CO05-PZM006 6/10/2015**		CO07-PZM008 6/10/2015**		CO07-PZM008DUP 6/10/2015*		CO08-PZM005 6/10/2015**		CO09-PZM007 6/10/2015**		CO10-PZM006 6/11/2015**		CO13-PZM008 6/10/2015*		CO15-PZM005 6/9/2015*		CO16-PZM006 6/9/2015*	
Volatile Organics																							
1,1,1,2-Tetrachloroethane	ug/L	1.6	U	0.33	U	8.2	U	66	U	66	U	41.2	U	8.2	U	0.33	U	8.2	U	8.2	U	8.2	U
1,1,1-Trichloroethane	ug/L	1.4	U	0.48	U	12	U	96	U	96	U	60	U	12	U	0.48	U	12	U	12	U	12	U
1,1,2,2-Tetrachloroethane	ug/L	1.1	U	0.4	U	10	U	80	U	80	U	50	U	10	U	0.4	U	10	U	10	U	10	U
1,1,2-Trichloroethane	ug/L	1.6	U	0.29	U	7.2	U	58	U	58	U	36.2	U	7.2	U	0.29	U	7.2	U	7.2	U	7.2	U
1,1-Dichloroethane	ug/L	0.93	U	0.32	U	8	U	64	U	64	U	40	U	8	U	0.32	U	8	U	8	U	8	U
1,1-Dichloroethene	ug/L	1.3	U	0.56	U	14	U	112	U	112	U	70	U	14	U	0.56	U	14	U	14	U	14	U
1,2,3-Trichloropropane	ug/L	2.3	U	0.41	U	10.2	U	82	U	82	U	51.2	U	10.2	U	0.41	U	10.2	U	10.2	U	10.2	U
1,2-Dibromo-3-chloropropane	ug/L	4.2	U	2	U	50	U	400	U	400	U	250	U	50	U	2	U	50	U	50	U	50	U
1,2-Dibromoethane	ug/L	0.96	U	0.27	U	6.8	U	54	U	54	U	33.8	U	6.8	U	0.27	U	6.8	U	6.8	U	6.8	U
1,2-Dichlorobenzene	ug/L	0.94	U	0.3	U	7.5	U	60	U	60	U	37.5	U	7.5	U	0.3	U	7.5	U	7.5	U	7.5	U
1,2-Dichloroethane	ug/L	1.8	U	0.24	U	6	U	48	U	24	U	30	U	6	U	0.24	U	6	U	6	U	6	U
1,2-Dichloropropane	ug/L	1.1	U	0.27	U	6.8	U	54	U	54	U	33.8	U	6.8	U	0.27	U	6.8	U	6.8	U	6.8	U
1,4-Dichlorobenzene	ug/L	1.2	U	0.33	U	8.2	U	66	U	66	U	41.2	U	8.2	U	0.33	U	8.2	U	8.2	U	8.2	U
2-Butanone	ug/L	12	U	0.96	U	24	U	192	U	192	U	120	U	24	U	0.96	U	24	U	24	U	24	U
2-Hexanone	ug/L	2.9	U	0.46	U	11.5	U	92	U	92	U	57.5	U	11.5	U	0.46	U	11.5	U	11.5	U	11.5	U
4-Methyl-2-Pentanone (MIBK)	ug/L	2.8	U	0.33	U	8.2	U	66	U	66	U	41.2	U	8.2	U	0.33	U	8.2	U	8.2	U	8.2	U
Acetone	ug/L	11.4	U	10	U	396	J	2000	U	2000	U	1250	U	250	U	10	U	250	U	250	U	250	U
Acrylonitrile	ug/L	14.4	U	2.2	U	55.2	U	442	U	442	U	276	U	55.2	U	2.2	U	55.2	U	55.2	U	55.2	U
Benzene	ug/L	168000		0.25	U	1850		27000		26700		15000		358		0.32	J	332		169000		119000	
Bromochloromethane	ug/L	2.1	U	0.17	U	4.2	U	34	U	34	U	21.2	U	4.2	U	0.17	U	4.2	U	4.2	U	4.2	U
Bromodichloromethane	ug/L	0.77	U	0.18	U	4.5	U	36	U	36	U	22.5	U	4.5	U	0.18	U	4.5	U	4.5	U	4.5	U
Bromoform	ug/L	1.5	U	0.26	U	6.5	U	52	U	52	U	32.5	U	6.5	U	0.26	U	6.5	U	6.5	U	6.5	U
Bromomethane	ug/L	2.9	U	0.29	U	7.2	U	58	U	58	U	36.2	U	7.2	U	0.29	U	7.2	U	7.2	U	7.2	U
Carbon Disulfide	ug/L	1.6	U	1.2	U	28.8	U	230	U	230	U	144	U	28.8	U	1.2	U	28.8	U	28.8	U	28.8	U
Carbon Tetrachloride	ug/L	1.1	U	0.25	U	6.2	U	50	U	50	U	31.2	U	6.2	U	0.25	U	6.2	U	6.2	U	6.2	U
Chlorobenzene	ug/L	0.65	U	0.23	U	5.8	U	46	U	46	U	28.8	U	5.8	U	0.23	U	5.8	U	5.8	U	5.8	U
Chloroethane	ug/L	3.5	U	0.54	U	13.5	U	108	U	108	U	67.5	U	13.5	U	0.54	U	13.5	U	13.5	U	13.5	U
Chloroform	ug/L	0.93	U	0.14	U	3.5	U	28	U	28	U	17.5	U	3.5	U	0.21	J	3.5	U	3.5	U	3.5	U
Chloromethane	ug/L	1.3	U	0.11	U	2.8	U	22	U	22	U	13.8	U	2.8	U	0.11	U	2.8	U	2.8	U	2.8	U
cis-1,2-Dichloroethene	ug/L	1.2	U	0.19	U	4.8	U	38	U	38	U	23.8	U	4.8	U	0.19	U	4.8	U	4.8	U	4.8	U
cis-1,3-Dichloropropene	ug/L	1.4	U	0.13	U	3.2	U	26	U	26	U	16.2	U	3.2	U	0.13	U	3.2	U	3.2	U	3.2	U
Dibromochloromethane	ug/L	0.85	U	0.21	U	5.2	U	42	U	42	U	26.2	U	5.2	U	0.21	U	5.2	U	5.2	U	5.2	U
Dibromomethane	ug/L	1.5	U	0.21	U	5.2	U	42	U	42	U	26.2	U	5.2	U	0.21	U	5.2	U	5.2	U	5.2	U
Ethylbenzene	ug/L	374		0.3	U	109		96.5	J	106	J	198		21.9	J	0.3	U	12.4	J	121		387	
Iodomethane	ug/L	8.6	U	0.32	U	8	U	64	U	64	U	40	U	8	U	0.32	U	8	U	8	U	8	U
Methyl tert_butyl ether	ug/L	0.87	U	0.21	U	5.2	U	42	U	42	U	26.2	U	5.2	U	0.21	U	5.2	U	5.2	U	5.2	U
Methylene Chloride	ug/L	3	U	2.7	B	249	0	1380	B	1520	B	752	B	204	B	2.2	B	164	B	370		343	
Naphthalene	ug/L	373		44.1		5750		827		749		1020		1480	0	0.35	J	2520		88.7		524	
Styrene	ug/L	11.7		0.26	U	32.6		52	U	52	U	202		17.1	J	0.26	U	8.2	J	16.5	J	91.3	
Tetrachloroethene	ug/L	1.4	U	0.46	U	11.5	U	92	U	92	U	57.5	U	11.5	U	0.46	U	11.5	U	11.5	U	11.5	U
Toluene	ug/L	156		0.26	U	464		1020		1020		6150		279		0.26	U	105		10300		9660	
trans-1,2-Dichloroethene	ug/L	1.1	U	0.49	U	12.2	U	98	U	98	U	61.2	U	12.2	U	0.49	U	12.2	U	12.2	U	12.2	U
trans-1,3-Dichloropropene	ug/L	0.83	U	0.26	U	6.5	U	52	U	52	U	32.5	U	6.5	U	0.26	U	6.5	U	6.5	U	6.5	U
Trans-1,4-Dichloro-2-Butene	ug/L	3.6	U	1	U	25	U	200	U	200	U	125	U	25	U	1	U	25	U	25	U	25	U
Trichloroethene	ug/L	1.6	U	0.47	U	11.8	U	94	U	94	U	58.8	U	11.8	U	0.47	U	11.8	U	11.8	U	11.8	U
Trichlorofluoromethane	ug/L	1.7	U	0.2	U	5	U	40	U	40	U	25	U	5	U	0.2	U	5	U	5	U	5	U
Vinyl Acetate	ug/L	6.8	U	0.35	U	8.8	U	70	U	70	U	43.8	U	8.8	U	0.35	U	8.8	U	8.8	U	8.8	U
Vinyl Chloride	ug/L	1	U	0.62	U	15.5	U	124	U	124	U	77.5	U	15.5	U	0.62	U	15.5	U	15.5	U	15.5	U
Xylene	ug/L	753		0.66	U	483		132	U	132	U	2760		401		0.66	U	251		740		3020	

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO02-PZM006 6/10/2015		CO03-PZM005 6/10/2015*		CO05-PZM006 6/10/2015**		CO07-PZM008 6/10/2015**		CO07-PZM008DUP 6/10/2015*		CO08-PZM005 6/10/2015**		CO09-PZM007 6/10/2015**		CO10-PZM006 6/11/2015**		CO13-PZM008 6/10/2015*		CO15-PZM005 6/9/2015*		CO16-PZM006 6/9/2015*	
Semi-Volatile Organics																							
1,2,4-Trichlorobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.22	U	0.21	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
1,3-Dichlorobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.22	U	0.21	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
2,4,5-Trichlorophenol	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.17	U	0.16	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4-Dichlorophenol	ug/L	0.18	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.18	U	0.19	U	0.18	U	0.19	U	0.18	U
2,4-Dimethylphenol	ug/L	10.4		0.13	U	116		2.1		2.2		2.6		26.1		0.13	U	16.6		14		8.4	
2,4-Dinitrophenol	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	1		0.12	U	0.12	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chloronaphthalene	ug/L	0.18	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.18	U	0.19	U	0.18	U	0.19	U	0.18	U
2-Chlorophenol	ug/L	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
2-Methylnaphthalene	ug/L	3.4		0.25	J	63.8		6.5		6.9		8.7		32.1		0.18	U	100		0.59	J	9.3	
2-Methylphenol	ug/L	4.8		0.19	U	53.9		3.4		3.4		3.6	0	22.5		0.19	U	19.4		35.4		10.3	
2-Nitrophenol	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U
3,4-Methylphenol	ug/L	1.1	J	0.36	U	109		1.4	J	1.5	J	5		40.1		0.36	U	21.2		16		6.8	
4,6-Dinitro-2-Methylphenol	ug/L	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
4-Bromophenyl-phenylether	ug/L	0.12	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.12	U	0.13	U	0.12	U	0.13	U	0.13	U
4-Chloro-3-methylphenol	ug/L	0.16	U	0.17	U	1.3		0.17	U	0.17	U	0.17	U	0.16	U	0.17	U	0.16	U	0.17	U	0.17	U
4-Chlorophenyl-phenylether	ug/L	0.12	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
4-Nitrophenol	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Acenaphthene	ug/L	3.3		3.2		17.4		5.7		6.2		0.49	J	1.9	0	0.15	U	5.3		1.2	0	7.5	
Acenaphthylene	ug/L	1.1		0.49	J	16.7		1.2		1.3		1.3		7	0	0.13	U	55.7		0.75	J	0.78	J
Aniline	ug/L	3.6		0.21	U	0.21	U	0.21	U	1.4	J	0.21	U	6.8	0	0.21	U	16.3		4.3		3.3	
Anthracene	ug/L	1.7		0.47	J	7.8		1.8		2		0.27	J	1.7	0	0.073	U	4.9		0.39	J	0.78	J
Benzo(a)anthracene	ug/L	0.2	J	0.11	U	0.57	J	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.82	J	0.29	J	0.11	U
Benzo(a)pyrene	ug/L	0.062	U	0.063	U	0.27	J	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U	0.57	J	0.24	J	0.063	U
Benzo(b)fluoranthene	ug/L	0.26	J	0.21	J	0.54	J	0.17	U	0.17	U	0.17	U	0.16	U	0.17	U	0.84	J	0.4	J	0.17	U
Benzo(g,h,i)perylene	ug/L	0.1	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Benzo(k)fluoranthene	ug/L	0.26	J	0.24	U	0.28	J	0.24	U	0.24	U	0.24	U	0.23	U	0.24	U	0.33	J	0.24	U	0.23	U
bis(2-Chloroethoxy) Methane	ug/L	0.35	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
bis(2-Ethylhexyl)phthalate	ug/L	0.24	J	0.31	J	0.29	J	0.29	J	0.13	U	0.32	J	0.13	U	0.13	U	0.13	U	0.27	J	0.13	U
Butylbenzylphthalate	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Chrysene	ug/L	0.13	U	0.13	U	0.42	J	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.72	J	0.3	J	0.13	U
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dibenzofuran	ug/L	3.2		0.64	J	32.1		3.5		3.8		1.1		10		0.16	U	25.7		0.69	J	3.9	
Diethylphthalate	ug/L	0.11	U	0.35	J	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dimethylphthalate	ug/L	0.15	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Di-n-Butylphthalate	ug/L	0.081	U	0.22	J	0.082	U	0.082	U	0.082	U	0.082	U	0.082	U	0.082	U	0.082	U	0.083	U	0.082	U
Di-n-Octyl phthalate	ug/L	0.16	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
Fluoranthene	ug/L	2.9		1.2		8.6		2		2.3		0.43	J	3		0.081	U	5.5		1.3		1.2	
Fluorene	ug/L	5		1	J	35		5.5		5.9		1.3		10.4		0.16	U	25.6		0.87	J	4.6	
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
Hexachlorobutadiene	ug/L	0.17	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO02-PZM006 6/10/2015		CO03-PZM005 6/10/2015*		CO05-PZM006 6/10/2015**		CO07-PZM008 6/10/2015**		CO07-PZM008DUP 6/10/2015*		CO08-PZM005 6/10/2015**		CO09-PZM007 6/10/2015**		CO10-PZM006 6/11/2015**		CO13-PZM008 6/10/2015*		CO15-PZM005 6/9/2015*		CO16-PZM006 6/9/2015*	
Semi-Volatile Organics																							
Hexachloroethane	ug/L	0.23	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
Indeno(1,2,3-cd)pyrene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.21	J	0.13	U	0.13	U
Isophorone	ug/L	0.19	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.19	U	0.2	U	0.19	U	0.2	U	0.2	U
Naphthalene	ug/L	201		24.5		2810	B	140	B	159	B	257	B	810	B	1.9		1830	B	47.9	B	244	B
Nitrobenzene	ug/L	0.2	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
N-Nitrosodimethylamine	ug/L	0.31	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.31	U	0.32	U	0.31	U	0.32	U	0.31	U
Pentachlorophenol	ug/L	1.5	J	0.11	U	0.11	U	0.11	U	0.11	U	1.9	J	0.11	U	0.11	U	1.5	J	0.11	U	2	J
Phenanthrene	ug/L	9.6		2.5		43.3		12.9		14.4		2.4		16.7		0.066	U	34.9		0.59	J	5.9	
Phenol	ug/L	36.3		0.12	U	36.4		9.8		10.5		7.9		26.8		0.12	U	6.2		51.7		39	
Pyrene	ug/L	1.7		0.98	J	5.9		1.5		1.6		0.29	J	1.8		0.052	U	3.3		1	J	0.81	J
Pyridine	ug/L	0.27	J	0.18	U	6.3		0.18	U	0.18	U	0.38	J	4.2		0.18	U	15.9		3	0	0.4	J

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO18-PZM006 6/9/2015		CO19-PZM004 6/10/2015**		CO20-PZM004 6/10/2015**		CO23-PZM008 6/10/2015		CO24-PZM007 6/10/2015		CO25-PZM008 6/10/2015		CO25-PZM008 DUP 6/10/2015*		CO26-PZM007 6/10/2015*		CO27-PZM012 6/8/2015		CO28-PZM010 6/9/2015*		CO28-PZM010 DUP 6/9/2015*	
Volatile Organics																							
1,1,1,2-Tetrachloroethane	ug/L	1.6	U	1.3	U	8.2	U	1.6	U	0.31	U	33	U	33	U	8.2	U	0.31	U	8.2	U	8.2	U
1,1,1-Trichloroethane	ug/L	1.4	U	1.9	U	12	U	1.4	U	0.29	U	48	U	48	U	12	U	0.29	U	12	U	12	U
1,1,2,2-Tetrachloroethane	ug/L	1.1	U	1.6	U	10	U	1.1	U	0.23	U	40	U	40	U	10	U	0.23	U	10	U	10	U
1,1,2-Trichloroethane	ug/L	1.6	U	1.2	U	7.2	U	1.6	U	0.32	U	29	U	29	U	7.2	U	0.32	U	7.2	U	7.2	U
1,1-Dichloroethane	ug/L	0.93	U	1.3	U	8	U	0.93	U	0.19	U	32	U	32	U	8	U	0.19	U	8	U	8	U
1,1-Dichloroethene	ug/L	1.3	U	2.2	U	14	U	1.3	U	0.26	U	56	U	56	U	14	U	0.26	U	14	U	14	U
1,2,3-Trichloropropane	ug/L	2.3	U	1.6	U	10.2	U	2.3	U	0.47	U	41	U	41	U	10.2	U	0.47	U	10.2	U	10.2	U
1,2-Dibromo-3-chloropropane	ug/L	4.2	U	8	U	50	U	4.2	U	0.85	U	200	U	200	U	50	U	0.85	U	50	U	50	U
1,2-Dibromoethane	ug/L	0.96	U	1.1	U	6.8	U	0.96	U	0.19	U	27	U	27	U	6.8	U	0.19	U	6.8	U	6.8	U
1,2-Dichlorobenzene	ug/L	0.94	U	1.2	U	7.5	U	0.94	U	0.19	U	30	U	30	U	7.5	U	0.19	U	7.5	U	7.5	U
1,2-Dichloroethane	ug/L	1.8	U	0.96	U	6	U	1.8	U	0.36	U	24	U	24	U	6	U	0.36	U	6	U	6	U
1,2-Dichloropropane	ug/L	1.1	U	1.1	U	6.8	U	1.1	U	0.23	U	27	U	27	U	6.8	U	0.23	U	6.8	U	6.8	U
1,4-Dichlorobenzene	ug/L	1.2	U	1.3	U	8.2	U	1.2	U	0.24	U	33	U	33	U	8.2	U	0.24	U	8.2	U	8.2	U
2-Butanone	ug/L	12	U	3.8	U	24	U	12	U	2.4	U	96	U	96	U	24	U	2.4	U	24	U	24	U
2-Hexanone	ug/L	2.9	U	1.8	U	11.5	U	2.9	U	0.58	U	46	U	46	U	11.5	U	0.58	U	11.5	U	11.5	U
4-Methyl-2-Pentanone (MIBK)	ug/L	2.8	U	1.3	U	8.2	U	2.8	U	0.57	U	33	U	33	U	8.2	U	0.57	U	8.2	U	8.2	U
Acetone	ug/L	72.8		100		250	U	11.4	U	2.3	U	1000	U	1000	U	250	U	2.3	U	250	U	250	U
Acrylonitrile	ug/L	14.4	U	8.8	U	55.2	U	14.4	U	2.9	U	221	U	221	U	55.2	U	2.9	U	55.2	U	55.2	U
Benzene	ug/L	13200		409		70.9		531		4.8		1210		1160		406		8340		20900		20900	
Bromochloromethane	ug/L	2.1	U	0.68	U	4.2	U	2.1	U	0.42	U	17	U	17	U	4.2	U	0.42	U	4.2	U	4.2	U
Bromodichloromethane	ug/L	0.77	U	0.72	U	4.5	U	0.77	U	0.15	U	18	U	18	U	4.5	U	0.15	U	4.5	U	4.5	U
Bromoform	ug/L	1.5	U	1	U	6.5	U	1.5	U	0.31	U	26	U	26	U	6.5	U	0.31	U	6.5	U	6.5	U
Bromomethane	ug/L	2.9	U	1.2	U	7.2	U	2.9	U	0.58	U	29	U	29	U	7.2	U	0.58	U	7.2	U	7.2	U
Carbon Disulfide	ug/L	1.6	U	4.6	U	28.8	U	1.6	U	0.32	U	115	U	115	U	28.8	U	0.35	J	28.8	U	28.8	U
Carbon Tetrachloride	ug/L	1.1	U	1	U	6.2	U	1.1	U	0.22	U	25	U	25	U	6.2	U	0.22	U	6.2	U	6.2	U
Chlorobenzene	ug/L	0.65	U	0.92	U	5.8	U	0.65	U	0.13	U	23	U	23	U	5.8	U	0.13	U	5.8	U	5.8	U
Chloroethane	ug/L	3.5	U	2.2	U	13.5	U	3.5	U	0.69	U	54	U	54	U	13.5	U	0.69	U	13.5	U	13.5	U
Chloroform	ug/L	0.93	U	0.56	U	3.5	U	0.93	U	0.19	U	14	U	14	U	3.5	U	0.19	U	3.5	U	3.5	U
Chloromethane	ug/L	1.3	U	0.44	U	2.8	U	1.3	U	0.26	U	11	U	11	U	2.8	U	0.26	U	2.8	U	2.8	U
cis-1,2-Dichloroethene	ug/L	1.2	U	0.76	U	4.8	U	1.2	U	0.23	U	19	U	19	U	4.8	U	0.23	U	4.8	U	4.8	U
cis-1,3-Dichloropropene	ug/L	1.4	U	0.52	U	3.2	U	1.4	U	0.27	U	13	U	13	U	3.2	U	0.27	U	3.2	U	3.2	U
Dibromochloromethane	ug/L	0.85	U	0.84	U	5.2	U	0.85	U	0.17	U	21	U	21	U	5.2	U	0.17	U	5.2	U	5.2	U
Dibromomethane	ug/L	1.5	U	0.84	U	5.2	U	1.5	U	0.31	U	21	U	21	U	5.2	U	0.31	U	5.2	U	5.2	U
Ethylbenzene	ug/L	4.7	J	7.9		7.5	U	22.2		7.2		36.2	J	30	U	14.2	J	95.8		36.6		37.3	
Iodomethane	ug/L	8.6	U	1.3	U	8	U	8.6	U	1.7	U	32	U	32	U	8	U	1.7	U	8	U	8	U
Methyl tert_butyl ether	ug/L	0.87	U	0.84	U	5.2	U	0.87	U	0.17	U	21	U	21	U	5.2	U	0.17	U	5.2	U	5.2	U
Methylene Chloride	ug/L	6.1	B	47.5		319		6.6	B	0.59	U	662	B	659	B	89.5		0.59	U	298		365	
Naphthalene	ug/L	33.8		10.5		1100		1370		2810		9520		9370		4020		937		627		594	
Styrene	ug/L	4.9	J	1	U	6.5	U	10.7		1.3		264		243		72.1		110		6.5	U	7	J
Tetrachloroethene	ug/L	1.4	U	1.8	U	11.5	U	1.4	U	0.29	U	46	U	46	U	11.5	U	0.29	U	11.5	U	11.5	U
Toluene	ug/L	237		2.4	J	6.5	U	276		4.2		1010		956		262		2720		1080		1140	
trans-1,2-Dichloroethene	ug/L	1.1	U	2	U	12.2	U	1.1	U	0.22	U	49	U	49	U	12.2	U	0.22	U	12.2	U	12.2	U
trans-1,3-Dichloropropene	ug/L	0.83	U	1	U	6.5	U	0.83	U	0.17	U	26	U	26	U	6.5	U	0.17	U	6.5	U	6.5	U
Trans-1,4-Dichloro-2-Butene	ug/L	3.6	U	4	U	25	U	15.1	J	0.73	U	100	U	100	U	25	U	0.73	U	25	U	25	U
Trichloroethene	ug/L	1.6	U	1.9	U	11.8	U	1.6	U	0.33	U	47	U	47	U	11.8	U	0.33	U	11.8	U	11.8	U
Trichlorofluoromethane	ug/L	1.7	U	0.8	U	5	U	1.7	U	0.34	U	20	U	20	U	5	U	0.34	U	5	U	5	U
Vinyl Acetate	ug/L	6.8	U	1.4	U	8.8	U	6.8	U	1.4	U	35	U	35	U	8.8	U	1.4	U	8.8	U	8.8	U
Vinyl Chloride	ug/L	1	U	2.5	U	15.5	U	1	U	0.2	U	62	U	62	U	15.5	U	0.2	U	15.5	U	15.5	U
Xylene	ug/L	380		2.6	U	16.5	U	383		17		740		661		312		793		436		452	

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO18-PZM006 6/9/2015		CO19-PZM004 6/10/2015**		CO20-PZM004 6/10/2015**		CO23-PZM008 6/10/2015		CO24-PZM007 6/10/2015		CO25-PZM008 6/10/2015		CO25-PZM008 DUP 6/10/2015*		CO26-PZM007 6/10/2015*		CO27-PZM012 6/8/2015		CO28-PZM010 6/9/2015*		CO28-PZM010 DUP 6/9/2015*	
Semi-Volatile Organics																							
1,2,4-Trichlorobenzene	ug/L	0.21	U	0.22	U	0.22	U	0.21	U	0.21	U	1.1	U	1.1	U	0.21	U	0.21	U	0.21	U	0.21	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.79	U	0.8	U	0.16	U	0.16	U	0.16	U	0.16	U
1,3-Dichlorobenzene	ug/L	0.21	U	0.22	U	0.22	U	0.21	U	0.21	U	1.1	U	1.1	U	0.21	U	0.21	U	0.21	U	0.21	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.89	U	0.9	U	0.18	U	0.18	U	0.18	U	0.18	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.25	U	0.25	U	0.24	U	0.24	U	1.2	U	1.2	U	0.24	U	0.24	U	0.24	U	0.24	U
2,4,5-Trichlorophenol	ug/L	0.16	U	0.17	U	0.17	U	0.16	U	0.16	U	0.82	U	0.83	U	0.28	J	0.16	U	0.16	U	0.16	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.17	U	0.16	U	0.16	U	0.16	U	0.81	U	0.82	U	0.23	J	0.16	U	0.16	U	0.16	U
2,4-Dichlorophenol	ug/L	0.18	U	0.19	U	0.19	U	0.18	U	0.18	U	0.92	U	0.93	U	0.19	U	0.18	U	0.18	U	0.18	U
2,4-Dimethylphenol	ug/L	25.9		0.14	U	2.7		41.1		0.53	J	96		85.1		41.3		3.1		0.89	J	0.81	J
2,4-Dinitrophenol	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.6	U	0.61	U	0.12	U	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.12	U	0.22	J	0.12	U	0.12	U	0.6	U	0.61	U	0.12	U	0.12	U	0.12	U	0.12	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.89	U	0.9	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chloronaphthalene	ug/L	0.18	U	0.19	U	0.19	U	0.18	U	0.18	U	0.92	U	0.93	U	0.19	U	0.18	U	0.18	U	0.18	U
2-Chlorophenol	ug/L	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U	0.95	U	0.97	U	0.19	U	0.19	U	0.19	U	0.19	U
2-Methylnaphthalene	ug/L	1.1		0.19	U	12.1		27.5		86.8		389		331		80.1		12.5		4.3		3.3	
2-Methylphenol	ug/L	1.9		0.19	U	1.5		43.2		0.19	U	73.6		73.7		31.6		4.4		1.5		1.3	
2-Nitrophenol	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.84	U	0.85	U	0.17	U	0.17	U	0.17	U	0.17	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.15	U	0.14	U	0.14	U	0.14	U	0.71	U	0.72	U	0.14	U	0.14	U	0.14	U	0.14	U
3,4-Methylphenol	ug/L	0.35	U	0.37	U	0.41	J	74.4		0.36	U	146		143		47.1		4.6		0.59	J	0.42	J
4,6-Dinitro-2-Methylphenol	ug/L	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.76	U	0.77	U	0.15	U	0.15	U	0.15	U	0.15	U
4-Bromophenyl-phenylether	ug/L	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U	0.62	U	0.63	U	0.13	U	0.12	U	0.13	U	0.13	U
4-Chloro-3-methylphenol	ug/L	0.16	U	0.17	U	0.17	U	0.16	U	0.16	U	0.82	U	0.83	U	0.17	U	0.16	U	0.17	U	0.17	U
4-Chlorophenyl-phenylether	ug/L	0.12	U	0.13	U	0.13	U	0.13	U	0.13	U	0.63	U	0.64	U	0.13	U	0.12	U	0.13	U	0.13	U
4-Nitrophenol	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.56	U	0.56	U	0.11	U	0.11	U	0.11	U	0.11	U
Acenaphthene	ug/L	0.69	J	1.2		15.3		2.4		17.9		14.1		12.7		3.9		0.6	J	0.59	J	0.51	J
Acenaphthylene	ug/L	0.26	J	0.14	U	5		11		58.5		348		290		62.8		0.84	J	2.1		1.6	
Aniline	ug/L	0.2	U	0.21	U	0.79	J	12.9		9		45.7		47		29.2		1.4	J	0.34	J	0.2	U
Anthracene	ug/L	0.63	J	0.074	U	4		1.6		8.9		17.2		18.3		3.8		0.21	J	0.28	J	0.29	J
Benzo(a)anthracene	ug/L	0.96	J	0.12	U	0.53	J	0.32	J	2.5		1.2	J	1.3	J	0.11	U	0.11	U	0.11	U	0.11	U
Benzo(a)pyrene	ug/L	0.7	J	0.064	U	0.064	U	0.063	U	2		0.31	U	0.32	U	0.063	U	0.062	U	0.063	U	0.063	U
Benzo(b)fluoranthene	ug/L	1.7		0.17	U	0.19	J	0.3	J	3.8		1	J	1.2	J	0.17	U	0.16	U	0.17	U	0.17	U
Benzo(g,h,i)perylene	ug/L	0.24	J	0.11	U	0.11	U	0.11	U	0.5	J	0.53	U	0.53	U	0.11	U	0.1	U	0.11	U	0.11	U
Benzo(k)fluoranthene	ug/L	0.64	J	0.24	U	0.24	U	0.23	U	3.8		1.2	U	1.2	J	0.24	U	0.23	U	0.23	U	0.23	U
bis(2-Chloroethoxy) Methane	ug/L	0.35	U	0.36	U	0.36	U	0.36	U	0.36	U	1.8	U	1.8	U	0.36	U	0.35	U	0.36	U	0.36	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	1.1	U	1.1	U	0.22	U	0.22	U	0.22	U	0.22	U
bis(2-Ethylhexyl)phthalate	ug/L	2.8		0.23	J	0.13	U	1.5		0.68	J	0.63	U	0.64	U	0.13	U	0.2	J	0.13	U	0.13	U
Butylbenzylphthalate	ug/L	0.16	U	0.17	U	0.16	U	0.16	U	0.16	U	0.81	U	0.82	U	0.16	U	0.16	U	0.16	U	0.16	U
Chrysene	ug/L	1.3		0.13	U	0.34	J	0.33	J	2.1		1.5	J	1.4	J	0.13	U	0.13	U	0.13	U	0.13	U
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.54	U	0.55	U	0.11	U	0.11	U	0.11	U	0.11	U
Dibenzofuran	ug/L	0.54	J	0.53	J	16.3		6.9		40.5		90.5		88.3		17.3		0.71	J	0.71	J	0.6	J
Diethylphthalate	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.54	U	0.55	U	0.11	U	0.11	U	0.11	U	0.11	U
Dimethylphthalate	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.78	U	0.79	U	0.16	U	0.15	U	0.16	U	0.16	U
Di-n-Butylphthalate	ug/L	0.081	U	0.084	U	0.083	U	0.082	U	0.082	U	0.41	U	0.41	U	0.082	U	0.081	U	0.082	U	0.082	U
Di-n-Octyl phthalate	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.83	U	0.84	U	0.17	U	0.16	U	0.17	U	0.17	U
Fluoranthene	ug/L	5.1		0.082	U	9.7		2.1		18		11.3		11.9		2.2		0.23	J	0.31	J	0.31	J
Fluorene	ug/L	0.88	J	0.65	J	16.9		7.8		27.6		88.8		90.5		19		1.1		0.88	J	0.73	J
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.59	U	0.6	U	0.12	U	0.12	U	0.12	U	0.12	U
Hexachlorobutadiene	ug/L	0.17	U	0.18	U	0.18	U	0.18	U	0.18	U	0.88	U	0.89	U	0.18	U	0.17	U	0.18	U	0.18	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.14	U	0.13	U	0.13	U	0.13	U	0.66	U	0.67	U	0.13	U	0.13	U	0.13	U	0.13	U

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO18-PZM006 6/9/2015		CO19-PZM004 6/10/2015**		CO20-PZM004 6/10/2015**		CO23-PZM008 6/10/2015		CO24-PZM007 6/10/2015		CO25-PZM008 6/10/2015		CO25-PZM008 DUP 6/10/2015*		CO26-PZM007 6/10/2015*		CO27-PZM012 6/8/2015		CO28-PZM010 6/9/2015*		CO28-PZM010 DUP 6/9/2015*	
Semi-Volatile Organics																							
Hexachloroethane	ug/L	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	1.2	U	1.2	U	0.24	U	0.23	U	0.24	U	0.24	U
Indeno(1,2,3-cd)pyrene	ug/L	0.26	J	0.13	U	0.13	U	0.13	U	0.58	J	0.63	U	0.64	U	0.13	U	0.13	U	0.13	U	0.13	U
Isophorone	ug/L	0.19	U	0.2	U	0.2	U	0.19	U	0.19	U	0.97	U	0.99	U	0.2	U	0.19	U	0.2	U	0.2	U
Naphthalene	ug/L	20.2		0.19	U	231	B	886		1220		3710	B	3440		1350	B	391		146	B	147	0
Nitrobenzene	ug/L	0.2	U	0.21	U	0.21	U	0.21	U	0.21	U	1	U	1	U	0.21	U	0.2	U	0.21	U	0.21	U
N-Nitrosodimethylamine	ug/L	0.31	U	0.32	U	0.32	U	0.31	U	0.31	U	1.6	U	1.6	U	0.32	U	0.31	U	0.31	U	0.31	U
Pentachlorophenol	ug/L	0.11	U	0.12	U	0.11	U	0.11	U	0.11	U	0.56	U	0.57	U	1.9	J	0.11	U	0.11	U	0.11	U
Phenanthrene	ug/L	3.7		0.067	U	35.9		9.3		86.9		83.8		88.8		28.5	0	0.98	J	1.3		1.3	
Phenol	ug/L	8.6		3.2		0.12	U	41.8		0.12	U	60.6		62.7		19.8		3.4		3.6		3.8	
Pyrene	ug/L	4.1		0.053	U	5.5		1.4		10.3		6.4		7.1		1.1		0.051	U	0.051	U	0.051	U
Pyridine	ug/L	1.6		0.18	U	0.18	U	8.1		22.7		82.3		93.3		38.1		0.26	J	0.18	U	0.18	U

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO29-PZM010 6/10/2015*		CO29-PZM010 DUP 6/10/2015*		CO30-PZM015 6/9/2015		CO32-PZM004 6/11/2015**		CO35-PZM013 6/11/2015**		CO36-PZM008 6/8/2015		CO38-PZM006 6/8/2015		CO39-PZM007 6/8/2015		CO40-PZM008 6/9/2015		CO41-PZM001 6/9/2015		CO42-PZM004 6/9/2015	
Volatile Organics																							
1,1,1,2-Tetrachloroethane	ug/L	8.2	U	0.33	U	0.31	U	0.33	U	1.6	U	0.31	U	1.6	U	0.31	U	1.6	U	1.6	U	0.31	U
1,1,1-Trichloroethane	ug/L	12	U	0.48	U	0.29	U	0.48	U	2.4	U	0.29	U	1.4	U	0.29	U	1.4	U	1.4	U	0.29	U
1,1,2,2-Tetrachloroethane	ug/L	10	U	0.4	U	0.23	U	0.4	U	2	U	0.23	U	1.1	U	0.23	U	1.1	U	1.1	U	0.23	U
1,1,2-Trichloroethane	ug/L	7.2	U	0.29	U	0.32	U	0.29	U	1.4	U	0.32	U	1.6	U	0.32	U	1.6	U	1.6	U	0.32	U
1,1-Dichloroethane	ug/L	8	U	0.32	U	0.19	U	0.32	U	1.6	U	0.19	U	0.93	U	0.19	U	0.93	U	0.93	U	0.19	U
1,1-Dichloroethene	ug/L	14	U	0.56	U	0.26	U	0.56	U	2.8	U	0.26	U	1.3	U	0.26	U	1.3	U	1.3	U	0.26	U
1,2,3-Trichloropropane	ug/L	10.2	U	0.41	U	0.47	U	0.41	U	2	U	0.47	U	2.3	U	0.47	U	2.3	U	2.3	U	0.47	U
1,2-Dibromo-3-chloropropane	ug/L	50	U	2	U	0.85	U	2	U	10	U	0.85	U	4.2	U	0.85	U	4.2	U	4.2	U	0.85	U
1,2-Dibromoethane	ug/L	6.8	U	0.27	U	0.19	U	0.27	U	1.4	U	0.19	U	0.96	U	0.19	U	0.96	U	0.96	U	0.19	U
1,2-Dichlorobenzene	ug/L	7.5	U	0.3	U	0.19	U	0.3	U	1.5	U	0.19	U	0.94	U	0.19	U	0.94	U	0.94	U	0.19	U
1,2-Dichloroethane	ug/L	6	U	0.24	U	0.36	U	0.24	U	1.2	U	0.36	U	1.8	U	0.36	U	1.8	U	1.8	U	0.36	U
1,2-Dichloropropane	ug/L	6.8	U	0.27	U	0.23	U	0.27	U	1.4	U	0.23	U	1.1	U	0.23	U	1.1	U	1.1	U	0.23	U
1,4-Dichlorobenzene	ug/L	8.2	U	0.33	U	0.24	U	0.33	U	1.6	U	0.24	U	1.2	U	0.24	U	1.2	U	1.2	U	0.24	U
2-Butanone	ug/L	24	U	0.96	U	2.4	U	0.96	U	4.8	U	2.4	U	12	U	2.4	U	12	U	12	U	2.4	U
2-Hexanone	ug/L	11.5	U	0.46	U	0.58	U	0.46	U	2.3	U	0.58	U	2.9	U	0.58	U	2.9	U	2.9	U	0.58	U
4-Methyl-2-Pentanone (MIBK)	ug/L	8.2	U	0.33	U	0.57	U	0.33	U	1.6	U	0.57	U	2.8	U	0.57	U	2.8	U	2.8	U	0.57	U
Acetone	ug/L	250	U	10	U	2.3	U	23.9	J	50	U	2.3	U	11.4	U	8.1	J	11.4	U	11.4	U	2.3	U
Acrylonitrile	ug/L	55.2	U	2.2	U	2.9	U	2.2	U	11	U	2.9	U	14.4	U	2.9	U	14.4	U	14.4	U	2.9	U
Benzene	ug/L	15.1	J	17.2		67900		0.35	J	109		27300		13100		336		6590		76200		650	
Bromochloromethane	ug/L	4.2	U	0.17	U	0.42	U	0.17	U	0.85	U	0.42	U	2.1	U	0.42	U	2.1	U	2.1	U	0.42	U
Bromodichloromethane	ug/L	4.5	U	0.18	U	0.15	U	0.18	U	0.9	U	0.15	U	0.77	U	0.15	U	0.77	U	0.77	U	0.15	U
Bromoform	ug/L	6.5	U	0.26	U	0.31	U	0.26	U	1.3	U	0.31	U	1.5	U	0.31	U	1.5	U	1.5	U	0.31	U
Bromomethane	ug/L	7.2	U	0.29	U	7.8		0.29	U	1.4	U	0.58	U	2.9	U	0.58	U	2.9	U	2.9	U	10	
Carbon Disulfide	ug/L	28.8	U	1.2	U	0.46	J	1.2	U	5.8	U	0.5	J	1.6	U	0.32	U	1.6	U	1.6	U	0.62	J
Carbon Tetrachloride	ug/L	6.2	U	0.25	U	0.22	U	0.25	U	1.2	U	0.22	U	1.1	U	0.22	U	1.1	U	1.1	U	0.22	U
Chlorobenzene	ug/L	5.8	U	0.23	U	0.13	U	0.23	U	1.2	U	0.13	U	0.65	U	0.13	U	0.65	U	0.65	U	0.13	U
Chloroethane	ug/L	13.5	U	0.54	U	0.69	U	0.54	U	2.7	U	0.69	U	3.5	U	0.69	U	3.5	U	3.5	U	0.69	U
Chloroform	ug/L	3.5	U	0.14	U	0.19	U	0.14	U	0.7	U	0.19	U	0.93	U	0.19	U	0.93	U	0.93	U	0.19	U
Chloromethane	ug/L	2.8	U	0.11	U	0.26	U	0.11	U	0.55	U	0.26	U	1.3	U	0.26	U	1.3	U	1.3	U	0.26	U
cis-1,2-Dichloroethene	ug/L	4.8	U	0.19	U	0.23	U	0.19	U	0.95	U	0.23	U	1.2	U	0.23	U	1.2	U	1.2	U	0.23	U
cis-1,3-Dichloropropene	ug/L	3.2	U	0.13	U	0.27	U	0.13	U	0.65	U	0.27	U	1.4	U	0.27	U	1.4	U	1.4	U	0.27	U
Dibromochloromethane	ug/L	5.2	U	0.21	U	0.17	U	0.21	U	1	U	0.17	U	0.85	U	0.17	U	0.85	U	0.85	U	0.17	U
Dibromomethane	ug/L	5.2	U	0.21	U	0.31	U	0.21	U	1	U	0.31	U	1.5	U	0.31	U	1.5	U	1.5	U	0.31	U
Ethylbenzene	ug/L	7.5	U	2.3		107		0.3	U	2.8	J	88.4		127		2.3		73.1		990		103	
Iodomethane	ug/L	8	U	0.32	U	1.7	U	0.32	U	1.6	U	1.7	U	8.6	U	1.7	U	8.6	U	8.6	U	1.1	
Methyl tert_butyl ether	ug/L	5.2	U	0.21	U	0.17	U	0.21	U	1	U	0.17	U	0.87	U	0.17	U	0.87	U	0.87	U	0.17	U
Methylene Chloride	ug/L	177		0.97	U	1	B	2	B	27.9	B	0.97	J	3	U	0.59	U	3.2	J	3.1	J	1	B
Naphthalene	ug/L	732		426		3320		4.3		457		1180		800		489		8380		707		327	
Styrene	ug/L	6.5	U	1.5		25.2		0.26	U	3.4	J	22.1		97.9		1.2		105		0.78	U	100	
Tetrachloroethene	ug/L	11.5	U	0.46	U	0.29	U	0.46	U	2.3	U	0.29	U	1.4	U	0.29	U	1.4	U	1.4	U	0.29	U
Toluene	ug/L	6.5	U	6.2		4930		0.26	U	23.5		5610		1890		24.5		1910		42600		1310	
trans-1,2-Dichloroethene	ug/L	12.2	U	0.49	U	0.22	U	0.49	U	2.4	U	0.22	U	1.1	U	0.22	U	1.1	U	1.1	U	0.22	U
trans-1,3-Dichloropropene	ug/L	6.5	U	0.26	U	0.17	U	0.26	U	1.3	U	0.17	U	0.83	U	0.17	U	0.83	U	0.83	U	0.17	U
Trans-1,4-Dichloro-2-Butene	ug/L	25	U	1	U	0.73	U	1	U	5	U	0.73	U	3.6	U	0.73	U	3.6	U	3.6	U	0.73	U
Trichloroethene	ug/L	11.8	U	0.47	U	0.33	U	0.47	U	2.4	U	0.33	U	1.6	U	0.33	U	1.6	U	1.6	U	0.33	U
Trichlorofluoromethane	ug/L	5	U	0.2	U	0.34	U	0.2	U	1	U	0.34	U	1.7	U	0.34	U	1.7	U	1.7	U	0.34	U
Vinyl Acetate	ug/L	8.8	U	0.35	U	1.4	U	0.35	U	1.8	U	1.4	U	6.8	U	1.4	U	6.8	U	6.8	U	1.4	U
Vinyl Chloride	ug/L	15.5	U	0.62	U	0.2	U	0.62	U	3.1	U	0.2	U	1	U	0.2	U	1	U	1	U	0.2	U
Xylene	ug/L	16.5	U	17.4		1630		0.66	U	38.4		1630		838		13.5		849		16300		908	

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO29-PZM010 6/10/2015*		CO29-PZM010 DUP 6/10/2015*		CO30-PZM015 6/9/2015		CO32-PZM004 6/11/2015**		CO35-PZM013 6/11/2015**		CO36-PZM008 6/8/2015		CO38-PZM006 6/8/2015		CO39-PZM007 6/8/2015		CO40-PZM008 6/9/2015		CO41-PZM001 6/9/2015		CO42-PZM004 6/9/2015	
Semi-Volatile Organics																							
1,2,4-Trichlorobenzene	ug/L	0.22	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
1,3-Dichlorobenzene	ug/L	0.22	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
2,4,5-Trichlorophenol	ug/L	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4-Dichlorophenol	ug/L	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2,4-Dimethylphenol	ug/L	0.43	J	0.42	J	15		0.13	U	4.5		8.8		1.3		0.13	U	1.2		3.2		2	
2,4-Dinitrophenol	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	1.7	J	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chloronaphthalene	ug/L	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chlorophenol	ug/L	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
2-Methylnaphthalene	ug/L	12.1		10		36.3		0.18	U	9		6.6		8.1		10.1		117		8.3		6.5	
2-Methylphenol	ug/L	0.25	J	0.29	J	21.6		0.19	U	5.5		19		3.1		0.24	J	2.4		5.5		4.3	
2-Nitrophenol	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U
3,4-Methylphenol	ug/L	0.53	J	0.58	J	13.2		0.36	U	6.6		3.9		2.3		0.35	U	1.8	J	7.3		0.54	J
4,6-Dinitro-2-Methylphenol	ug/L	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
4-Bromophenyl-phenylether	ug/L	0.13	U	0.12	U	0.12	U	0.12	U	0.13	U	0.13	U	0.13	U	0.12	U	0.12	U	0.12	U	0.12	U
4-Chloro-3-methylphenol	ug/L	0.17	U	0.16	U	0.16	U	0.16	U	0.17	U	0.17	U	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U
4-Chlorophenyl-phenylether	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.12	U	0.13	U	0.13	U	0.13	U
4-Nitrophenol	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Acenaphthene	ug/L	0.74	J	0.57	J	4.7		0.15	U	2.5		0.85	J	0.61	J	0.39	J	2.6		0.92	J	0.24	J
Acenaphthylene	ug/L	3.9		3.3		27.3		0.13	U	3		3.2		0.58	J	0.39	J	6.7		0.91	J	0.88	J
Aniline	ug/L	0.21	U	0.2	U	3.5		0.2	U	5.1		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Anthracene	ug/L	0.29	J	0.31	J	1.6		0.072	U	0.53	J	0.073	U	0.43	J	0.072	U	0.55	J	0.44	J	0.34	J
Benzo(a)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.22	J	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Benzo(a)pyrene	ug/L	0.064	U	0.063	U	0.063	U	0.063	U	0.063	U	0.32	J	0.063	U	0.062	U	0.063	U	0.063	U	0.063	U
Benzo(b)fluoranthene	ug/L	0.17	U	0.16	U	0.16	U	0.16	U	0.17	U	0.45	J	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U
Benzo(g,h,i)perylene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.1	U	0.11	U	0.11	U	0.11	U
Benzo(k)fluoranthene	ug/L	0.24	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U
bis(2-Chloroethoxy) Methane	ug/L	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.35	U	0.36	U	0.36	U	0.36	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
bis(2-Ethylhexyl)phthalate	ug/L	0.27	J	0.13	U	0.28	J	0.13	U	0.27	J	0.13	U	0.13	U	0.12	U	0.24	J	0.13	U	0.13	U
Butylbenzylphthalate	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Chrysene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.23	J	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dibenzofuran	ug/L	1.2		1		8.1		0.15	U	2		0.89	J	1.1		2.5		8.9		1.4		0.56	J
Diethylphthalate	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.21	J
Dimethylphthalate	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Di-n-Butylphthalate	ug/L	0.083	U	0.082	U	0.082	U	0.082	U	0.082	U	0.082	U	0.082	U	0.081	U	0.082	U	0.082	U	0.082	U
Di-n-Octyl phthalate	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
Fluoranthene	ug/L	0.36	J	0.4	J	1.7		0.08	U	0.72	J	0.56	J	0.76	J	0.08	U	1.2		0.48	J	0.26	J
Fluorene	ug/L	1.6		1.3		10.2		0.16	U	2.4		1		1.5		1.5		4.9		2.3		0.88	J
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
Hexachlorobutadiene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.17	U	0.18	U	0.18	U	0.18	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO29-PZM010 6/10/2015*		CO29-PZM010 DUP 6/10/2015*		CO30-PZM015 6/9/2015		CO32-PZM004 6/11/2015**		CO35-PZM013 6/11/2015**		CO36-PZM008 6/8/2015		CO38-PZM006 6/8/2015		CO39-PZM007 6/8/2015		CO40-PZM008 6/9/2015		CO41-PZM001 6/9/2015		CO42-PZM004 6/9/2015	
Semi-Volatile Organics																							
Hexachloroethane	ug/L	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
Indeno(1,2,3-cd)pyrene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Isophorone	ug/L	0.2	U	0.19	U	0.19	U	0.19	U	0.2	U	0.2	U	0.2	U	0.19	U	0.19	U	0.19	U	0.19	U
Naphthalene	ug/L	193		180	B	1510		0.19	U	210		223		240		133		3410		326		94.8	
Nitrobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.2	U	0.21	U	0.21	U	0.21	U
N-Nitrosodimethylamine	ug/L	0.32	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U
Pentachlorophenol	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.42	J	1.3	J	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Phenanthrene	ug/L	1.7		1.7		8.7		0.065	U	3.7		0.89	J	2.9		0.84	J	4		2.3		1.5	
Phenol	ug/L	0.37	J	0.38	J	10.8		0.12	U	0.34	J	9.1		3.1		0.33	J	2.1	0	13.4		0.2	J
Pyrene	ug/L	0.23	J	0.25	J	0.98	J	0.051	U	0.66	J	0.4	J	0.5	J	0.051	U	0.76	J	0.28	J	0.35	J
Pyridine	ug/L	0.18	U	0.43	J	2		0.18	U	3.1		0.82	J	0.18	U	0.18	U	1		0.18	U	0.18	U

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO56-PZP001 6/11/2015		CO57-PZP002 6/10/2015		CO58-PZM001 6/10/2015		CO59-PZP002 6/10/2015		CO60-PZP001 6/10/2015		CO79-PZM 6/9/2015*		CO88-PZM 6/9/2015*		CO93-PZMXXX 6/9/2015		CO101-PZMXXX 6/9/2015		CO102-PZMXXX 6/10/2015		CO103-PZMXXX 6/10/2015	
Volatile Organics																							
1,1,1,2-Tetrachloroethane	ug/L	1.6	U	0.31	U	0.31	U	0.31	U	1.6	U	8.2	U	8.2	U	1.6	U	0.31	U	1.6	U	1.6	U
1,1,1-Trichloroethane	ug/L	1.4	U	0.29	U	0.29	U	0.29	U	1.4	U	12	U	12	U	1.4	U	0.29	U	1.4	U	1.4	U
1,1,2,2-Tetrachloroethane	ug/L	1.1	U	0.23	U	0.23	U	0.23	U	1.1	U	10	U	10	U	1.1	U	0.23	U	1.1	U	1.1	U
1,1,2-Trichloroethane	ug/L	1.6	U	0.32	U	0.32	U	0.32	U	1.6	U	7.2	U	7.2	U	1.6	U	0.32	U	1.6	U	1.6	U
1,1-Dichloroethane	ug/L	0.93	U	0.19	U	0.46	J	0.19	U	0.93	U	8	U	8	U	0.93	U	0.19	U	0.93	U	0.93	U
1,1-Dichloroethene	ug/L	1.3	U	0.26	U	0.26	U	0.26	U	1.3	U	14	U	14	U	1.3	U	0.26	U	1.3	U	1.3	U
1,2,3-Trichloropropane	ug/L	2.3	U	0.47	U	0.47	U	0.47	U	2.3	U	10.2	U	10.2	U	2.3	U	0.47	U	2.3	U	2.3	U
1,2-Dibromo-3-chloropropane	ug/L	4.2	U	0.85	U	0.85	U	0.85	U	4.2	U	50	U	50	U	4.2	U	0.85	U	4.2	U	4.2	U
1,2-Dibromoethane	ug/L	0.96	U	0.19	U	0.19	U	0.19	U	0.96	U	6.8	U	6.8	U	0.96	U	0.19	U	0.96	U	0.96	U
1,2-Dichlorobenzene	ug/L	0.94	U	0.19	U	0.19	U	0.19	U	0.94	U	7.5	U	7.5	U	0.94	U	0.19	U	0.94	U	0.94	U
1,2-Dichloroethane	ug/L	1.8	U	0.36	U	0.36	U	0.36	U	1.8	U	6	U	6	U	1.8	U	0.36	U	1.8	U	1.8	U
1,2-Dichloropropane	ug/L	1.1	U	0.23	U	0.23	U	0.23	U	1.1	U	6.8	U	6.8	U	1.1	U	0.23	U	1.1	U	1.1	U
1,4-Dichlorobenzene	ug/L	1.2	U	0.24	U	0.24	U	0.24	U	1.2	U	8.2	U	8.2	U	1.2	U	0.24	U	1.2	U	1.2	U
2-Butanone	ug/L	12	U	2.4	U	2.4	U	2.4	U	12	U	24	U	24	U	12	U	2.4	U	12	U	12	U
2-Hexanone	ug/L	2.9	U	0.58	U	0.58	U	0.58	U	2.9	U	11.5	U	11.5	U	2.9	U	0.58	U	2.9	U	2.9	U
4-Methyl-2-Pentanone (MIBK)	ug/L	2.8	U	0.57	U	0.57	U	0.57	U	2.8	U	8.2	U	8.2	U	2.8	U	0.57	U	2.8	U	2.8	U
Acetone	ug/L	11.4	U	2.3	U	2.3	U	2.3	U	11.4	U	250	U	250	U	11.4	U	2.3	U	11.4	U	11.4	U
Acrylonitrile	ug/L	14.4	U	2.9	U	2.9	U	2.9	U	14.4	U	55.2	U	55.2	U	14.4	U	2.9	U	14.4	U	14.4	U
Benzene	ug/L	639		9.7		195		389		467		1380		166000		302000		15600		23400		50900	
Bromochloromethane	ug/L	2.1	U	0.42	U	0.42	U	0.42	U	2.1	U	4.2	U	4.2	U	2.1	U	0.42	U	2.1	U	2.1	U
Bromodichloromethane	ug/L	0.77	U	0.15	U	0.15	U	0.15	U	0.77	U	4.5	U	4.5	U	0.77	U	0.15	U	0.77	U	0.77	U
Bromoform	ug/L	1.5	U	0.31	U	0.31	U	0.31	U	1.5	U	6.5	U	6.5	U	1.5	U	0.31	U	1.5	U	1.5	U
Bromomethane	ug/L	2.9	U	10.8		8.2		8.7		2.9	U	7.2	U	7.2	U	2.9	U	0.58	U	2.9	U	2.9	U
Carbon Disulfide	ug/L	1.6	U	0.32	U	0.32	U	0.43	J	1.6	U	28.8	U	28.8	U	12.3		0.32	U	1.6	U	1.6	U
Carbon Tetrachloride	ug/L	1.1	U	0.22	U	0.22	U	0.22	U	1.1	U	6.2	U	6.2	U	1.1	U	0.22	U	1.1	U	1.1	U
Chlorobenzene	ug/L	0.65	U	0.13	U	0.13	U	0.13	U	0.65	U	5.8	U	5.8	U	16.4		0.13	U	0.65	U	0.65	U
Chloroethane	ug/L	3.5	U	0.69	U	0.69	U	0.69	U	3.5	U	13.5	U	13.5	U	3.5	U	0.69	U	3.5	U	3.5	U
Chloroform	ug/L	0.93	U	0.19	U	0.19	U	0.19	U	0.93	U	3.5	U	3.5	U	0.93	U	0.19	U	0.93	U	0.93	U
Chloromethane	ug/L	1.3	U	5.7		0.26	U	4.8		1.3	U	2.8	U	2.8	U	1.3	U	0.26	U	1.3	U	1.3	U
cis-1,2-Dichloroethene	ug/L	1.2	U	0.23	U	0.23	U	0.23	U	1.2	U	4.8	U	4.8	U	1.2	U	0.23	U	1.2	U	1.2	U
cis-1,3-Dichloropropene	ug/L	1.4	U	0.27	U	0.27	U	0.27	U	1.4	U	3.2	U	3.2	U	1.4	U	0.27	U	1.4	U	1.4	U
Dibromochloromethane	ug/L	0.85	U	0.17	U	0.17	U	0.17	U	0.85	U	5.2	U	5.2	U	0.85	U	0.17	U	0.85	U	0.85	U
Dibromomethane	ug/L	1.5	U	0.31	U	0.31	U	0.31	U	1.5	U	5.2	U	5.2	U	1.5	U	0.31	U	1.5	U	1.5	U
Ethylbenzene	ug/L	21.4		0.23	U	11.2		20.4		14.3		7.5	U	535		2970		22		25.4		94.2	
Iodomethane	ug/L	8.6	U	1.7	U	1.7	U	1.7	U	8.6	U	8	U	8	U	8.6	U	1.7	U	8.6	U	8.6	U
Methyl tert_butyl ether	ug/L	0.87	U	0.17	U	0.17	U	0.17	U	0.87	U	5.2	U	5.2	U	0.87	U	0.17	U	0.87	U	0.87	U
Methylene Chloride	ug/L	6.5	B	1	B	1.1	B	1.2	B	6.8	B	454		282		6.3	B	1	B	6	B	3	U
Naphthalene	ug/L	4390		3.3		1520		1630		2420		18.3	J	809	0	1880		1120		1340		5880	
Styrene	ug/L	79.7		0.16	U	24.2		19.5		47.2		6.5	U	50.5	0	1550		8.1		8.9		16.3	
Tetrachloroethene	ug/L	1.4	U	0.29	U	0.29	U	0.29	U	1.4	U	11.5	U	11.5	U	1.4	U	0.29	U	1.4	U	1.4	U
Toluene	ug/L	360		0.88	J	56		241		228		43.3		10600		51800		1310		1190		3920	
trans-1,2-Dichloroethene	ug/L	1.1	U	0.22	U	0.22	U	0.22	U	1.1	U	12.2	U	12.2	U	1.1	U	0.22	U	1.1	U	1.1	U
trans-1,3-Dichloropropene	ug/L	0.83	U	0.17	U	0.17	U	0.17	U	0.83	U	6.5	U	6.5	U	0.83	U	0.17	U	0.83	U	0.83	U
Trans-1,4-Dichloro-2-Butene	ug/L	3.6	U	0.73	U	0.73	U	0.73	U	3.6	U	25	U	25	U	3.6	U	0.73	U	3.6	U	3.6	U
Trichloroethene	ug/L	1.6	U	0.33	U	0.33	U	0.33	U	1.6	U	11.8	U	11.8	U	1.6	U	0.33	U	1.6	U	1.6	U
Trichlorofluoromethane	ug/L	1.7	U	0.34	U	0.34	U	0.34	U	1.7	U	5	U	5	U	1.7	U	0.34	U	1.7	U	1.7	U
Vinyl Acetate	ug/L	6.8	U	1.4	U	1.4	U	1.4	U	6.8	U	8.8	U	8.8	U	6.8	U	1.4	U	6.8	U	6.8	U
Vinyl Chloride	ug/L	1	U	0.2	U	0.2	U	0.2	U	1	U	15.5	U	15.5	U	1	U	0.2	U	1	U	1	U
Xylene	ug/L	432		0.55	U	182		321		290		33	J	4060		37000		270		285		1490	

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO56-PZP001 6/11/2015		CO57-PZP002 6/10/2015		CO58-PZM001 6/10/2015		CO59-PZP002 6/10/2015		CO60-PZP001 6/10/2015		CO79-PZM 6/9/2015*		CO88-PZM 6/9/2015*		CO93-PZMXXX 6/9/2015		CO101-PZMXXX 6/9/2015		CO102-PZMXXX 6/10/2015		CO103-PZMXXX 6/10/2015	
Semi-Volatile Organics																							
1,2,4-Trichlorobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
1,3-Dichlorobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
2,4,5-Trichlorophenol	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4-Dichlorophenol	ug/L	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U
2,4-Dimethylphenol	ug/L	38.2		0.13	U	16.7		30.3		55.5		18.2		8.7		31.2		3.9		4.4		10.8	
2,4-Dinitrophenol	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chloronaphthalene	ug/L	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U
2-Chlorophenol	ug/L	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
2-Methylnaphthalene	ug/L	43.9		0.3	J	45.3		23.7		62.3		0.29	J	6.2		27.9	0	13.5		31.6		71.1	
2-Methylphenol	ug/L	28.2		0.19	U	16.7		30.4		55.4		0.73	J	7.3		20.5	0	5		8.2		17.7	
2-Nitrophenol	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U
3,4-Methylphenol	ug/L	39.9		0.36	U	20.6		38.3		68.5		0.36	U	6.6		22		2.5		4.2		8.3	
4,6-Dinitro-2-Methylphenol	ug/L	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
4-Bromophenyl-phenylether	ug/L	0.12	U	0.13	U	0.12	U	0.12	U	0.13	U	0.12	U	0.12	U	0.13	U	0.12	U	0.12	U	0.12	U
4-Chloro-3-methylphenol	ug/L	0.16	U	0.17	U	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U	0.16	U
4-Chlorophenyl-phenylether	ug/L	0.13	U	0.13	U	0.12	U	0.13	U	0.13	U	0.13	U	0.12	U	0.13	U	0.12	U	0.12	U	0.12	U
4-Nitrophenol	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Acenaphthene	ug/L	4.2		0.15	U	4.4		3.1		4.5		0.41	J	4		4.1		3.2		5.7		3.8	
Acenaphthylene	ug/L	35		0.13	U	25.2		10.6		44.9		0.13	U	1.3		1.9		10.5		19.6		30	
Aniline	ug/L	33	E	0.21	U	7.2		8.7		27.9		0.2	U	4.2		0.21	U	1	J	1.9	J	1.9	J
Anthracene	ug/L	2.5		0.073	U	2.1		1.2		1.8		0.072	U	1.1		3.7		2.4		4.3		3.5	
Benzo(a)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.5	J	0.11	U	1.9		0.33	J	0.22	J	0.3	J
Benzo(a)pyrene	ug/L	0.063	U	0.063	U	0.062	U	0.063	U	0.063	U	0.6	J	0.062	U	1.8		0.25	J	0.062	U	0.062	U
Benzo(b)fluoranthene	ug/L	0.16	U	0.17	U	0.16	U	0.16	U	0.17	U	1.6		0.16	U	3.2		0.45	J	0.16	U	0.16	U
Benzo(g,h,i)perylene	ug/L	0.11	U	0.11	U	0.1	U	0.11	U	0.11	U	0.11	U	0.1	U	0.26	J	0.1	U	0.1	U	0.1	U
Benzo(k)fluoranthene	ug/L	0.23	U	0.24	U	0.23	U	0.23	U	0.23	U	1.6		0.23	U	1.4		0.23	U	0.23	U	0.23	U
bis(2-Chloroethoxy) Methane	ug/L	0.36	U	0.36	U	0.35	U	0.36	U	2.9		0.36	U	0.35	U	0.36	U	0.35	U	0.35	U	0.35	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
bis(2-Ethylhexyl)phthalate	ug/L	0.24	J	0.13	U	0.22	J	0.24	J	0.26	J	0.13	U	0.12	U	1	J	0.3	J	0.21	J	0.28	J
Butylbenzylphthalate	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Chrysene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.6	J	0.13	U	1.9		0.35	J	0.22	J	0.26	J
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dibenzofuran	ug/L	13.4		0.16	U	10.1		5.4		13.6		0.29	J	2.5		5		6.6		12.6		8	
Diethylphthalate	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dimethylphthalate	ug/L	0.16	U	0.16	U	0.15	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.15	U	0.16	U	0.16	U
Di-n-Butylphthalate	ug/L	0.082	U	0.082	U	0.081	U	0.082	U	0.082	U	0.082	U	0.081	U	0.082	U	0.081	U	0.081	U	0.081	U
Di-n-Octyl phthalate	ug/L	0.17	U	0.17	U	0.16	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.16	U	0.17	U	0.17	U
Fluoranthene	ug/L	1.8		0.36	J	2		0.86	J	1.3		1.7		1.2		7.2		3		4.9		4.6	
Fluorene	ug/L	14.6		0.16	U	10.8		6.4		13.4		0.58	J	3.5		9.9		11.3		22.1		8.6	
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
Hexachlorobutadiene	ug/L	0.18	U	0.18	U	0.17	U	0.18	U	0.18	U	0.18	U	0.17	U	0.18	U	0.17	U	0.17	U	0.17	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U

TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO56-PZP001 6/11/2015		CO57-PZP002 6/10/2015		CO58-PZM001 6/10/2015		CO59-PZP002 6/10/2015		CO60-PZP001 6/10/2015		CO79-PZM 6/9/2015*		CO88-PZM 6/9/2015*		CO93-PZMXXX 6/9/2015		CO101-PZMXXX 6/9/2015		CO102-PZMXXX 6/10/2015		CO103-PZMXXX 6/10/2015	
Semi-Volatile Organics																							
Hexachloroethane	ug/L	0.24	U	0.24	U	0.23	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.23	U	0.24	U	0.24	U
Indeno(1,2,3-cd)pyrene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.22	J	0.13	U	0.31	J	0.13	U	0.13	U	0.13	U
Isophorone	ug/L	0.19	U	0.2	U	0.19	U	0.19	U	0.2	U	0.19	U	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U
Naphthalene	ug/L	993		4.9		865		642	0	1750	0	9.3	B	172	B	1740		421		872		3030	
Nitrobenzene	ug/L	0.21	U	0.21	U	0.2	U	0.21	U	0.21	U	0.21	U	0.2	U	0.21	U	0.2	U	0.2	U	0.2	U
N-Nitrosodimethylamine	ug/L	0.31	U	0.32	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.32	U	0.31	U	0.31	U	0.31	U
Pentachlorophenol	ug/L	0.11	U	0.11	U	1.5	J	0.11	U	0.11	U	0.11	U	0.11	U	2.8		0.11	U	0.11	U	0.11	U
Phenanthrene	ug/L	15.2		0.5	J	11.7		6.8	0	10	0	0.54	J	6.1		16.5		14.6		32		15.2	
Phenol	ug/L	16.8		0.12	U	1.7		13.6	0	21.2	0	8		8.4		93.3		4.1		5.5		13.3	
Pyrene	ug/L	1.1		0.27	J	1.1		0.51	J	0.87	J	1.4		0.69	J	4.4		1.9		2.8		2.8	
Pyridine	ug/L	22.8		0.18	U	3.6		15.3	0	10.2	0	0.18	U	1.8		19.5		0.26	J	0.24	J	1.5	

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO104-PZMXXX 6/9/2015		CO121-PZM 6/10/2015*		TS06-PPM008 6/11/2015*	
Volatile Organics							
1,1,1,2-Tetrachloroethane	ug/L	0.31	U	8.2	U	3.3	U
1,1,1-Trichloroethane	ug/L	0.29	U	12	U	4.8	U
1,1,2,2-Tetrachloroethane	ug/L	0.23	U	10	U	4	U
1,1,2-Trichloroethane	ug/L	0.32	U	7.2	U	2.9	U
1,1-Dichloroethane	ug/L	0.19	U	8	U	3.2	U
1,1-Dichloroethene	ug/L	0.26	U	14	U	5.6	U
1,2,3-Trichloropropane	ug/L	0.47	U	10.2	U	4.1	U
1,2-Dibromo-3-chloropropane	ug/L	0.85	U	50	U	20	U
1,2-Dibromoethane	ug/L	0.19	U	6.8	U	2.7	U
1,2-Dichlorobenzene	ug/L	0.19	U	7.5	U	3	U
1,2-Dichloroethane	ug/L	0.36	U	6	U	2.4	U
1,2-Dichloropropane	ug/L	0.23	U	6.8	U	2.7	U
1,4-Dichlorobenzene	ug/L	0.24	U	8.2	U	3.3	U
2-Butanone	ug/L	2.4	U	24	U	571	
2-Hexanone	ug/L	0.58	U	11.5	U	4.6	U
4-Methyl-2-Pentanone (MIBK)	ug/L	0.57	U	8.2	U	3.3	U
Acetone	ug/L	2.3	U	250	U	473	
Acrylonitrile	ug/L	2.9	U	55.2	U	22.1	U
Benzene	ug/L	31.1		1970		7.3	J
Bromochloromethane	ug/L	0.42	U	4.2	U	1.7	U
Bromodichloromethane	ug/L	0.15	U	4.5	U	1.8	U
Bromoform	ug/L	0.31	U	6.5	U	2.6	U
Bromomethane	ug/L	3.8	0	7.2	U	2.9	U
Carbon Disulfide	ug/L	0.32	U	28.8	U	11.5	U
Carbon Tetrachloride	ug/L	0.22	U	6.2	U	2.5	U
Chlorobenzene	ug/L	0.13	U	5.8	U	2.3	U
Chloroethane	ug/L	0.69	U	13.5	U	5.4	U
Chloroform	ug/L	0.19	U	3.5	U	1.4	U
Chloromethane	ug/L	0.26	U	2.8	U	1.1	U
cis-1,2-Dichloroethene	ug/L	0.23	U	4.8	U	1.9	U
cis-1,3-Dichloropropene	ug/L	0.27	U	3.2	U	1.3	U
Dibromochloromethane	ug/L	0.17	U	5.2	U	2.1	U
Dibromomethane	ug/L	0.31	U	5.2	U	2.1	U
Ethylbenzene	ug/L	0.45	J	61.7		3	U
Iodomethane	ug/L	1	0	8	U	3.2	U
Methyl tert_butyl ether	ug/L	0.17	U	5.2	U	2.1	U
Methylene Chloride	ug/L	0.59	U	167	B	57	B
Naphthalene	ug/L	25.8		1760		3.4	J
Styrene	ug/L	0.2	J	121		2.6	U
Tetrachloroethene	ug/L	0.29	U	11.5	U	4.6	U
Toluene	ug/L	7		1650		2.9	J
trans-1,2-Dichloroethene	ug/L	0.22	U	12.2	U	4.9	U
trans-1,3-Dichloropropene	ug/L	0.17	U	6.5	U	2.6	U
Trans-1,4-Dichloro-2-Butene	ug/L	0.73	U	25	U	10	U
Trichloroethene	ug/L	0.33	U	11.8	U	4.7	U
Trichlorofluoromethane	ug/L	0.34	U	5	U	2	U
Vinyl Acetate	ug/L	1.4	U	8.8	U	3.5	U
Vinyl Chloride	ug/L	0.2	U	15.5	U	6.2	U
Xylene	ug/L	6		642		6.6	U

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TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO104-PZMXXX 6/9/2015		CO121-PZM 6/10/2015*		TS06-PPM008 6/11/2015*	
Semi-Volatile Organics							
1,2,4-Trichlorobenzene	ug/L	0.21	U	0.21	U	0.23	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.17	U
1,3-Dichlorobenzene	ug/L	0.21	U	0.21	U	0.23	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.18	U	0.19	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.24	U	0.26	U
2,4,5-Trichlorophenol	ug/L	0.16	U	0.16	U	0.18	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.16	U	0.18	U
2,4-Dichlorophenol	ug/L	0.18	U	0.19	U	0.2	U
2,4-Dimethylphenol	ug/L	0.13	U	3		0.14	U
2,4-Dinitrophenol	ug/L	0.12	U	0.12	U	0.13	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.12	U	0.13	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.18	U	0.19	U
2-Chloronaphthalene	ug/L	0.18	U	0.19	U	0.2	U
2-Chlorophenol	ug/L	0.19	U	0.19	U	0.21	U
2-Methylnaphthalene	ug/L	0.18	U	25.5		0.2	U
2-Methylphenol	ug/L	0.19	U	5.9		0.2	U
2-Nitrophenol	ug/L	0.17	U	0.17	U	0.18	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.14	U	0.16	U
3,4-Methylphenol	ug/L	0.36	U	9.2		0.39	U
4,6-Dinitro-2-Methylphenol	ug/L	0.15	U	0.15	U	0.17	U
4-Bromophenyl-phenylether	ug/L	0.13	U	0.13	U	0.14	U
4-Chloro-3-methylphenol	ug/L	0.17	U	0.17	U	0.18	U
4-Chlorophenyl-phenylether	ug/L	0.13	U	0.13	U	0.14	U
4-Nitrophenol	ug/L	0.11	U	0.11	U	0.12	U
Acenaphthene	ug/L	0.15	U	1.2		0.16	U
Acenaphthylene	ug/L	0.13	U	5.1		0.14	U
Aniline	ug/L	0.2	U	1.3	J	0.22	U
Anthracene	ug/L	0.073	U	0.52	J	0.079	U
Benzo(a)anthracene	ug/L	0.11	U	0.11	U	0.12	U
Benzo(a)pyrene	ug/L	0.063	U	0.063	U	0.069	U
Benzo(b)fluoranthene	ug/L	0.17	U	0.17	U	0.18	U
Benzo(g,h,i)perylene	ug/L	0.11	U	0.11	U	0.12	U
Benzo(k)fluoranthene	ug/L	0.23	U	0.24	U	0.25	U
bis(2-Chloroethoxy) Methane	ug/L	0.36	U	0.36	U	0.39	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.22	U	0.24	U
bis(2-Ethylhexyl)phthalate	ug/L	0.13	U	0.13	U	0.14	U
Butylbenzylphthalate	ug/L	0.16	U	0.16	U	0.18	U
Chrysene	ug/L	0.13	U	0.13	U	0.14	U
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.12	U
Dibenzofuran	ug/L	0.15	U	5.3		0.17	U
Diethylphthalate	ug/L	0.11	U	0.11	U	0.12	U
Dimethylphthalate	ug/L	0.16	U	0.16	U	0.17	U
Di-n-Butylphthalate	ug/L	0.082	U	0.082	U	0.089	U
Di-n-Octyl phthalate	ug/L	0.17	U	0.17	U	0.18	U
Fluoranthene	ug/L	0.081	U	0.28	J	0.088	U
Fluorene	ug/L	0.16	U	4.4		0.17	U
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.13	U
Hexachlorobutadiene	ug/L	0.18	U	0.18	U	0.19	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.13	U	0.14	U

TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO104-PZMXXX 6/9/2015		CO121-PZM 6/10/2015*		TS06-PPM008 6/11/2015*	
Semi-Volatile Organics							
Hexachloroethane	ug/L	0.24	U	0.24	U	0.26	U
Indeno(1,2,3-cd)pyrene	ug/L	0.13	U	0.13	U	0.14	U
Isophorone	ug/L	0.2	U	0.2	U	0.21	U
Naphthalene	ug/L	4.2		324		0.21	U
Nitrobenzene	ug/L	0.21	U	0.21	U	0.22	U
N-Nitrosodimethylamine	ug/L	0.31	U	0.32	U	0.34	U
Pentachlorophenol	ug/L	0.11	U	0.11	U	0.12	U
Phenanthrene	ug/L	0.066	U	5.1		0.072	U
Phenol	ug/L	0.38	J	6.9		0.13	U
Pyrene	ug/L	0.42	J	0.052	U	0.056	U
Pyridine	ug/L	0.18	U	0.8	J	0.19	U

TABLE 3-9
GROUNDWATER ANALYTICAL RESULTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL, BALTIMORE, MARYLAND

Notes:
* Semi-volatiles analyzed 6/17/2015
** Semi-volatiles analyzed 6/18/2015
ug/L - micrograms per liter
J - Estimated concentration above the method detection limit and below the reporting limit
U - Compound was analyzed for but was not detected
B - Analyte was detected in the associated method blank
E - Estimated concentration over calibration limit

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TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO02-PZM041 6/9/2015*		CO04-PZM048 6/10/2015**		CO04-PZM048DUP 6/10/2015**		CO08-PZM036 6/11/2015**		CO13-PZM030 6/10/2015**		CO26-PZM032 6/10/2015*		CO27-PZM046 6/8/2015		CO28-PZM048 6/9/2015*		CO29-PZM051 6/9/2015*		CO30-PZM060 6/9/2015	
Volatile Organics																					
1,1,1,2-Tetrachloroethane	ug/L	1.3	U	0.33	U	0.33	U	8.2	U	0.33	U	0.33	U	1.6	U	8.2	U	0.33	U	0.31	U
1,1,1-Trichloroethane	ug/L	1.9	U	0.48	U	0.48	U	12	U	0.48	U	0.48	U	1.4	U	12	U	0.48	U	0.29	U
1,1,2,2-Tetrachloroethane	ug/L	1.6	U	0.4	U	0.4	U	10	U	0.4	U	0.4	U	1.1	U	10	U	0.4	U	0.23	U
1,1,2-Trichloroethane	ug/L	1.2	U	0.29	U	0.29	U	7.2	U	0.29	U	0.29	U	1.6	U	7.2	U	0.29	U	0.32	U
1,1-Dichloroethane	ug/L	1.3	U	0.32	U	0.32	U	8	U	0.32	U	0.32	U	0.99	J	8	U	0.32	U	0.19	U
1,1-Dichloroethene	ug/L	2.2	U	0.56	U	0.56	U	14	U	0.56	U	0.56	U	1.3	U	14	U	0.56	U	0.26	U
1,2,3-Trichloropropane	ug/L	1.6	U	0.41	U	0.41	U	10.2	U	0.41	U	0.41	U	2.3	U	10.2	U	0.41	U	0.47	U
1,2-Dibromo-3-chloropropane	ug/L	8	U	2	U	2	U	50	U	2	U	2	U	4.2	U	50	U	2	U	0.85	U
1,2-Dibromoethane	ug/L	1.1	U	0.27	U	0.27	U	6.8	U	0.27	U	0.27	U	0.96	U	6.8	U	0.27	U	0.19	U
1,2-Dichlorobenzene	ug/L	1.2	U	0.3	U	0.3	U	7.5	U	0.3	U	0.3	U	0.94	U	7.5	U	0.3	U	0.19	U
1,2-Dichloroethane	ug/L	0.96	U	0.24	U	0.12	U	6	U	0.24	U	0.24	U	1.8	U	6	U	0.24	U	0.36	U
1,2-Dichloropropane	ug/L	1.1	U	0.27	U	0.27	U	6.8	U	0.27	U	0.27	U	1.1	U	6.8	U	0.27	U	0.23	U
1,4-Dichlorobenzene	ug/L	1.3	U	0.33	U	0.33	U	8.2	U	0.33	U	0.33	U	1.2	U	8.2	U	0.33	U	0.24	U
2-Butanone	ug/L	3.8	U	0.96	U	0.96	U	160		0.96	U	0.96	U	12	U	24	U	0.96	U	2.4	U
2-Hexanone	ug/L	1.8	U	0.46	U	0.46	U	11.5	U	0.46	U	0.46	U	2.9	U	11.5	U	0.46	U	0.58	U
4-Methyl-2-Pentanone (MIBK)	ug/L	1.3	U	0.33	U	0.33	U	8.2	U	0.33	U	0.33	U	2.8	U	8.2	U	0.33	U	0.57	U
Acetone	ug/L	40	U	44.8		44.5		250	U	10	U	10	U	11.4	U	250	U	10	U	2.3	U
Acrylonitrile	ug/L	8.8	U	2.2	U	2.2	U	55.2	U	2.2	U	2.2	U	14.4	U	55.2	U	2.2	U	2.9	U
Benzene	ug/L	36.4		0.25	U	0.25	U	35300		1.7		0.25	U	413000		291000		0.29	J	15.3	
Bromochloromethane	ug/L	0.68	U	0.17	U	0.17	U	4.2	U	0.17	U	0.17	U	2.1	U	4.2	U	0.17	U	0.42	U
Bromodichloromethane	ug/L	0.72	U	0.18	U	0.18	U	4.5	U	0.18	U	0.18	U	0.77	U	4.5	U	0.18	U	0.15	U
Bromoform	ug/L	1	U	0.26	U	0.26	U	6.5	U	0.26	U	0.26	U	1.5	U	6.5	U	0.26	U	0.31	U
Bromomethane	ug/L	1.2	U	0.29	U	0.29	U	7.2	U	0.29	U	0.29	U	2.9	U	7.2	U	0.29	U	0.58	U
Carbon Disulfide	ug/L	4.6	U	1.2	U	1.2	U	28.8	U	1.2	U	1.2	U	1.7	J	28.8	U	1.2	U	0.32	U
Carbon Tetrachloride	ug/L	1	U	0.25	U	0.25	U	6.2	U	0.25	U	0.25	U	1.1	U	6.2	U	0.25	U	0.22	U
Chlorobenzene	ug/L	0.92	U	0.23	U	0.23	U	15.9	J	0.23	U	0.23	U	0.65	U	5.8	U	0.23	U	0.13	U
Chloroethane	ug/L	2.2	U	0.54	U	0.54	U	13.5	U	0.54	U	0.54	U	3.5	U	13.5	U	0.54	U	0.69	U
Chloroform	ug/L	0.56	U	0.14	U	0.14	U	3.5	U	0.14	U	0.14	U	0.93	U	3.5	U	0.14	U	0.19	U
Chloromethane	ug/L	0.44	U	0.11	U	0.11	U	2.8	U	0.11	U	0.11	U	1.3	U	2.8	U	0.11	U	0.26	U
cis-1,2-Dichloroethene	ug/L	0.76	U	0.19	U	0.19	U	4.8	U	0.19	U	0.19	U	1.2	U	4.8	U	0.19	U	0.23	U
cis-1,3-Dichloropropene	ug/L	0.52	U	0.13	U	0.13	U	3.2	U	0.13	U	0.13	U	1.4	U	3.2	U	0.13	U	0.27	U
Dibromochloromethane	ug/L	0.84	U	0.21	U	0.21	U	5.2	U	0.21	U	0.21	U	0.85	U	5.2	U	0.21	U	0.17	U
Dibromomethane	ug/L	0.84	U	0.21	U	0.21	U	5.2	U	0.21	U	0.21	U	1.5	U	5.2	U	0.21	U	0.31	U
Ethylbenzene	ug/L	3.7	J	0.3	U	0.3	U	1070		0.3	U	0.3	U	773		525		0.3	U	0.31	J
Iodomethane	ug/L	1.3	U	0.32	U	0.32	U	8	U	0.32	U	0.32	U	8.6	U	8	U	0.32	U	1.7	U
Methyl tert_butyl ether	ug/L	0.84	U	0.21	U	0.21	U	7.1	J	0.21	U	0.21	U	0.87	U	5.2	U	0.21	U	0.17	U
Methylene Chloride	ug/L	36.3		0.97	U	0.97	U	531		0.97	U	0.97	U	6.3	B	294		2	B	0.59	U
Naphthalene	ug/L	376		1.1		9.5		6390		7.3		0.24	U	11400		4620		3		2.9	
Styrene	ug/L	1	U	0.26	U	0.26	U	632		0.26	U	0.26	U	347		160		0.26	U	0.17	J
Tetrachloroethene	ug/L	1.8	U	0.46	U	0.46	U	11.5	U	0.46	U	0.46	U	1.4	U	11.5	U	0.46	U	0.29	U
Toluene	ug/L	1	U	0.26	U	0.26	U	17700		0.3	J	0.26	U	63500		34300		0.26	U	3.7	
trans-1,2-Dichloroethene	ug/L	2	U	0.49	U	0.49	U	12.2	U	0.49	U	0.49	U	1.1	U	12.2	U	0.49	U	0.22	U
trans-1,3-Dichloropropene	ug/L	1	U	0.26	U	0.26	U	6.5	U	0.26	U	0.26	U	0.83	U	6.5	U	0.26	U	0.17	U
Trans-1,4-Dichloro-2-Butene	ug/L	4	U	1	U	1	U	25	U	1	U	1	U	3.6	U	25	U	1	U	0.73	U

TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO02-PZM041 6/9/2015*		CO04-PZM048 6/10/2015**		CO04-PZM048DUP 6/10/2015**		CO08-PZM036 6/11/2015**		CO13-PZM030 6/10/2015**		CO26-PZM032 6/10/2015*		CO27-PZM046 6/8/2015		CO28-PZM048 6/9/2015*		CO29-PZM051 6/9/2015*		CO30-PZM060 6/9/2015	
Volatile Organics (continued)																					
Trichloroethene	ug/L	1.9	U	0.47	U	0.47	U	11.8	U	0.47	U	0.47	U	1.6	U	11.8	U	0.47	U	0.33	U
Trichlorofluoromethane	ug/L	0.8	U	0.2	U	0.2	U	5	U	0.2	U	0.2	U	1.7	U	5	U	0.2	U	0.34	U
Vinyl Acetate	ug/L	1.4	U	0.35	U	0.35	U	8.8	U	0.35	U	0.35	U	6.8	U	8.8	U	0.35	U	1.4	U
Vinyl Chloride	ug/L	2.5	U	0.62	U	0.62	U	15.5	U	0.62	U	0.62	U	1	U	15.5	U	0.62	U	0.2	U
Xylene	ug/L	9.9		0.66	U	0.66	U	8770		0.66	U	0.66	U	12100		6610		0.66	U	3.3	
Semi-Volatile Organics																					
1,2,4-Trichlorobenzene	ug/L	0.21	U	0.21	U	0.22	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
1,3-Dichlorobenzene	ug/L	0.21	U	0.21	U	0.22	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.24	U	0.25	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
2,4,5-Trichlorophenol	ug/L	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4-Dichlorophenol	ug/L	0.18	U	0.19	U	0.19	U	0.18	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.18	U
2,4-Dimethylphenol	ug/L	1.9	0	0.13	U	0.14	U	7.1		0.13	U	0.13	U	22.8	0	17.5		0.13	U	0.69	J
2,4-Dinitrophenol	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chloronaphthalene	ug/L	0.18	U	0.19	U	0.19	U	0.18	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.18	U
2-Chlorophenol	ug/L	0.19	U	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
2-Methylnaphthalene	ug/L	0.32	J	0.18	U	0.19	U	58.4		1.2		0.18	U	64.3		30.1		0.18	U	0.18	U
2-Methylphenol	ug/L	0.28	J	0.19	U	0.19	U	13		0.19	U	0.18	U	37.6		30.3		0.19	U	0.2	J
2-Nitrophenol	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.14	U	0.15	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U
3,4-Methylphenol	ug/L	1	J	0.36	U	0.37	U	14.9	0	0.36	U	0.35	U	40.2		16.1		0.35	U	0.36	U
4,6-Dinitro-2-Methylphenol	ug/L	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
4-Bromophenyl-phenylether	ug/L	0.12	U	0.13	U	0.13	U	0.12	U	0.13	U	0.12	U	0.12	U	0.13	U	0.12	U	0.12	U
4-Chloro-3-methylphenol	ug/L	0.16	U	0.17	U	0.17	U	0.16	U	0.17	U	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U
4-Chlorophenyl-phenylether	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.12	U	0.13	U	0.13	U	0.12	U	0.13	U
4-Nitrophenol	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Acenaphthene	ug/L	25.2		0.15	U	0.15	U	0.83	J	0.26	J	0.15	U	10.2		2.5		0.15	U	0.15	U
Acenaphthylene	ug/L	0.13	U	0.13	U	0.14	U	4.1		1.8		0.13	U	47.3		17.3		0.13	U	0.13	U
Aniline	ug/L	0.26	J	0.21	U	0.21	U	0.2	U	0.21	U	0.2	U	14.3		5.1		0.2	U	0.2	U
Anthracene	ug/L	0.072	U	0.073	U	0.074	U	0.26	J	1.5		0.072	U	1.6		0.22	J	0.072	U	0.072	U
Benzo(a)anthracene	ug/L	0.11	U	0.48	J	0.34	J	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Benzo(a)pyrene	ug/L	0.063	U	0.063	U	0.064	U	0.063	U	0.063	U	0.062	U	0.063	U	0.063	U	0.062	U	0.063	U
Benzo(b)fluoranthene	ug/L	0.16	U	0.26	J	0.17	U	0.16	U	0.17	U	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U
Benzo(g,h,i)perylene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.1	U	0.11	U	0.11	U	0.1	U	0.11	U
Benzo(k)fluoranthene	ug/L	0.23	U	0.28	J	0.24	U	0.23	U	0.24	U	0.23	U	0.23	U	0.24	U	0.23	U	0.23	U
bis(2-Chloroethoxy) Methane	ug/L	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.35	U	0.36	U	0.36	U	0.35	U	0.36	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
bis(2-Ethylhexyl)phthalate	ug/L	0.13	U	0.22	J	0.31	J	0.29	J	0.13	U	0.21	J	0.28	J	0.24	J	0.12	U	0.13	U
Butylbenzylphthalate	ug/L	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Chrysene	ug/L	0.13	U	0.38	J	0.26	J	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U

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TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO02-PZM041 6/9/2015*		CO04-PZM048 6/10/2015**		CO04-PZM048DUP 6/10/2015**		CO08-PZM036 6/11/2015**		CO13-PZM030 6/10/2015**		CO26-PZM032 6/10/2015*		CO27-PZM046 6/8/2015		CO28-PZM048 6/9/2015*		CO29-PZM051 6/9/2015*		CO30-PZM060 6/9/2015	
Semi-Volatile Organics (continued)																					
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dibenzofuran	ug/L	5.4		0.16	U	0.16	U	2.3		1.7		0.15	U	15.1		3.5		0.15	U	0.15	U
Diethylphthalate	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dimethylphthalate	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.15	U	0.16	U	0.16	U	0.16	U	0.16	U
Di-n-Butylphthalate	ug/L	0.082	U	0.082	U	0.084	U	0.082	U	0.35	J	0.081	U	0.082	U	0.082	U	0.081	U	0.082	U
Di-n-Octyl phthalate	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.16	U	0.17	U	0.17	U	0.17	U	0.17	U
Fluoranthene	ug/L	0.45	J	2.6		1.9		0.27	J	3.3		0.079	U	0.39	J	0.081	U	0.08	U	0.23	J
Fluorene	ug/L	0.7	J	0.16	U	0.16	U	7.3		2.3		0.16	U	11.8	0	3.1		0.16	U	0.16	U
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
Hexachlorobutadiene	ug/L	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.17	U	0.18	U	0.18	U	0.17	U	0.18	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.13	U	0.14	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Hexachloroethane	ug/L	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.23	U	0.24	U	0.24	U	0.24	U	0.24	U
Indeno(1,2,3-cd)pyrene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Isophorone	ug/L	0.19	U	0.2	U	0.2	U	0.19	U	0.2	U	0.19	U	0.19	U	0.2	U	0.19	U	0.19	U
Naphthalene	ug/L	114	B	0.19	U	0.19	U	2170	B	0.66	J	0.93	J	3230		1250	B	2		1.9	
Nitrobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.2	U	0.21	U	0.21	U	0.2	U	0.21	U
N-Nitrosodimethylamine	ug/L	0.31	U	0.32	U	0.32	U	0.31	U	0.32	U	0.31	U	0.31	U	0.32	U	0.31	U	0.31	U
Pentachlorophenol	ug/L	0.11	U	0.11	U	0.12	U	1.6	J	0.11	U	0.11	U	1.4	J	0.11	U	0.11	U	0.11	U
Phenanthrene	ug/L	4.4		0.066	U	0.067	U	1.8		8.1		0.065	U	8.4		0.97	J	0.065	U	0.22	J
Phenol	ug/L	0.69	J	0.12	U	0.12	U	26.5		0.12	U	0.12	U	59.7		38.7		1.4		0.27	J
Pyrene	ug/L	0.26	J	1.7		1.3		0.051	U	1.7		0.051	U	0.051	U	0.052	U	0.051	U	0.051	U
Pyridine	ug/L	0.18	U	0.18	U	0.18	U	2.6		0.18	U	0.18	U	24.4		13.4		0.18	U	0.18	U

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TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO32-PZM041 6/9/2015*		CO34-PZM048 6/10/2015*		CO35-PZM056 6/11/2015**		CO36-PZM043 6/8/2015		CO37-PZM038 6/11/2015		CO38-PZM043 6/8/2015		CO39-PZM042 6/8/2015		CO41-PZM036 6/9/2015	
Volatile Organics																	
1,1,1,2-Tetrachloroethane	ug/L	0.33	U	0.33	U	0.33	U	1.6	U	1.6	U	0.31	U	1.6	U	1.6	U
1,1,1-Trichloroethane	ug/L	0.48	U	0.48	U	0.48	U	1.4	U	1.4	U	0.29	U	1.4	U	1.4	U
1,1,2,2-Tetrachloroethane	ug/L	0.4	U	0.4	U	0.4	U	1.1	U	1.1	U	0.23	U	1.1	U	1.1	U
1,1,2-Trichloroethane	ug/L	0.29	U	0.29	U	0.29	U	1.6	U	1.6	U	0.32	U	1.6	U	1.6	U
1,1-Dichloroethane	ug/L	0.32	U	0.32	U	0.32	U	0.93	U	0.93	U	0.19	U	0.93	U	0.93	U
1,1-Dichloroethene	ug/L	0.56	U	0.56	U	0.56	U	1.3	U	1.3	U	0.26	U	1.3	U	1.3	U
1,2,3-Trichloropropane	ug/L	0.41	U	0.41	U	0.41	U	2.3	U	2.3	U	0.47	U	2.3	U	2.3	U
1,2-Dibromo-3-chloropropane	ug/L	2	U	2	U	2	U	4.2	U	4.2	U	0.85	U	4.2	U	4.2	U
1,2-Dibromoethane	ug/L	0.27	U	0.27	U	0.27	U	0.96	U	0.96	U	0.19	U	0.96	U	0.96	U
1,2-Dichlorobenzene	ug/L	0.3	U	0.3	U	0.3	U	0.94	U	0.94	U	0.19	U	0.94	U	0.94	U
1,2-Dichloroethane	ug/L	0.24	U	0.24	U	0.24	U	1.8	U	1.8	U	0.36	U	1.8	U	1.8	U
1,2-Dichloropropane	ug/L	0.27	U	0.27	U	0.27	U	1.1	U	1.1	U	0.23	U	1.1	U	1.1	U
1,4-Dichlorobenzene	ug/L	0.33	U	0.33	U	0.33	U	1.2	U	1.2	U	0.24	U	1.2	U	1.2	U
2-Butanone	ug/L	0.96	U	0.96	U	0.96	U	12	U	12	U	2.4	U	12	U	12	U
2-Hexanone	ug/L	0.46	U	0.46	U	0.46	U	2.9	U	2.9	U	0.58	U	2.9	U	2.9	U
4-Methyl-2-Pentanone (MIBK)	ug/L	0.33	U	0.33	U	0.33	U	2.8	U	2.8	U	0.57	U	2.8	U	2.8	U
Acetone	ug/L	10	U	10	U	251		11.4	U	11.4	U	6.4	J	11.4	U	11.4	U
Acrylonitrile	ug/L	2.2	U	2.2	U	2.2	U	14.4	U	14.4	U	2.9	U	14.4	U	14.4	U
Benzene	ug/L	0.25	U	0.25	U	21.2		26500		35900		7.4		52600		616000	
Bromochloromethane	ug/L	0.17	U	0.17	U	0.17	U	2.1	U	2.1	U	0.42	U	2.1	U	2.1	U
Bromodichloromethane	ug/L	0.18	U	0.18	U	0.18	U	0.77	U	0.77	U	0.15	U	0.77	U	0.77	U
Bromoform	ug/L	0.26	U	0.26	U	0.26	U	1.5	U	1.5	U	0.31	U	1.5	U	1.5	U
Bromomethane	ug/L	0.29	U	0.29	U	0.29	U	2.9	U	2.9	U	0.58	U	2.9	U	2.9	U
Carbon Disulfide	ug/L	1.2	U	1.2	U	1.2	U	1.6	U	3.7	J	0.32	U	1.6	U	3.9	J
Carbon Tetrachloride	ug/L	0.25	U	0.25	U	0.25	U	1.1	U	1.1	U	0.22	U	1.1	U	1.1	U
Chlorobenzene	ug/L	0.23	U	0.23	U	0.23	U	0.65	U	0.65	U	0.61	J	0.65	U	0.65	U
Chloroethane	ug/L	0.54	U	0.54	U	0.54	U	3.5	U	3.5	U	0.69	U	3.5	U	3.5	U
Chloroform	ug/L	0.14	U	0.14	U	0.14	U	0.93	U	0.93	U	0.19	U	0.93	U	0.93	U
Chloromethane	ug/L	0.11	U	0.11	U	0.11	U	1.3	U	1.3	U	0.26	U	1.3	U	1.3	U
cis-1,2-Dichloroethene	ug/L	0.19	U	0.19	U	0.19	U	1.2	U	1.2	U	0.23	U	1.2	U	1.2	U
cis-1,3-Dichloropropene	ug/L	0.13	U	0.13	U	0.13	U	1.4	U	1.4	U	0.27	U	1.4	U	1.4	U
Dibromochloromethane	ug/L	0.21	U	0.21	U	0.21	U	0.85	U	0.85	U	0.17	U	0.85	U	0.85	U
Dibromomethane	ug/L	0.21	U	0.21	U	0.21	U	1.5	U	1.5	U	0.31	U	1.5	U	1.5	U
Ethylbenzene	ug/L	0.3	U	0.3	U	6.3		71.5		423		0.23	U	466		1260	
Iodomethane	ug/L	0.32	U	0.32	U	0.32	U	8.6	U	8.6	U	1.7	U	8.6	U	8.6	U
Methyl tert_butyl ether	ug/L	0.21	U	0.21	U	0.21	U	0.87	U	0.87	U	0.25	J	1.6	J	0.87	U
Methylene Chloride	ug/L	0.97	U	0.97	U	0.97	U	6	B	6.4	B	0.59	U	5.7	B	6.6	B
Naphthalene	ug/L	1.2		0.24	U	0.24	U	690		1780		0.64	J	1920		282	
Styrene	ug/L	0.26	U	0.26	U	4.6		12.8		616		0.16	U	701		416	
Tetrachloroethene	ug/L	0.46	U	0.46	U	0.46	U	1.4	U	1.4	U	0.29	U	1.4	U	1.4	U
Toluene	ug/L	0.26	U	0.26	U	15.8		4410		15800		1.3		18200		138000	
trans-1,2-Dichloroethene	ug/L	0.49	U	0.49	U	0.49	U	1.1	U	1.1	U	0.22	U	1.1	U	1.1	U
trans-1,3-Dichloropropene	ug/L	0.26	U	0.26	U	0.26	U	0.83	U	0.83	U	0.17	U	0.83	U	0.83	U
Trans-1,4-Dichloro-2-Butene	ug/L	1	U	1	U	1	U	3.6	U	3.6	U	0.73	U	3.6	U	3.6	U

TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO32-PZM041 6/9/2015*		CO34-PZM048 6/10/2015*		CO35-PZM056 6/11/2015**		CO36-PZM043 6/8/2015		CO37-PZM038 6/11/2015		CO38-PZM043 6/8/2015		CO39-PZM042 6/8/2015		CO41-PZM036 6/9/2015	
Volatile Organics (continued)																	
Trichloroethene	ug/L	0.47	U	0.47	U	0.47	U	1.6	U	1.6	U	0.33	U	1.6	U	1.6	U
Trichlorofluoromethane	ug/L	0.2	U	0.2	U	0.2	U	1.7	U	1.7	U	0.34	U	1.7	U	1.7	U
Vinyl Acetate	ug/L	0.35	U	0.35	U	0.35	U	6.8	U	6.8	U	1.4	U	6.8	U	6.8	U
Vinyl Chloride	ug/L	0.62	U	0.62	U	0.62	U	1	U	1	U	0.2	U	1	U	1	U
Xylene	ug/L	0.66	U	0.66	U	70.1		1120		3340		0.55	U	3580		30000	
Semi-Volatile Organics																	
1,2,4-Trichlorobenzene	ug/L	0.23	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,2-Dichlorobenzene	ug/L	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
1,3-Dichlorobenzene	ug/L	0.23	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
1,4-Dichlorobenzene	ug/L	0.2	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.27	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
2,4,5-Trichlorophenol	ug/L	0.18	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4,6-Trichlorophenol	ug/L	0.18	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
2,4-Dichlorophenol	ug/L	0.2	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U
2,4-Dimethylphenol	ug/L	0.4	J	0.13	U	0.44	J	3.2		6.3		0.27	J	42.4		8.8	
2,4-Dinitrophenol	ug/L	0.13	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	ug/L	0.13	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,6-Dinitrotoluene	ug/L	0.2	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
2-Chloronaphthalene	ug/L	0.2	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U
2-Chlorophenol	ug/L	0.21	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
2-Methylnaphthalene	ug/L	0.2	U	0.18	U	0.29	J	9.3		58.4		0.18	U	49.6		4.2	
2-Methylphenol	ug/L	0.49	J	0.19	U	0.63	J	4.9		10.7		0.19	U	53.4		16.6	
2-Nitrophenol	ug/L	0.18	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
3,3'-Dichlorobenzidine	ug/L	0.16	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U
3,4-Methylphenol	ug/L	0.39	U	0.36	U	0.65	J	2.3		17.9		0.35	U	94.1		19.7	
4,6-Dinitro-2-Methylphenol	ug/L	0.17	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
4-Bromophenyl-phenylether	ug/L	0.14	U	0.13	U	0.12	U	0.12	U	0.13	U	0.12	U	0.12	U	0.13	U
4-Chloro-3-methylphenol	ug/L	0.18	U	0.17	U	0.16	U	0.16	U	0.17	U	0.16	U	0.16	U	0.17	U
4-Chlorophenyl-phenylether	ug/L	0.14	U	0.13	U	0.13	U	0.12	U	0.13	U	0.12	U	0.12	U	0.13	U
4-Nitrophenol	ug/L	0.12	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Acenaphthene	ug/L	0.16	U	0.15	U	0.25	J	2.3		1.7		2.5		1.4		0.55	J
Acenaphthylene	ug/L	0.14	U	0.13	U	0.13	U	4.6		6.8		0.29	J	5.7		1.3	
Aniline	ug/L	0.22	U	0.21	U	0.43	J	0.72	J	0.21	U	0.2	U	9.4		3.1	
Anthracene	ug/L	0.08	U	0.073	U	0.072	U	1.3		1.1		0.59	J	0.87	J	0.48	J
Benzo(a)anthracene	ug/L	0.12	U	0.11	U	0.11	U	0.35	J	0.11	U	0.11	U	0.11	U	0.11	U
Benzo(a)pyrene	ug/L	0.069	U	0.063	U	0.063	U	0.27	J	0.063	U	0.062	U	0.062	U	0.063	U
Benzo(b)fluoranthene	ug/L	0.18	U	0.17	U	0.16	U	0.56	J	0.17	U	0.16	U	0.16	U	0.19	J
Benzo(g,h,i)perylene	ug/L	0.12	U	0.11	U	0.11	U	0.1	U	0.11	U	0.1	U	0.1	U	0.11	U
Benzo(k)fluoranthene	ug/L	0.26	U	0.24	U	0.23	U	0.56	J	0.24	U	0.23	U	0.23	U	0.23	U
bis(2-Chloroethoxy) Methane	ug/L	0.39	U	0.36	U	0.36	U	0.35	U	0.36	U	0.35	U	0.35	U	0.36	U
Bis-(2-Chloroethyl) Ether	ug/L	0.24	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
bis(2-Ethylhexyl)phthalate	ug/L	0.23	J	0.29	J	0.13	U	0.51	J	0.26	J	0.24	J	0.32	J	0.54	J
Butylbenzylphthalate	ug/L	0.18	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Chrysene	ug/L	0.14	U	0.13	U	0.13	U	0.33	J	0.13	U	0.13	U	0.13	U	0.13	U

TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO32-PZM041 6/9/2015*		CO34-PZM048 6/10/2015*		CO35-PZM056 6/11/2015**		CO36-PZM043 6/8/2015		CO37-PZM038 6/11/2015		CO38-PZM043 6/8/2015		CO39-PZM042 6/8/2015		CO41-PZM036 6/9/2015	
Semi-Volatile Organics (continued)																	
Dibenz(a,h)anthracene	ug/L	0.12	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U
Dibenzofuran	ug/L	0.17	U	0.16	U	0.15	U	2.4		4.7		1.6		4		1.5	
Diethylphthalate	ug/L	0.12	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.25	J
Dimethylphthalate	ug/L	0.17	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Di-n-Butylphthalate	ug/L	0.09	U	0.082	U	0.082	U	0.081	U	0.082	U	0.081	U	0.081	U	0.082	U
Di-n-Octyl phthalate	ug/L	0.18	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
Fluoranthene	ug/L	0.088	U	0.081	U	0.22	J	2.4		0.55	J	1.1		0.59	J	0.55	J
Fluorene	ug/L	0.17	U	0.16	U	0.16	U	3.9		4.6		1.6		5.9		1.5	
Hexachlorobenzene	ug/L	0.13	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
Hexachlorobutadiene	ug/L	0.19	U	0.18	U	0.18	U	0.17	U	0.18	U	0.17	U	0.17	U	0.18	U
Hexachlorocyclopentadiene	ug/L	0.14	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Hexachloroethane	ug/L	0.26	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
Indeno(1,2,3-cd)pyrene	ug/L	0.14	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Isophorone	ug/L	0.21	U	0.2	U	0.19	U	0.19	U	0.2	U	0.19	U	0.19	U	0.2	U
Naphthalene	ug/L	0.32	J	0.56	J	6.6	B	307		1190		0.64	J	1640		181	
Nitrobenzene	ug/L	0.23	U	0.21	U	0.21	U	0.2	U	0.21	U	0.2	U	0.2	U	0.21	U
N-Nitrosodimethylamine	ug/L	0.34	U	0.32	U	0.31	U	0.31	U	0.32	U	0.31	U	0.31	U	0.31	U
Pentachlorophenol	ug/L	0.12	U	0.11	U	0.11	U	0.11	U	1.7	J	0.11	U	0.11	U	0.11	U
Phenanthrene	ug/L	0.072	U	0.066	U	0.83	J	7.3		5.6		0.065	U	4.6		1.6	
Phenol	ug/L	0.13	U	0.12	U	0.12	U	5.7		17.3		0.12	U	95.7		27.9	
Pyrene	ug/L	0.056	U	0.052	U	0.051	U	1.4		0.48	J	0.58	J	0.27	J	0.39	J
Pyridine	ug/L	0.2	U	0.18	U	0.57	J	0.18	U	3.2		0.18	U	13.7		0.68	J

TABLE 3-10
GROUNDWATER ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL, BALTIMORE, MARYLAND

Notes:

*   Semi-volatiles analyzed 6/17/2015
** Semi-volatiles analyzed 6/18/2015

ug/L - micrograms per liter
J - Estimated concentration above the method detection limit and below the reporting limit
U - Compound was analyzed for but was not detected
B - Analyte was detected in the associated method blank

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TABLE 3-11
ISOFLOW GROUNDWATER ANALYTICAL RESULTS - CELL 3
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Chemical	Units	CO126-WS14.3 4/27/2015		CO126-WS25 4/28/2015		CO126-WS35 4/28/2015		CO127-WS14 4/28/2015		CO127-WS25 4/28/2015		CO127-WS35 4/28/2015		CO128-WS14.5 5/4/2015		CO128-WS25 5/4/2015		CO128-WS35 5/4/2015		CO129-WS14.5 5/4/2015		CO129-WS25 5/4/2015		CO129-WS35 5/5/2015		CO130-WS14.5 5/5/2015		CO130-WS25 5/5/2015		CO130-WS35 5/5/2015	
Volatile Organics																															
1,1,1-Trichloroethane	ug/L	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U
1,1,2,2-Tetrachloroethane	ug/L	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U
1,1,2-Trichloroethane	ug/L	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U
1,1-Dichloroethane	ug/L	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
1,1-Dichloroethene	ug/L	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U
1,2-Dibromo-3-chloropropane	ug/L	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U
1,2-Dibromoethane	ug/L	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U	0.19	U
1,2-Dichloroethane	ug/L	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U	0.36	U
1,2-Dichloropropane	ug/L	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U
2-Butanone	ug/L	8.9	J	2.4	U	2.4	U	4.8	J	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U
4-Methyl-2-Pentanone (MIBK)	ug/L	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U	0.57	U
Acetone	ug/L	23.9		16.4		2.3	U	27.5		9.5	J	2.3	U	2.3	U	2.3	U	2.3	U	2.3	U	2.3	U	2.3	U	11		2.3	U	2.3	U
Benzene	ug/L	51.3		1450		15		544		124		0.49	J	373		51800		3300		1240		10300		129		137		14.5		1.9	
Bromodichloromethane	ug/L	0.63	J	1.2		0.15	U	0.15	U	3.2		0.15	U	2.9		1.6		0.15	U	1		0.15	U	1.3		0.15	U	2.5		1.4	
Bromoform	ug/L	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U
Bromomethane	ug/L	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U	0.58	U
Carbon Disulfide	ug/L	3.1		2.6		0.58	J	1.4		4.3		0.32	U	1.1		0.32	U	1.3		2		1.3		2.8		0.32	U	0.32	U	2	
Carbon Tetrachloride	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
Chlorobenzene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Chloroethane	ug/L	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U	0.69	U
Chloroform	ug/L	2.2		5.2		1.1		1.8		10.6		0.19	U	6.7		4.9		3.5		3.6		2.3		5.8		2.4		7.1		6.3	
Chloromethane	ug/L	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U	0.26	U
cis-1,2-Dichloroethene	ug/L	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U	0.23	U
cis-1,3-Dichloropropene	ug/L	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U	0.27	U
Dibromochloromethane	ug/L	0.17	U	2.1		0.17	U	2		2.6		0.17	U	2.5		2.2		0.17	U	2		0.17	U	0.17	U	0.17	U	2.4		0.17	U
Ethylbenzene	ug/L	0.3	J	8.9		0.23	U	1.9		4.4		0.23	U	0.23	U	28.3		6.1		17.5		16.4		0.23	U	0.23	U	2.1		0.23	U
Isopropylbenzene	ug/L	0.14	U	0.53	J	0.14	U	0.14	U	1.4		0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U	0.14	U
Methyl tert_butyl ether	ug/L	0.17	U	0.19	J	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
Methylene Chloride	ug/L	0.59	U	4		0.59	U	0.59	U	4.1		0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	4	
Naphthalene	ug/L	69.5		82200		25.5		523		177000		258		64.9		1770		818		74.7		951		396		41.2		4290		504	
Styrene	ug/L	0.16	U	5.3		0.16	U	0.16	U	1.2		0.16	U	0.16	U	5.2		0.16	U	3.5		4.2		0.16	U	0.16	U	0.16	U	0.16	U
Tetrachloroethene	ug/L	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U
Toluene	ug/L	11		355		0.93	J	105		17		0.13	U	39.1		2990		113		94.8		693		13		3.7		3.7		0.13	U
Total 1,2-Dichloroethenes	ug/L	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U
trans-1,2-Dichloroethene	ug/L	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
trans-1,3-Dichloropropene	ug/L	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U
Trichloroethene	ug/L	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U
Vinyl Chloride	ug/L	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Xylene	ug/L	3.9		158		0.55	U	52.5		34.6		0.55	U	15.8		378		50.3		197		180		4.4		0.55	U	11.8		0.55	U
Semi-Volatile Organics																															
1,2,4-Trichlorobenzene	ug/L	0.22	U	0.22	U	0.21	U	0.21	U	0.22	U	0.21	U	0.26	U	0.25	U	0.31	U	0.25	U	0.23	U	0.28	U	0.28	U	0.21	U	0.28	U
1,2-Dichlorobenzene	ug/L	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.2	U	0.18	U	0.23	U	0.18	U	0.17	U	0.21	U	0.21	U	0.16	U	0.2	U
1,3-Dichlorobenzene	ug/L	0.22	U	0.22	U	0.21	U	0.21	U	0.22	U	0.21	U	0.26	U	0.25	U	0.31	U	0.25	U	0.23	U	0.28	U	0.28	U	0.21	U	0.28	U
1,4-Dichlorobenzene	ug/L	0.18	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.22	U	0.21	U	0.26	U	0.21	U	0.19	U	0.23	U	0.23	U	0.18	U	0.23	U
2,2'-Oxybis(1-Chloropropane)	ug/L	0.24	U	0.25	U	0.24	U	0.24	U	0.25	U	0.24	U	0.3	U	0.28	U	0.35	U	0.28	U	0.26	U	0.31	U	0.31	U	0.24	U	0.31	U
2,4,5-Trichlorophenol	ug/L	0.17	U	0.17	U	0.16	U	0.16	U	0.17	U	0.16	U	0.2	U	0.19	U	0.24	U	0.19	U	0.18	U	0.21	U	0.21	U	0.16	U	0.21	U
2,4,6-Trichlorophenol	ug/L	0.16	U	0.17	U	0.16	U	0.16	U	0.34	J	0.16	U	0.2	U	0.19	U	0.23	U	0.19	U	0.17	U	0.21	U	0.21	U	0.16	U	0.21	U
2,4-Dichlorophenol	ug/L	0.19	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.23	U	0.21	U	0.27	U	0.21	U	0.2	U	0.24	U	0.24	U	0.18	U	0.24	U
2,4-Dimethylphenol	ug/L	0.13	U	2		0.13	U	0.13	U	9.3		0.13	U	0.16	U	3		0.19	U	0.15	U	1.9		0.17	U	0.17	U	0.13	U	0.17	U
2,4-Dinitrophenol	ug/L	0.12	U	0.13	U	0.12	U	0.12	U	2	J	0.12	U	0.15	U	0.14	U	0.17	U	0.14	U	0.13	U	0.16	U	0.16	U	0.12	U	0.15	U
2,4-Dinitrotoluene	ug/L	0.12	U	0.13	U	0.12	U	0.12	U	0.13	U	0.12	U	0.15	U	0.14	U	0.17	U	0.14	U	0.13	U	0.16	U	0.16	U	0.12	U	0.15	U
2,6-Dinitrotoluene	ug/L	0.18	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.22	U	0.21	U	0.26	U	0.21	U	0.19	U	0.23	U	0.23	U	0.18	U	0.23	U
2-Chloronaphthalene	ug/L	0.19	U	0.19	U	0.18	U	0.18	U	0.19	U	0.18	U	0.23	U	0.21	U	0.27	U	0.21	U	0.2	U	0.24	U	0.24	U	0.18	U	0.24	U
2-Chlorophenol	ug/L	0.19	U	0.2	U	0.19	U	0.19	U	0.2	U	0.19	U	0.24	U	0.22	U	0.28	U	0.22	U	0.21	U	0.25	U	0.25	U	0.19	U	0.25	U
2-Methylnaphthalene	ug/L	5.9		55.4		0.28	J	6.9		42.5		1.7		0.23	U	9.9		4.7		0.21	U	10.8		2.9		0.24	U	73.1		8.2	
2-Methylphenol	ug/L	0.67	J	2.6		0.19	U	1.3		3.4		0.19	U	0.23	U	6		2		0.22	U	3.4		0.24	U	0.24	U	0.19	U	0.24	U
3,3'-Dichlorobenzidine	ug/L	0.14	U	0.15	U	0.14	U	0.14	U	0.15	U	0.14	U	0.18	U	0.16	U	0.21	U	0.17	U	0.15	U	0.19	U	0.19	U	0.14	U	0.18	U
3,4-Methylphenol	ug/L	1.4	J	5.4		0.36	U	1.5	J	7.6		0.35	U	0.44	U	3.7		0.52	U	0.42	U	0.38	U	0.47	U	0.47	U	0.35	U	0.46	U
4-Chloroaniline	ug/L	0.16	U	0.16	U	0.15	U	0.15	U	0.16	U	0.15	U	0.19	U	0.18	U	0.22	U	0.18	U	0.16	U	0.2	U	0.2	U	0.15	U	0.2	U
Acenaphthene	ug/L	2.9		36.8		0.3	J	3		6.3		0.42	J	0.18	U	1.4		0.21	U	0.17	U	2.2		0.19	U	0.19	U	125		10	
Acenaphthylene	ug/L	0.43	J	5.1		0.13	U	0.98	J	50.8		1.5		0.16	U	8.9		2.6		0.15	U	8.4		2.2		0.17	U	36.7		3.2	
Anthracene	ug/L	0.55	J	4.6		0.81	J	1.8		8.1		0.46	J	0.09	U	0.084	U	0.11	U	0.085	U	1.8		0.095	U	0.095	U	122		1.7	
Benzo(a)anthracene	ug/L	0.11	U	0.23	J	0.22	J	0.11	U	1.2		0.11	U	0.14	U	0.13	U	0.16	U	0.13	U	0.12	U	0.15	U	0.15	U	88.7		0.15	U
Benzo(a)pyrene	ug/L	0.064	U	0.066	U	0.063	U	0.062	U	0.72	J	0.062	U	0.078	U	0.073	U	0.091	U	0.073	U	0.067	U	0.082	U	0.082	U	71		0.081	U
Benzo(b)fluoranthene	ug/L	0.17	U	0.17	U	0.27	J	0.16	U	1.5		0.2	J	0.21	U	0.19	U	0.24	U	0.19	U	0.18	U	0.21	U	0.21	U	101		0.21	U
Benzo(g,h,i)perylene	ug/L	0.11	U	0.11	U	0.11	U	0.1	U	0.11	U	0.1	U	0.13	U	0.12	U	0.15	U	0.12	U	0.11	U	0.14	U	0.14	U	14.8		0.14	U

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TABLE 3-11
ISOFLOW GROUNDWATER ANALYTICAL RESULTS - CELL 3
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Chemical	Units	CO126-WS14.3 4/27/2015		CO126-WS25 4/28/2015		CO126-WS35 4/28/2015		CO127-WS14 4/28/2015		CO127-WS25 4/28/2015		CO127-WS35 4/28/2015		CO128-WS14.5 5/4/2015		CO128-WS25 5/4/2015		CO128-WS35 5/4/2015		CO129-WS14.5 5/4/2015		CO129-WS25 5/4/2015		CO129-WS35 5/5/2015		CO130-WS14.5 5/5/2015		CO130-WS25 5/5/2015		CO130-WS35 5/5/2015	
Semi-Volatile Organics (continued)																															
Benzo(k)fluoranthene	ug/L	0.24	U	0.24	U	0.23	U	0.23	U	1.5		0.23	U	0.29	U	0.27	U	0.34	U	0.27	U	0.25	U	0.3	U	0.3	U	45		0.3	U
Bis-(2-Chloroethyl) Ether	ug/L	0.22	U	0.23	U	0.22	U	0.22	U	0.23	U	0.22	U	0.27	U	0.25	U	0.32	U	0.25	U	0.23	U	0.28	U	0.28	U	0.22	U	0.28	U
bis(2-Ethylhexyl)phthalate	ug/L	0.84 B	JB	0.62 B	JB	0.99 B	JB	0.92 B	JB	0.40 B	JB	0.78 B	JB	0.16	U	0.15	U	0.18	U	0.15	U	0.14	U	0.16	U	0.16	U	0.12	U	0.16	U
Carbazole	ug/L	4.5		44		0.36	J	8.7		20.9		0.54	J	0.13	U	9.3		0.16	U	0.12	U	7.7		0.14	U	0.14	U	116		11.7	
Chrysene	ug/L	0.13	U	0.27	J	0.28	J	0.13	U	0.91	J	0.13	U	0.16	U	0.15	U	0.19	U	0.15	U	0.14	U	0.17	U	0.17	U	92		0.17	U
Dibenz(a,h)anthracene	ug/L	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.11	U	0.14	U	0.13	U	0.16	U	0.13	U	0.12	U	0.14	U	0.14	U	0.11	U	0.14	U
Dibenzofuran	ug/L	3.3		39.9		0.38	J	4		20.2		0.83	J	0.19	U	2.8		0.22	U	0.18	U	4.6		0.2	U	0.2	U	100		7.3	
Diethylphthalate	ug/L	0.11	U	0.11	U	1	J	0.11	U	0.11	U	0.24	J	0.14	U	0.13	U	0.16	U	0.13	U	0.12	U	0.14	U	0.14	U	0.11	U	0.14	U
Di-n-Butylphthalate	ug/L	0.57	J	0.086	U	0.74	J	0.58	J	0.086	U	0.65	J	0.1	U	0.095	U	0.12	U	0.095	U	0.088	U	0.11	U	0.11	U	0.081	U	0.11	U
Fluoranthene	ug/L	0.81	J	3.6		0.66	J	4.1		7.6		0.85	J	0.1	U	0.093	U	1.7		0.093	U	0.086	U	0.1	U	0.1	U	232		2.5	
Fluorene	ug/L	1.5		20.1		0.4	J	0.91	J	27.3		1.1		0.2	U	4.3		2		0.18	U	7.8		2.2		0.21	U	133		8.5	
Hexachlorobenzene	ug/L	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.15	U	0.14	U	0.17	U	0.14	U	0.13	U	0.15	U	0.15	U	0.12	U	0.15	U
Hexachlorobutadiene	ug/L	0.18	U	0.18	U	0.18	U	0.17	U	0.18	U	0.17	U	0.22	U	0.2	U	0.25	U	0.2	U	0.19	U	0.23	U	0.23	U	0.17	U	0.23	U
Hexachlorocyclopentadiene	ug/L	0.13	U	0.14	U	0.13	U	0.13	U	0.14	U	0.13	U	0.16	U	0.15	U	0.19	U	0.15	U	0.14	U	0.17	U	0.17	U	0.13	U	0.17	U
Hexachloroethane	ug/L	0.24	U	0.25	U	0.24	U	0.24	U	0.25	U	0.24	U	0.3	U	0.27	U	0.34	U	0.28	U	0.25	U	0.31	U	0.31	U	0.24	U	0.31	U
Indeno(1,2,3-cd)pyrene	ug/L	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.16	U	0.15	U	0.18	U	0.15	U	0.14	U	0.17	U	0.17	U	18.3		0.16	U
Isophorone	ug/L	0.2	U	0.2	U	0.19	U	0.19	U	0.2	U	0.19	U	0.24	U	0.23	U	0.28	U	0.23	U	0.21	U	0.25	U	0.25	U	0.19	U	0.25	U
Naphthalene	ug/L	270		2760		6		221		4810		75.9		20.2		380		305		17.5		417		261		0.25	U	1150		203	
Nitrobenzene	ug/L	0.21	U	0.21	U	0.21	U	0.2	U	0.21	U	0.2	U	0.26	U	0.24	U	0.3	U	0.24	U	0.22	U	0.27	U	0.27	U	0.2	U	0.27	U
N-Nitrosodimethylamine	ug/L	0.32	U	0.33	U	0.31	U	0.31	U	0.33	U	0.31	U	0.39	U	0.36	U	0.45	U	0.37	U	0.34	U	0.41	U	0.41	U	0.31	U	0.41	U
N-Nitroso-Di-N-Propylamine	ug/L	0.27	U	0.28	U	0.27	U	0.27	U	0.28	U	0.27	U	0.34	U	1.5		0.39	U	0.31	U	0.29	U	0.35	U	0.35	U	0.27	U	0.35	U
Pentachlorophenol	ug/L	0.11	U	0.12	U	0.11	U	0.11	U	0.12	U	0.11	U	0.14	U	0.13	U	0.16	U	0.13	U	0.12	U	0.15	U	0.15	U	0.11	U	0.15	U
Phenanthrene	ug/L	4.6		51.5		1.3		13.8		32.6		2.2		0.082	U	4		2.9		1.3		10.2		3.5		0.085	U	348		11.7	
Phenol	ug/L	2.5		12.2		0.12	U	3		24.3		0.12	U	0.15	U	7.5		12.2		0.14	U	3.9		3.1		0.15	U	0.12	U	0.15	U
Pyrene	ug/L	0.44	J	2.5		0.45	J	2.4		5.1		0.58	J	0.064	U	0.059	U	0.074	U	0.06	U	0.055	U	0.067	U	0.067	U	178		1.8	
Miscellaneous																															
Conductivity	ms/cm	9.462		9.983		11.84		9.75		2.393		13.34		0.932		1.542		2.285		0.992		1.529		1.565		2.283		1.973		2.219	
Dissolved Oxygen	mg/L	1.96		2.99		0.83		3.79		0.48		27.9		8.52		5.73		0.15		5.08		2.95		3.51		5.13		6.2		3.97	
Oxidation Reduction Potential	mV	-71.8		-69.7		-30.9		10.3		-53		-130.9		74.4		46.5		-34.2		-6.6		-133.1		66.5		-51.3		45.6		46.6	
pH	S.U.	12.68		12.73		8.88		12.53		11.65		7.52		10.51		11.41		8.64		10.29		11.21		9.01		11.7		9.16		8.26	
Temperature	°C	NA		NA		NA		16.36		NA		19.71		23.13		22.61		22.6		27.41		22.29		21.19		24.31		22.76		23.33	
Turbidity	ntu	0.51		3.13		1.21		67.5		1.57		21.6		59		95		OR		76		644		OR		718		2034		OR	

Notes:
ug/L = micrograms per liter
mg/L = milligrams per liter
ms/cm = milliSiemens per centimeter
mV = millivolts
S.U. = standard units
°C = degrees celsius
ntu = nephelometric turbidity unit
NA = not available; data not representative
OR = out of range
J - Estimated concentration above the method detection limit and below the reporting limit
U - Compound was analyzed for but was not detected

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TABLE 3-12
FIELD PARAMETER MEASUREMENTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Well Designation	Sample Date	Conductivity (ms/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (S.U.)	Temperature (°C)	Turbidity (ntu)
1, 2, 6	CO02-PZM006	6/10/2015	1.18	1.18	-158	6.89	19.71	89.8
	CO03-PZM005	6/10/2015	0.829	1.16	-180.9	7.72	15.24	7.49
	CO03-PZM005	6/17/2015	0.856	0.61	-244.6	7.84	13.16	8.31
	CO07-PZM008	6/10/2015	0.896	1.22	-387.3	11.04	14.88	4.45
	CO07-PZM008	6/18/2015	0.865	0.29	-256.3	11.33	16.01	1.99
	CO121-PZM	6/10/2015	2.369	1.55	-438.7	11.93	15.52	1.93
	CO121-PZM	6/17/2015	2.309	0.49	-339.8	11.87	15.7	1.8
	CO15-PZM005	6/9/2015	0.694	0.62	10.8	7.37	17.24	4.34
	CO15-PZM005	6/17/2015	0.945	0.56	-183.5	7.27	15.96	4.25
	CO16-PZM006	6/9/2015	0.847	0.89	17.1	11.31	17.43	2.15
	CO16-PZM006	6/17/2015	1.056	0.8	-402.1	10.92	15.01	1.08
	CO18-PZM006	6/9/2015	1.88	0.7	-223	7.03	22	351
	CO19-PZM004	6/10/2015	0.725	0.55	-272.5	7.36	16.43	4.65
	CO19-PZM004	6/18/2015	0.83	0.5	-257.2	7.37	16.7	5.01
	CO27-PZM012	6/8/2015	1.43	2.66	-342	10.12	19.5	104
	CO28-PZM010	6/9/2015	1.211	1.98	-239.5	8.91	14.94	7.31
	CO28-PZM010	6/17/2015	1.107	0.96	-248.6	9.04	14.04	0.8
	CO38-PZM006	6/8/2015	1.25	2.63	-309	8.85	20.49	114
	CO39-PZM007	6/8/2015	2.73	0.89	-255	9.11	21.34	266
	CO40-PZM008	6/9/2015	2.9	1.55	-332	10.2	15.46	114
	CO41-PZM001	6/9/2015	1.03	0.71	-202	7.07	22.19	74.4
	CO42-PZM004	6/9/2015	1.22	0.85	-196	8.82	19.22	77.1
	CO79-PZM	6/9/2015	3.001	0.57	-38.2	6.85	23.92	8.45
	CO79-PZM	6/17/2015	2.734	0.59	-101.9	6.73	21.58	26.6
	CO88-PZM	6/9/2015	0.577	0.87	20.8	9.75	19.26	0.87
	CO88-PZM	6/17/2015	0.688	0.82	-301.2	9.4	16.14	1.08
	CO93-PZM	6/9/2015	1.57	0.73	-385	10.53	18.48	108

TABLE 3-12
FIELD PARAMETER MEASUREMENTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Well Designation	Sample Date	Conductivity (ms/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (S.U.)	Temperature (°C)	Turbidity (ntu)
3	CO101-PZM	6/9/2015	1.97	0.68	-323	11.15	20.2	112
	CO102-PZM	6/10/2015	1.89	0.78	-357	11.3	18.29	87.3
	CO103-PZM	6/10/2015	3.32	0.67	-336	11.74	18.32	93.5
	CO104-PZM	6/9/2015	2.18	2.1	-150	12.07	18.9	141
	CO29-PZM010	6/10/2015	3.459	0.51	-265.4	12.35	16.12	4.82
	CO29-PZM010	6/17/2015	3.564	0.49	-253.3	12.15	17.36	4.31
	CO30-PZM014	6/9/2015	2.41	1	-324	11.2	20.14	128
	CO32-PZM004	6/18/2015	0.603	1.03	-274.8	7.63	19.35	32.6
	TS06-PPM008	6/11/2015	1.877	0.47	20.6	6.75	14.97	9.92
	TS06-PPM008	6/17/2015	1.819	0.72	14.7	6.6	14.76	22.5
4, 5	CO13-PZM008	6/10/2015	1.57	0.44	16.9	10.7	17.63	3.71
	CO13-PZM008	6/17/2015	1.846	0.72	-233.5	10.8	14.39	1.22
	CO23-PZM008	6/10/2015	1.17	1.02	-246	10.61	18.22	0
	CO24-PZM007	6/10/2015	1.82	1.22	-99	8.96	16.26	140
	CO25-PZM008	6/10/2015	1.624	0.77	29.9	10.93	15.71	2.27
	CO25-PZM008	6/17/2015	2.087	0.29	-250.8	10.87	16.38	3.9
	CO26-PZM007	6/10/2015	1.957	0.76	11.5	11.78	18.53	3.66
	CO26-PZM007	6/17/2015	2.458	0.39	-253.8	11.94	18.47	9.27
	CO35-PZM013	6/11/2015	2.091	0.82	-405.6	11.9	17.5	2.52
	CO35-PZM013	6/18/2015	2.153	0.48	-378.6	12.05	19.8	3.36
	CO56-PZP001	6/11/2015	1.9	0.94	-154	10.84	18.76	84.4
	CO57-PZP002	6/10/2015	2.27	0.81	-107	11.53	20.63	95.9
	CO58-PZM001	6/10/2015	1.7	0.89	-89	1104	18.05	98.4
	CO59-PZP002	6/10/2015	2.17	0.79	-93	11.32	18.54	94.1
	CO60-PZP001	6/10/2015	1.65	0.63	-97	10.75	19.03	97.1

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TABLE 3-12
FIELD PARAMETER MEASUREMENTS - SHALLOW ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Well Designation	Sample Date	Conductivity (ms/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (S.U.)	Temperature (°C)	Turbidity (ntu)
East of 6	CO05-PZM006	6/10/2015	2.037	0.41	-317.5	12.13	20.47	6.06
	CO05-PZM006	6/18/2015	2.15	0.52	-404.1	11.8	16.45	4.28
	CO08-PZM005	6/10/2015	3.171	1.41	-501.9	12.18	14.48	6.76
	CO08-PZM005	6/18/2015	3.512	0.31	-314.7	12.5	15.43	5.89
	CO09-PZM007	6/10/2015	1.193	1	-375.4	11.46	13.4	3.52
	CO09-PZM007	6/18/2015	1.278	0.67	-324.1	11.85	15.65	5.02
	CO10-PZM006	6/11/2015	1.475	1.22	-94.2	11.83	15.77	8.33
	CO10-PZM006	6/18/2015	1.73	1.52	-157.3	11.62	18.7	2.62
	CO20-PZM004	6/10/2015	1.163	0.61	-164.7	8.65	15.48	4.39
	CO20-PZM004	6/18/2015	1.156	0.65	-236	8.22	13.05	2.55

Notes:
ms/cm - milliSiemens per centimeter
mg/L - milligrams per liter
mV - millivolts
S.U. - standard units
°C - degrees Celsius
ntu - nephelometric turbidity units

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TABLE 3-13
FIELD PARAMETER MEASUREMENTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Well Designation	Sample Date	Conductivity (ms/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (S.U.)	Temperature (°C)	Turbidity (ntu)
1, 2, 6	CO02-PZM041	6/9/2015	3.309	0.75	-81.9	6.76	21.49	5.38
	CO02-PZM041	6/17/2015	3.577	0.85	-168.1	6.74	17.51	8.98
	CO27-PZM046	6/8/2015	1.61	2.23	-212	7.36	19.32	300
	CO27-PZM046	6/9/2015	2.269	0.86	-286.1	8.09	15.34	8.48
	CO28-PZM048	6/9/2015	1.186	0.7	-372.7	10.48	17.44	2.68
	CO28-PZM048	6/17/2015	1.438	0.58	-342.1	10.59	16.62	3.58
	CO36-PZM008	6/8/2015	1.28	2.7	-131	10.18	18.47	877
	CO36-PZM043	6/8/2015	2.68	3.45	-296	10.23	17.2	0
	CO36-PZM043	6/9/2015	3.359	0.84	-400.9	11.17	15.17	7.28
	CO37-PZM038	6/11/2015	1.85	0.56	-454	11.36	18.15	361
	CO37-PZM038	6/10/2015	2.047	0.51	-424.1	11.56	15.92	6.65
	CO38-PZM043	6/8/2015	1.55	2.77	-179	6.15	17.61	0
	CO38-PZM043	6/9/2015	3.247	1.99	-202.1	6.87	17.55	30.5
	CO39-PZM042	6/8/2015	0.952	0.56	-243	8.48	17.41	449
	CO39-PZM042	6/10/2015	1.127	1.03	-370.1	9.77	16.61	9.46
	CO41-PZM036	6/9/2015	1.29	2.82	-401	10.47	20.3	0
	CO41-PZM036	6/9/2015	1.946	1.41	-413.5	10.59	18.17	9.36
3	CO29-PZM051	6/9/2015	12.42	0.34	-182.7	7.98	16.57	9.54
	CO29-PZM051	6/17/2015	12.57	0.19	-265.5	8.28	17.55	5.18
	CO30-PZM060	6/9/2015	8.49	0.54	-253	6.93	18.62	113
	CO32-PZM041	6/9/2015	8.817	1.56	-64.2	5.7	16.14	9.47
	CO32-PZM041	6/17/2015	8.905	0.4	-66.1	5.81	17.1	8.93

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TABLE 3-13
FIELD PARAMETER MEASUREMENTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Cell Number	Well Designation	Sample Date	Conductivity (ms/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (S.U.)	Temperature (°C)	Turbidity (ntu)
4, 5	CO13-PZM030	6/10/2015	6.972	0.51	-18.1	6.62	19.11	9.73
	CO13-PZM030	6/18/2015	8.623	0.42	-61.9	6.22	17.31	7.99
	CO123-PZM	6/10/2015	3.072	0.27	-231.9	11.52	17.52	4.8
	CO124-PZM	6/10/2015	3.096	0.29	-212.8	11.43	17.27	2.24
	CO125-PZM	6/10/2015	2.826	0.18	-187.9	11.17	17.25	4.02
	CO26-PZM032	6/10/2015	14.8	0.43	-42.3	7.62	20.17	8.79
	CO26-PZM032	6/17/2015	15.55	0.38	-150.2	7.77	19.23	8.09
	CO34-PZM048	6/10/2015	5.128	0.63	-40.8	6.29	19.89	5.31
	CO34-PZM048	6/17/2015	6.159	0.25	-86.8	6.4	20.92	6.8
	CO35-PZM056	6/11/2015	4.555	0.87	-156.5	12.48	21.36	6.27
	CO35-PZM056	6/18/2015	5.642	0.22	-290.6	11.53	22.34	2.19
East of Cell 6	CO04-PZM048	6/10/2015	7.049	0.61	-87.2	6.26	18.75	9.78
	CO04-PZM048	6/18/2015	8.124	0.62	-88.2	6.48	16.72	8.88
	CO08-PZM036	6/11/2015	2.189	1.28	-328	12.3	18.38	9.74
	CO08-PZM036	6/18/2015	2.36	0.27	-432.8	12.23	17.96	8.1

Notes:
ms/cm - milliSiemens per centimeter
mg/L - milligrams per liter
mV - millivolts
S.U. - standard units
°C - degrees Celsius
ntu - nephelometric turbidity units

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TABLE 3-14
CHLORIDE AND SULFATE ANALYTICAL RESULTS - INTERMEDIATE ZONE
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Analyte	Units	CO02-PZM041 6/9/2015		CO27-PZM046 6/8/2015		CO28-PZM048 6/9/2015		CO36-PZM043 6/8/2015		CO37-PZM038 6/11/2015		CO38-PZM043 6/8/2015		CO39-PZM042 6/10/2015		CO41-PZM036 6/9/2015	
Chloride	mg/L	830		318		248		507		235		461		143		298	
Sulfate	mg/L	6.2	J	163		111		333		175		45.9		277		175	

Notes:
mg/L - milligrams per liter

TABLE 3-15
GEOTECHNICAL SAMPLE ANALYTICAL RESULTS
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Boring ID	Sample Type	Sample Intervals (feet-bgs)	Description	Moisture Content (%)	USCS classification	Permeability (cm/sec)	Granular %	Silt %	Clay %	Liquid Limit	Plastic Limit	Plasticity Index
C0121-SB075	SS	65-67	Very stiff clay	15.6	CL	NT	9.4	90.6		33	22	11
	SS	67-69	Very stiff clay	14.6	CL	NT	9.3	90.7		29	19	10
	ST	69-71	Very stiff, dense, pinkish gray and dark reddish orange clay with some dark yellow blotches from ~66-75 ft-bgs, trace to some silt; potentially good aquitard quality	16.36	ML	2.29E-08	0.1	53.0	46.9	35	24	11
	SS	75	Clay	14.6	CL	NT	5.6	40.3	54.1	28	20	8
C0123-SB072	SS	60-62	Dense, stiff mottled clay	17.3	ML-CL	NT	3.9	96.1		24	18	6
	ST	62-62.4	Very stiff, dense, mottled dark red, buff, white, and dark yellow clay from ~56.5-65 ft-bgs; white component has potentially low aquitard quality	19.3	ML	NT	1.1	30.4	68.5	43	29	14
	SS	65-67	Dense, stiff mottled clay	23.7	CL	NT	3.3	96.7		38	25	13
	ST	67-68.3	Very stiff, dense, dark red, light gray, and yellowish brown clay from ~65-72 ft-bgs; potentially good aquitard quality	19.3	ML	2.62E-08	0.8	34.8	64.4	43	28	15
C0124-SB073	SS	63.5-65.5	Dense, stiff mottled clay	12.6	NT	NT	25.4	74.6		NT	NT	NT
	ST	65.5-66	Very stiff, dense, dark red, pink, and light gray mottled clay from ~61.8-73.5 ft-bgs; potentially good aquitard quality	13.52	ML-CL	2.59E-08	38.5	25.1	36.4	25	21	4
	SS	66-68	Dense, stiff mottled clay	NT	ML-CL	NT	31.2	26.7	42.1	23	17	6
	SS	70-72	Dense, stiff mottled clay	NT	ML	NT	2.5	39.6	57.9	35	25	10
	ST	72-73.5	Same as above, but dark red, light gray, and dark yellow mottled clay from ~61.8-73.5 ft-bgs; potentially good aquitard quality	22.7	ML	NT	0.9	41.3	57.8	41	34	7
C0125-SB087	ST	47-49	White silty clay seam at ~42 to ~61.5 ft-bgs with interbedded sands; potentially low aquitard quality	16.78	ML-CL	8.07E-08	14.1	37.8	48.1	25	20	5
	ST	82-82.6	White silty clay seam at ~42 to ~61.5 ft-bgs with interbedded sands; potentially low aquitard quality	16.10	ML	8.66E-08	0.1	29.9	70.0	41	32	9

Notes:
ST - Shelby Tube
SS - Split-spoon
NT - Not tested
ML - Low plasticity silt
CL - Low plasticity clay

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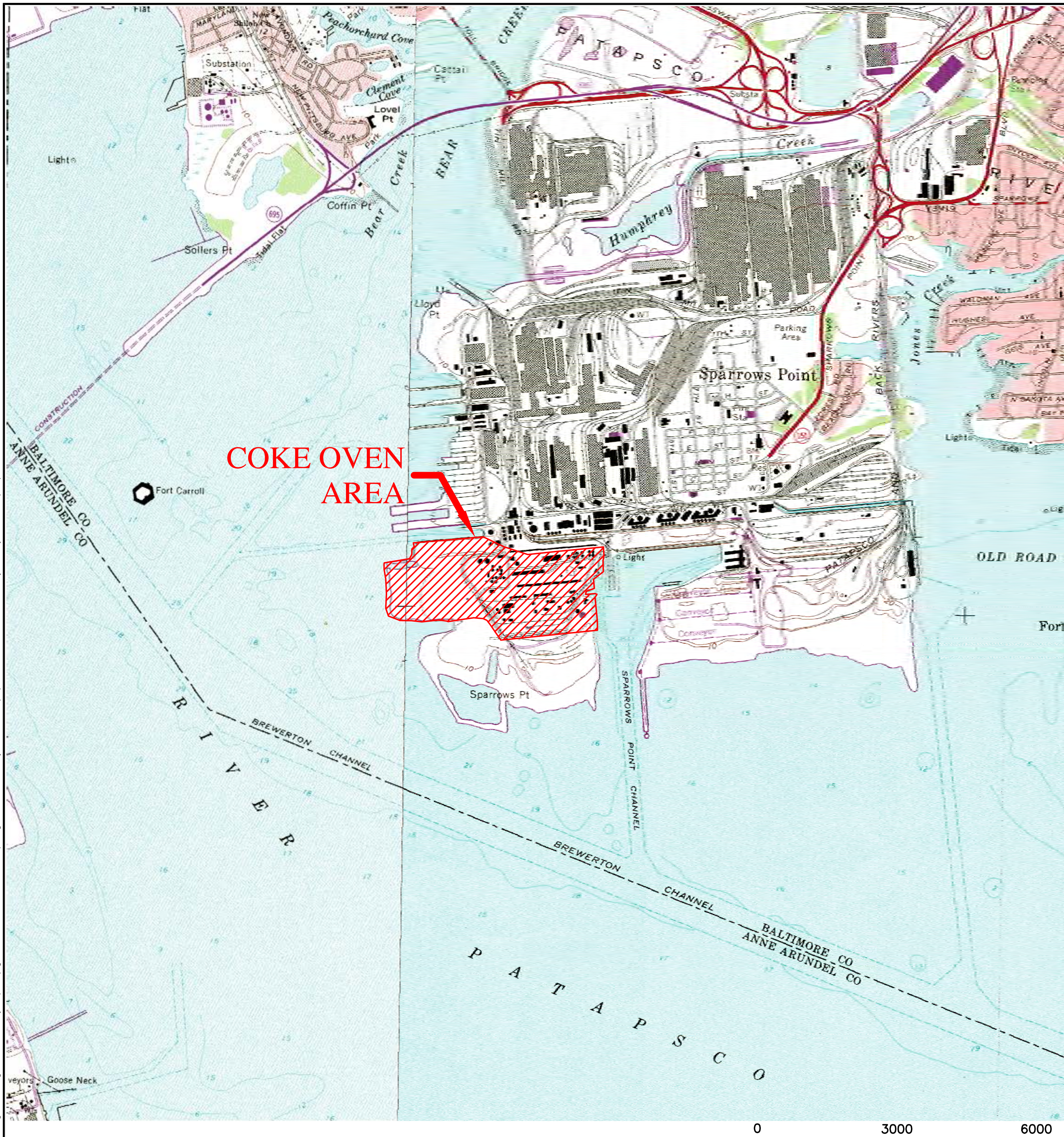
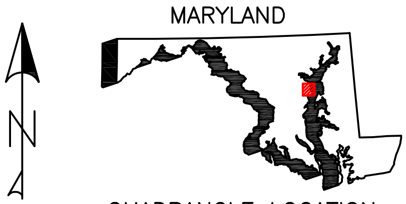
TABLE 3-16
LNAPL & DNAPL PHYSICAL PROPERTIES - CELLS 2, 4/5 AND 6
FORMER COKE OVEN AREA
SPARROWS POINT TERMINAL
BALTIMORE, MARYLAND

Sample Collection Location	Tare Weight (g)	Total Weight (g)	Product Weight (g)	Density[(1)] (g/ml)	Time (sec)	Temperature (F)	Cup Number	Kinematic Viscosity[(2)] (cst)	Average Interfacial Tension[(3)] (dynes/cm)		
									Oil-Water	Oil-Air	Water-Air
LNAPL											
CO04-PZM004	22.38	56.63	34.25	0.856	38	75	1	29.7			
CO89-PZM	21.94	56.90	34.96	0.874	33	75	1	16.2	12.3	30.7	
CO92-PZM	22.03	59.11	37.08	0.927	56	75	1	78.3	3.4 [(4)]	32.6	46.9
CO95-PZM	22.04	60.22	38.18	0.955					16	33.2	
CO99-PZM	22.00	57.77	35.77	0.894	33	75	1	16.2			
DNAPL											
CO123-PZM	21.85	65.67	43.82	1.096	52	75	2	211.64	15.7		60.3
CO123-PZM					42	75	2	159.64			

1. Density (ρ) = Mass (M)/Volume (V) = Product Weight/40 ml, where V=40 ml.
2. ASTM D 4212 Standard Test Method for Viscosity by Dip Type Viscosity Cups.
   Viscosity Formulas where t = seconds and V = centistokes (cst):
   Cup 1: V = 2.7 (t - 27)
   Cup 2: V= 5.2 (t - 11.3)
3. Result presented is the average where multiple samples were run or the measured result if one sample was run.
4. Result is questionable, use lower limit of other measurements (11.0 dyne/cm).

FIGURES





DRAFT

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15
CHKD: AEH	DATE: 09/02/15
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SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

REFERENCE: – USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES:
– CURTIS BAY, MARYLAND 1969 REVISED 1974
– SPARROWS POINT, MARYLAND 1969 REVISED 1974

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

SITE LOCATION MAP

PROJECT NO:

FIGURE 1–1

y:\eit\sparrows point\coke oven area drawings\14–933\pre–design investigation summary report\figure 1–1 site location map.dwg Last Saved By: Scomer 9/2/2015 1:37 PM Plotted By: Shelly Comer 9/24/2015 2:07 PM Scale: 1:1

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE: THE GEOREFERENCED DIGITAL AERIAL PHOTOGRAPH WAS OBTAINED BY LINKING TO THE USGS EROS ORTHO IMAGE SERVER ON DECEMBER 1, 2014 (HTTP://RASTER.NATIONALMAP.GOV/ARCGIS/REST/SERVICES/ORTHOIMAGERY/USGS_EROS_ORTHO/IMAGESERVER). THIS AERIAL IMAGERY WAS COLLECTED FOR THE USGS ON SEPTEMBER 30, 2008.

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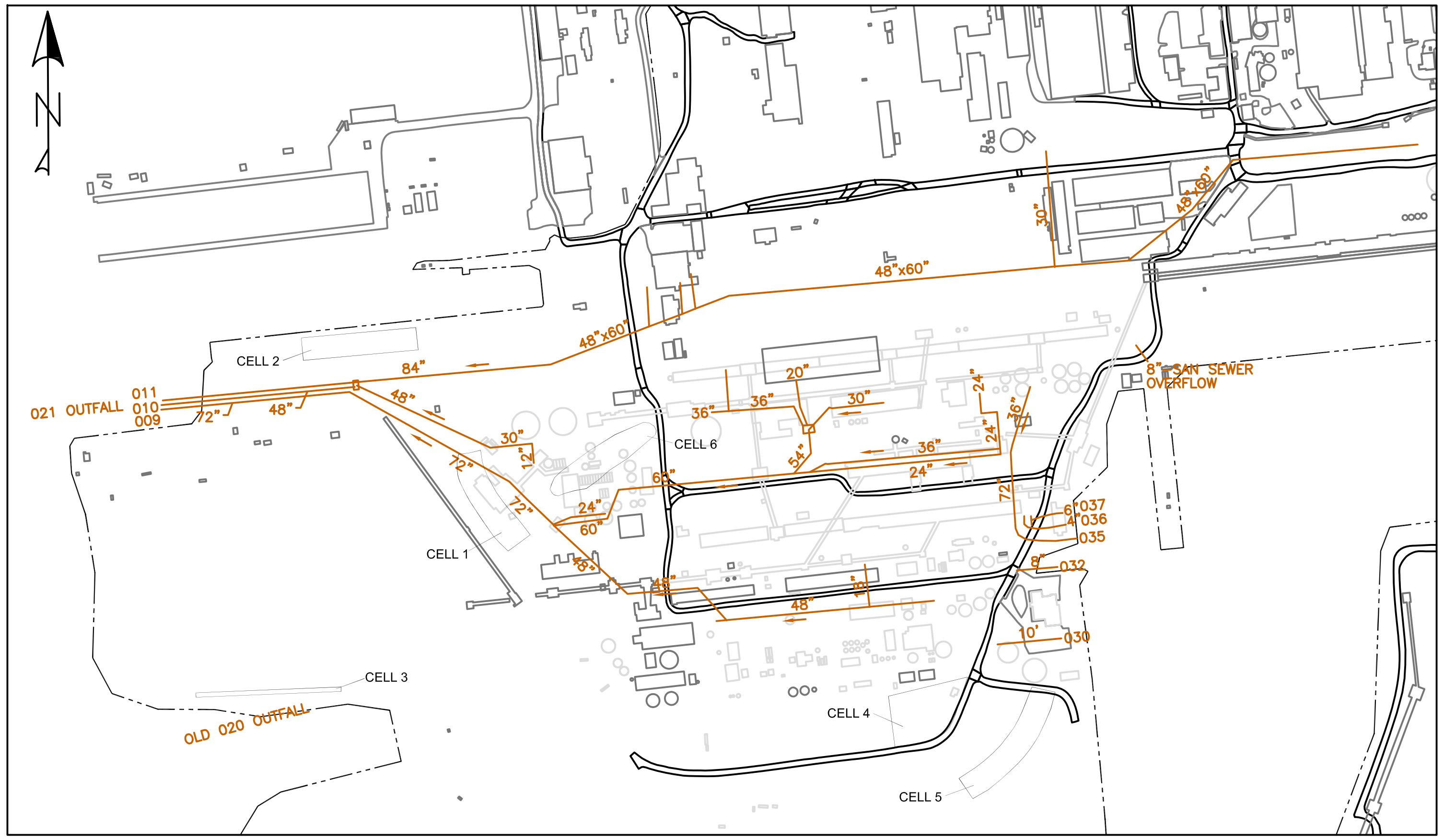
COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

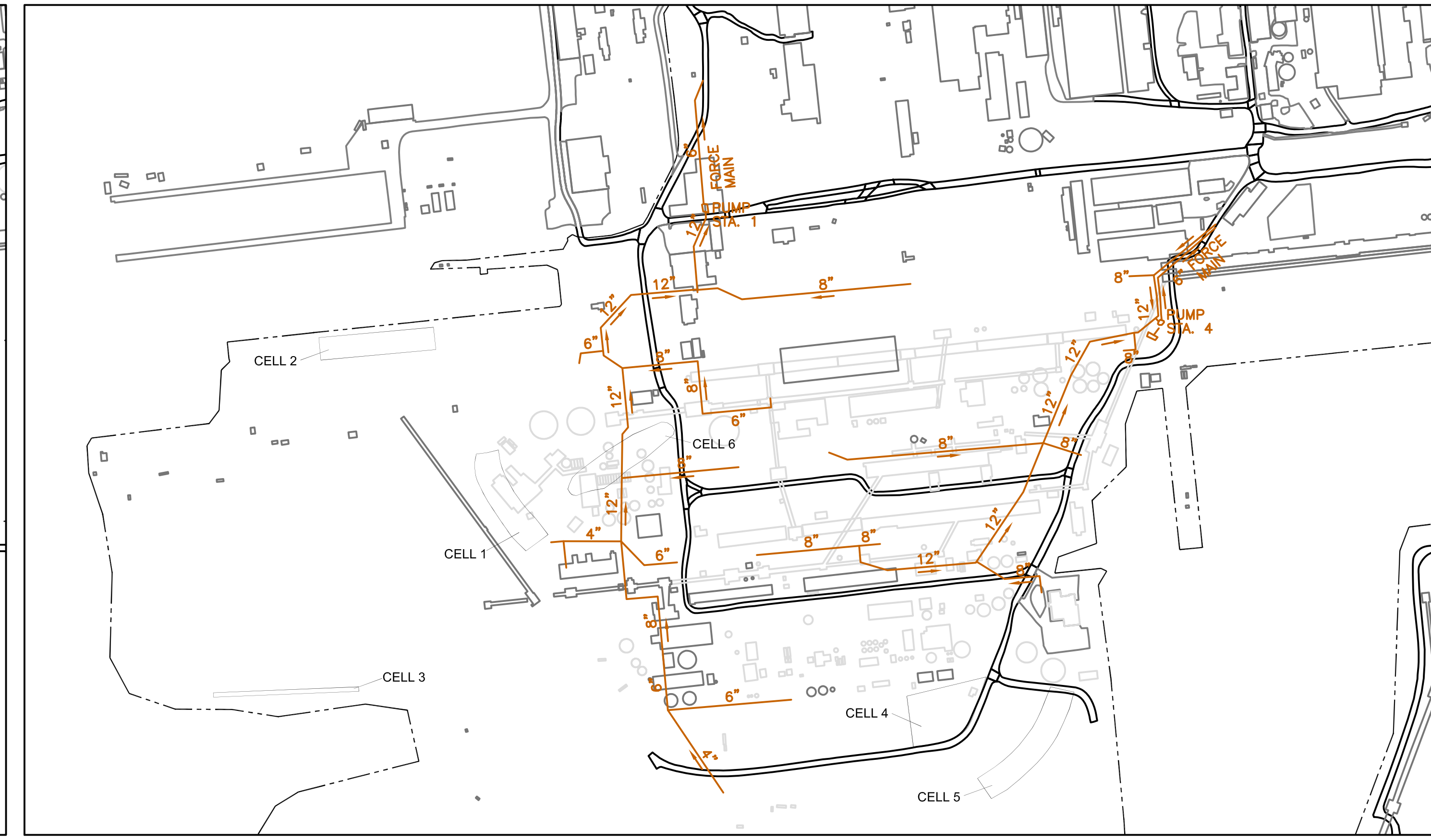
HISTORICAL SITE ARRANGEMENT
COKE OVEN AREA

PROJECT NO: 14-933

FIGURE 1-2



STORM SEWERS



SANITARY SEWERS

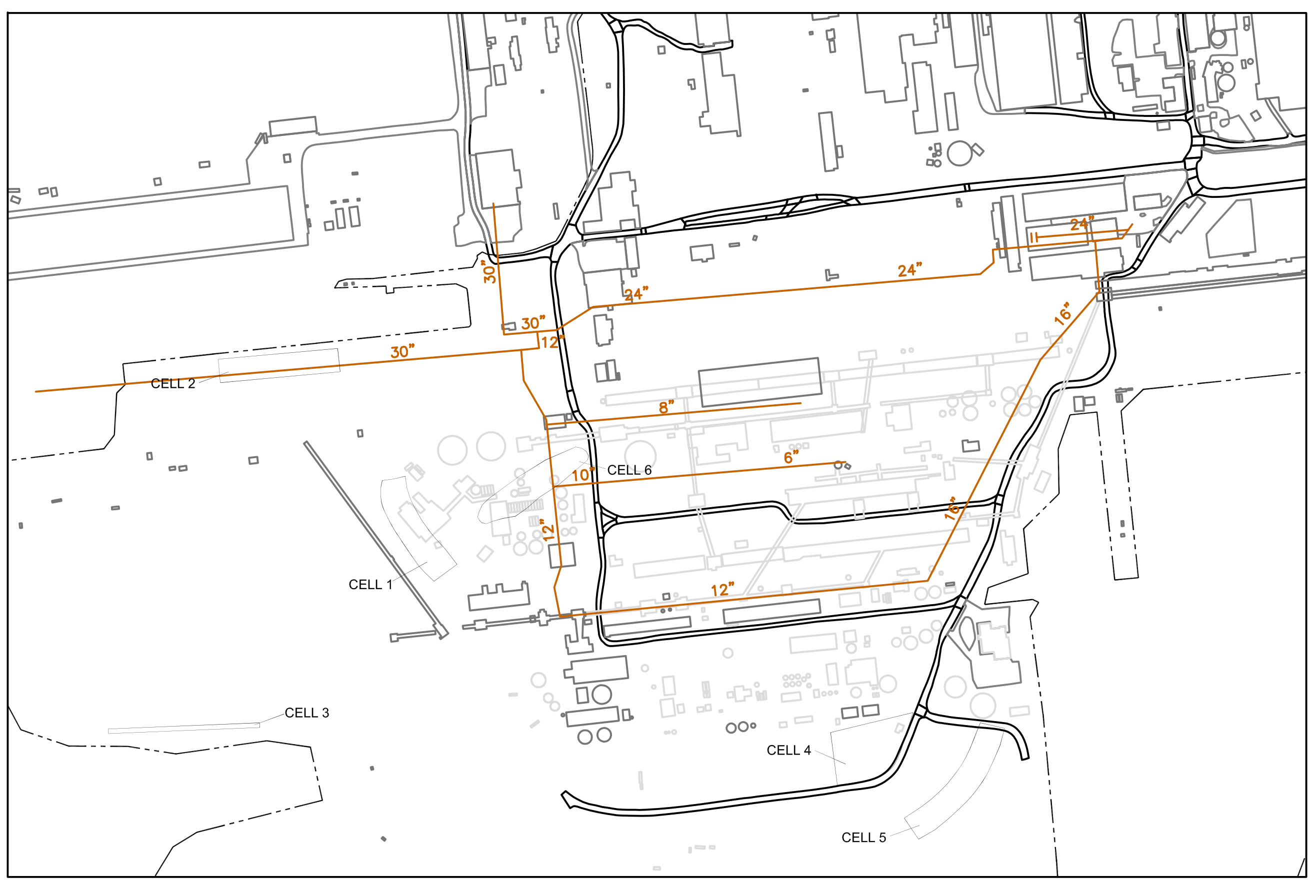
LEGEND

— - — -	PROPERTY BOUNDARY
▭	EXISTING BUILDINGS
▭	FORMER BUILDINGS
——	ROADS
——	UTILITY LINE
→	FLOW DIRECTION
8"	NOMINAL PIPE DIAMETER
032	OUTFALL NUMBER

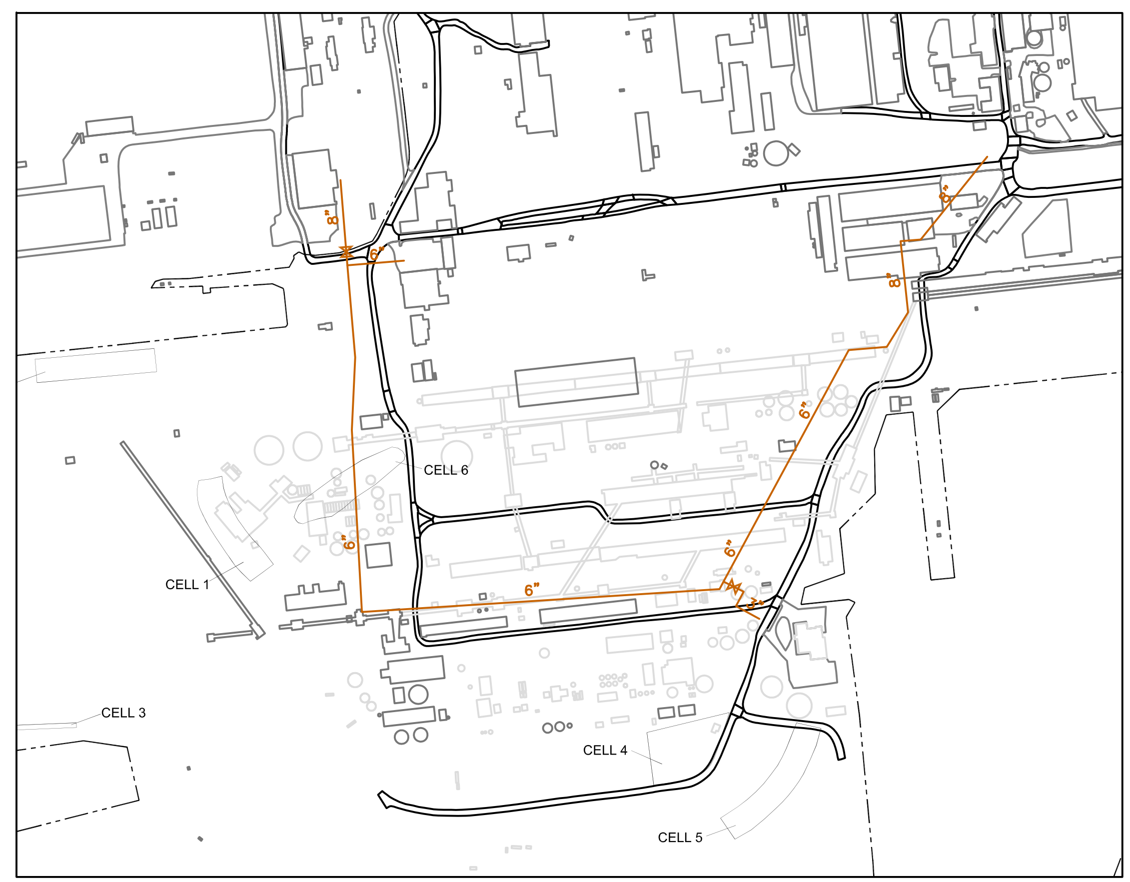
NOTE:
1. NO KNOWN BURIED ELECTRICAL OR GAS LINES PRESENT IN COKE OVEN AREA.

DRAFT

0 600 1200
FEET



INDUSTRIAL WATER



POTABLE WATER

ENVIROANALYTICS GROUP

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COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

SUBSURFACE UTILITY LINES

PROJECT NO:

FIGURE 1-3

REV #	DATE	DESCRIPTION	APPD
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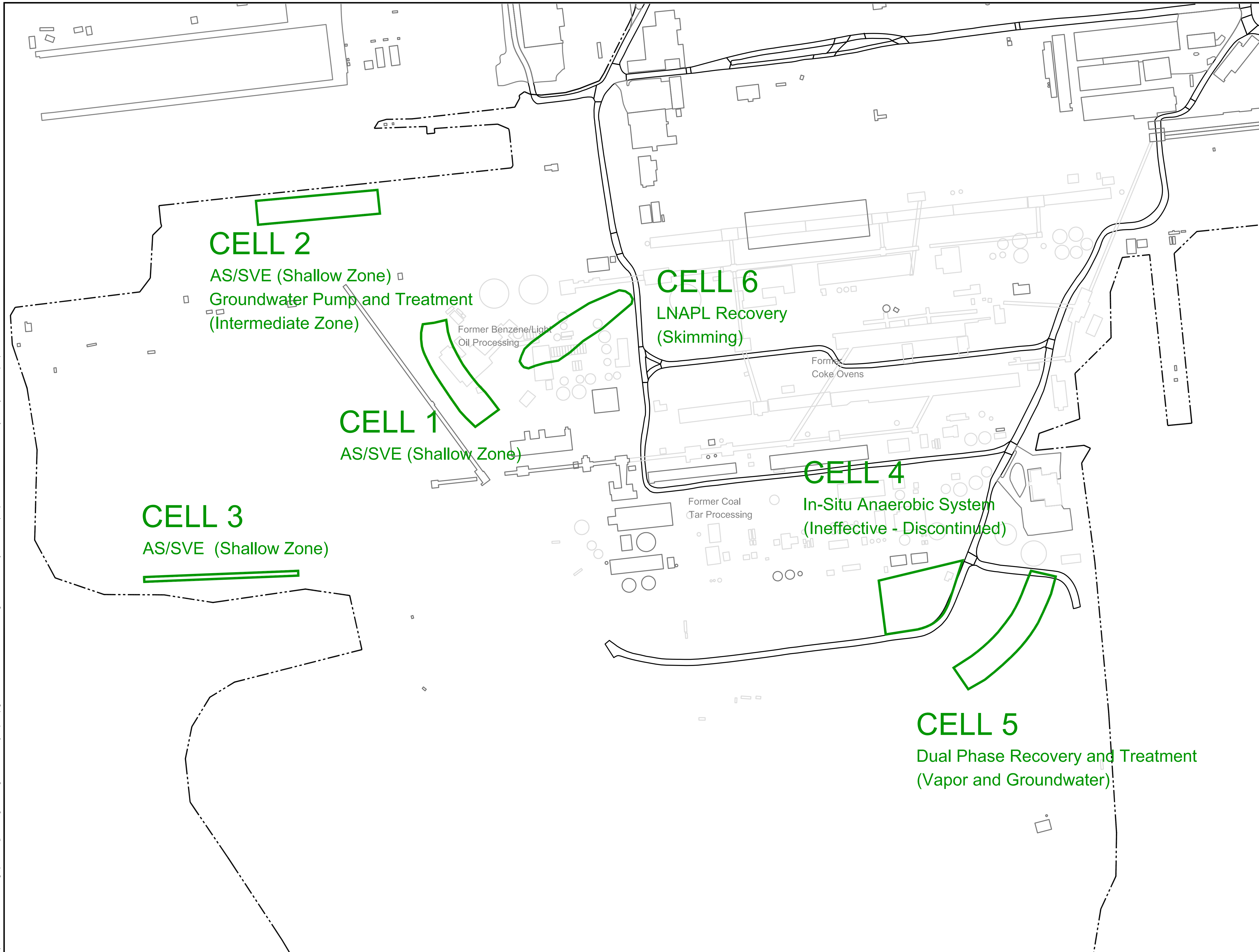

LEGEND

— - - —	PROPERTY BOUNDARY
	EXISTING BUILDINGS
	FORMER BUILDINGS
	ROADS
	INTERIM MEASURE AREA

NOTES:
1. CELL 5 IM DESIGNED TO ADDRESS CELLS 4 AND 5 AS A COMBINED UNIT.
2. AS/SVE – AIR SPARGE AND SOIL VAPOR EXTRACTION.

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

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COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

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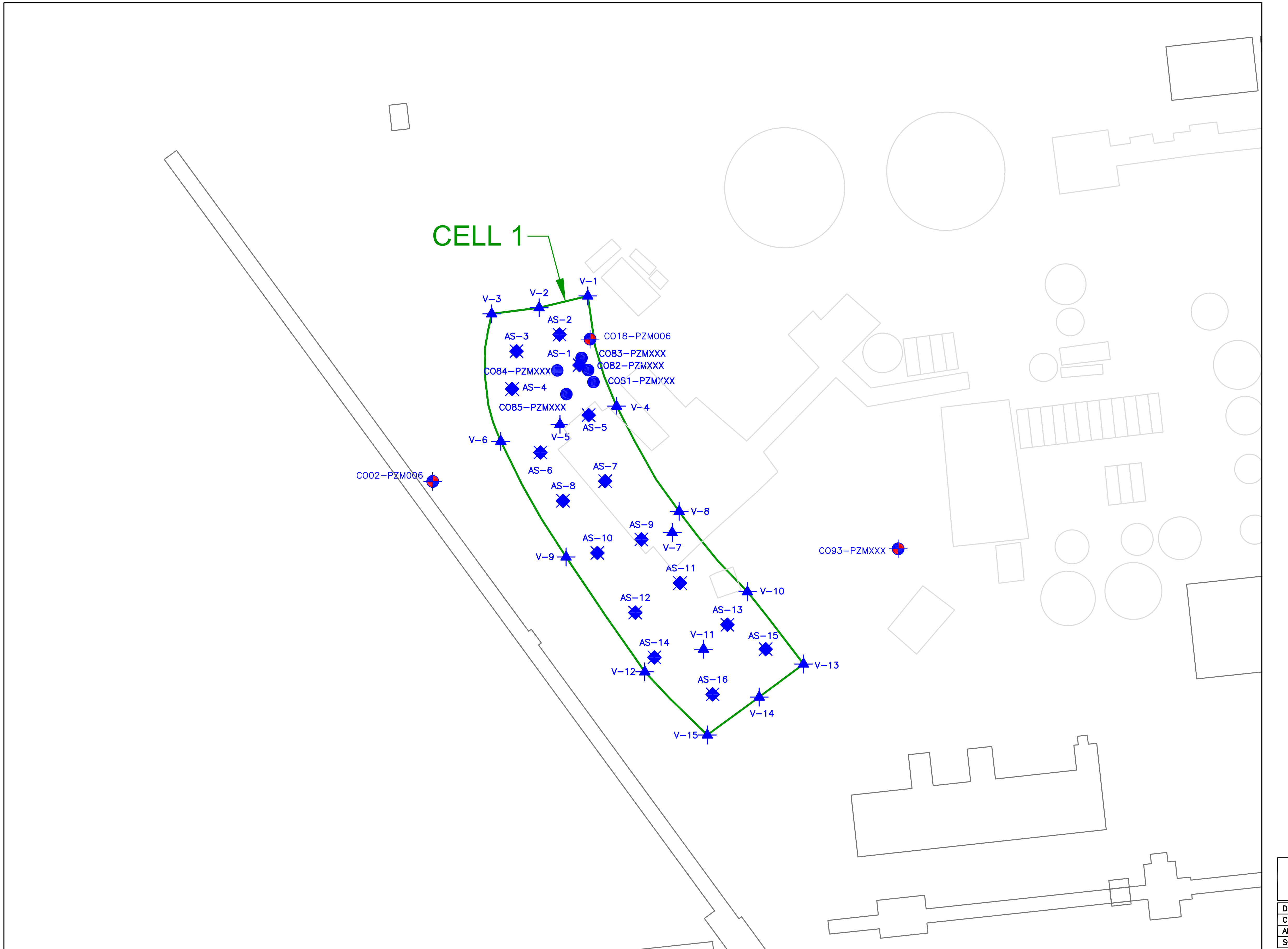
CARNEGIE, PA 15106

CURRENT SITE ARRANGEMENT AND EXISTING INTERIM MEASURES

PROJECT NO: 14-933

FIGURE 1–4



LEGEND

EXISTING BUILDINGS

FORMER BUILDINGS

ROADS

INTERIM MEASURE AREA AND VAPOR COLLECTION TRENCH (EXISTING)

SHALLOW WELL LOCATION (EXISTING)

V-1 TRENCH VAPOR EXTRACTION RISER (EXISTING)

C081-PZM SVE PILOT TEST OBSERVATION WELL (EXISTING)

AS-2 AIR SPARGE POINT (EXISTING)

NOTES:
1. EIGHT OF THE AIR SPARGE POINTS AND SIX OF THE SOIL VAPOR EXTRACTION POINTS CURRENTLY OPERATED.
2. DEPICTED SHALLOW MONITORING WELLS USED FOR CELL 1 PERFORMANCE MONITORING.

DRAFT

0 100 200 FEET

ENVIROANALYTICS GROUP

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COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

INTERIM MEASURE CONFIGURATION CELL 1

PROJECT NO: 14-933

FIGURE 1-5

REV #	DATE	DESCRIPTION	APPD
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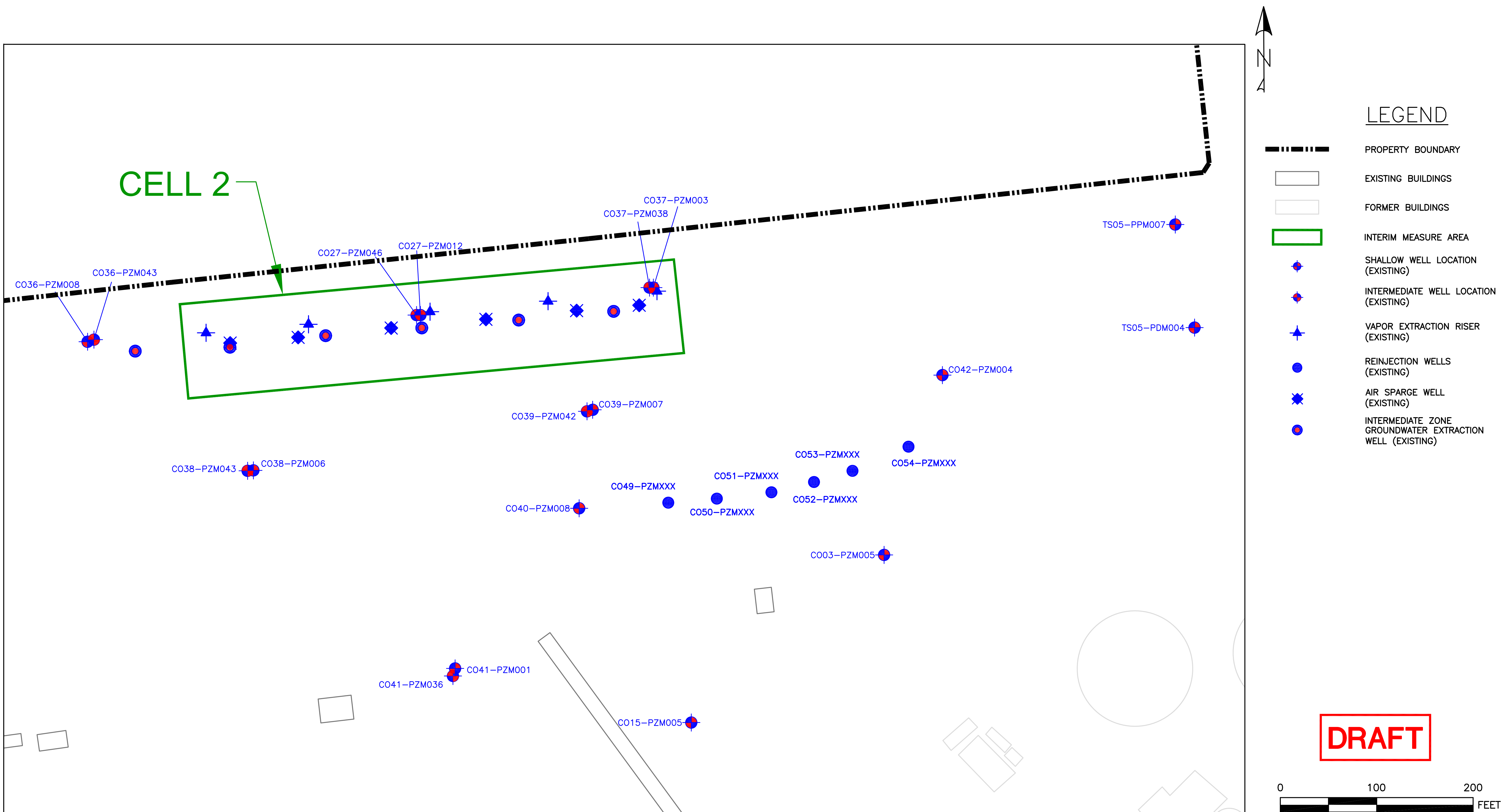

ENVIROANALYTICS GROUP

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APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

INTERIM MEASURE CONFIGURATION
CELL 2

PROJECT NO: 14–933

FIGURE 1–6

REV #	DATE	DESCRIPTION	APPD
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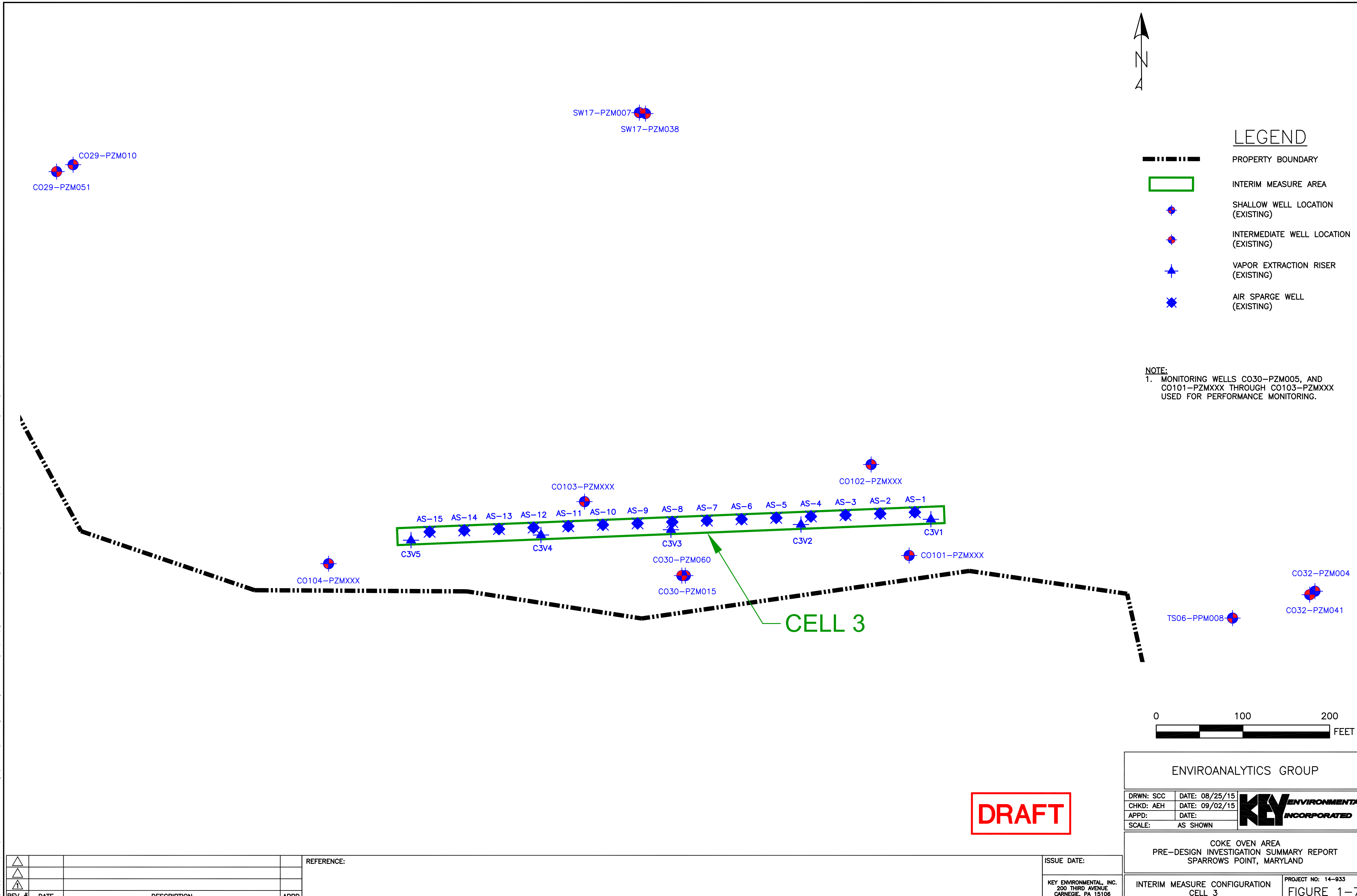

N
LEGEND
PROPERTY BOUNDARY
INTERIM MEASURE AREA
SHALLOW WELL LOCATION (EXISTING)
INTERMEDIATE WELL LOCATION (EXISTING)
VAPOR EXTRACTION RISER (EXISTING)
AIR SPARGE WELL (EXISTING)
NOTE:
1. MONITORING WELLS CO30-PZM005, AND CO101-PZMXXX THROUGH CO103-PZMXXX USED FOR PERFORMANCE MONITORING.
SW17-PZM007
SW17-PZM038
CO29-PZM010
CO29-PZM051
CO103-PZMXXX
CO102-PZMXXX
AS-15
AS-14
AS-13
AS-12
AS-11
AS-10
AS-9
AS-8
AS-7
AS-6
AS-5
AS-4
AS-3
AS-2
AS-1
C3V1
C3V2
C3V3
C3V4
C3V5
CO101-PZMXXX
CO104-PZMXXX
CO30-PZM060
CO30-PZM015
CELL 3
CO32-PZM004
CO32-PZM041
TS06-PPM008
0
100
200
FEET
DRAFT
ENVIROANALYTICS GROUP
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DATE:
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COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND
REV #
DATE
DESCRIPTION
APPD
REFERENCE:
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KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
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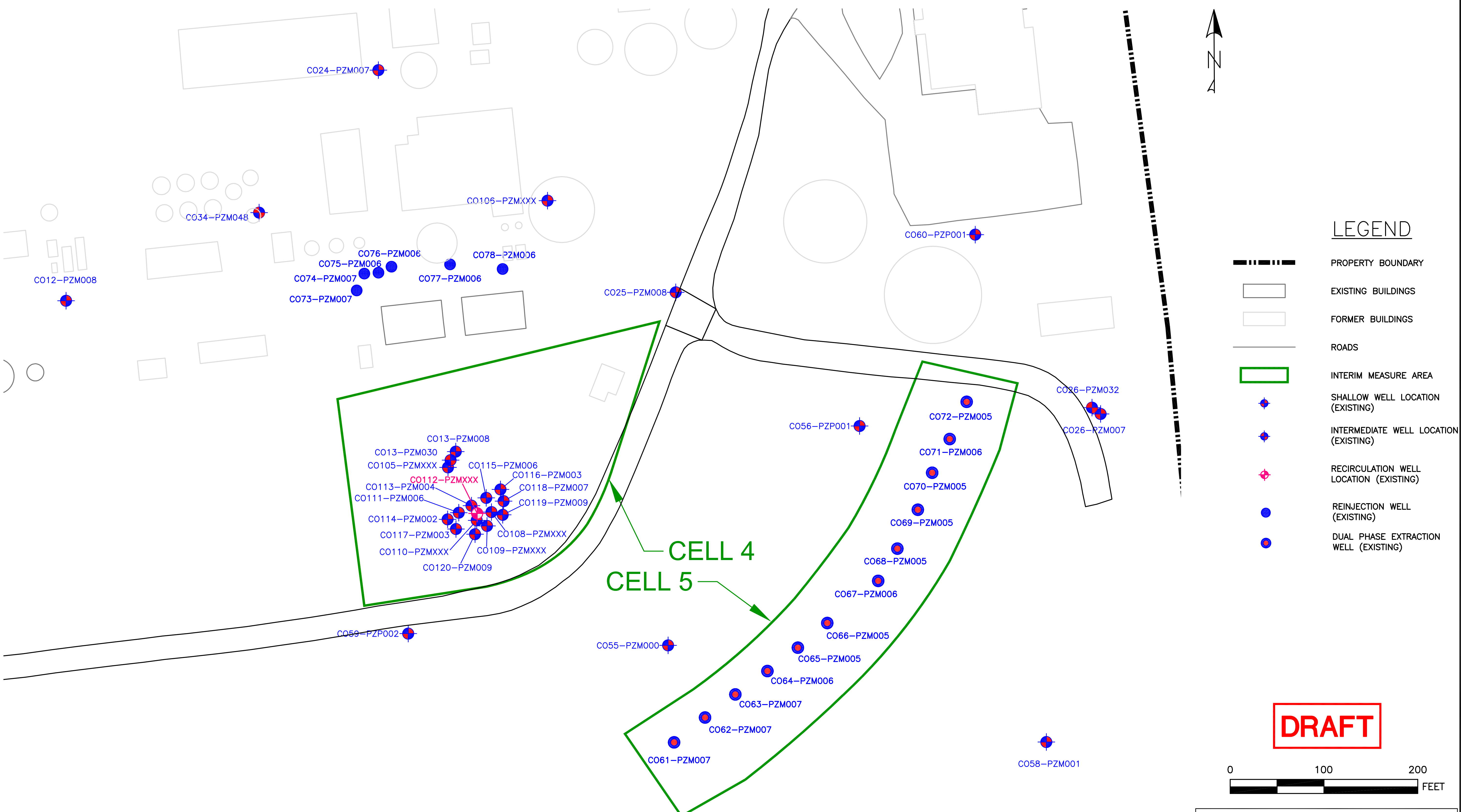
INTERIM MEASURE CONFIGURATION
CELL 3
PROJECT NO: 14-933
FIGURE 1-7



ENVIROANALYTICS GROUP

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APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

INTERIM MEASURE CONFIGURATION
CELLS 4 AND 5

PROJECT NO: 14–933

FIGURE 1–8

REV #	DATE	DESCRIPTION	APPD
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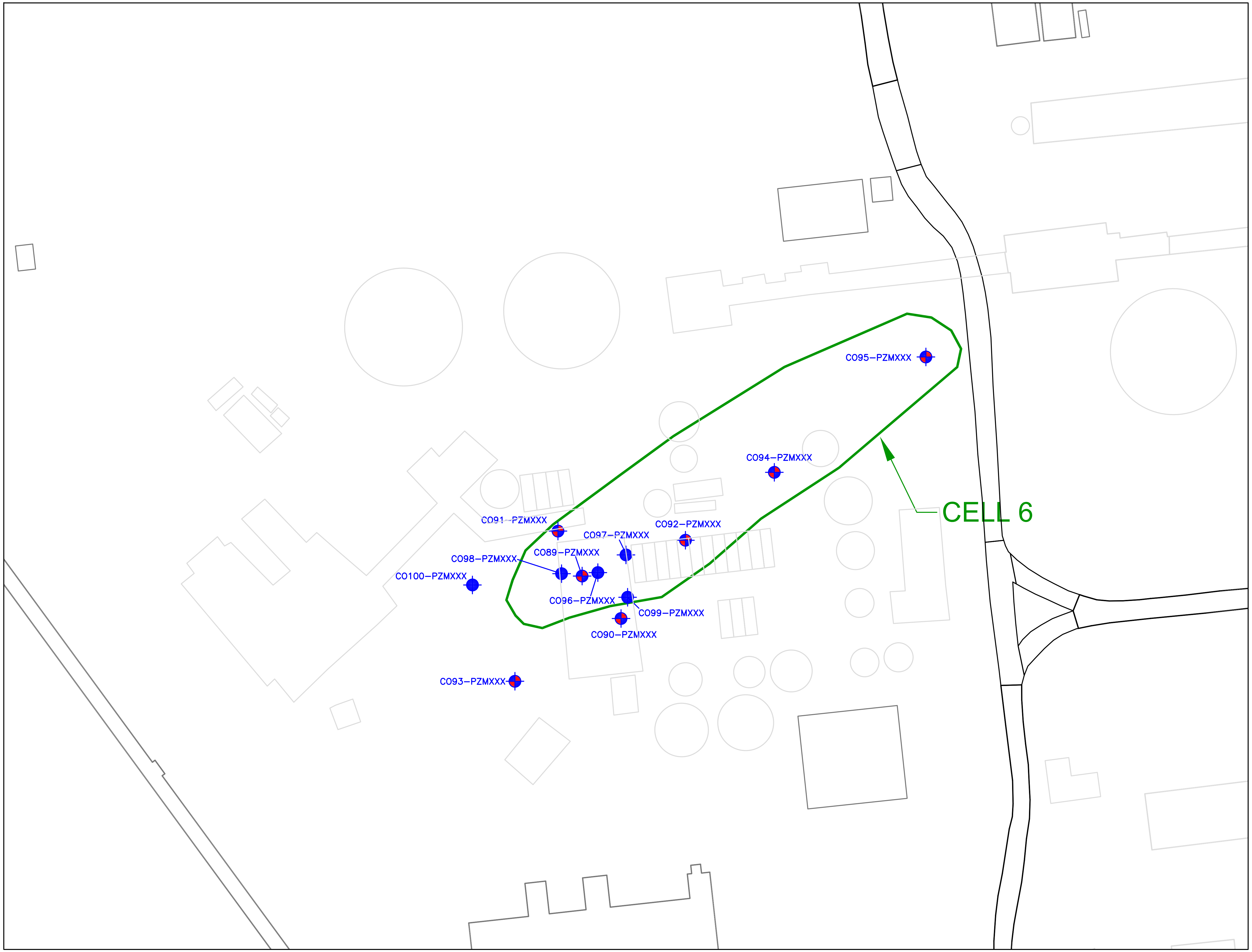

LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS
- FORMER BUILDINGS
- ROADS
- INTERIM MEASURE AREA
- SHALLOW WELL LOCATION (EXISTING)
- RECOVERY WELL LOCATION (EXISTING)

NOTE:
1. LNAPL HISTORICALLY REPORTED TO BE PRESENT IN MONITORING WELL C004–PZM004.

DRAFT

0 100 200 FEET

ENVIROANALYTICS GROUP

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KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

INTERIM MEASURE CONFIGURATION
CELL 6

PROJECT NO: 14–933

FIGURE 1–9

REV #	DATE	DESCRIPTION	APPD
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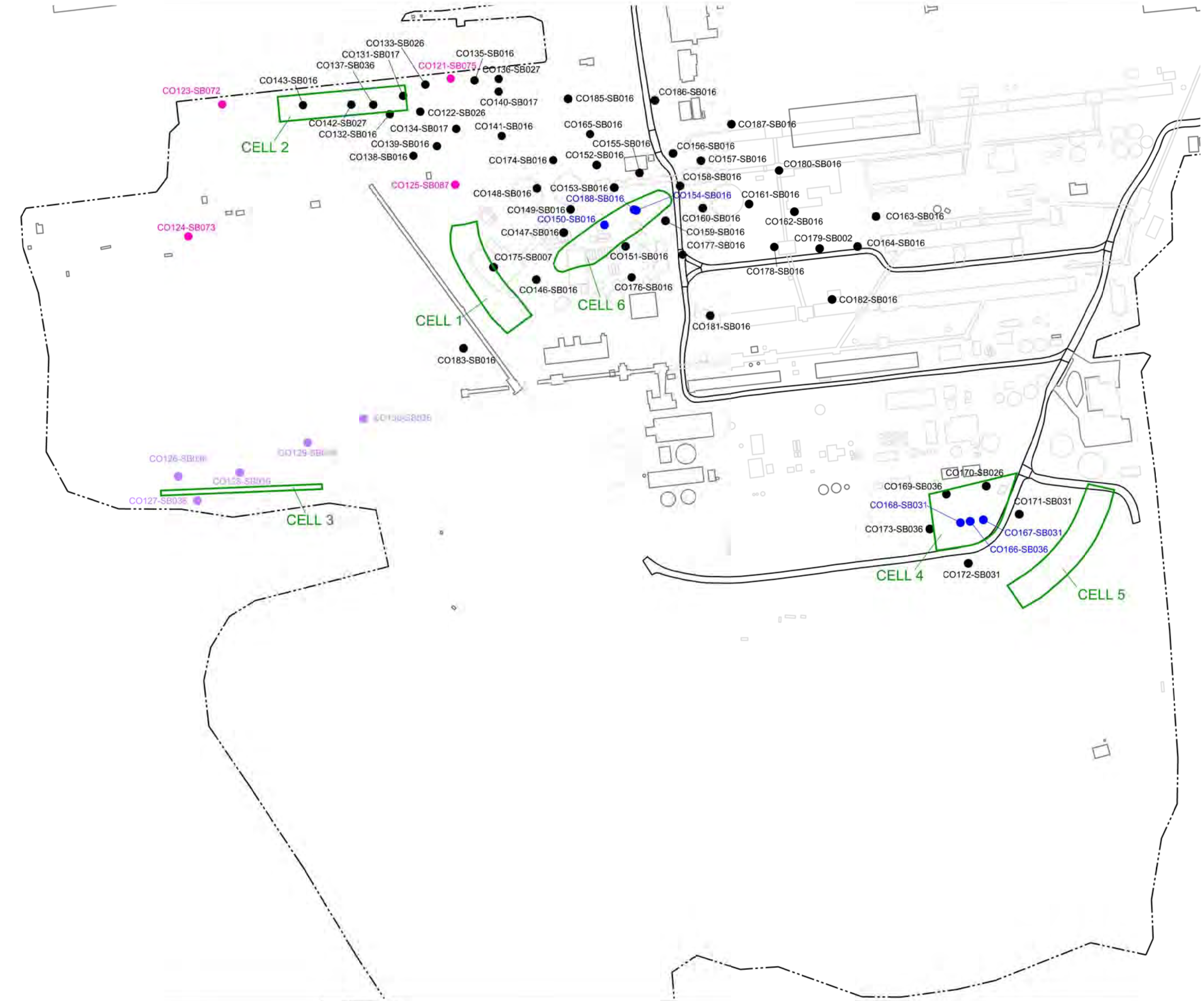

LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS
- FORMER BUILDINGS
- ROADS
- INTERIM MEASURE AREA
- SOIL BORING LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- SOIL BORING/ISOFLOW GROUNDWATER SAMPLING LOCATIONS
- SOIL BORING CONVERTED TO MONITORING WELL (CO166–SB36=CO123–PZM; CO167–SB31=CO124–PZM; CO168–SB31=CO125–PZM; CO150–SB16=CO126–PZM; CO154–SB16=CO127–PZM; CO188–SB16=CO128–PZM)

NOTES:
1. BORING DESIGNATIONS CO144, CO145, AND CO184 WERE NOT USED.
2. REFUSAL ENCOUNTERED AT BORING LOCATION CO175 (7 FEET).
3. VOID ENCOUNTERED AT LOCATION CO179 (VAULT OR BASEMENT).

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

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KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

SOIL BORING LOCATIONS

PROJECT NO: 14–933

FIGURE 2–1

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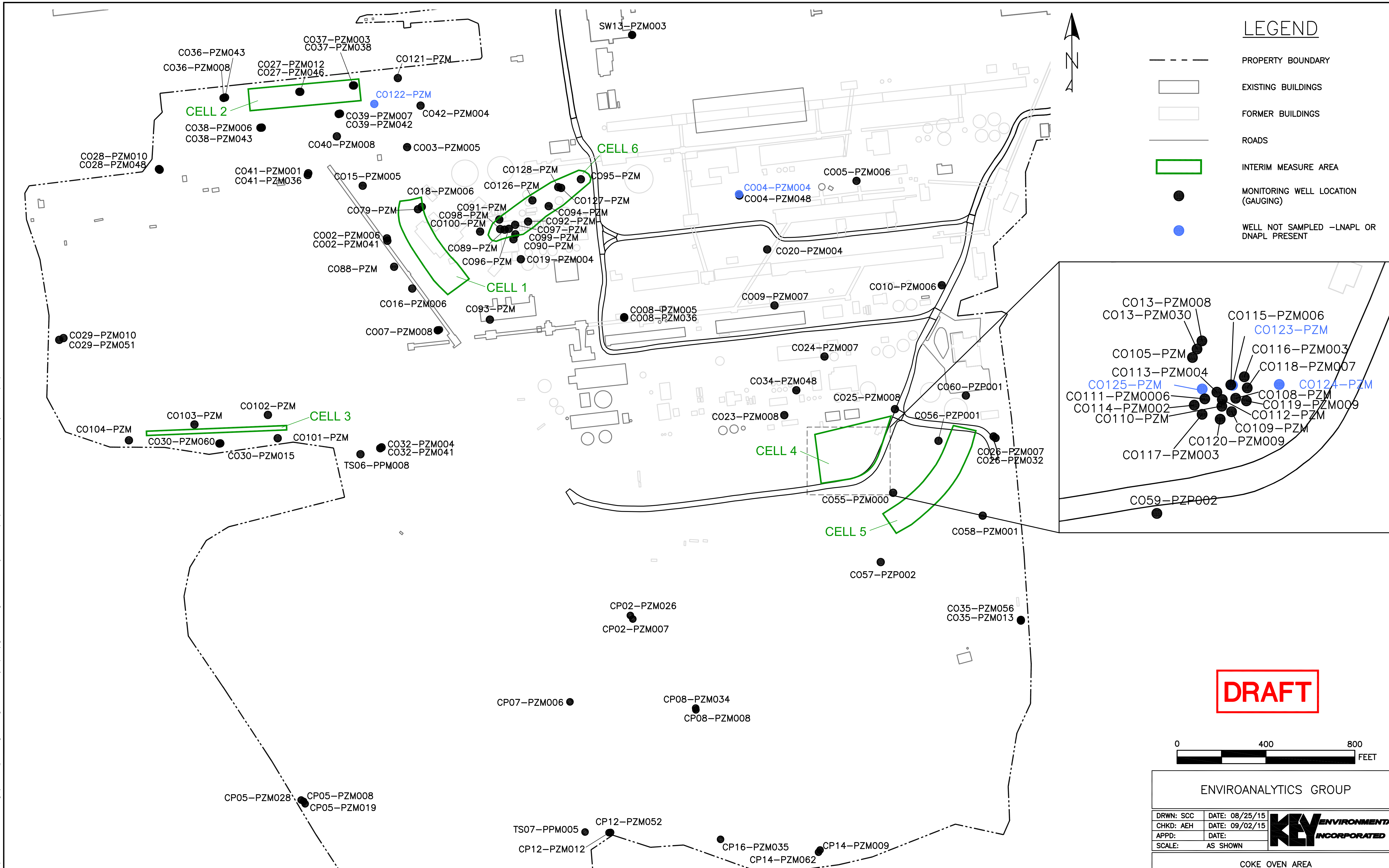
REV #	DATE	DESCRIPTION	APPD



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ENVIROANALYTICS GROUP

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APPD:	DATE:
SCALE:	AS SHOWN

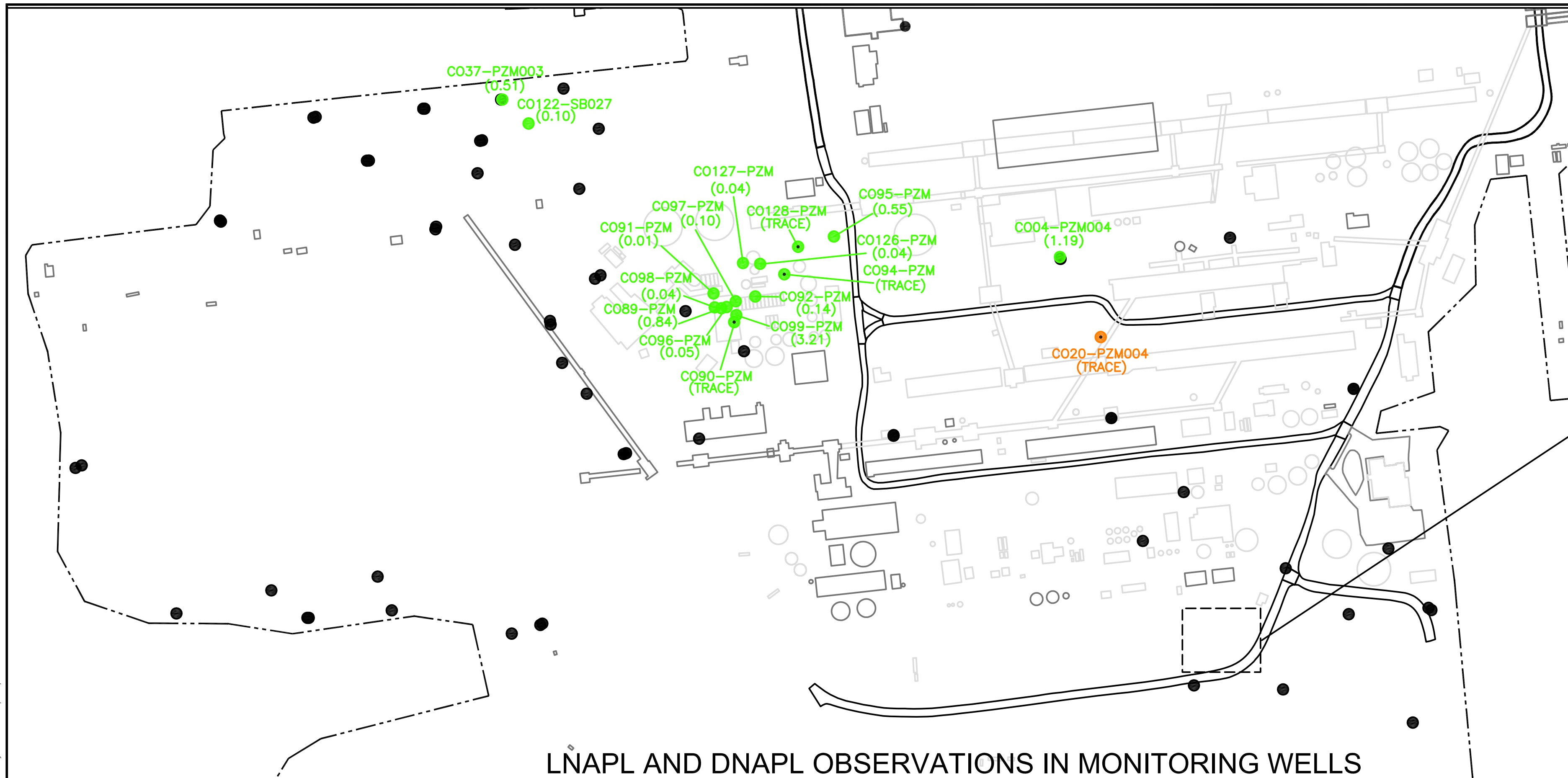
KEY ENVIRONMENTAL INCORPORATED

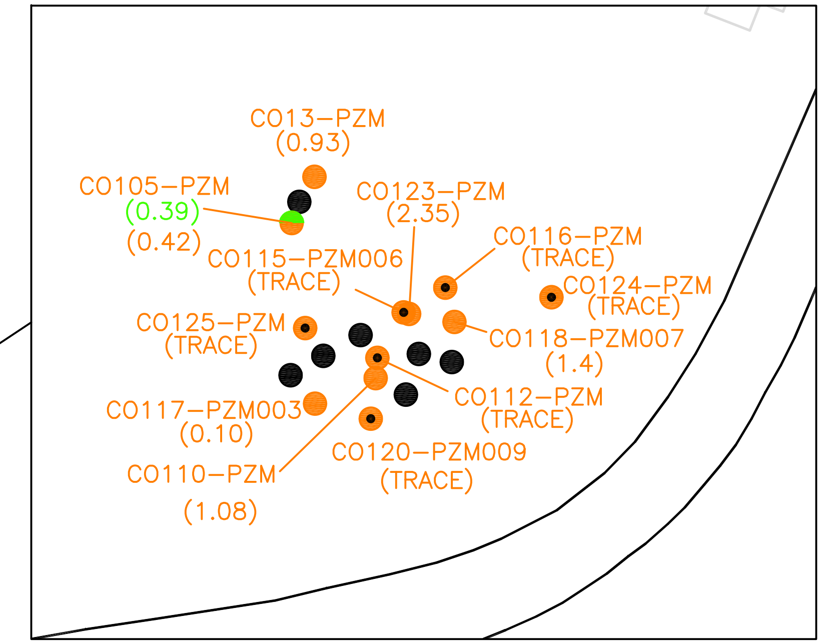
COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

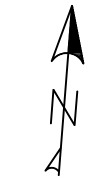
WELL GAUGING AND
SAMPLING LOCATIONS

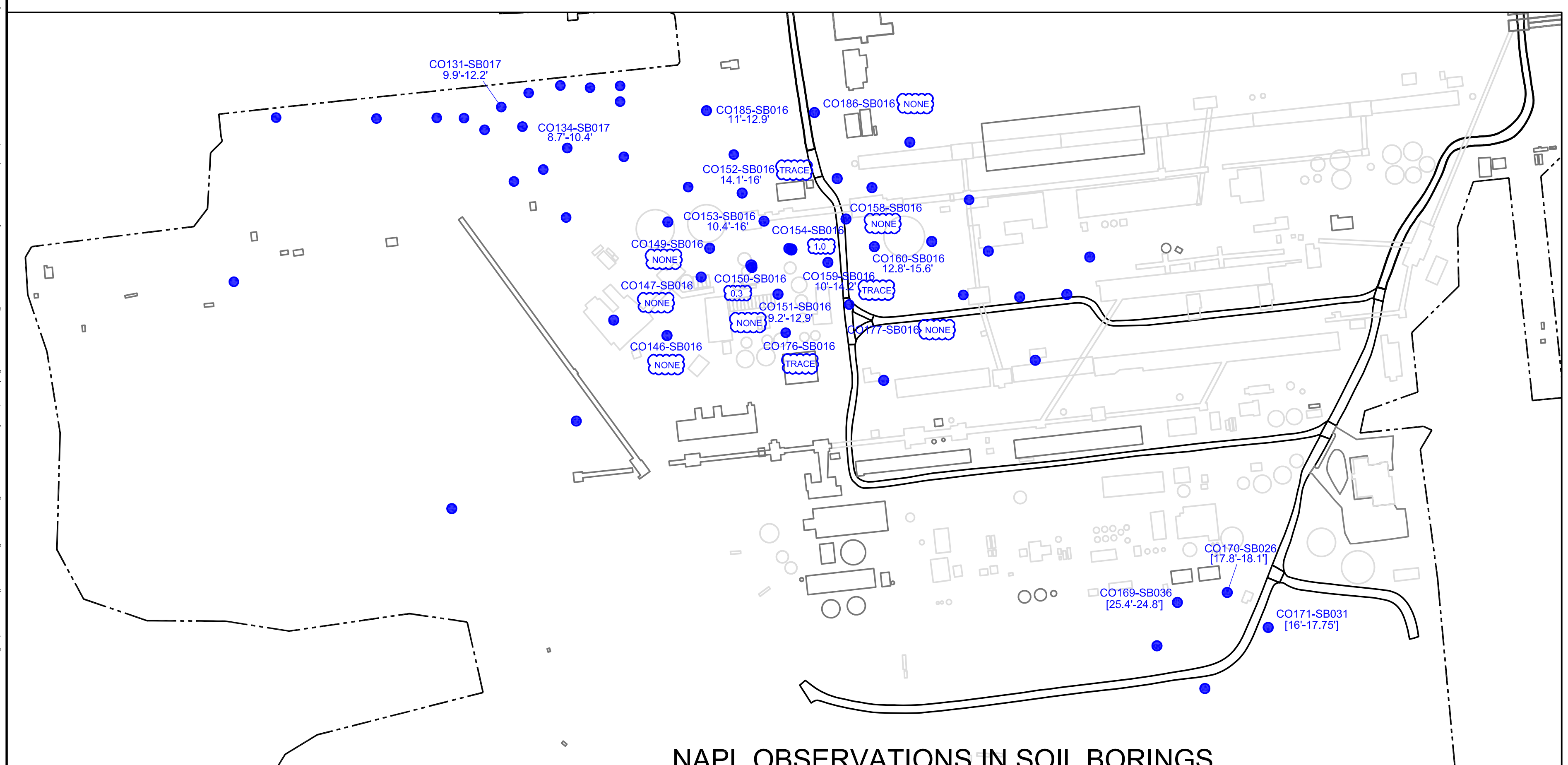
PROJECT NO: 14–933

FIGURE 2–2









LEGEND

— — —	PROPERTY BOUNDARY
	EXISTING BUILDINGS
	FORMER BUILDINGS
	ROADS
	MONITORING WELL WITH NO LNAPL OR DNAPL PRESENT
	LNAPL OBSERVED (APPARENT THICKNESS, FEET)
	LNAPL OBSERVED (TRACE, <0.01 FEET)
	DNAPL OBSERVED (APPARENT THICKNESS, FEET)
	DNAPL OBSERVED (TRACE, <0.01 FEET)
	SOIL BORING LOCATION
10.4'–16'	DEPTH AT WHICH POTENTIAL RECOVERABLE PRODUCT WAS IDENTIFIED
0.3	PRODUCT ACCUMULATION IN OPEN BOREHOLE LEFT OPEN FOR AT LEAST 1 DAY (FT)

0 500 1000 FEET

DRAFT

ENVIROANALYTICS GROUP

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COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

LNAPL/DNAPL/NAPL OBSERVATIONS
JUNE 2015

PROJECT NO: 14-933
FIGURE 3-1

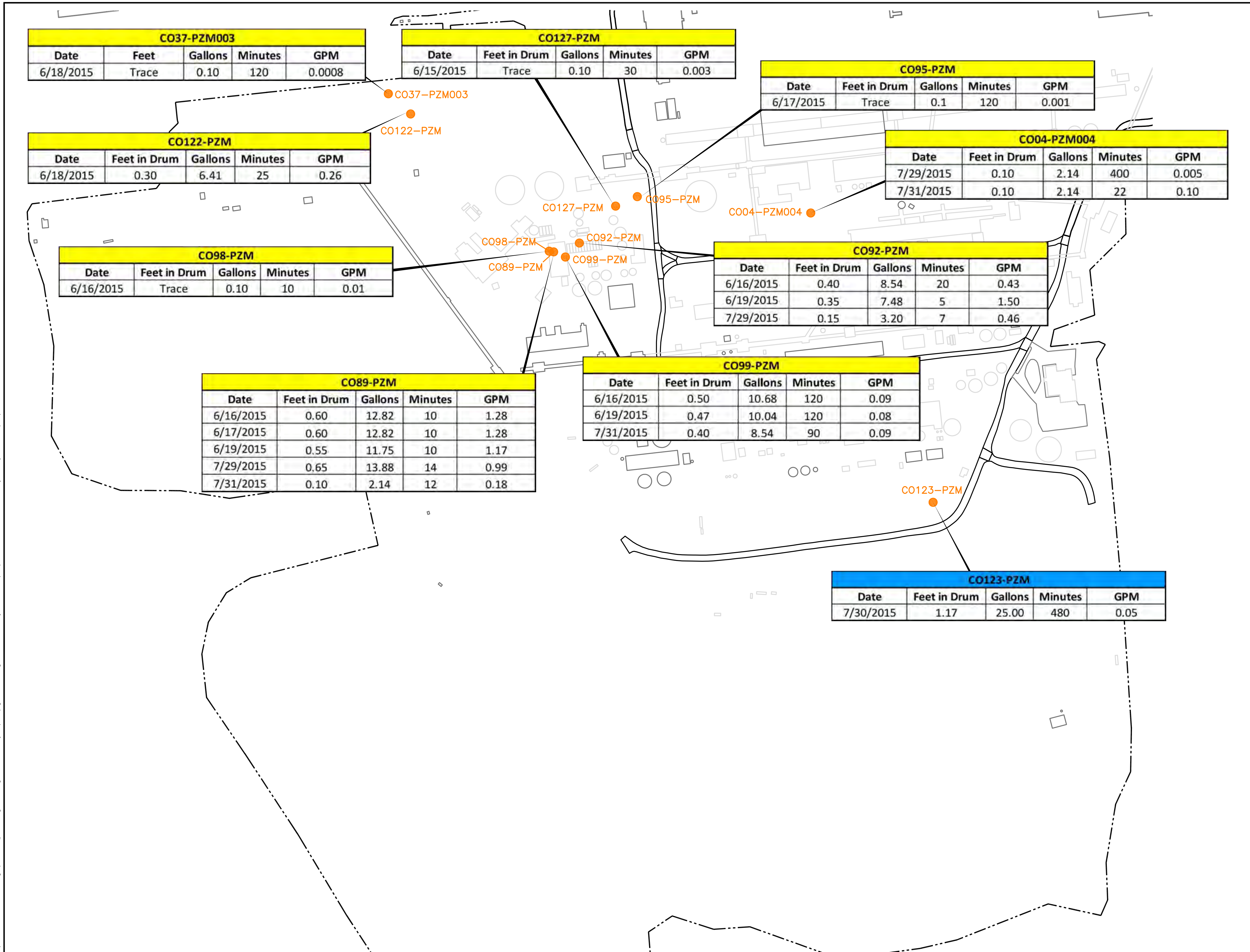
ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

REV #	DATE	DESCRIPTION	APPD
△			
△			
△			

REFERENCE:

NOTE:
1. CO122 LNAPL VISCOUS. INTERFERED WITH PROBE ON 6-8-15. REGAUGED MULTIPLE TIMES ON 6-17-15.



CO37-PZM003

Date	Feet	Gallons	Minutes	GPM
6/18/2015	Trace	0.10	120	0.0008

CO127-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/15/2015	Trace	0.10	30	0.003

CO95-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/17/2015	Trace	0.1	120	0.001

CO122-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/18/2015	0.30	6.41	25	0.26

CO04-PZM004

Date	Feet in Drum	Gallons	Minutes	GPM
7/29/2015	0.10	2.14	400	0.005
7/31/2015	0.10	2.14	22	0.10

CO98-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/16/2015	Trace	0.10	10	0.01

CO92-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/16/2015	0.40	8.54	20	0.43
6/19/2015	0.35	7.48	5	1.50
7/29/2015	0.15	3.20	7	0.46

CO89-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/16/2015	0.60	12.82	10	1.28
6/17/2015	0.60	12.82	10	1.28
6/19/2015	0.55	11.75	10	1.17
7/29/2015	0.65	13.88	14	0.99
7/31/2015	0.10	2.14	12	0.18

CO99-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
6/16/2015	0.50	10.68	120	0.09
6/19/2015	0.47	10.04	120	0.08
7/31/2015	0.40	8.54	90	0.09

CO123-PZM

Date	Feet in Drum	Gallons	Minutes	GPM
7/30/2015	1.17	25.00	480	0.05

LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS
- FORMER BUILDINGS
- ROADS
- MONITORING WELL LOCATION
- LNAPL RECOVERY (VACUUM)
- DNAPL RECOVERY (PUMP)

NOTE:
CONVERSION OF THICKNESS IN DRUM TO VOLUME WAS COMPLETED USING 1.78 GALLONS PER INCH IN A STANDARD 55–GALLON DRUM.

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

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CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

LNAPL AND DNAPL RECOVERY RESULTS

PROJECT NO: 14–933

FIGURE 3–2

REV #	DATE	DESCRIPTION	APPD

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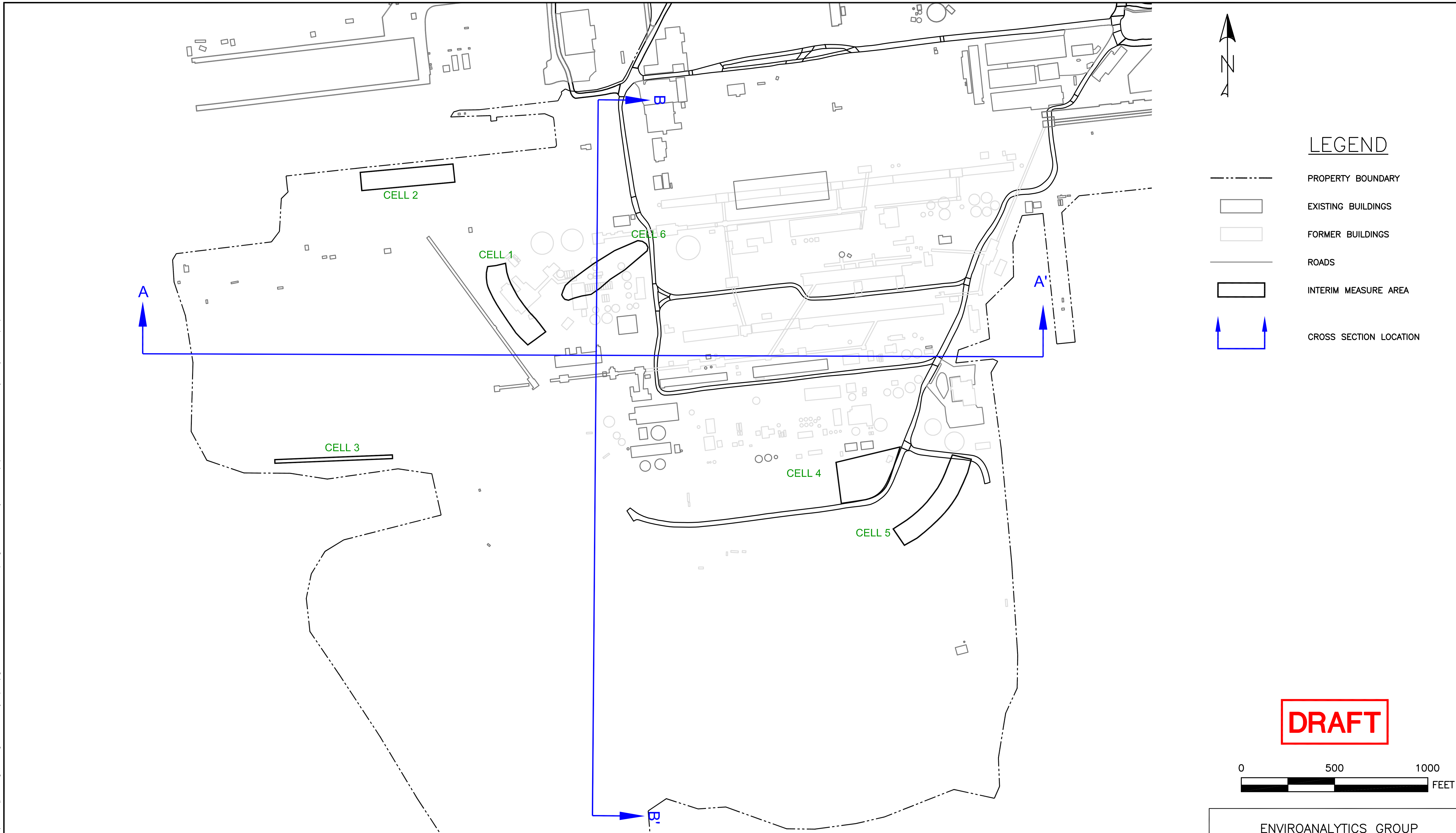

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

CROSS SECTION LOCATION MAP

PROJECT NO: 14–933

FIGURE 3–3

REV #	DATE	DESCRIPTION	APPD

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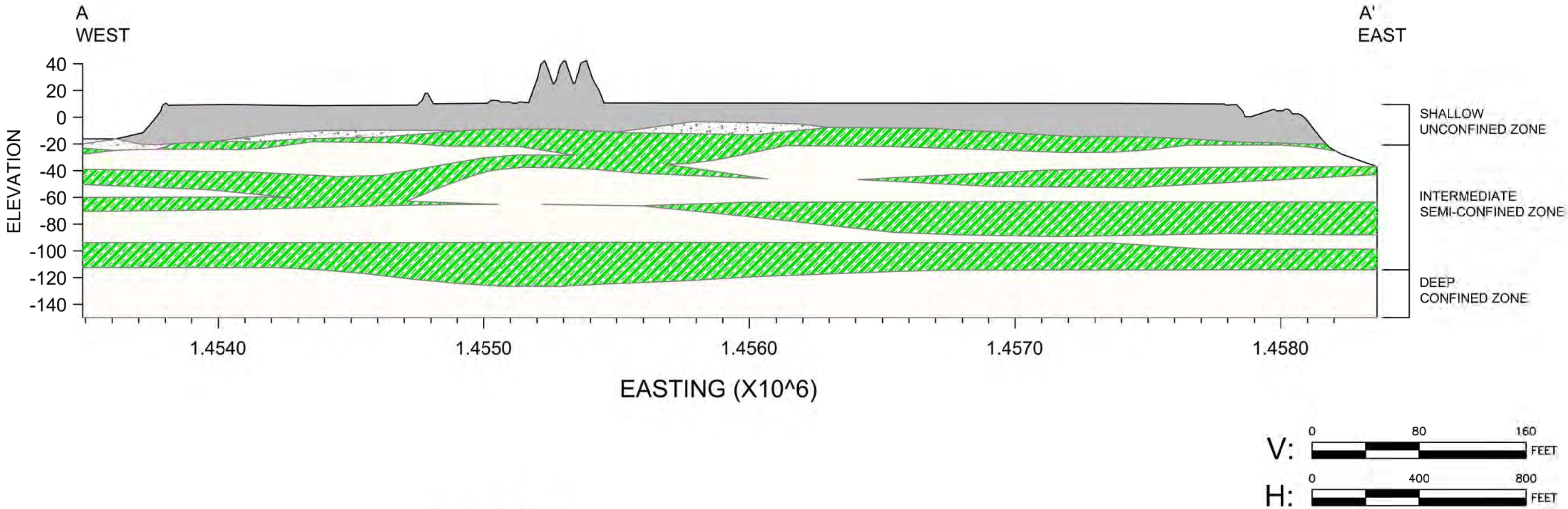


LEGEND

- FILL–TYPICALLY SLAG
- RIVER BOTTOM SEDIMENTS
- SAND
- CLAY
- DEEP SAND

DRAFT

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

GENERALIZED CROSS SECTION A–A'

PROJECT NO: 14–933

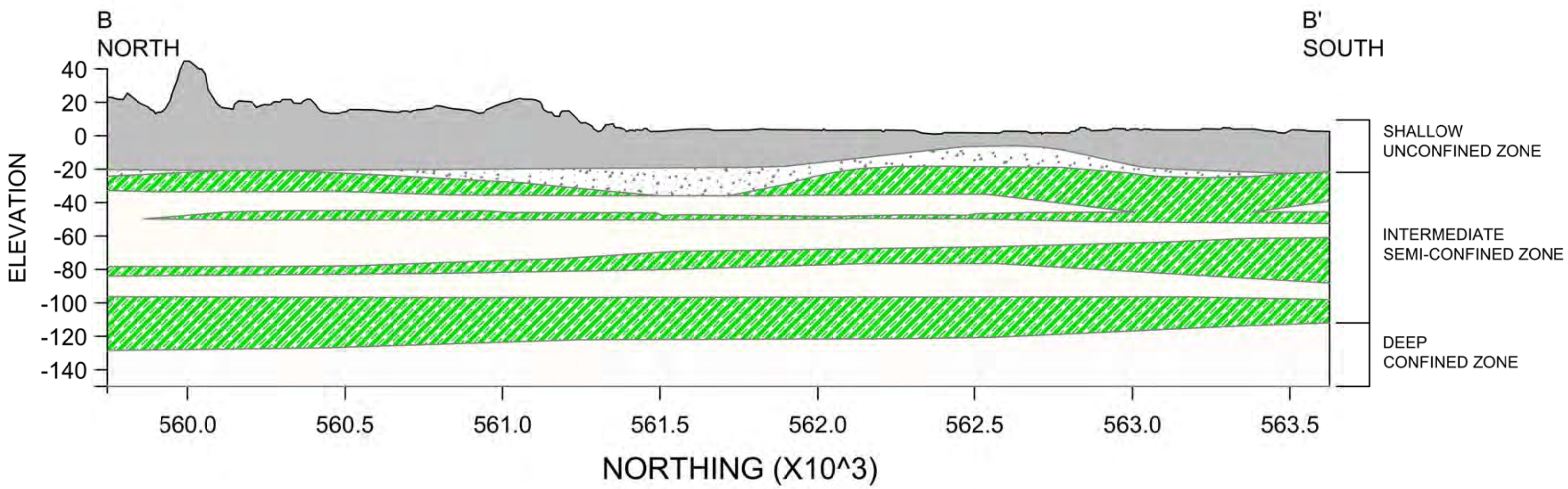
FIGURE 3–4

REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106



LEGEND

- FILL–TYPICALLY SLAG
- RIVER BOTTOM SEDIMENTS
- SAND
- CLAY
- DEEP SAND

V: 0 80 160 FEET

H: 0 400 800 FEET

DRAFT

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15
CHKD: TJH	DATE: 09/02/15
APPD:	DATE:
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

GENERALIZED CROSS SECTION B–B'

PROJECT NO: 14–933

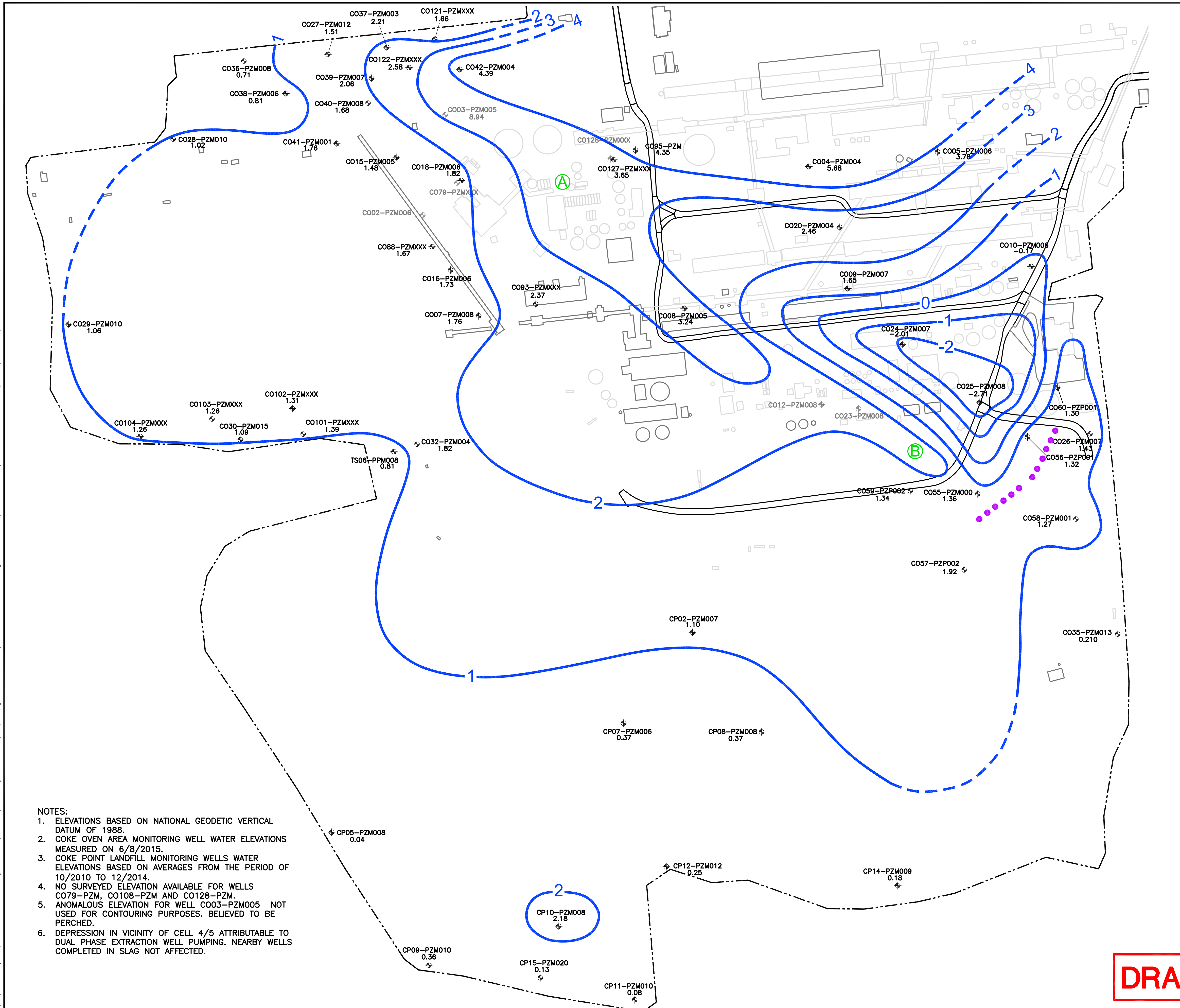
FIGURE 3–5

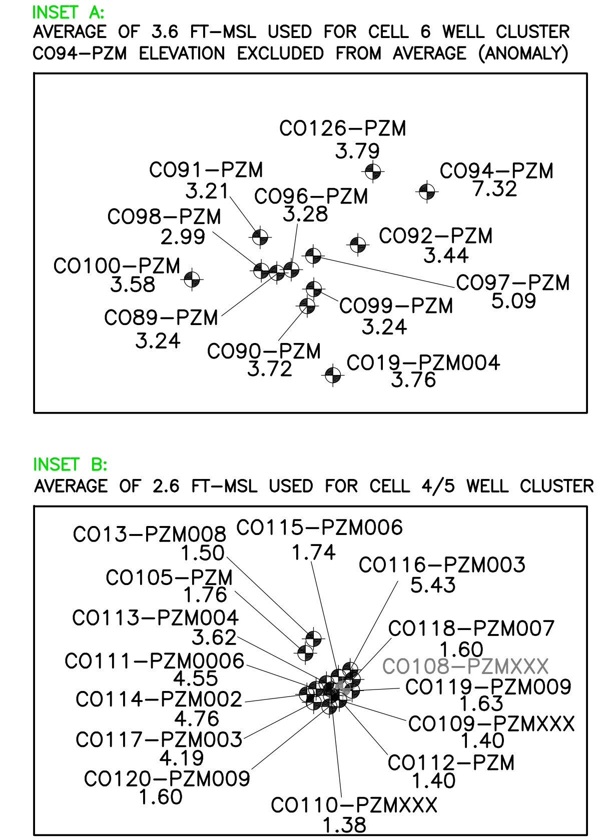
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106





NOTES:
1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1988.
2. COKE OVEN AREA MONITORING WELL WATER ELEVATIONS MEASURED ON 6/8/2015.
3. COKE POINT LANDFILL MONITORING WELLS WATER ELEVATIONS BASED ON AVERAGES FROM THE PERIOD OF 10/2010 TO 12/2014.
4. NO SURVEYED ELEVATION AVAILABLE FOR WELLS C079-PZM, C0108-PZM AND C0128-PZM.
5. ANOMALOUS ELEVATION FOR WELL C003-PZM005 NOT USED FOR CONTOURING PURPOSES. BELIEVED TO BE PERCHED.
6. DEPRESSION IN VICINITY OF CELL 4/5 ATTRIBUTABLE TO DUAL PHASE EXTRACTION WELL PUMPING. NEARBY WELLS COMPLETED IN SLAG NOT AFFECTED.

LEGEND

	PROPERTY BOUNDARY
	EXISTING BUILDINGS
	FORMER BUILDINGS
	ROADS
C010-PZM006	COKE OVEN AREA MONITORING WELL LOCATION
CP14-PZM009	COKE POINT LANDFILL MONITORING WELL LOCATION
1.30	POTENTIOMETRIC SURFACE ELEVATION
1	POTENTIOMETRIC SURFACE CONTOUR (DASHED WHERE INFERRED)
	CELL 4/5 DPE RECOVERY WELL LOCATION

0 400 800
FEET

DRAFT

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/05/15
CHKD: AEH	DATE: 09/02/15
APPD:	DATE:
SCALE:	AS SHOWN

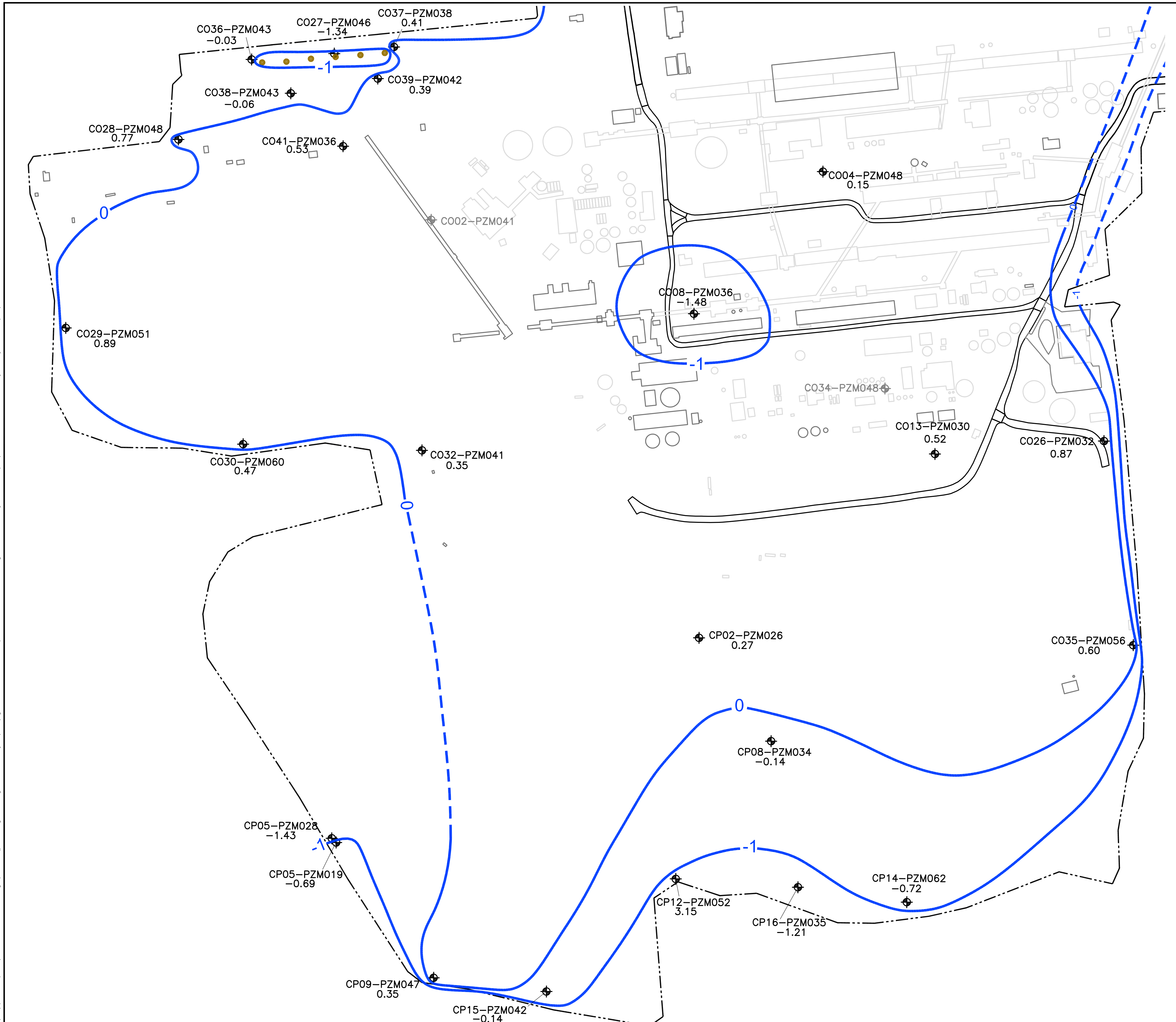
KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

POTENTIOMETRIC SURFACE CONTOURS
SHALLOW ZONE – JUNE 2015

PROJECT NO: 14-933
FIGURE 3-6

y:\elt\sparrows point\coke oven area drawings\14-933\pre-design investigation summary report\figure 3-6 shallow potentiometric contours.dwg Last Saved By: Scomer 9/17/2015 8:08 AM Plotted By: Shelly Comer 9/24/2015 2:24 PM Scale: 1:1



LEGEND

	PROPERTY BOUNDARY
	EXISTING BUILDINGS
	FORMER BUILDINGS
	ROADS
C026–PZM032	COKE OVEN AREA MONITORING WELL LOCATION
CP16–PZM035	COKE POINT LANDFILL MONITORING WELL LOCATION
3.24	POTENTIOMETRIC ELEVATION
-1	POTENTIOMETRIC CONTOUR (DASHED WHERE INFERRED)
	CELL 2 INTERMEDIATE ZONE RECOVERY WELL LOCATION

NOTES:
1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1988.
2. COKE OVEN AREA MONITORING WELLS WATER ELEVATIONS WERE MEASURED ON 6/8/2015.
3. WELL CP12–PZM052 HAD HIGH VARIANCE IN HISTORICAL WATER LEVEL MEASUREMENTS AND WAS NOT USED FOR CONTOURING PURPOSES.
4. COKE POINT LANDFILL MONITORING WELLS WATER ELEVATIONS WERE BASED ON AVERAGES FROM THE PERIOD OF 10/2010 TO 12/2014.
5. WELL C008–PZM036 WATER LEVEL WAS MEASURED ON JUNE 11, 2015.
6. NO SURVEYED ELEVATION AVAILABLE FOR WELL C034–PZM048 THEREFORE WATER LEVEL NOT USED FOR CONTOURING.
7. DRAWDOWN ASSUMED TO EXIST IN VICINITY OF CELL 2 RECOVERY WELLS.

DRAFT

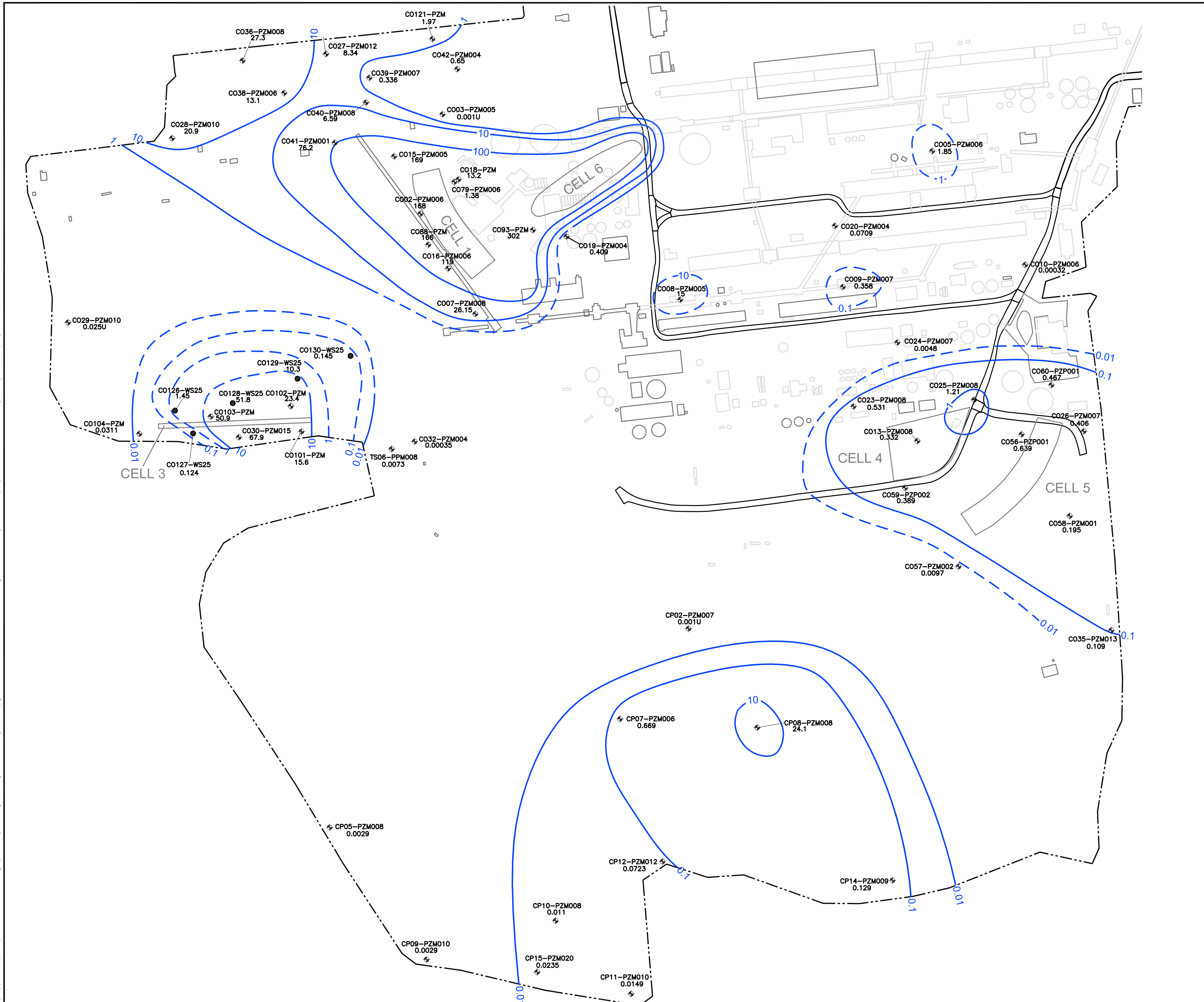
ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD:	DATE: 09/02/15	
APPD: AEH	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

POTENTIOMETRIC SURFACE CONTOURS
INTERMEDIATE ZONE – JUNE 2015

PROJECT NO: 14–933
FIGURE 3–7



LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS
- FORMER BUILDINGS
- ROADS
- MONITORING WELL LOCATION
- ISOFLOW GROUNDWATER SAMPLE LOCATION
- 0.467 — BENZENE CONCENTRATION (MG/L)
- 0.1 — BENZENE CONCENTRATION CONTOUR DASHED WHERE INFERRED

NOTES:
1. COKE OVEN AREA WELLS SAMPLED JUNE 2015; COKE POINT LANDFILL WELLS SAMPLED JUNE 2014.
2. ALL RESULTS ARE IN PARTS PER MILLION (PPM).
3. DUPLICATE RESULTS ARE AVERAGED.
4. REPORTED RESULTS FOR ISOFLOW SAMPLES WERE FROM THE INTERMEDIATE (25–FOOT) SAMPLE DEPTH. CONTOUR INTERVALS DRAWN USING THESE VALUES ARE DASHED AS SAMPLES WERE TURBID.

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

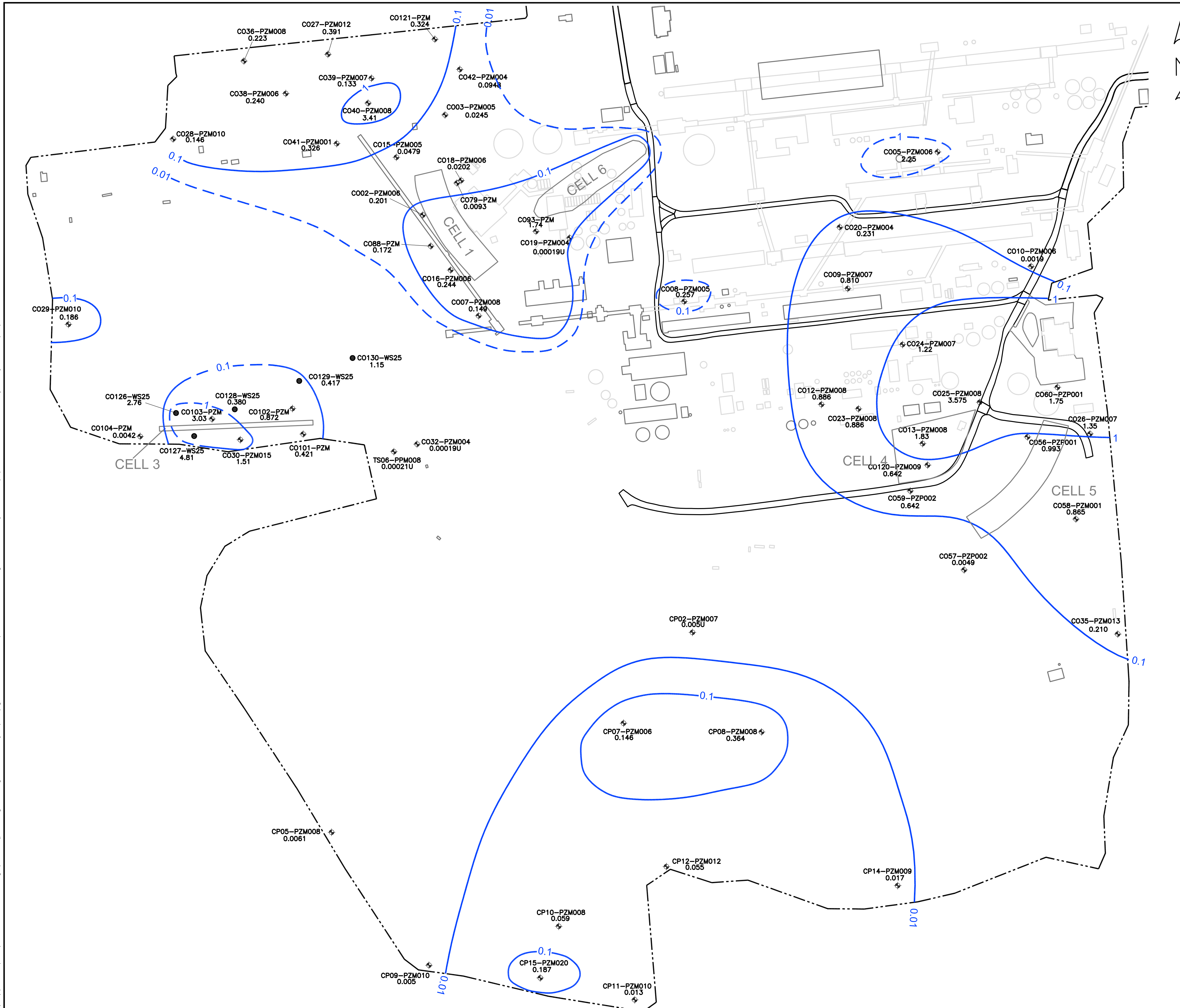
DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

BENZENE CONCENTRATIONS SHALLOW ZONE (MG/L)

PROJECT NO: 14–933

FIGURE 3–8



LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS
- FORMER BUILDINGS
- ROADS
- MONITORING WELL LOCATION
- ISOFLOW GROUNDWATER SAMPLE LOCATION
- 0.0019 NAPHTHALENE CONCENTRATION (MG/L)
- 0.1 NAPHTHALENE CONCENTRATION CONTOUR DASHED WHERE INFERRED

NOTES:
1. COKE OVEN AREA WELLS SAMPLED JUNE 2015; COKE POINT LANDFILL WELLS SAMPLED JUNE 2014.
2. NAPHTHALENE RESULTS FOR THE COKE POINT LANDFILL WELLS ARE FOR THE MOST RECENT ROUND AVAILABLE (AUGUST, 2011).
3. ALL RESULTS ARE IN PARTS PER MILLION (PPM).
4. DUPLICATE RESULTS ARE AVERAGED.
5. REPORTED RESULTS FOR ISOFLOW SAMPLES WERE FROM THE INTERMEDIATE (25-FOOT) SAMPLE DEPTH. CONTOUR INTERVALS DRAWN USING THESE VALUES ARE DASHED AS SAMPLES WERE TURBID.

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

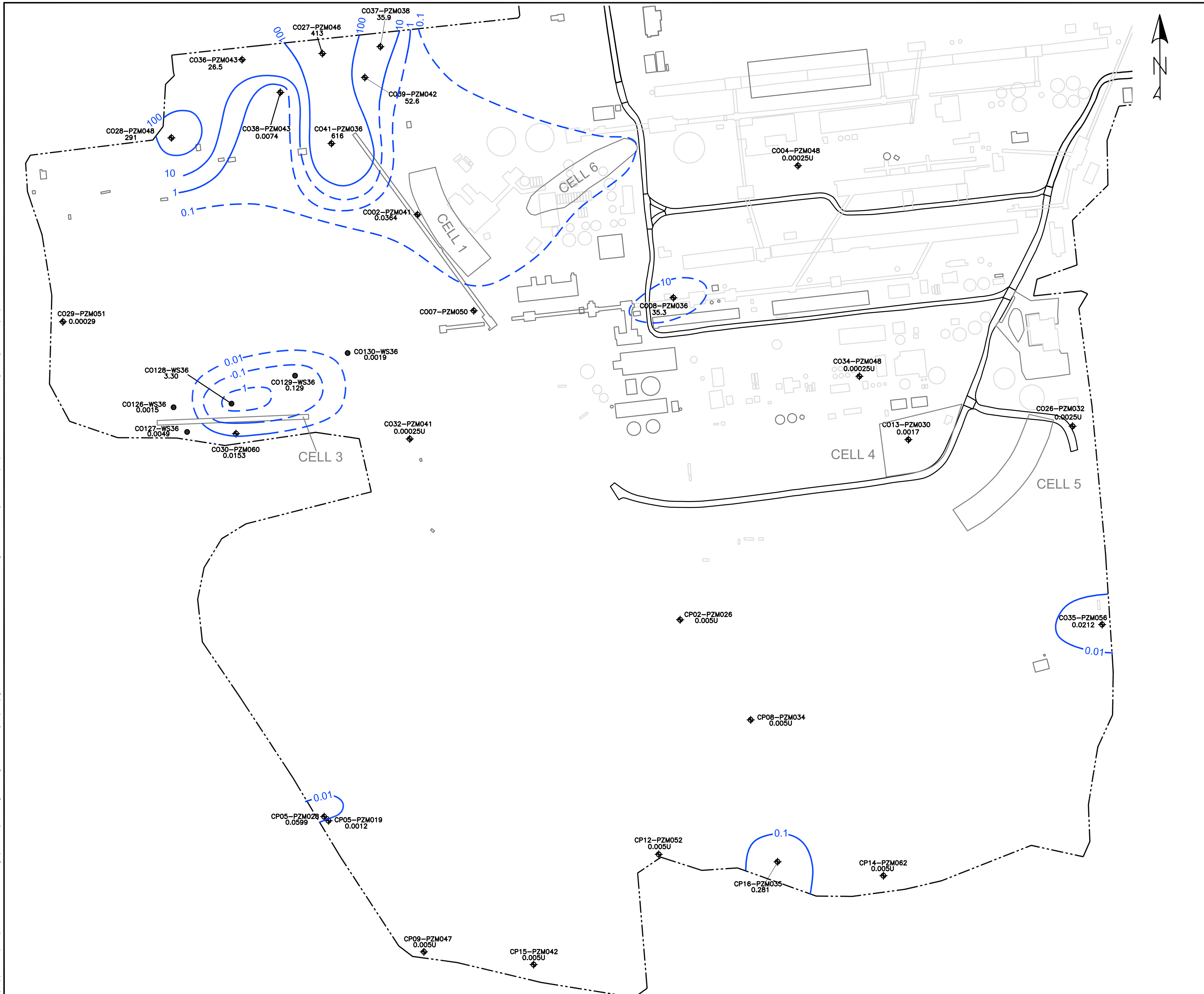
COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

NAPHTHALENE CONCENTRATIONS SHALLOW ZONE (MG/L)

PROJECT NO: 14-933

FIGURE 3-10

y:\ell\sparrows point\coke oven area drawings\14-933\pre-design investigation summary report\Figure 3-10 shallow naphthalene contours.dwg Last Saved By: Scomer 9/2/2015 1:24 PM Plotted By: Shelly Comer 9/24/2015 2:29 PM Scale: 1:1



LEGEND

PROPERTY BOUNDARY

EXISTING BUILDINGS

FORMER BUILDINGS

ROADS

MONITORING WELL LOCATION

ISOFLOW GROUNDWATER SAMPLE BORING LOCATION

0.0019 BENZENE CONCENTRATION (MG/L)

0.1 BENZENE CONCENTRATION CONTOUR DASHED WHERE INFERRED

NOTES:
1. COKE OVEN AREA WELLS SAMPLED JUNE 2015; COKE POINT LANDFILL WELLS SAMPLED JUNE 2014.
2. ALL RESULTS ARE IN PARTS PER MILLION (PPM).
3. DUPLICATE RESULTS ARE AVERAGED.
4. CONTOUR LINES DRAWN USING ISOFLOW SAMPLES ARE DASHED AS SAMPLES WERE TURBID.

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

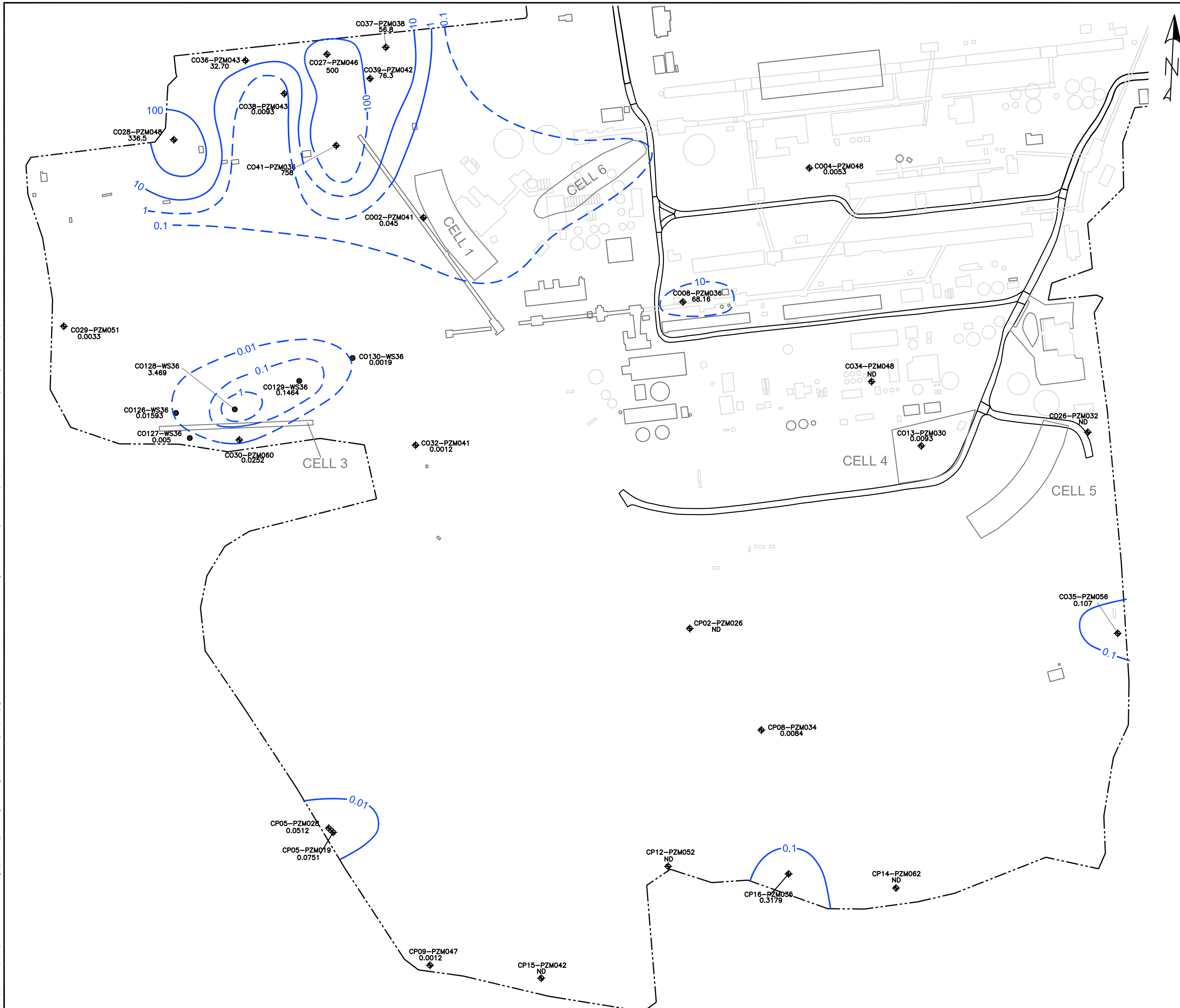
DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

BENZENE CONCENTRATIONS INTERMEDIATE ZONE (MG/L)

PROJECT NO: 14-933

FIGURE 3-11



LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS
- FORMER BUILDINGS
- ROADS
- MONITORING WELL LOCATION
- ISOFLOW GROUNDWATER SAMPLE LOCATION
- 0.0019 BTEX CONCENTRATION (MG/L)
- 0.1 BTEX CONCENTRATION CONTOUR DASHED WHERE INFERRED

NOTES:
1. COKE OVEN AREA WELLS SAMPLED JUNE 2015; COKE POINT LANDFILL WELLS SAMPLED JUNE 2014.
2. ALL RESULTS ARE IN PARTS PER MILLION (PPM).
3. ND – NOT DETECTED. DETECTION LIMITS VARIED FOR INDIVIDUAL ANALYSIS AND ARE REPORTED IN TABLE 3–3.
4. CONTOUR LINES DRAWN USING ISOFLOW SAMPLES ARE DASHED AS SAMPLES WERE TURBID.

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

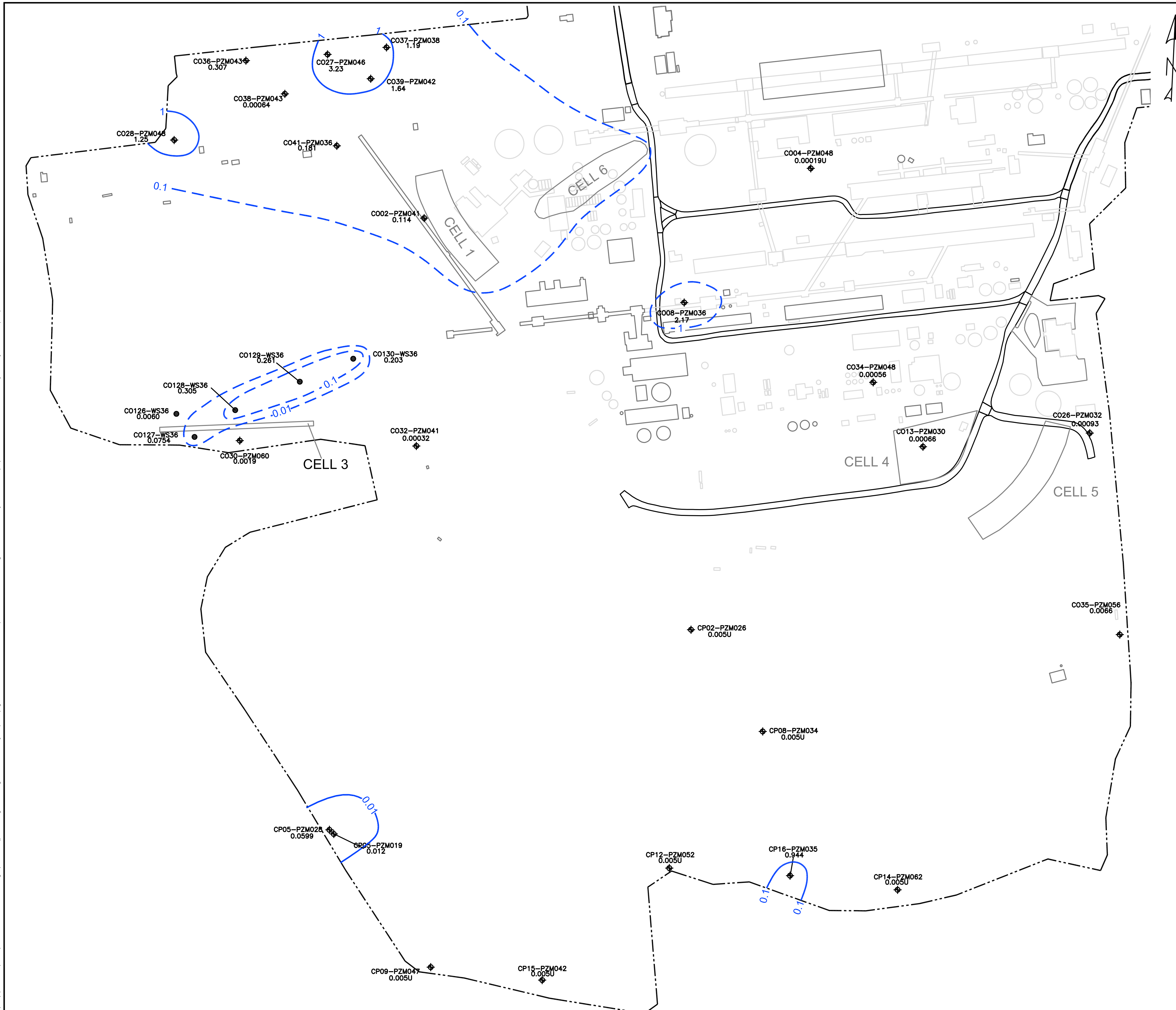
COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

BTEX CONCENTRATIONS INTERMEDIATE ZONE (MG/L)

PROJECT NO: 14–933

FIGURE 3–12

y:\ell\sparrows point\coke oven area drawings\14–933\pre–design investigation summary report\figure 3–12 intermediate btex contours.dwg Last Saved By: Scorner 9/16/2015 12:58 PM Plotted By: Shelly Corner 9/24/2015 2:30 PM Scale: 1:1



LEGEND

PROPERTY BOUNDARY

EXISTING BUILDINGS

FORMER BUILDINGS

ROADS

MONITORING WELL LOCATION

ISOFLOW GROUNDWATER SAMPLE LOCATION

0.0066 NAPHTHALENE CONCENTRATION (MG/L)

0.1 NAPHTHALENE CONCENTRATION CONTOUR DASHED WHERE INFERRED

NOTES:
1. COKE OVEN AREA WELLS SAMPLED JUNE 2015; COKE POINT LANDFILL WELLS SAMPLED JUNE 2014.
2. NAPHTHALENE RESULTS DEPICTED ARE FOR THE MOST RECENT ROUND AVAILABLE (AUGUST, 2011).
3. ALL RESULTS ARE IN PARTS PER MILLION (PPM).
4. CONTOUR LINES DRAWN USING ISOFLOW SAMPLES ARE DASHED AS SAMPLES WERE TURBID.

DRAFT

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/25/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: AEH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

NAPHTHALENE CONCENTRATIONS INTERMEDIATE ZONE (MG/L)

PROJECT NO: 14-933

FIGURE 3-13

APPENDIX A

MONITORING WELL CROSS REFERENCE TABLE (INCLUDING COORDINATES AND ELEVATIONS)

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APPENDIX A
CURRENT AND FORMER MONITORING WELL DESIGNATIONS INCLUDING COORDINATES AND ELEVATIONS

Cell Number	Current Monitoring Well Designation	Previous Monitoring Well Designation	Original Survey		2015 Survey		Top of Casing Elevation (ft)[1]
			Northing	Easting	Northing	Easting	
Cells 1 & 2	CO02-PZM006[2]		1455306.54	562580.28			13.89
	CO02-PZM041[2]		1455309.10	562569.38			13.88
	CO03-PZM005		1455398.33	562990.71			13.53
	CO15-PZM005		1455197.57	562817.33			12.33
	CO16-PZM006		1455420.98	562354.36			12.88
	CO18-PZM006		1455463.84	562722.38			13.57
	CO27-PZM012		1454916.92	563239.97			5.12
	CO27-PZM046		1454913.37	563239.96			5.17
	CO28-PZM010		1454280.62	562891.93			12.34
	CO28-PZM048		1454283.65	562888.76			12.69
	CO36-PZM008	Cell 2-MW1 (S)	563212.31	1454571.76			6.94
	CO36-PZM043	Cell 2-MW8 (I)	563214.49	1454578.37			6.92
	CO37-PZM003	Cell 2-MW2 (S)	563268.52	1455158.69			12.34
	CO37-PZM038	Cell 2-MW9 (I)	563268.50	1455154.68			12.12
	CO38-PZM006	Cell 2-MW3 (S)	563078.80	1454743.79			6.75
	CO38-PZM043	Cell 2-MW10 (I)	563078.33	1454737.75			6.65
	CO39-PZM007	Cell 2-MW4 (S)	563141.66	1455095.70			7.75
	CO39-PZM042	Cell 2-MW11 (I)	563140.07	1455089.80			7.91
	CO40-PZM008	Cell 2-MW5 (S)	563039.41	1455081.70			7.47
	CO41-PZM001	Cell 2-MW6 (S)	562873.18	1454953.00			13.57
	CO41-PZM036	Cell 2-MW12 (I)	562865.34	1454950.75			13.6
	CO42-PZM004	Cell 2-MW7 (S)	563177.72	1455458.51			10.83
	CO79-PZM	BP-MW-02S	562711.28	1455446.84			NA[4]
	CO88-PZM	BP-MW-04	562449.85	1455344.68	562452.16	1455339.41	14.07
	CO121-PZM[3]				563301.93	1455356.12	11.87
	CO122-PZM[3]				563185.36	1455250.14	19.42
Cell 3	CO29-PZM010		1453850.90	562130.61			14.86
	CO29-PZM051		1453832.12	562122.89			13.48
	CO30-PZM015		1454556.55	561657.06	561656.39	1454556.56	12.30
	CO30-PZM060		1454552.77	561656.78	561656.18	1454552.79	13.29
	CO32-PZM004		1456563.71	562496.15			13.73
	CO32-PZM041		1455277.06	561634.59			13.15
	CO101-PZM	Cell 3-1	561680.18	1454815.09	561680.07	1454815.22	12.39
	CO102-PZM	Cell 3-2	561785.11	1454771.22	561785.09	1454771.31	12.88
	CO103-PZM	Cell 3-3	561742.32	1454440.72	561741.99	1454440.73	13.48
	CO104-PZM	Cell 3-4	561670.74	1454145.60	561670.74	1454145.53	13.29

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APPENDIX A
CURRENT AND FORMER MONITORING WELL DESIGNATIONS INCLUDING COORDINATES AND ELEVATIONS

Cell Number	Current Monitoring Well Designation	Previous Monitoring Well Designation	Original Survey		2015 Survey		Top of Casing Elevation (ft)(1)
			Northing	Easting	Northing	Easting	
Cells 4 & 5	CO12-PZM008		1456944.46	561802.37			10.94
	CO13-PZM008		1457359.08	561640.00			12.01
	CO13-PZM030		1457354.36	561632.24			12.15
	CO24-PZM007		1457276.82	562048.18			12.02
	CO25-PZM008		1457594.22	561811.33			12.03
	CO26-PZM007		1458048.05	561682.43			12.76
	CO26-PZM032		1458037.91	561688.42			14.987
	CO34-PZM048		1457149.74	561895.79			NA
	CO55-PZM000	Cell 5-MW1 (S)	561434.42	1457585.90			15.1
	CO56-PZP001	Cell 5-MW2 (S)	561668.41	1457790.05			15.92
	CO57-PZP002	Cell 5-MW3 (S)	561122.52	1457530.00			16.59
	CO58-PZM001	Cell 5-MW4 (S)	561331.31	1457989.13			14.31
	CO59-PZP002	Cell 5-MW5 (S)	561446.98	1457308.79			16.75
	CO60-PZP001	Cell 5-MW6 (S)	561872.55	1457913.36			15.83
	CO105-PZM	CT-MW-01	561624.28	1457351.21	561622.48	1457348.86	14.90
	CO106-PZM	CT-MW-05	561908.79	1457457.34			NA
	CO108-PZM	OBS-7	561576.60	1457397.54			NA
	CO109-PZM	OBS-8	561561.80	1457392.82	561561.44	1457392.87	14.94
	CO110-PZM	OBS-9	561567.80	1457381.81	561567.60	1457381.91	15.43
	CO111-PZM006	OBS-10	561575.91	1457362.74			18.278
	CO112-PZM	AS-2	561575.18	1457382.43	561575.14	1457382.40	14.94
	CO113-PZM004	EXT-2	561583.47	1457376.31			17.69
	CO114-PZM002	Cell 4-1	561568.85	1457350.82			18.825
	CO115-PZM006	Cell 4-2	561591.74	1457392.01			15.04
	CO116-PZM003	Cell 4-3	561600.77	1457407.18			18.4775
	CO117-PZM003	Cell 4-4	561558.50	1457359.72			18.025
	CO118-PZM007	Cell 4-5	561588.27	1457410.51			14.48
	CO119-PZM009	Cell 4-6	561573.65	1457409.54			14.61
	CO120-PZM009	Cell 4-7	561553.02	1457380.03			15.16
	CO123-PZM(3)				561584.33	1457395.77	15.06
	CO124-PZM (3)				561592.12	1457446.48	14.83
	CO125-PZM(3)				561587.03	1457359.84	14.98
	RW22-PZM(3)				571968.28	1456057.32	14.19
	RW23-PZM(3)				572001.04	1456249.52	14.11
	RW24-PZM(3)				572054.52	1456353.05	14.05

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APPENDIX A
CURRENT AND FORMER MONITORING WELL DESIGNATIONS INCLUDING COORDINATES AND ELEVATIONS

Cell Number	Current Monitoring Well Designation	Previous Monitoring Well Designation	Original Survey		2015 Survey		Top of Casing Elevation (ft)[1]
			Northing	Easting	Northing	Easting	
Cell 6	CO04-PZM004		1456891.79	562778.70			12.30
	CO05-PZM006		1457420.75	562838.82			11.01
	CO17-PZM005		1455781.46	562410.52			9.96
	CO19-PZM004		1455909.59	562485.77			13.27
	CO20-PZM004		1457019.09	562530.23			12.75
	CO89-PZM	BP-MW-05	562619.76	1455839.78	562619.27	1455837.02	13.46
	CO90-PZM	BP-MW-06	562576.60	1455879.37	562576.01	1455876.59	13.32
	CO91-PZM	BP-MW-07	562665.49	1455815.26	562664.82	1455812.91	13.21
	CO92-PZM	BP-MW-08	562656.19	1455944.92	562655.65	1455942.45	14.69
	CO93-PZM	BP-MW-09	562512.74	1455771.46	562511.91	1455769.43	12.12
	CO94-PZM	BP-MW-10	562725.24	1456035.29	562724.81	1456032.31	14.32
	CO95-PZM	BP-MW-11	562842.58	1456189.45	562846.24	1456180.11	15.60
	CO96-PZM	RW-1	562623.30	1455855.84	562623.28	1455855.84	13.64
	CO97-PZM	RW-2	562641.30	1455884.38	562641.10	1455884.25	14.11
	CO98-PZM	RW-3			562621.86	1455816.85	11.49
	CO99-PZM	RW-4			562598.12	1455885.15	11.80
	CO100-PZM	RW-5			562610.55	1455726.50	12.27
	CO126-PZM[3]				562750.98	1455962.01	14.65
	CO127-PZM[3]				562807.24	1456091.19	14.55
	CO128-PZM[3]				Not surveyed	Not surveyed	Not surveyed

Notes:

1 Top of casing elevation based on 2105 survey if well was resurveyed. Elevations based on North American Vertical Datum of 1988.

2. Well destroyed and re-installed. Survey information presented in this table is therefore suspect and could not be used.

3. Well installed in 2015 during Pre-Design Investigation

4. NA - Not Available.

APPENDIX B

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS
2015 PRE-DESIGN INVESTIGATION

BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Gray grading to dark brown, silty slag FILL, some coal fines, trace clay, disk of green fiberglass sheeting at 0.2'	16/24	16	0.2		
1				18	0.4		Nominal 6" Borehole
		No Recovery		28	0.2		
2				49	N/A		
3							
4							Portland Cement & Bentonite Grout
5		Dark grayish brown, silty, f. to m. slag FILL, some bluish gray staining	10/24	11	1.3		
6		No Recovery		6	1.1		
				4	N/A		
7				5	N/A		
8							
9							

NOTES:

DRAFT

BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Light blue, granular FILL material, few white c. granules, iridescent sheen, aromatic odor noted	7.5/24	9	2.6		
		Gray, silty, c. slag with sheen		4	N/A		
11		No Recovery		5	N/A		
				7	N/A		
12							
13							
14							
15		Light to dark grayish blue, granular FILL material, some f. to m. slag, few white c. granules, sheen noted, some aromatic odor	15/24	5	1.8		
16				6	3.9		
		No Recovery		8	1.0		
17				7	N/A		
18							
19							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20-22		Light to dark grayish blue, granular FILL material, some slag, faint aromatic odor	24/24	8 8 9 10	1.6 1.6 0.5 0.4		
22-25							
25-27		No Recovery	0/24	13 14 9 10	N/A N/A N/A N/A		
27-30							

NOTES:

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BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
30		Dark gray, native SILT, iridescent sheen, liquified	17/24	11	0.2		
31				12	0.2		
		Dark gray, Sandy SILT, blue staining, dense black shiny rock at base, faint odor		14	0.2		
32		Dark greenish brown, Silty, m. SAND, black streaks, some aromatic odor		30	0.3		
33							
34							
35		Dark bluish gray, sticky CLAY, some shell fragments, trace c. sand	5"/3"	50/3"	1.0		
		Dark greenish brown, Silty, m. SAND, iron oxide stains at base, faint aromatic odor			N/A		
36		Refusal			N/A		
					N/A		
37							
38							
39							

NOTES:

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BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
40		Brown, Silty, m. to c. SAND, gray sandy clay lens at 40.9'-41.2', stains above clay: 0.5" iron oxide; 1.5" v. dk. brown; 1.25" greenish gold; and 1.5" v. dk brown with some iron oxide, black staining below clay	24/15	14	1.7		
41				30	3.3		
		Tan, Silty, m. to c. SAND, dark greenish brown stains at top and bottom		50/3"	1.4		
		Refusal			N/A		
42							
43							
44							
45		Dark brownish gray, Silty, c. SAND, red mudstone at bottom	24/23	12	3.4		
		White, Silty, v.f. SAND, pale blue staining throughout, greenish gold stain near top					
46		Gray CLAY with blue stains		24	0.5		
		Light gray, v.f. SAND, dark gray streaks, aromatic odor noted		32	N/A		
				50/5"	N/A		
47		Refusal					
48							
49							

NOTES:

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BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
50		Dark gray, Silty, f. SAND, pinkish with grayish blue stains at top, aromatic odor	19/16	12	0.8		
51		Light gray grading to greenish gold and then dark greenish gray, Silty, f. SAND		26	0.5		
		Refusal		50/4"	2.6		
52					N/A		
53							
54							
55		Medium brownish gray, Silty, f. SAND, liquified at top, some dark buish gray, olive green, and dark gray staining, faint aromatic odor	24/23	15	2.1		
56				20	1.5		
				30	0.6		
57		Refusal		50/5"	1.5		
58							
59							

NOTES:

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BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
60		Medium brownish gray, Silty, f. SAND, some dark blue and dark gray staining	4/9	16	1.5		
61		No Recovery and Refusal		50/3"	N/A		
					N/A		
					N/A		
62		Top of Clay Seam between 62' and 63'					
63							
64							
65		Pinkish gray and dark reddish orange CLAY, very stiff, barely moist	11/24	6	0.0		
66		No Recovery		16	0.0		
				30	N/A		
				40	N/A		
67		Light gray CLAY, extensive pink, dark reddish orange, and ochre yellow blotching, very stiff, barely moist	14/24	6	0.0		
68				12	0.0		
		No Recovery		20	0.0		
69				30	N/A		
							Shelby Tube 69'-71'

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO121-SB075

DATE DRILLED: 5/24-6/8/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455360.0072 N: 563318.6783	ELEVATION: GND SURF: 8.32 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 75 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
70							
70.7–71		Same CLAY at bottom of Shelby Tube					
71							
72							
73							
74							
74.7–75		Same CLAY at auger bottom					Overdrilled to 75'
75							

NOTES:

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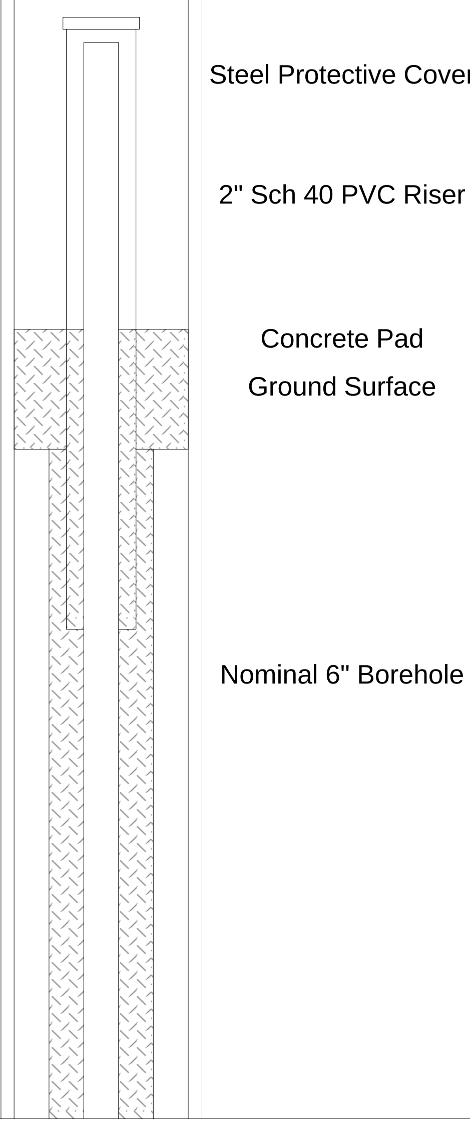
BOREHOLE LOG:
WELL LOG: CO122-PZMXXX
DATE DRILLED: 4/22/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1455250.1448 N: 563185.359	ELEVATION: GND SURF: 16.42 ft TOC: 19.42 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
4							
3							Steel Protective Cover
2							2" Sch 40 PVC Riser
1							Concrete Pad
0		Brown silty FILL with some clay, plant roots, and many taconite pellets	22/72	N/A	0.0		Ground Surface
1					0.0		
2					0.0		Nominal 6" Borehole
3					0.0		
4					0.0		
5		Brown silty FILL with some clay, taconite pellets throughout, seam of white, c. sand at 1.4', some iron staining at 8.75'			0.0		
6							



NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG:
WELL LOG: CO122-PZMXXX
DATE DRILLED: 4/22/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1455250.1448 N: 563185.359	ELEVATION: GND SURF: 16.42 ft TOC: 19.42 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
			107/120		0.0		
7					0.0		Bentonite Seal
8					0.0		
9					0.0		
10		Orangish-brown, clayey FILL, some silt, iron stained, no taconite			0.0		
		Brown, silty, angular, v.c. to c. gravel FILL, some clay					
11		Tan and light gray, silty, c. sand and c. to v.c. gravel FILL			0.0		#2 Quartz Sand
12					26.7		
13		Orangish-brown, silty, angular, c. to v.c. gravel FILL			0.0		
14					0.0		
15		Bluish-gray, silty gravel FILL, strong aromatic odor			30.5		
		Light gray slag FILL, strong aromatic odor noted					
16							

NOTES:

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BOREHOLE LOG:
WELL LOG: CO122-PZMXXX
DATE DRILLED: 4/22/15

ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1455250.1448 N: 563185.359	ELEVATION: GND SURF: 16.42 ft TOC: 19.42 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Slate gray, silty c. sand and c. to v.c. gravel FILL, saturated with black free product at 16'-18.4', possible colorless product at 18.4'-18.8', strong aromatic odor noted, color change to dark bluish gray at 18.8'-21.9',	105/120		38.5		
17					915.0		2" Sch 40 PVC 10-Slot Screen
18					24.8		
19					4.3		
20					13.7		
21					3.6		
22		Dark bluish gray, silty, gravel FILL with some white, c. grains, no odor noted			1.8		
23					0.8		
24					0.0		Bentonite Plug
25					0.5		
26							

NOTES:

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BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Sample Description	Recov	Blow Count	PID	Completion Description
0–1.8	Beige, silty FILL, processed mineral pile	20.5/24	WTH	5.6	Nominal 6" Borehole
			WTH	10.0	
			WTH	12.6	
1.8–2.0	Black slag FILL, plant fibers and rusty metal		5	5.4	
5.0–5.2	Light brown, f. sandy, silty FILL	9/9	17	1.3	Portland Cement & Bentonite Grout
5.2–5.9	Very dark brown, silty, m. sand and angular f. to m. slag FILL, dark purple-red and black stains at bottom		50/3"	3.1	
5.9–7.0	Refusal		N/A	N/A	
			N/A	N/A	

NOTES:

DRAFT

BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10	🟩	Brownish black, silty, angular, f. to m. slag FILL, some f. sand, some odor noted	14.5/24	24	1.5		
11	🟩	Dark orangish red grading to dark purple-red, silty, angular, f. to m. slag FILL, some f. sand		26	1.9		
		No Recovery		14	2.1		
12				12	N/A		
13							
14							
15	🟩	Blackish brown, silty, f. to c. sand and f. to m. coal/coke FILL	20.5/24	8	2.6		
16	🟩	Dark grayish brown, silty, f. to c. sand and angular, f. to m. gravel FILL		15	1.7		
				25	1.2		
17				25	1.1		
18							
19							

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20		Dark grayish brown, silty, f. to c. sand and angular, f. to m. gravel FILL	6/24	9	19.7		
21		No Recovery		14	N/A		
				10	N/A		
22				12	N/A		
23							
24							
25		Very dark brown, silty, f. to c. sand and angular, f. gravel FILL, purple tint, slight aromatic odor	14/16	15	0.8		
26				30	1.2		
		Refusal		50/4"	2.1		
27				N/A	N/A		
28							

NOTES:

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BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
29							
30		V. dk brown, silty, f. to c. sand and f. gravel FILL, purple tint, slight aromatic odor	4/4	50/4"	1.7		
31		Refusal		N/A	N/A		
				N/A	N/A		
				N/A	N/A		
32							
33							
34							
35		No Recovery and Refusal	0/4	50/4"	N/A		
36				N/A	N/A		
				N/A	N/A		
				N/A	N/A		
37							
38							

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
39							
40		Black, silty, f. to c. sand and f. gravel FILL, purple tint, slight aromatic odor	15/14	8	2.7		
		SAA with m. to c. slag, fire brick and coal					
41		Black, silty, sand and f. gravel FILL, aromatic odor noted		28	4.7		
				50/2"	1.2		
		Refusal		N/A	N/A		
42							
43							
44							
45		Dark purple-brown, f. sandy silt FILL, some f. to m. gravel, slight aromatic odor	7.5/24	9	0.5		
		Blackish brown, silty clay FILL, some m. sand and f. to m. gravel		22	7.3		
46		No Recovery		30	N/A		
				42	N/A		
47							

NOTES:

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BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
48							
49							
50		Black, silty, f. to c. gravel FILL, some f. sand, sine dark bluish gray staining, slight aromatic odor	15/24	19	1.8		
51				24	1.3		
		No Recovery		34	2.4		
52				6	N/A		
53							
54							
55		White, native, v.f. SAND, dark gray stain at top, 1.5" pale orange grading to dark yellowish brown at bottom, faint arom. odor	12/24	8	1.1		
		Dark red CLAY, dense and stiff					
56				8	0.2		
		No Recovery		8	N/A		
57				9	N/A		

NOTES:

DRAFT

BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
58							
59							
60		Red and yellowish brown, Silty, m. SAND	23/24	7	0.0		
61		Red, buff, very light gray, and ochre yellow mottled CLAY, dense and stiff		14	0.0		
				21	0.0		
62				24	0.0		Shelby Tube 62'-62.3' Red/Gray Clay at Base
63							
64							
65		Red, light gray, and yellowish brown mottled CLAY, dense and stiff	24/24	17	0.0		
66				21	0.0		
				35	0.0		
67				48	0.0		

NOTES:

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BOREHOLE LOG: CO123-SB072

DATE DRILLED: 6/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454470.6906 N: 563223.0177	ELEVATION: GND SURF: 5.37 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 72 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
68							Shelby Tube 67'-68.3' Red/Gray Clay at Base
69							
70–72		Red, light gray, and yellowish brown mottled CLAY, dense and stiff	24/24	18 26 37 42	0.0 0.0 0.0 0.0		

NOTES:

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BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Black FILL, clayey coal fines					
		Grayish brown, f. sandy and silty FILL, some f. gravel	8/8	35	0.0		
1				50/2"	N/A		Nominal 6" Borehole
		Refusal		N/A	N/A		
2				N/A	N/A		
3							
4							Portland Cement & Bentonite Grout
5		Yellowish brown, clayey and silty FILL, some coal and coal fines	17/24	6	5.2		
6		Brownish black, f.to c. sandy and silty FILL, some m. coal		10	0.5		
				12	0.2		
		No Recovery		14	N/A		
7							
8							
9							

NOTES:

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BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10			0/8	13	N/A		
11		No Recovery and Refusal		50/2"	N/A		
				N/A	N/A		
				N/A	N/A		
12							
13							
14							
15			0/24	9	N/A		
16		No Recovery		7	N/A		
				6	N/A		
17				5	N/A		
18							
19							

NOTES:

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BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20		Black, silty, f. to c. sand and f. to c. gravel FILL, faint aromatic odor	9/11	5	0.4		
21		Refusal		50/5"	0.4		
				N/A	N/A		
22				N/A	N/A		
23							
24							
25		Unable to sample - drilling rods jammed on gritty fill materials - cannot be extracted to insert sampler - augered ahead	N/A	N/A	N/A		
26				N/A	N/A		
				N/A	N/A		
27				N/A	N/A		
28							
29							

NOTES:

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BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
30–32		Unable to sample - drilling rods jammed on gritty fill materials - cannot be extracted to insert sampler - augered ahead	N/A	N/A N/A N/A N/A	N/A N/A N/A N/A		
32–35							
35–37		Blackish brown, silty, f. to c. sand and f. gravel FILL, some dark grayish blue staining, aromatic odor noted Very light gray, native, Silty, v.f. SAND White, Silty CLAY, gray and blue stains No Recovery	15/24	10 4 26 16	2.0 2.2 N/A N/A		
37–40							

NOTES:

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BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
40		Dark pink, Silty CLAY					
		Very dark olive green, Silty, f. to m. SAND, v.f. shell fragments throughout, 1" black residual product lens at 40.8', gray stainingg at 41.3'-41.7', dark blue and black stains at 41.8'-41.9', aromatic odor noted	24/24	4	2.6		
41				18	1.9		
				24	10.5		
42		Light greenish gray, Silty, "SAND", grainy texture (possible ooids), trace clay		23	5.8		
43							
44							
45		White, Silty, v.f. SAND, white silty clay lens at bottom, few very thin dark gray bands at 45.2'-45.3', dark grayish blue and light gray stains throughout	11/11	30	10.4		
46				50/5"	13.6		
		Refusal		N/A	N/A		
47				N/A	N/A		
48							
49							

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
50		White, Silty, v.f. SAND, dark grayish blue and gray stains throughout, aromatic odor	11/15	10	2.8		
		Medium gray, f. SAND, some silt, dark blue and dark gray stains throughout		47	0.3		
51		No Recovery and Refusal		50/3"	N/A		
				N/A	N/A		
52							
53							
54							
55		Medium gray, f. SAND, some silt, aromatic odor	16/15	17	4.4		
56				34	0.8		
		Refusal		50/3"	0.3		
				N/A	N/A		
57							
58							
59							

NOTES:

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BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
60		Medium gray, f. SAND, some silt, dark gray stains at bottom, faint aromatic odor	14.5/20	15	0.0		
61		Medium gray grading to peach colored, Silty, v.f. to f. SAND		17	1.6		
		Dark red and light gray mottled CLAY, dense and stiff		20	0.6		
62		No Recovery and Refusal		50/2"	N/A		
63							
64		Dark red, pink, and very light gray mottled CLAY, dense and stiff	5/24	8	0.0		
		No Recovery		17	N/A		
65				22	N/A		
				34	N/A		Shelby Tube 65.5'-65.8' Gray/Red Clay at Base
66		Light gray, dark red, and ochre yellow CLAY, dense and stiff	19/24	12	0.0		
67				24	0.0		
				36	0.0		
68		No Recovery		44	N/A		
69							

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO124-SB073

DATE DRILLED: 6/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1454325.6893 N: 562716.5684	ELEVATION: GND SURF: 9.17 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 73.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
70–72		Light gray, dark red, and ochre yellow CLAY, dense and stiff	22/24	12 24 31 37	0.0 0.0 0.0 0.0		
72–73							Shelby Tube 72'-73.5' Gray/Red Clay at Base
73–73.5		Light gray, dark red, and ochre yellow CLAY, dense and stiff					

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Black FILL of coal fines, trace f. gravel	13/24	4	0.2		
1		Brown, silty, c. sand and f. to c. slag FILL, some coal fines at bottom		10	1.3		Nominal 6" Borehole
		No Recovery		12	N/A		
2				12	N/A		
3							
4							Portland Cement & Bentonite Grout
5		Brown, silty, c. sand and f. to c. slag FILL	7/11	3	0.3		
6		No Recovery and Refusal		50/5"	N/A		
				N/A	N/A		
7				N/A	N/A		
8							
9							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Brown, silty, m. sand and f. to m. gravel FILL	7/8	2	0.2		
11		Refusal		50/2"	N/A		
				N/A	N/A		
				N/A	N/A		
12							
13							
14							
15		Black, silty slag FILL, some aromatic odor	2/24	7	74.0		
16		No Recovery		4	N/A		
				3	N/A		
				4	N/A		
17							
18							
19							

NOTES:

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BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20		Light to medium gray, f. to c. slag and granular FILL, some white c. granules	18/24	5	156.0		
21		Black, native SILT, black residual product		3	343.0		
		Pinkish brown CLAY, soft and malleable, some black residual product, strong aromatic odor		2	33.8		
				1	105.0		
22							Shelby Tube 22'-24' Sand at Base
23							
24		Greenish gray, Silty, f. SAND	18/24	2	7.7		
		Pinkish brown CLAY, soft and malleable		2	256.0		
25		Greenish gray, Silty, f. SAND, strong aromatic odor		5	296.0		
				9	419.0		
26							
27							
28							
29							

NOTES:

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BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
30		Brown, Silty, f. to m. SAND	16/15	6	11.8		
		Reddish brown, Silty, f. to m. SAND, dark stain with aromatic odor at bottom		29	7.0		
31		Bright yellowish brown grading to pinkish orange, m. Sandy SILT		50/3"	12.3		
		Refusal		N/A	N/A		
32							
33							
34							
35		Ochre yellow grading to pinkish orange, Silty, f. to m. SAND, sweet aromatic odor noted	24/21	3	86.1		
36				6	52.7		
				10	151.0		
		Refusal		50/3"	33.2		
37							
38							
39							

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
40		Light gray, Silty, f. SAND, 1.25" ochre yellow coated rock at base, aromatic odor	22/24	3	18.1		
41				10	123.0		
		White, stiff, Silty CLAY, trace brown rock fragments at center		10	218.0		
42		Light gray, Silty f. to m. SAND, trace clay		15	136.0		
43							
44							
45		White, stiff, Silty CLAY	16/24	5	1.0		
46				7	0.9		
		No Recovery		7	1.9		
47				9	N/A		Shelby Tube 47'-49' Silty Clay at Base
48							
49							

NOTES:

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BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
50		White, stiff, Silty CLAY, some pockets of orange sand at 50.7'-51.2'	24/24	7	11.9		
51				24	6.8		
		Brownish white, Silty, f. SAND, few interbedded white silty clay lenses, dark gray staining at top, aromatic odor noted		22	12.6		
52				20	47.0		
53							
54							
55		White, soft, Silty CLAY, some very small oily blebs, aromatic odor	16/11	9	3.6		
		Brownish white, Silty, f. SAND					
56				50/5"	34.9		
		Refusal		N/A	N/A		
57				N/A	N/A		
58							
59							

NOTES:

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BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
60		Brownish white, Silty, f. SAND					
		White, Silty CLAY, soft, small olive green and brown blebs throughout, aromatic odor noted	21/21	9	2.9		
61				15	10.8		
		Same white, Silty, f. SAND, dk gray stains		30	42.1		
		Refusal		50/3"	24.5		
62							
63							
64							
65		Very light grayish brown, Silty, f. SAND, few 1/8" light pinkish brown clay lenses, trace black organic material and possible oil blebs at 65.5'-65.6'	10/15	7	0.6		
66				30	0.3		
		No Recovery and Refusal		50/3"	N/A		
				N/A	N/A		
67							
68							
69							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION

PROJECT: SPARROWS POINT PDI
SITE LOCATION: SPARROWS POINT, MD
PROJECT NO: 14933
FIELD GEOLOGIST: B. HAMEL
PROJECT MANAGER: A. BRIGGS
COORDINATES: E: 1455116.4021 N: 562906.5027
DATUM: STATE PLANE MARYLAND NAD83/NAVD88

DRILLING INFORMATION

DRILLING CO: TRIAD ENGINEERING, INC.
DRILLER: HAROLD BROWN
DRILLING RIG / METHOD: CME 55 / AUGER
HAMMER WT./DROP: 140# / 30"
SAMPLING METHOD: SPLIT SPOON
ELEVATION: GND SURF: 9.55 ft TOC: N/A
TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
70		Very light grayish brown grading to brownish white, Silty, f. SAND, trace 1/8" light pinkish brown clay lenses	10/15	7	0.0		
71		No Recovery and Refusal		6	0.0		
				50/3"	N/A		
72				N/A	N/A		
73							
74							
75		Light grayish brown, Silty, f. SAND	15/24	12	0.0		
		Brownish white, Silty, f. to m. SAND interbedded with 0.1"-0.9" pinkinsh white clay lenses, ochre yellow, reddish brown, and orange staining throughout					
76				12	0.0		
				19	0.0		
		No Recovery		24	N/A		
77							
78							
79							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO125-SB087

DATE DRILLED: 6/2-4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TRIAD ENGINEERING, INC.
SITE LOCATION: SPARROWS POINT, MD	DRILLER: HAROLD BROWN
PROJECT NO: 14933	DRILLING RIG / METHOD: CME 55 / AUGER
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: 140# / 30"
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: SPLIT SPOON
COORDINATES: E: 1455116.4021 N: 562906.5027	ELEVATION: GND SURF: 9.55 ft TOC: N/A
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 87 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
80-82		Very light brownish gray CLAY, stiff texture, extensive pink, dark red, and yellowish brown mottling	22/24	15 20 30 35	0.0 0.0 0.0 0.0		Shelby Tube 82'-82.6' Same Clay at Base
82.6-84.6		Dark red CLAY, some light gray mottling, very stiff	21/24	15 20 35 42	0.0 0.0 0.0 0.0		
85-86.7		Dark red CLAY, some light gray mottling, very stiff	17/24	6 20 30 30	0.0 0.0 0.0 0.0		
86.7-87		No Recovery					

Depth scale: 80, 81, 82, 83, 84, 85, 86, 87

NOTES:

DRAFT

BOREHOLE LOG: CO126-SB036

DATE DRILLED: 4/27/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Pale yellowish brown, silty FILL, grainy texture, some coal fines noted, dark yellow spots throughout Black, FILL of f. to m. coal and coal fines	70/72	N/A	0.7		Nominal 6" Borehole
1		Iron oxide stained, silty, f. to v.c. gravel FILL			1.0		
2					0.3		
3		Brown, silty, f. to v.c slag FILL, some clay, hint of reddish color at 4.1'-4.9'			0.3		
4		Moist @ ~3.5'			0.2		Portland Cement & Bentonite Grout
5					0.4		
6		Reddish brown, clayey, f. to c. slag FILL, some silt	73/60		0.0		
7					0.0		
8		Grayish brown, silty gravel FILL			0.0		
9					0.0		

NOTES:

DRAFT

BOREHOLE LOG: CO126-SB036

DATE DRILLED: 4/27/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Grayish brown, silty gravel FILL, faint odor noted			3.2		
11		Brown, silty, f. to v.c. slag FILL, few brick fragments, gritty texture, no odor noted	42/60		N/A		
12					N/A		
13					N/A		
14		Water Table @ ~14.5'			N/A		Water Sample: CO126-WS14.3
15		Brown, clayey and silty FILL, some f. to m. gravel, slight aromatic odor			N/A		
16		Dark grayish brown, silty gravel FILL, some clay, strong aromatic odor throughout	125/120		N/A		
17					N/A		
18					N/A		
19					N/A		

NOTES:

DRAFT

BOREHOLE LOG: CO126-SB036

DATE DRILLED: 4/27/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20		Dark grayish brown, silty gravel FILL, some clay, lens of light gray clay in "chip" form at 21.9'-22.2', 3" lens of fragmented orangish brown sandstone at 29.0'-29.4', darker gray color at 26.0'-26.5', strong aromatic odor throughout	122/120		N/A		
21					N/A		
22					N/A		
23					N/A		
24					N/A		
25					N/A		Water Sample: CO126-WS25
26					N/A		
27					N/A		Sudan IV test Result Positive
28					N/A		
29					N/A		

NOTES:

DRAFT

BOREHOLE LOG: CO126-SB036

DATE DRILLED: 4/27/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
30–34		Dark grayish green, native, Silty CLAY, 15% shell fragments (one complete oyster shell noted)			N/A, N/A, N/A, N/A		
34–36		Dark grayish green, Silty, m. SAND, some shell fragments			N/A, N/A		Water Sample: CO126-WS35

NOTES: DRAFT

BOREHOLE LOG: CO127-SB036

DATE DRILLED: 4/28/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Grayish brown, silty, m. sand and m. to v.c. slag FILL, no odor noted	68/72	N/A	N/A		Nominal 6" Borehole
1		Orangish brown, silty, m. sandy FILL, some m. to v.c. gravel, no odor noted			N/A		
2					N/A		
3					N/A		
4		Moist @ ~4.5'			N/A		Portland Cement & Bentonite Grout
5		Orangish brown, silty, m. sandy FILL, some m. to v.c. gravel, iron oxide stained sandy lens at 8.3'-8.8', no odor noted			N/A		
6			99/108		N/A		
7					N/A		
8					N/A		
9					N/A		

NOTES:

DRAFT

BOREHOLE LOG: CO127-SB036

DATE DRILLED: 4/28/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9.5–10		Dark brownish gray, clayey, silty FILL, possible colorless free product at 9.5'-10.0'	112/132				
10		Dark brownish gray, clayey, silty FILL, some m. sand and m. to c. slag, strong aromatic odor throughout			N/A		
11					N/A		
12					N/A		
13					N/A		
14		Water Table @ ~14.0'			N/A		Water Sample: CO127-WS14
15		Dark brownish gray, clayey, silty FILL, some m. sand and m. to c. slag, strong aromatic odor throughout			N/A		
16					N/A		
17					N/A		
18					N/A		

NOTES: DRAFT

BOREHOLE LOG: CO127-SB036

DATE DRILLED: 4/28/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
19					N/A		
20		Dark brownish gray, clayey, silty FILL, some m. sand and m. to c. slag, clay lens at 21.9'-22.3', strong aromatic odor throughout			N/A		
21					N/A		
22		Very dark brownish black, silty, m. sandy FILL, strong aromatic odor noted			N/A		
23		Very dark gray to black, silty, clayey FILL, clay lenses present at 26.0'-29.4', strong to very strong aromatic odor noted			N/A		
24					N/A		
25					N/A		Water Sample: CO127-WS25
26			109/120		N/A		
27					N/A		
28							

NOTES:

DRAFT

BOREHOLE LOG: CO127-SB036

DATE DRILLED: 4/28/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
28.5–29.5					N/A		
29					N/A		
29.5–31.75		Dark gray, native, Silty CLAY, 15% shell fragments, no impact noted			N/A		
31					N/A		
31.75–35.2		Dark gray, Silty, m. SAND, 10% shell fragments, no impact noted			N/A		
33					N/A		
34					N/A		Water Sample: CO127-WS35
35.2–36		Light brownish gray, f. Sandy CLAY, very stiff, no impact noted			N/A		

NOTES:

DRAFT

BOREHOLE LOG: CO128-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, m. to c. sand and semi-angular, f. to c. slag FILL, black coal fines throughout at 0.4'-2.5', iron oxide staining at 4.3'-4.5', no odor noted	74/72	N/A	0.0		Nominal 6" Borehole
1					0.9		
2					0.2		
3					0.2		
4					0.1		Portland Cement & Bentonite Grout
5		Moist @ ~5.0'			0.1		
6		Brown, silty, m. to c. sand and semi-angular, f. to c. slag FILL, no odor noted	123/108		0.1		
7					0.1		
8					0.1		
9							

NOTES: DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO128-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9–10					12.2		
10–14		Brown grading to very dark brownish gray at 12.1', silty, m. to c. sand and semi-angular, f. to c. slag FILL, strong aromatic odor			202.0 344.0 77.7 78.5		
14–15		Water Table @ ~14.5'			397.0		Water Sample: CO128-WS14.5
15–18		Very dark brownish gray, silty, c. sand and f. to v.c. slag FILL, strong aromatic odor at 19.5'-20.0'	133/132		10.9 82.9 52.3		

NOTES:

DRAFT

BOREHOLE LOG: CO128-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					18.0		
19					164.0		
20					25.9		
21					148.0		
22					168.0		
23					377.0		
24		Very dark brownish gray, silty, c. sand and f. to v.c. slag FILL, apparent colorless oil at 22.3'-26.0', strong aromatic odor at 20.5'-28.0'			125.0		
25					117.0		Water Sample: CO128-WS25
26			117/120		198.0		
27							

NOTES: DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO128-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					105.0		
28					14.9		
29		Medium brownish gray, native Silty CLAY, trace to some v.c. gravel, stained dark gray to black, aromatic odor noted			2.4		
30		Medium brownish gray, Silty CLAY, trace to some v.c. gravel, dark gray to black stains and streaks, aromatic aromatic odor noted			4.8		
31		Light grayish brown, Silty, f. to m. SAND			2.1		
32					1.1		
33					1.3		
34					0.5		
35		Medium yellowish brown, Silty, f. to m. SAND, trace rounded, f. to m. gravel			0.7		Water Sample: CO128-WS35
36							

NOTES: DRAFT

BOREHOLE LOG: CO129-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			91/72	N/A	0.3		
1					0.8		Nominal 6" Borehole
2					0.7		
3		Dark grayish brown, silty, f. to c. sand and f. to m. gravel FILL, coal fines throughout at 1.8'-2.4'			0.4		
4					0.4		Portland Cement & Bentonite Grout
5					0.4		
6		Damp @ ~6.0'	91/108		0.1		
7					0.2		
8		Dark grayish brown, silty, f. to c. sand and f. to m. gravel FILL, some clay at 8.7'-10.0', aromatic odor increasing with depth			0.2		
9					2.4		

NOTES:

DRAFT

BOREHOLE LOG: CO129-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Dark grayish brown, silty, f. to c. sand and f. to m. gravel FILL, some clay, strong aromatic odor noted			17.9		
11					1.7		
12					8.9		
13		Water Table @ ~14.5'			7.3		
14					47.9		Water Sample: CO129-WS14.5
15			119/132		10.7		
16					32.8		
17		Dark grayish brown, silty, f. to c. sand and f. gravel FILL, some v.c. pieces of brick at 12.4'-15.0', seam of orange clayey silt at 19.8'-20.0', strong aromatic odor			11.0		
18					34.7		
19					102.0		

NOTES:

DRAFT

BOREHOLE LOG: CO129-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20		Dark grayish brown, silty, f. to c. sand and f. gravel FILL, v. c. piece of rock at 20.4', strong aromatic odor			39.0		
21					55.0		
22					141.0		
23					101.0		
24					31.3		
25					61.5		Water Sample: CO129-WS25
26		Black, silty, f. to c. sand and rounded, f. to m. gravel FILL, strong aromatic odor	121/120		23.1		
27		Dark gray, native, Silty CLAY, some oyster shells, black residual staining with aromatic odor at 27.0'-27.7'			7.0		
28		Tan to buff colored, Silty, f. SAND, very dark greenish gray staining at 28.1'-29.9' with aromatic odor noted			1.3		
29					1.2		

NOTES:

DRAFT

BOREHOLE LOG: CO129-SB036

DATE DRILLED: 5/4/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
30					2.0		
31		Tan to light brown, Silty, f. to m. SAND, no impact noted			0.6		
32					0.3		
33					0.3		
34		Orangish brown, Silty, c. SAND, no impact noted			0.3		
35		Buff colored, Silty CLAY, some m. sand in pockets			0.3		Water Sample: CO129-WS35
36							

NOTES:

DRAFT

BOREHOLE LOG: CO130-SB036

DATE DRILLED: 5/5/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, f. to c. sand and f. to v.c. gravel FILL, coal fines mixed in at 0.7'-1.8' and 2.6'-6.0'	80/72	N/A	0.3		Nominal 6" Borehole
1					1.9		
2					0.9		
3					1.4		
4					1.1		Portland Cement & Bentonite Grout
5					0.4		
6		Damp @ ~6.0'	104/108		0.2		
7		Brown, silty, f. to c. sand and f. to v.c. gravel FILL			0.3		
8					0.4		
9		Dark brownish gray, silty, f. to c. sand and f. to v.c. gravel FILL, faint aromatic odor noted			3.0		
10							

NOTES:

DRAFT

BOREHOLE LOG: CO130-SB036

DATE DRILLED: 5/5/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					3.2		
11					6.2		
12		Dark brownish gray grading to very dark gray at 11.5', silty, f. to c. sand and f. to v.c. gravel FILL, aromatic odor noted			3.2		
13					8.6		
14					1.6		Water Sample: CO130-WS14.5
15		Wet @ ~14.5'	128/132		0.2		
16					0.3		
17					0.5		
18		Very dark gray, silty, f. to c. sand and f. to v.c. gravel FILL with seams of sandy versus gravelly material, faint aromatic odor noted			1.0		
19					1.6		
20							

NOTES:

DRAFT

ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO130-SB036

DATE DRILLED: 5/5/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20–22		Very dark gray, silty, f. to c. sand and f. to v.c. gravel FILL with seams of sandy versus gravelly material, aromatic odor noted			7.0, 63.0		
22–25		Very dark gray, native, Silty CLAY, some shells, some sand in pockets, 2" lens of plant fibers at 23.0'			10.6, 8.5, 9.0		
25–27.1		Greenish brown, Silty, f. to m. SAND, some shells, very dark gray residual streaks, aromatic odor noted	127/120		7.3, 1.5		Water Sample: CO130-WS25
27.1–28		Orangish brown, Silty, f. SAND, some rounded, f. to m. gravel, trace very dark gray residual stains, faint aromatic odor			0.6		
28–29.4		Buff colored, Silty CLAY, some sand in pockets, no impact noted			0.3, 0.3		
29.4–30		Tan, Silty, m. to c. SAND					

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO130-SB036

DATE DRILLED: 5/5/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Tan, Silty, m. to c. SAND			0.3		
31		Light brown, Silty, f. SAND, mottled with orange and gray			0.2		
32					0.2		
33					0.2		
34		Orangish tan, Silty, f. to c. SAND, some buff colored clay rip-up clasts			0.2		
35					0.2		Water Sample: CO130-WS35
36							

NOTES:

DRAFT

BOREHOLE LOG: CO131-SB017

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			48/84	N/A	0.0		
1					0.0		Nominal 6" Borehole
2					0.0		
3		Brown, clayey, silty FILL with 30-40% taconite pellets throughout, pellets coated with iron oxide veneer below 2'			0.0		
4					0.0		Portland Cement & Bentonite Grout
5					0.0		
6					0.0		
7		Very dark gray, silty, angular slag FILL	143/120		4.7		
8		Black, silty, c. to v.c. gravel FILL, residual product at 7.0'-9.9', possible free product at 9.9'-10.0'			32.4		
9					20.5		

NOTES:

DRAFT

BOREHOLE LOG: CO131-SB017

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Black FILL of coal and coal fines, free product at 10.0'-10.4', residual product at 10.4'-10.7'			50.3		
11		Light grayish brown, silty, grit and gravel FILL (possibly ash), possible free product throughout, aromatic odor			11.5		
12		Medium to dark bluish gray, silty, f. to m. granular FILL material, possible free product with very strong aromatic odor at 11.4'-12.2', residual product in seams at 12.2'-13.2'			1756.0		
13					12.6		
14		Brown, silty, sandy FILL, some reddish and white, v.c. angular gravel			1.4		
15					0.1		
16					1.2		
16.7–17		Dark bluish gray, silty, granular to v.c. gravelly FILL					

NOTES: DRAFT

BOREHOLE LOG: CO132-SB016

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0–2		Brown, clayey, silty FILL with 30-50% taconite pellets throughout, pellets coated with iron oxide veneer below 1.5'	73/72	N/A	11.6 11.2		Nominal 6" Borehole
2–4.4		Brownish black, silty, angular, c. to v.c. slag FILL, some clay, aromatic odor			12.2 12.4		
4.4–4.8		Light gray to tan, gritty silty FILL (likely ash)			12.8		Portland Cement & Bentonite Grout
4.8–6		Water Table @ ~5.8'			2.3		
6–10		Dark grayish blue, silty, granular FILL material, trace angular v.c. gravel, trace black residual product on gravel at 5.6', possible clear product at 5.6'-6', aromatic odor noted	146/120		16.2 15.5 22.6 6.8		Sudan IV test trace clear oil present

NOTES: DRAFT

BOREHOLE LOG: CO132-SB016

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Medium grayish blue, silty, granular FILL material, trace angular v.c. gravel			2.9		
11					6.6		
12					2.4		
13					2.3		
14					2.2		
15					628.0		
16		Brownish black clayey FILL w/black stains					

NOTES: DRAFT

BOREHOLE LOG: CO133-SB026

DATE DRILLED: 4/23/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			48/72	N/A	0.0		
1					10.5		Nominal 6" Borehole
2		Brown, c. sandy, silty FILL, trace angular, f. to v.c. gravel, trace clay			1.1		
3					7.0		
4		Wet @ ~4.0'			4.4		Portland Cement & Bentonite Grout
5		Brown, c. sandy, silty FILL, trace angular, f. to v.c. gravel, trace clay			2.6		
6			134/120		0.0		
7		Brown, c. sandy, silty FILL, trace semi-rounded, f. to c. gravel, trace clay			17.8		
8					0.0		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO133-SB026

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9		Blackish brown, clayey, silty FILL, trace f. to m. gravel			73.8		
10		Blackish brown grading to orangish brown, clayey, silty FILL, trace f. to m. gravel			15.1		
11					2.6		
12		Brown, c. sandy, silty FILL, trace semi-rounded, f. to c. gravel, trace clay			19.6		
13					88.2		
14		Black FILL, coal and coal fines, residual product at 14.6'-16.0', strong aromatic odor			215.0		
15					231.0		
16		Light blue and medium grayish blue, silty, granular FILL material	137/120		6.5		
17		Dark grayish blue, silty, granular FILL material, solid piece at 17.9'-18.3'			107.0		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO133-SB026

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
18							
		Dark gray, clayey and silty FILL, some blue streaks and granules			33.8		
19		Black FILL, coal and coal fines, trace residual product, faint odor of coal			17.1		
20		Black FILL, coal and coal fines with blue granular material increasing with depth			17.7		
21					21.1		
22					30.1		
23		Very dark bluish gray, silty, granular to v.c. gravelly FILL, strong aromatic odor			19.7		
24					N/A		
25					N/A		
26							

NOTES:

DRAFT

BOREHOLE LOG: CO134-SB017

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty sand and m. gravel FILL	84/84	N/A	16.1		Nominal 6" Borehole
1					15.5		
		Wet @ ~1.8'					
2		Brown, silty and clayey FILL, mottled with black, white, and iron oxide			17.3		
3		White to light gray, silty FILL, some f. to m. gravel, some brown residual stains with high PID readings at 2.9'-3.1', aromatic odor			168.0		
4					4.6		Portland Cement & Bentonite Grout
5		Light gray, silty c. to v.c. slag FILL, residual product noted, strong odor at 5.3'-7'			26.1		
6					49.8		
7			144/120		9.2		
8					43.1		

NOTES:

DRAFT

BOREHOLE LOG: CO134-SB017

DATE DRILLED: 4/23/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9		Light gray, silty c. to v.c. slag FILL, with possible colorless product increasing with depth, aromatic odor			50.4		
10		Black, silty c. to v.c. slag FILL, possible free product throughout, strong aromatic odor			3704.0		
11		Dark grayish blue, granular FILL material, some f. to c. gravel, colorless residual product at 10.4'-11.0', strong aromatic odor			1524.0		
12					725.0		
13					68.4		
14					89.5		
15					345.0		
16					394.0		
17							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO135-SB016

DATE DRILLED: 4/24/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty FILL, some f. to m. gravel and coal	91/72	N/A	0.0		Nominal 6" Borehole
1					0.0		
2		Brown, clayey and silty FILL, some f. to m. gravel			0.0		
3		Blackish brown, silty, f. to c. gravel FILL, coal fines throughout			0.0		
4		Tan, silty sand and f. to v.c. gravel FILL, faint aromatic odor noted			0.0		Portland Cement & Bentonite Grout
4.5		Yellowish brown, clayey, silty FILL, some coal fines and f. to m. gravel throughout, faint aromatic odor					
5		Black, FILL of coal and coal fines, faint aromatic odor			0.0		
6		Wet @ ~5.9'					
6		Brown, clayey, silt and f. to v.c. gravel FILL, light sheen, possible colorless residual product noted, pocket of black residual product at 6.5'-7.0', strong odor throughout (strong winds affecting PID measurements)	115/120		0.0		
7					2.8		
8							

NOTES:

DRAFT

BOREHOLE LOG: CO135-SB016

DATE DRILLED: 4/24/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
8–10		Gray, f. to v.c. slag FILL, some silt, some white granules, colorless residual product noted at 8.1'-10.0', strong aromatic odor (strong winds affecting PID measurements)			1.7 0.6		
10–16		Gray, f. to v.c. slag FILL, some silt, some white granules, colorless residual product noted at 10.0'-10.7', sheen at 10.7'-12.4', strong aromatic odor (strong winds affecting PID measurements)			0.6 0.5 0.0 0.0 0.0 0.0		

Depth scale: 9, 10, 11, 12, 13, 14, 15, 16

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO136-SB027

DATE DRILLED: 4/24/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 27 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			84/84	N/A	0.0		Nominal 6" Borehole
1					0.0		
2		Brown, silty, sand and f. to m. slag FILL, trace clay at 2.1'-3.9'			0.0		
3					0.0		
4		Wet @ ~4.0'			0.0		
		Black, gritty gravel FILL with coal fines and white granules					Portland Cement & Bentonite Grout
5					0.0		
6		Orange sand and f. to v.c. gravel FILL, some coal fines at 5.0'-6.3'			0.0		
7			115/120		0.0		
8		Light brown, silty, f. to v.c. gravel FILL			0.0		
9					0.0		

NOTES:

DRAFT

BOREHOLE LOG: CO136-SB027

DATE DRILLED: 4/24/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 27 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Dark to medium gray, silty, f. to v.c. slag FILL, some white granules present, less silty and faint aromatic odor at 16.4'-17.0' light blue staining at 17.0'-17.4'			0.0		
11					0.0		
12					0.1		
13					0.0		
14					0.0		
15					0.0		
16					0.0		
17			134/120		0.0		
18		Medium pinkish grayish brown, silty and clayey FILL, some black streaks throughout			0.0		
19					0.0		

NOTES:

DRAFT

BOREHOLE LOG: CO136-SB027

DATE DRILLED: 4/24/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 27 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
20		Medium pinkish grayish brown, silty and clayey FILL, brick fragment at 20.6', some black streaks throughout			0.0		
21		White and tan, native Silty, m. to c. SAND, stained gray in seams with faint aromatic odor			0.0		
22		Ochre yellow and tan banded, native Clayey, m. to c. SAND			0.0		
23		White and tan, native, Silty, m. to c. SAND, some gray staining at top and middle			0.0		
24					0.0		
25					0.0		
26					0.0		
27							

NOTES:

DRAFT

BOREHOLE LOG: CO137-SB036

DATE DRILLED: 4/25/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0–1.7		Brown, silty, gravelly FILL with 30-40% taconite pellets throughout, strong aromatic odor	36/72	N/A	97.8, 40.1		Nominal 6" Borehole
1.7–2.5		Brown and dark gray, silty, slag FILL, colorless residual product at 2.0'-2.5', very strong aromatic odor			438.0		
2.5–3.5		Blackish brown, silty slag FILL, coal and coal fines throughout, very strong aromatic odor			9999.0		
3.5–6.5		Black,silty slag FILL, free product, very strong aromatic odor			8055.0, 1932.0		Portland Cement & Bentonite Grout
6.5–6.8		White, silty, c. sandy FILL, strong odor	96/120		275.0		
6.8–7.0		Slate gray, silty clay FILL, strong odor					
7.0–7.4		Dark grayish blue, silty, grainy slag FILL, strong aromatic odor			114.0		
7.4–9.5		Black, silty, slag FILL, residual product, strong aromatic odor			55.6, 85.7		

NOTES:

DRAFT

BOREHOLE LOG: CO137-SB036

DATE DRILLED: 4/25/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		SAA, very strong aromatic odor					
		Lt. bluish gray, silty clay FILL, gray streaks			617.0		
11					127.0		
12					279.0		
13		Brown, native, Silty, m. to c. SAND, some f. to v.c. rounded gravel, blackish brown stains at 10.6'-11.8', orangish brown stains at 11.8'-12.9', black stains at 14.9'-15.6', very strong aromatic odor			47.0		
14					635.0		
15					167.0		
		Grayish brown, Silty CLAY					
16		Brown, Silty, f. to m. SAND					
		Brown SANDSTONE fragments in silty sand matrix (suspected boulder)	116/120		13.7		
17		Black, Silty, f. to m. SAND, stains, very strong aromatic odor			855.0		
18		White, stiff, Silty CLAY, red smears and greenish brown blebs noted, strong aromatic odor			30.7		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO137-SB036

DATE DRILLED: 4/25/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Orangish brown, Silty, f. SAND, strong aromatic odor			84.2		
		Orangish brown, Silty, f. SAND, 1" dark orangish red band at 20.4', 1/4" white streak at 20.6', 3/4" dark gray streak at 20.7, 1" light gray streak at 20.8', strong aromatic odor			182.0		
		Light gray, stiff, Silty CLAY, dark rose-pink staining throughout, ochre yellow stains at base, strong aromatic odor			228.0		
		Brown, Silty, f. to m. SAND, stained in bands as follows: dark gray, orangish red, ochre yellow, and orangish red, strong odor			83.8		
		White, Silty CLAY, red streaks mixed with yellow and dark gray at top, 2" dark gray band at 22.6', strong aromatic odor					
		Yellowish brown, Silty, f. to m. SAND, pieces of sandstone at 24.9', dark gray and light gray stains in bands at 25.1'-26', dark gray stains at 26.0'-27.6', very strong aromatic odor	116/120		252.0 394.0 936.0 120.0 122.0		
		White, Silty CLAY, some red and very dark gray streaks, aromatic odor noted					

NOTES:

DRAFT

BOREHOLE LOG: CO137-SB036

DATE DRILLED: 4/25/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					23.7		
29		Light pinkish gray, Clayey SAND, numerous dark and very dark gray stained bands, aromatic odor throughout			48.5		
30							
		Light pinkish gray, Clayey SAND, numerous dark and very dark gray stained bands, aromatic odor throughout			36.4		
31					20.9		
32					30.1		
33		Brownish white, stiff, Silty CLAY, some f. sand, greenish black blebs and aromatic odor throughout			23.4		
34					31.7		
		Dark gray, Clayey, f. SAND, brown blebs, aromatic odor noted					
35		Brownish white, stiff, Silty CLAY, some f. sand, greenish brown stains noted			12.0		
36							

NOTES:

DRAFT

BOREHOLE LOG: CO138-SB016

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, c. to v.c. slag FILL, some clay increasing with depth, 10% taconite pellets, phragmites shoots and roots, some aromatic odor	42/72	N/A	29.2		Nominal 6" Borehole
1					138.0		
2					347.0		
3					437.0		
4					0.0		Portland Cement & Bentonite Grout
		Wet @ ~4.6'					
5					3.7		
6		Brown, silty, sand and c. slag FILL, 10% taconite pellets, trace clay, bands of iron oxide and dark gray stains at 4.6'-5.4' and 6.0'-6.8', very dark gray staining at 7.7'-8.2'	96/120		0.0		
7					3.8		
8							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO138-SB016

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Dark brownish gray, silty, v.c. slag FILL, some light blue staining, some aromatic odor			8.9		
9		Medium grayish blue, silty, granular FILL material, aromatic odor noted			11.2		
10		Medium grading to dark grayish blue, silty, granular FILL material, aromatic odor noted			3.7		
11					12.4		
12					3.3		
13					1.5		
14					2.5		
15					2.2		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO139-SB016

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			38/72	N/A	12.1		Nominal 6" Borehole
1					9.9		
2					16.8		
3					72.5		
4		Brownish gray, silty slag FILL, dark gray staining at 4.3'-4.7', aromatic odor noted			20.5		Portland Cement & Bentonite Grout
5					85.0		
6			131/120		21.7		
7					11.4		
		Wet @ ~7.8'					
8							

NOTES:

DRAFT

BOREHOLE LOG: CO139-SB016

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Blackish brown, silty slag FILL, residual staining at 7.8'-8.9', aromatic odor noted			9.3		
9		Buff to light gray, granular FILL material			9.2		
10		Buff to light gray, granular FILL material, medium grayish blue staining at 11.0'-11.8', very dark gray grading to black residual staining and aromatic odor at 11.8'-12.7'			9.1		
11					9.3		
12					10.0		
13		Very dark gray, silty, v.c. slag and brick FILL, black residual product with aromatic odor at 14.9'-15.2'			16.8		
14					20.1		
15					10.5		
16							

NOTES: DRAFT

BOREHOLE LOG: CO140-SB017

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			43/84	N/A	31.1		Nominal 6" Borehole
1		Brown, silty gravel FILL, 10% taconite pellets, trace clay, some c. white granules below 1.5'			11.8		
2					9.8		
3					9.2		
4					8.9		Portland Cement & Bentonite Grout
5		Brown, silty, semi-rounded, f. to m. gravel FILL, 10% taconite pellets			9.1		
6					0.1		
7		Wet @ ~7.0'					
		Brown, silty, semi-rounded, f. to m. gravel FILL, 10% taconite pellets	144/120		10.2		
8					10.1		
9		Very dark brown, silty slag FILL, trace clay, apparent colorless residual product at 8.0'-8.5', possible black free product and strong aromatic odor at 8.5'-8.9', black staining at 8.9'-10.0'			8.1		

NOTES:

DRAFT

BOREHOLE LOG: CO140-SB017

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10					8.5		
11		Very dark brown, silty slag FILL, trace clay, black staining at 10.0'-12.6'			9.5		
12					7.6		
		Medium gray seam of clay FILL					
13					1.2		
14					9.4		
15		Dark gray, silty gravel FILL, some c. white granules throughout, black staining with aromatic odor at 15.0'-15.8', light bluish gray staining at 15.8'-17.0'			29.9		
16					14.9		
17							

NOTES:

DRAFT

BOREHOLE LOG: CO141-SB016

DATE DRILLED: 4/27/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Medium grayish brown, silty slag FILL	91/72	N/A	0.6		Nominal 6" Borehole
1		FILL composed of silt, c. granules, gritty gravel, and pieces of concrete, iron oxide staining noted			1.2		
2		Wet @ ~2.0'			1.5		
3		Brown, silty and clayey FILL, some f. to v.c. gravel			3.6		
4		Medium grayish brown, silty slag FILL, trace residual product at 4.5'-4.8', black residual product at 5.6'-6.0', aromatic odor noted			2.9		Portland Cement & Bentonite Grout
5					9.9		
6		Medium gray, silty slag FILL, trace residual product at 6.2'-7.0', brown residual product at 7.0'-8.0', colorless residual product at 8.0'-8.5', aromatic odor throughout	127/120		22.0		
7					35.5		
8					33.5		
9					5.0		

NOTES:

DRAFT

BOREHOLE LOG: CO141-SB016

DATE DRILLED: 4/27/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10–12		Medium gray, silty slag FILL, faint aromatic odor			3.0 1.0		
12–16		Dark bluish gray, silty granular FILL, some f. to v.c. slag, aromatic odor noted			0.5 0.3 2.3 1.1		

NOTES:

DRAFT

BOREHOLE LOG: CO142-SB027

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 27 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0–4		Medium gray, silty slag FILL, trace residual product, some aromatic odor	47/84	N/A	7.1, 13.9, 15.1, 8.1		Nominal 6" Borehole
4		Wet @ ~4.0'					
4.3–7		Black FILL of coal and coal fines, trace colorless residual product at 4.2'-4.8', aromatic odor noted			10.9, 12.2, 10.9		Portland Cement & Bentonite Grout
7–10		Medium gray, silty, f. to c. slag FILL, some blue staining at 8.8'-9.8', residual product at 8.8'-10.0', strong aromatic odor	100/120		88.5, 251.0, 329.0		

NOTES:

DRAFT

BOREHOLE LOG: CO142-SB027

DATE DRILLED: 4/26/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 27 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Dark bluish gray grading to medium gray, granular FILL material, strong aromatic odor			345.0		
11					136.0		
12					221.0		
13					18.9		
14		Yellowish brown, native, Silty, m. SAND, some f. to m. rounded gravel, white to gray silty clay lenses at 15.4'-16.0' and 16.5'-17.0', dark brown staining at 13.9'-14.9', strong aromatic odor			30.1		
15					35.8		
16					73.2		
17							

NOTES: DRAFT

BOREHOLE LOG: CO143-SB016

DATE DRILLED: 4/27/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Dark brown, silty, m. slag FILL, some clay	39/72	N/A	0.0		
1		Dark brown, silty, m. slag FILL, iron oxide staining at top			0.1		Nominal 6" Borehole
2–4		Light brown, silty and clayey FILL, some c. white granules, little f. to m. gravel, banded with dark greenish yellow and black at top, seam of gritty gravel with dark brown staining at 2.9'-3.8'			0.3, 0.5		
		Tan to light brown FILL of wood fragments in varying orientations			0.2		Portland Cement & Bentonite Grout
5		Tan, silty, c. granular FILL, slightly gummy, dark brown staining at top, faint aromatic odor			0.1		
6		Black FILL of coal and coal fines, faint odor noted	109/120		0.1		
7–8		Dark grayish brown, silty, f. to c. sand and m. slag FILL			0.0		

NOTES:

DRAFT

ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO143-SB016

DATE DRILLED: 4/27/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9		Medium grayish brown, Silty, f. to c. SAND coarsening with depth, some f. to m. rounded gravel, shell fragments throughout below 9.6'			0.0 0.2		
10–11		Medium grayish brown, Silty, f. to c. SAND coarsening with depth, some f. to m. rounded gravel, shell fragments throughout			0.2 0.0		
12		Light brownish gray, Silty CLAY, very dark gray stains through much of section, split at 12.3' with black residual product and aromatic odor			3.5		
13–16		Yellowish brown, Silty, f. to c. SAND, some f. to m. rounded gravel, 1" and 2" very dark gray stained clay lenses at 13.9' and 14.1', dark gray staining with aromatic odor at 12.9'-14.3' and 15.4'-16.0', black residual product above clay seam at 13.9'			1.6 1.1 1.5		

NOTES:

DRAFT

BOREHOLE LOG: CO146-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			78/72	N/A	6.2		
1					9.6		Nominal 6" Borehole
2					4.8		
3					15.9		
4		Dark brown, silty, f. sand and f. to v.c. gravel FILL, aromatic odor noted at 6.0'-9.4'			0.8		Portland Cement & Bentonite Grout
5					2.4		
6			107/120		20.9		
7					19.2		
8							

NOTES:

DRAFT

BOREHOLE LOG: CO146-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					50.9		
9							
		Wet @ ~9.4'			28.3		
10		Brownish black, c. sand and gravel FILL, some silt, residual product, aromatic odor					
					104.0		
11					386.0		
12					2335.0		
13		Black, c. sand and gravel FILL, some silt, clayey silt lens at 11.7'-12.7', m. sand lens at 14.5'-15.1', trace grayish blue staining, residual product present, very strong aromatic odor			675.0		
14					647.0		
15					3875.0		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO147-SB016

DATE DRILLED: 5/12/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		CONCRETE Foundation	78/72	N/A	4.9		
1		Brown, silty, f. to m. sand and f. to v.c. gravel FILL, black from coal fines at 0.8'-1.6', aromatic odor noted			3.5		Nominal 6" Borehole
2		Light gray, silty, f. to v.c. slag FILL, some rounded f. to m. gravel, orangish brown staining with some aromatic odor at 1.6'-1.8'; brown sheen with some aromatic odor at 2.2'-3.3'; black tar-like residual product with strong aromatic odor at 3.3'-3.5'; residual product with very strong aromatic odor at 5.3'-5.4'			11.7		
3					175.0		
4					53.8		Portland Cement & Bentonite Grout
5					1056.0		
6		Wet @ ~6.0'	115/120		113.0		
7		Bluish gray, silty, f. to v.c. slag FILL, some rounded f. to m. gravel, colorless residual product at 6.0'-8.4', residual product at 8.4'-10.0', strong aromatic odor throughout			133.0		
8					120.0		
9					246.0		

NOTES:

DRAFT

BOREHOLE LOG: CO147-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Bluish gray, silty, f. to v.c. slag FILL, some rounded f. to m. gravel, possible colorless residual product from 10.0'-14.3', very strong aromatic odor throughout			4810.0		
11					908.0		
12					904.0		
13					1480.0		
14					1447.0		
15		Bluish black, granular FILL material, strong aromatic odor			337.0		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO148-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Orangish brown, silty, rock FILL	79/72	N/A	10.5		
1		Dark brown, c. granular FILL material, some m. brick fragments, residual product throughout			7.7		Nominal 6" Borehole
2		Brown, clayey, f. to m. brick and rock FILL, some silt			9.0		
3		Light gray, silty FILL			7.1		
4		Orange, silty, f. to c. brick FILL			4.7		Portland Cement & Bentonite Grout
5		Brown, silty, f. to v.c. slag FILL			5.9		
6		Powder blue, silty, f. to m. slag FILL, lenses of black residual product at 6.5'-6.8', 7.2'-8.1', 8.8'-9.0', and 9.2'-10.0', aromatic odor noted	129/120		12.4		
7					6.7		
8					117.0		
9					35.6		

NOTES: DRAFT

BOREHOLE LOG: CO148-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Powder blue, silty, f. to m. slag FILL, lenses of black residual product at 10.0'-12.7' and 13.1'-16.0', black residual product at 11.2'-12.3', 13.6'-14.3', and 15.3'-15.7', very strong aromatic odor throughout			1417.0		
11					160.0		
12					1054.0		
13					192.0		
14					673.0		
15					303.0		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO149-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silt and f. to v.c. slag FILL	112/72	N/A	2.7		
1		Yellowish brown, clayey and silty FILL, some f. gravel			1.1		Nominal 6" Borehole
2		Gray, silty, f. to c. slag FILL, sheen at 2.9'-3.1', 3.5'-4.4', and 4.8'-5.3', aromatic odor noted			8.3		
3					16.7		
4					6.1		Portland Cement & Bentonite Grout
5					N/A		
6		Wet @ ~6.0'	123/120		54.7		
7		Gray, f. to v.c. slag FILL, some clayey silt, colorless residual product at 6.0'-7.2', thin light brown grading to dark brown residual product at 7.2'-10.0', very strong aromatic odor			182.0		
8					178.0		
9					845.0		

NOTES:

DRAFT

ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO149-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Gray, f. to v.c. slag FILL, some clayey silt, dark brown residual product at 10.0'-11.8', gray grading to very dark gray free product at 11.8'-13.8', very strong aromatic odor			514.0		
11					1519.0		
12					1170.0		
13					2177.0		
14		Very dark bluish gray, c. granular FILL material, residual product at 13.8'-14.2'			2127.0		
15					50.6		
16							

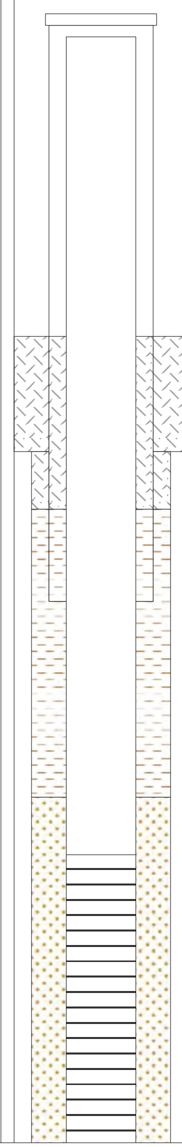
NOTES:

DRAFT

BOREHOLE LOG: CO150-SB016
WELL LOG: CO126-PZMXXX
DATE DRILLED: 5/19/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1455962.0149 N: 562750.9799	ELEVATION: GND SURF: 11.54 ft TOC: 14.65 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
4							
3							Steel Protective Cover
2							4" Sch 40 PVC Riser
1							
0							Concrete Pad Ground Surface
0–4.3		Brown, silty, f. to c. slag FILL with some rock and brick, coal fines at 1.6'-6' increasing with depth and becoming black at 3.9'-6', strong aromatic odor	81/72	N/A	0.3 3.8 44.8 754.0		Nominal 8" Borehole Bentonite Seal
4.3–6		Black, coal and coal fine FILL, black product at 5.0'-5.7', strong aromatic odor			204.0 574.0		#2 Quartz Sand
6			113/120		223.0		



NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO150-SB016
WELL LOG: CO126-PZMXXX
DATE DRILLED: 5/19/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1455962.0149 N: 562750.9799	ELEVATION: GND SURF: 11.54 ft TOC: 14.65 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
7		Light gray, silty, f. to c. slag FILL with residual product and possible bands of free product throughout			347.0		4" Sch 40 PVC 20-Slot Screen
8					791.0		
9					247.0		
10					170.0		
11					331.0		
12					177.0		
13					394.0		
14					648.0		
15		Dark bluish gray, f. granular FILL material with possible free product, very strong aromatic odor			N/A		Formation Collapse
16							

NOTES:

DRAFT

BOREHOLE LOG: CO151-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty FILL, some f. sand and f. to c. gravel, trace red brick fragments at bottom	94/72	N/A	3.0		Nominal 6" Borehole
1		Grayish tan, silty gravel FILL, sheen at bottom			2.7		
2		Gray, silty slag FILL, colorless residual product at 3.4'-3.6', strong aromatic odor			14.4		
3					30.2		
4		Wet @ ~4.0'			354.0		Portland Cement & Bentonite Grout
5		Gray, silty slag FILL, trace light blue staining, colorless residual product at 4.4'-4.8', very strong aromatic odor			545.0		
6		Light gray, silty slag FILL, trace light blue staining, brown grading to colorless residual product at 7.4'-8.7'; tan colored stains at 8.7'-9.2'; brown free product at 9.2'-9.9'; very strong aromatic odor	129/120		128.0		
7					82.0		
8					327.0		
9					187.0		

NOTES:

DRAFT

BOREHOLE LOG: CO151-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Yellowish brown, silty, f. gravel FILL, free product, very strong aromatic odor			373.0		
11		Light gray, silt and f. gravel FILL, some bluish gray staining, colorless free product at 10.4'-11.5'; black free product at 12.0'-12.9'; very strong aromatic odor			142.0		
12					1156.0		
13		Dark bluish gray, granular FILL material, apparent colorless residual product, strong aromatic odor noted			108.0		
14					195.0		
15					42.7		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO152-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Dark gray, silty slag FILL	86/72	N/A	0.8		Nominal 6" Borehole
1		Black, coal fines and slag FILL, odor noted			0.7		
2					0.9		
3		Dark gray, silty slag FILL, trace light blue staining, brown residual staining			1.1		
4		Wet @ ~4.0'			0.6		Portland Cement & Bentonite Grout
5		Black, silty slag FILL with black residual product, aromatic odor noted			10.7		
6			152/120		17.2		
7		Gray, silty slag FILL, trace light blue staining, colorless grading to black residual product at 7.0'-10.0', aromatic odor throughout			19.8		
8					24.7		
9					6.3		

NOTES:

DRAFT

BOREHOLE LOG: CO152-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10					60.7		
11					127.0		
12		Gray, silty slag FILL, trace light blue staining, brown grading to black residual product at 10.0'-13.4'; black free product at 13.4'-13.6'; colorless grading to black residual product at 13.6'-14.1'; brown grading to black free product at 14.1'-16.0', very strong aromatic odor throughout			144.0		
13					297.0		
14					463.0		
15					637.0		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO153-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Black FILL, coal and coal fines	48/72	N/A	0.0		Nominal 6" Borehole
1					0.0		
2		Medium gray, silty, f. to m. slag FILL, trace grayish blue staining			0.9		
		Wet @ ~2.6'					
3		Medium gray, silty, f. to m. slag FILL, gray sheen at 2.6'-3.4', black thick and tarry residual product at 3.4'-4.0', aromatic odor noted			30.2		
4		No Recovery			N/A		Portland Cement & Bentonite Grout
5					N/A		
6		Gray, silty, f. to c. slag FILL, trace blue staining, thick black free product at 6.0'-6.5', residual product lenses at 7.0'-7.1', 7.2'-7.4', and 8.0'-8.1', thick black free product at 8.4'-9.0', thick black product lenses at 9.5'-9.6' and 9.8'-9.9', aromatic odor noted	148/120		14.8		
7					34.4		
8					4.9		
9					39.1		

NOTES: DRAFT

BOREHOLE LOG: CO153-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10 – 12		Gray, silty, f. to c. slag FILL, trace blue staining, thick black free product at 10.4'-11.4', colorless residual product at 11.4'-11.9'; aromatic odor noted			9.2 23.7		
12 – 16		Blue, silty, f. to m. granular FILL material with tarry black free product, aromatic odor throughout			2.6 29.7 29.0 22.3		

NOTES:

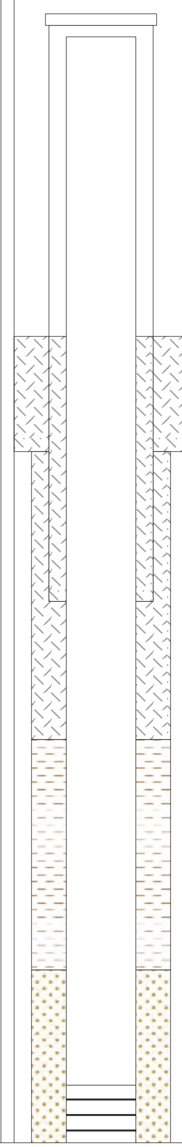
DRAFT

BOREHOLE LOG: CO154-SB016
WELL LOG: CO127-PZMXXX
DATE DRILLED: 5/19/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1456091.1925 N: 562807.2422	ELEVATION: GND SURF: 11.58 ft TOC: 14.55 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID
0–1		Light brown, silty, f. to v.c. slag and brick gravel FILL	72/72	N/A	2.8
1–6		Gray, silty slag FILL, with coal fines at 1.7'-2.8', some wood fibers at 2.8'			0.8
					1.4
					1.9
					4.0
					5.2
6–			139/120		1.6

Graphical Completion Log



Completion Description

Steel Protective Cover

4" Sch 40 PVC Riser

Concrete Pad

Ground Surface

Nominal 8" Borehole

Bentonite Seal

#2 Quartz Sand

NOTES:

DRAFT

BOREHOLE LOG: CO154-SB016
WELL LOG: CO127-PZMXXX
DATE DRILLED: 5/19/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1456091.1925 N: 562807.2422	ELEVATION: GND SURF: 11.58 ft TOC: 14.55 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
7					6.8		4" Sch 40 PVC 20-Slot Screen
8					7.4		
9					37.1		
10		Gray, silty, f. to c. slag FILL with residual and possible free product bands throughout			34.5		
11					70.0		
12					64.6		
13					56.1		
14					20.9		
15		Dark bluish gray, granular FILL material with c. white granules throughout			5.5		Formation Collapse
16							

NOTES:

DRAFT

BOREHOLE LOG: CO155-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			72/72	N/A	1.2		
1					1.1		Nominal 6" Borehole
2					1.0		
3		Light gray grading to bluish gray, silty, f. to v.c. slag FILL			1.1		
4					0.8		Portland Cement & Bentonite Grout
5					0.8		
6		Black, silty slag FILL, with coal fines throughout	104/120		0.5		
		Wet @ ~6.7'					
7		Medium gray, silty slag FILL, iron oxide staining throughout			1.1		
8					0.6		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO155-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9		Dark brown, silty, sandy FILL			0.6		
10		Medium gray, silty slag FILL			0.6		
11		Medium gray, silty slag FILL			0.6		
12					0.6		
13					0.5		
14					0.6		
15		Medium gray, silty slag FILL with residual product, aromatic odor noted			6.3		
16							

NOTES:

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BOREHOLE LOG: CO156-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty gravel FILL	101/72	N/A	1.1		Nominal 6" Borehole
1		Gray, silty slag FILL, some coal fines at 1.1'-1.4', trace light blue staining			1.1		
2					1.4		
3		Tan, silty sand and gravel FILL, some iron oxide staining present			1.1		
4					2.0		Portland Cement & Bentonite Grout
5					1.2		
6		Grayish tan, silty, rocky FILL, iron oxide staining at top	103/120		1.2		
7					0.8		
8					1.0		

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO156-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9		Gray, silty, rocky FILL			4.8		
10		Wet @ ~10.0'			1.2		
		Light brown, silty, clayey FILL, some gravel					
11		Gray, slag FILL, grayish blue staining throughout			0.9		
12					0.8		
13					0.8		
14					0.7		
15					0.8		
16							

NOTES:

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BOREHOLE LOG: CO157-SB016

DATE DRILLED: 5/7/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty sand and gravel FILL	72/72	N/A	0.1		
1							Nominal 6" Borehole
					0.5		
2		Black, silty sand and gravel FILL with coal fines throughout, some grayish blue staining					
					0.2		
3							
		Yellowish brown, silty, f. to c. sand and gravel FILL			0.5		
4							
		Black, silty sand and gravel FILL with coal fines throughout, trace brick fragments, faint odor			0.2		Portland Cement & Bentonite Grout
5							
					0.2		
6		Wet @ ~6.0'					
			127/120		0.1		
7		Very dark brown, silty sand and f. to v.c. gravel FILL with a brick and brick fragments					
					0.2		
8							

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DATE DRILLED: 5/7/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Medium brown, silty, granular FILL material			0.1		
9		Medium grayish brown, silty, c. sand and m. gravel FILL					
		Light gray FILL consisting of silty fragments of concrete			0.2		
10							
					1.3		
11		Light gray FILL consisting of silty fragments of concrete			0.2		
12							
					0.7		
13							
					0.6		
14		Light gray grading to dark bluish gray below 13.8', clayey granular FILL material, some white c. granules, no impact noted in boring			0.3		
15							
					N/A		
16							

NOTES:

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BOREHOLE LOG: CO158-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Dark brown, silty gravel FILL	85/72	N/A	2.0		Nominal 6" Borehole
1					1.1		
2		Dark gray, clayey gravel FILL, some silt			0.8		
		Light gray, clayey gravel FILL, some silt					
3		Tan, silty, sand and gravel FILL			0.6		
4		Gray, silty slag FILL, some light blue staining, brown staining at 5.3'-6.0'			0.6		Portland Cement & Bentonite Grout
5					0.8		
6		Wet @ ~ 6.0'	147/120		0.4		
7		Gray, silty slag FILL, trace bluish gray staining, some brown staining noted			0.5		
8							

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KEY ENVIRONMENTAL INCORPORATED

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
9 – 10		Gray, silty slag FILL, colorless grading to brown residual product at 9.0'-10.0'					
10 – 13.9		Gray, silty slag FILL, some bluish gray staining throughout, brown residual product at 10.0'-11.8', black viscous product at 11.8'-13.9', aromatic odor throughout					
13.9 – 16		Dark bluish gray, silty, f.slag FILL, sheen noted at 13.9'-16.0', faint aromatic odor					

PID
1.1
1.2
5.3
8.7
16.3
48.3
5.3
1.7

NOTES:

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BOREHOLE LOG: CO159-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Black FILL of coal and coal fines, trace v.c. slag, coal odor noted	77/72	N/A	1.7		Nominal 6" Borehole
1		Light brown grading to dark brownish gray, silty slag FILL, trace light blue staining, brown residual product, aromatic odor noted			5.0		
2					2.9		
		Wet @ ~2.7'					
3		Dark gray, silty, clayey FILL, black residual product throughout, aromatic odor noted			8.6		
4		Gray, silty slag FILL, dark grayish blue staining at 4.8'-5.5', black free product at 3.3'-3.7' and 5.0'-5.5' brown residual product at 5.7'-6.0', very strong aromatic odor			33.6		Portland Cement & Bentonite Grout
5					614.0		
6		Light gray, silty slag FILL, trace light blue staining, brown residual product at 7.2' to 8.2' and 8.6'-9.7', black free product at 9.7' to 10.0', very strong aromatic odor	125/120		23.1		
7					549.0		
8					215.0		
9					131.0		

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO159-SB016

DATE DRILLED: 5/6/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10–14.2		Light gray, silty slag FILL, black free product at 10.0' to 14.2', strong aromatic odor			15.0 72.4 31.8 59.0		
14.2–16		Dark bluish gray, granular FILL material, some c. white granules, brown residual product at 15.8'-16.0'			5.5 12.6		

NOTES:

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BOREHOLE LOG: CO160-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Very dark brown, clayey and silty FILL, some c. sand and f. to m. gravel	103/72	N/A	3.6		Nominal 6" Borehole
1		Black, FILL of oily coal fines, very strong coal odor			21.1		
2					14.0		
		Wet @ ~2.7'					
3		Light gray, silty slag FILL, some concrete, lens of brown c. sand at 4.8'-4.9', aromatic odor noted			20.7		
4					1.6		Portland Cement & Bentonite Grout
5					0.6		
6		Gray, silty slag FILL, lens of brown, c. sand at 7.0'-8.0', black free product at 7.8', brown residual product at 8.6'-10.0', aromatic odor noted	136/120		1.1		
7					2.7		
8					1.1		
9					13.1		

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BOREHOLE LOG: CO160-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Gray, silty slag FILL, brown residual product at 10.0'-12.8', black tarry free product at 12.8'-15.6', strong aromatic odor			19.1		
11					70.8		
12					36.7		
13					37.5		
14					39.9		
15					19.1		
16							

NOTES:

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BOREHOLE LOG: CO161-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			86/72	N/A	0.1		
1							Nominal 6" Borehole
					0.2		
2		Brown, silty, f. to c. sand and f. to c. gravel FILL, coal fines throughout at 1.5'-4.3'					
					0.2		
3					0.1		
4		Wet @ ~4.3'			0.1		Portland Cement & Bentonite Grout
5		Brown, clayey, f. to c. sand and f. to c. gravel FILL, some silt, coal fines througout at 4.3'-4.5'			0.2		
6			131/120		0.1		
7		Light yellowish brown, clayey f. to c. sand and f. to c. gravel FILL, coal fines and iron oxide staining throughout			0.2		
8							

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BOREHOLE LOG: CO161-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Light gray, silty slag FILL			0.3		
9					0.6		
10		Light gray, silty slag FILL			1.2		
11					1.8		
12		Dark bluish gray, granular FILL material with white c. granules			0.8		
13					2.0		
14					16.1		
15		Dark bluish gray, granular FILL material with white c. granules, black residual product, iridescent sheen, very strong odor			300.0		
16							

NOTES:

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BOREHOLE LOG: CO162-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Dark reddish brown, clayey gravel FILL, some silt	74/72	N/A	0.1		
1		Blackish brown, silty gravel FILL, coal fines throughout			0.2		Nominal 6" Borehole
2					0.5		
3		Light grayish brown, silty FILL, some f. to m. gravel			0.1		
4		Blackish brown, silty sand and gravel FILL			0.2		Portland Cement & Bentonite Grout
5					0.2		
6		Wet @ ~6.0'					
		Brown, silty sand and gravel FILL, faint aromatic odor noted	124/120		0.3		
7		Medium gray, silty slag FILL, some grayish blue staining, black residual product at 6.9'-7.25', apparent colorless residual product at 8.3'-10.0', aromatic odor noted			6.2		
8					16.1		
9					13.1		

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO162-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Medium gray, silty slag FILL, some grayish blue staining, apparent colorless residual product at 10.0'-10.3', dark gray to black residual product at 10.3'-11.3', apparent colorless to gray residual product at 11.3'-12.8', brown residual product at 12.8'-13.9'; black residual product at 13.9'-16.0', strong aromatic odor			5.1		
11					30.1		
12					33.3		
13					79.6		
14					30.2		
15					15.1		
16							

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DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Light to dark grayish brown, silty, f. to m. sand and f. to v.c. gravel FILL, trace to some coal fines throughout, trace brick,	71/72	N/A	0.3		Nominal 6" Borehole
1					14.7		
2					0.9		
3					0.5		
4					0.3		Portland Cement & Bentonite Grout
5					0.4		
6		Wet @ ~6.0'	105/120		5.1		
7		Blackish brown, silty, f. to c. sand and f. to m. gravel FILL, brown residual product throughout, sheen noted, strong aromatic odor			20.4		
8					76.7		
9					48.2		

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PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Dark grayish blue, silty, granular FILL material, little gravel, black residual product, odor			43.1		
11					17.8		
12		Dark grayish blue, silty, granular FILL material, some white c. granules, some f. to m. gravel, brown to black residual product throughout, strong becoming very strong aromatic odor			10.0		
13					3.6		
14					66.6		
15					225.0		
16							

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BOREHOLE LOG: CO164-SB016

DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Black to very dark brown, asphalt and slag road base FILL	70.5/72	N/A	0.1		Nominal 6" Borehole
1					0.1		
2		Brown, silty FILL, some f. to c. sand and f. to m. gravel, damp above concrete pillar			0.2		
3		Light gray, FILL of concrete fines and pieces from a concrete pillar (drilling bit destroyed at ~6.0')			0.1		
4					0.1		Portland Cement & Bentonite Grout
5					0.2		
6			114/120		0.1		
7					0.2		
8					3.9		
9					0.9		

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DATE DRILLED: 5/7/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Light gray, FILL of concrete fines and pieces from a concrete pillar			1.5		
11		Dark brown, clayey and silty FILL, some coal fines			23.4		
12		Dark bluish gray, granular FILL material, dark brown to black residual product throughout, lens of black free product at 13.5', sheen noted, very strong aromatic odor			N/A		
13					N/A		
14					N/A		
15		Very dark gray to black, silty, f. to m. sandy FILL, residual black stains throughout, strong aromatic odor noted			N/A		
16							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO165-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Very dark brown, clayey, silt and gravel FILL	93/72	N/A	0.0		
1		Black FILL of coal and coal fines, some odor			0.0		Nominal 6" Borehole
		Gray, silty, f. to c. slag FILL, few coal fines					
2					0.0		
3					0.0		
4					0.0		Portland Cement & Bentonite Grout
5					0.0		
6		Light to medium gray, silty, f. to v.c. slag FILL, some light blue staining, light brown residual stains with aromatic odor noted at 7.1'-10.0'	139/120		0.8		
7					1.2		
8					0.3		
9					0.9		

NOTES: DRAFT

BOREHOLE LOG: CO165-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Light to medium gray, silty, f. to v.c. slag FILL, some light blue staining, light brown grading to black residual stains with aromatic odor at 10.0'-14.7'			4.6		
11					7.6		
12					16.7		
13					16.7		
14					25.7		
15		Light to medium gray, silty, f. to m. gravel FILL material, some dark bluish gray staining, some brown residual staining throughout			0.9		
16							

NOTES:

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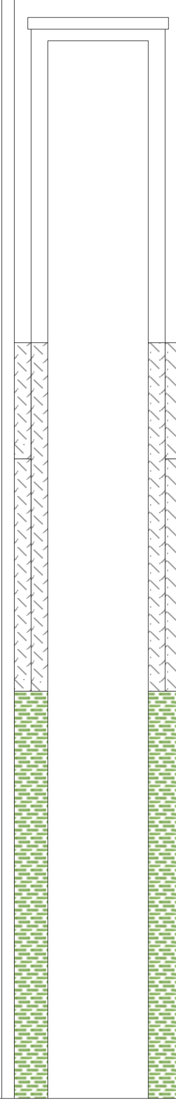
KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO166-SB036
WELL LOG: CO123-PZMXXX
DATE DRILLED: 5/21/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457395.7717 N: 561584.331	ELEVATION: GND SURF: 12.01 ft TOC: 15.06 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
4							
3							Steel Protective Cover
2							6" SS Riser
1							Concrete Pad
0							Ground Surface
0–1		Brown grading to light grayish brown, silty gravel FILL	105/72	N/A	0.1		
1		Black coal fines					
1–2		Brown grading to gray, silty gravel FILL			0.2		
2		Black coal fines					
2–3					0.7		Nominal 10" Borehole
3–4					0.9		
4–5		Wet @ 5.0'			0.2		Portland Cement & Bentonite Grout
5–6					0.2		
6							



NOTES:

DRAFT

BOREHOLE LOG: CO166-SB036
WELL LOG: CO123-PZMXXX
DATE DRILLED: 5/21/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457395.7717 N: 561584.331	ELEVATION: GND SURF: 12.01 ft TOC: 15.06 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
6		Brown, silty gravel FILL, becomes clayey below 5.1' at water table, yellowish brown lens at 4.3'-4.4', seam of residual product (black) at 10.5'-13' with slight aromatic odor, ammonia odor noted at 13'-16'	112/120		0.1		
7					0.7		
8					0.3		
9					0.4		
10					0.4		
11					11.1		
12					23.5		Bentonite Seal
13					36.9		
14					33.0		
15					58.2		#2 Quartz Sand
16							

NOTES: **DRAFT**

BOREHOLE LOG: CO166-SB036
WELL LOG: CO123-PZMXXX
DATE DRILLED: 5/21/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457395.7717 N: 561584.331	ELEVATION: GND SURF: 12.01 ft TOC: 15.06 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16		Black, silty, f. to v.c. slag FILL, free product (black) with strong naphthalene odor at 16 to 19.5 ft., very dense at 17.3'-17.7'	139/120		56.7		
17					50.6		6" SS 20-Slot Screen
18					174.0		
19					320.0		
20		Medium greenish gray, Silty, f. SAND, trace clay, 10% shell inclusions at 24.9'-26' black residual product stringers at 19.5'-20.3' with naphthalene odor throughout, staining with strong odor at 25.4'-26'			183.0		
21					162.0		
22					56.7		
23					83.7		
24					137.0		
25					27.6		
26							

NOTES: DRAFT

BOREHOLE LOG: CO166-SB036
WELL LOG: CO123-PZMXXX
DATE DRILLED: 5/21/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457395.7717 N: 561584.331	ELEVATION: GND SURF: 12.01 ft TOC: 15.06 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26		Light gray, Silty CLAY, some small pockets of orangish-brown silty m. sand at 26'-29.6', dark gray silty clay rip up clasts at 29.6'-31.6', black streaks and odor at 26'-27.4'	143/120		3.2		
27					3.3		
28					0.7		6" SS Sump
29					0.3		
30					0.3		
31					0.7		
32		Dark gray, Silty CLAY, stiff and sticky grading to plastic at 35.5'			0.3		Bentonite Seal
33					0.2		
34					N/A		
35					N/A		
36							Formation Collapse

NOTES:

DRAFT

BOREHOLE LOG: CO167-SB031
WELL LOG: CO124-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457446.4841 N: 561592.1203	ELEVATION: GND SURF: 11.74 ft TOC: 14.83 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 38 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
4							
3							Steel Protective Cover
2							6" PVC Riser
1							Concrete Pad
0							Ground Surface
0–4		Blackish brown, silty, f. to v.c. gravel FILL, with coal fines at 3.4'-4.0	90/72	N/A	6.1		
1					1.5		
2					1.8		Nominal 10" Borehole
3					1.2		
4–6		Some clay at 4.5'-6', Wet @ 4.5'			0.4		
5					0.6		Portland Cement & Bentonite Grout
6							

NOTES:

DRAFT

BOREHOLE LOG: CO167-SB031
WELL LOG: CO124-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457446.4841 N: 561592.1203	ELEVATION: GND SURF: 11.74 ft TOC: 14.83 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 38 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
6		Reddish and black, silty gravel FILL, sheen with some odor noted at 8.0'-8.8' and 10.1'-12.6', saturated with black product with strong naphthalene odor at 16'-18.1'	120/120		0.6		
7					1.1		
8					0.8		6" SS Riser
9					0.5		
10					0.5		
11					0.5		
12					2.0		Bentonite Seal
13					2.7		
14					10.7		
15					2.5		
16							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO167-SB031
WELL LOG: CO124-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457446.4841 N: 561592.1203	ELEVATION: GND SURF: 11.74 ft TOC: 14.83 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 38 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16			127/120		76.7		
17					193.0		#2 Quartz Sand
18		Black, Silty, f. SAND, residual product			176.0		
19		Dark greenish gray, Silty, f. SAND, black streaks, blebs, smears, sheen, and aromatic odor noted			304.0		
20					384.0		6" SS 20-Slot Screen
21					126.0		
22					38.4		
23		Same as above, few shells at 24.7'-25.2', no product noted			58.7		
24					14.6		
25		Same as above, dark gray, sheen			7.2		
26							

NOTES:

DRAFT

BOREHOLE LOG: CO167-SB031
WELL LOG: CO124-PZMXXX
DATE DRILLED: 5/20/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457446.4841 N: 561592.1203	ELEVATION: GND SURF: 11.74 ft TOC: 14.83 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 38 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26		Very dark gray SAND,sheen, ammonia odor noted	79/60		12.3		
27					13.9		
28		Light gray, Silty CLAY, small pockets of orangish-brown silty c. sand throughout, becoming plastic with depth, black streaks and smears noted, aromatic odor noted			3.8		
29					1.4		Bentonite Seal
30					0.6		
31		Interval not logged during well installation					
32							
33							6" SS Sump
34							
35							
36							

NOTES:

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KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO167-SB031
WELL LOG: CO124-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457446.4841 N: 561592.1203	ELEVATION: GND SURF: 11.74 ft TOC: 14.83 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 38 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
37							
38							

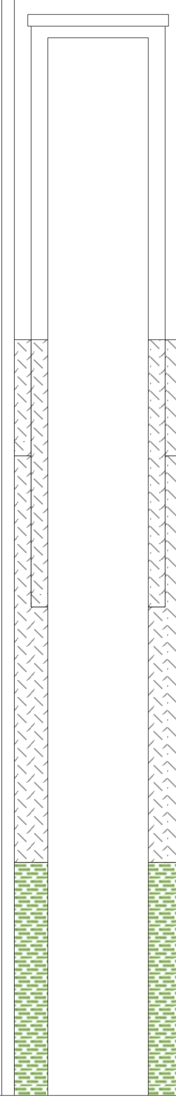
NOTES:

DRAFT

BOREHOLE LOG: CO168-SB031
WELL LOG: CO125-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457359.8429 N: 561587.0332	ELEVATION: GND SURF: 11.98 ft TOC: 14.98 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
4							
3							Steel Protective Cover
2							6" SS Riser
1							Concrete Pad
0							Ground Surface
0–5.5		Brown, silty, f. to v.c. gravel FILL, with coal fines below 2.0', seam of sulfur at 4.5'-4.75'	106/72	N/A	0.2		
1					0.2		
2					0.7		Nominal 10" Borehole
3					0.4		
4					0.9		Portland Cement & Bentonite Grout
5.5–6		Wet @ 5.5'			0.4		



NOTES:

DRAFT

BOREHOLE LOG: CO168-SB031
WELL LOG: CO125-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457359.8429 N: 561587.0332	ELEVATION: GND SURF: 11.98 ft TOC: 14.98 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
6			136/120		0.3		
7					0.4		
8					0.3		
9					0.4		
10					0.7		
11		Brown grading to grayish brown at 14.2', silty, f. to v.c. gravel FILL, faint aromatic odor noted			3.3		
12					2.4		Bentonite Seal
13					3.8		
14					2.5		
15					2.1		#2 Quartz Sand
16							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO168-SB031
WELL LOG: CO125-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457359.8429 N: 561587.0332	ELEVATION: GND SURF: 11.98 ft TOC: 14.98 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
16		Black, silty gravel FILL, very strong aromatic odor, free product 16'-19.5'	53/120		4.2		
17					6.9		6" SS 20-Slot Screen
18					63.0		
19					34.7		
20		Very dark greenish gray, Silty, f. SAND, some black blebs, sheen present, strong odor noted			27.7		
21		No Recovery			48.1		
22					97.4		
23					N/A		
24					N/A		
25					N/A		
26							

NOTES:

DRAFT

BOREHOLE LOG: CO168-SB031
WELL LOG: CO125-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457359.8429 N: 561587.0332	ELEVATION: GND SURF: 11.98 ft TOC: 14.98 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
26		Greenish gray, Silty, f. SAND, some black stains, strong aromatic odor	84/60		7.5		
27					17.7		
28		Light grayish brown, expansive, plastic CLAY, some dark gray streaks and stains at 27.7'-30.0' with aromatic odor noted			1.9		6" SS Sump
29					1.3		
30					1.0		
31		Interval not logged during well installation					
32							Bentonite Seal
33							
34							
35							
36							

NOTES: DRAFT

BOREHOLE LOG: CO168-SB031
WELL LOG: CO125-PZMXXX
DATE DRILLED: 5/20/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: 1457359.8429 N: 561587.0332	ELEVATION: GND SURF: 11.98 ft TOC: 14.98 ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 36.5 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
							Formation Collapse

NOTES: **DRAFT**

BOREHOLE LOG: CO169-SB036

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			71/72	N/A	0.0		
1					0.0		Nominal 6" Borehole
2					0.0		
3		Brownish black, silty, c. sand and f. to v.c. gravel FILL (slag, brick, and rock)			0.4		
4					0.0		Portland Cement & Bentonite Grout
5					0.2		
6		Wet @ ~6.2'	33/120		2.3		
7		Brownish black, silty, c. sand and f. to v.c. gravel FILL (slag, brick, and rock), sheen with sweet aromatic odor throughout			2.4		
8		Piece of metal prevented further recovery			3.1		
9							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO169-SB036

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		No Recovery			6.0		
10					N/A		
11					N/A		
12					N/A		
13		No Recovery			N/A		
14					N/A		
15					N/A		
16			44/120		2.9		
17					3.0		
18		No Recovery (Top of Sample Fell Out)			114.0		

NOTES:

DRAFT

BOREHOLE LOG: CO169-SB036

DATE DRILLED: 5/9/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
19					120.0		
20					225.0		
20–21.4		No Recovery (Top of Sample Fell Out)			N/A		
21.4–22.4		Dark brownish gray, silty, f. to c. sand and f. to m. gravel FILL			N/A		
22.4–25.7		Dark gray, silty, f. to v.c. slag FILL, black residual product throughout, black free product present at bottom			N/A		
					N/A		
					N/A		
25.7–26		Greenish gray, native, Silty, f. SAND, some m. gravel, black smears, aromatic odor					
26–26.9		Buff colored, Silty CLAY, few pockets of orange c. sand	135/120		16.5		
26.9–		Dark gray, Silty, f. SAND, faint black streaks, aromatic odor noted			4.0		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO169-SB036

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
28		Buff colored, stiff, Silty CLAY, some pockets of brown sand, few gray blebs					
		Buff colored, soft and plastic CLAY, some pockets of orange c. sand, some dark gray blebs at 28.1'-28.6'			0.6		
29					0.5		
30		Buff colored, soft and plastic CLAY			0.5		
31					0.6		
32					0.5		
33					1.5		
34					0.6		
35		Very dark grayish brown, stiff, Silty, CLAY			0.3		
36							

NOTES:

DRAFT

ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO170-SB026

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, f. to c. sand and f. to c. gravel FILL, ponded water at location	101/72	N/A	6.6		
1		Black FILL, wood debris with creosote, strong creosote odor			0.6		Nominal 6" Borehole
2		Black FILL, coal and coal fines			0.4		
3		Medium brownish gray, silty, f. to c. sand and f. to c. gravel FILL (slag, brick, and rock)			0.5		
4					0.4		Portland Cement & Bentonite Grout
5					N/A		
6		Wet @ ~5.8'	141/120		0.0		
7		Medium blackish brown, silty, f. to c. sand and f. to c. gravel FILL (slag, brick, and rock), trace clay, band of buff colored silty gravel at 7.7'-8.3', coal fines throughout at 8.3'-9.0'			0.4		
8					0.2		
9							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO170-SB026

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		Medium brownish gray, silty, f. to c. sand and f. to c. gravel FILL (slag, brick, and rock), trace clay			0.1		
10							
		Medium brownish gray, silty, f. to c. sand and f. to c. gravel FILL (slag, brick, and rock), trace clay			0.2		
11					0.2		
12					0.8		
13		Blackish brownish, silty, f. to c. sand and f. to v.c. slag FILL, trace clay, gray to black residual product throughout			0.6		
14					4.0		
15		Medium brownish gray, silty, f. to c. sand and f. to c. slag FILL, trace clay			6.6		
16		Dark brownish gray, silty, f. to c. sand and f. to v.c. slag FILL, trace clay, residual product at 16.0'-17.8', black free product with strong aromatic odor at 17.8'-18.1'	137/120		102.0		
17					387.0		
18					[illegible]		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO170-SB026

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 26 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					106.0		
19		Dark greenish gray, native, Silty, f. SAND, iridescent sheen and black stringers at 18.1'-18.8'			41.9		
20		Dark greenish gray, native, Silty, f. SAND, few shell fragments and black stains and streaks throughout at 21.3'-22.2'			62.6		
21					11.5		
22		Pinkish brown, Silty CLAY, few olive brown stained sand pockets, black smearing with naphthalene odor			12.8		
23		Light grayish brown, Silty CLAY, few olive brown stained sand pockets, black smears with naphthalene odor noted			6.3		
24					4.7		
25					N/A		
26		Light grayish brown, Silty CLAY					

NOTES: DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO171-SB031

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 31 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brownish black, silty, f. to v.c. slag FILL, some f. to c. sand	80/72	N/A	0.0		Nominal 6" Borehole
1					0.0		
2					0.0		
3					0.0		
4					0.0		Portland Cement & Bentonite Grout
5					0.0		
6		Wet @ ~6.0'	117/120		0.2		
7		Brownish black, silty, f. to v.c. slag FILL, some f. to c. sand, few brick fragments			0.2		
8					0.2		
9		Water Table @ ~9.5'			0.2		
10		Brown, silty, f. to v.c. slag FILL, some sand			0.2		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO171-SB031

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 31 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
11 – 13.9		Brown, silty, f. to v.c. slag FILL, some f. to c. sand, few brick fragments, some iron oxide staining at bottom of section	112/120		0.4, 0.9, 0.5		
13.9 – 16		Black, silty, f. to v.c. slag FILL, some f. to c. sand, staining throughout, black residual product with sheen and naphthalene odor at 13.4'-14.5'			2.3, N/A		
16 – 17.8		Black, silty, f. to v.c. slag FILL, some f. to c. sand, free product, strong naphthalene odor noted			13.8, 31.9		
17.8 – 20		Dark greenish gray, Silty, f. SAND, residual product with strong naphthalene odor at 17.8'-20.0'			53.1, 24.4		
20 – 21					57.7		

NOTES:

DRAFT

ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO171-SB031

DATE DRILLED: 5/9/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 31 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
21		Dark greenish gray, Silty, f. SAND, residual product with strong naphthalene odor at 20.0'-21.1'			64.3		
22					49.6		
23					47.8		
24		Dark greenish gray, Silty CLAY, some shell fragmenst, black staining at base of section, faint naphthalene odor			15.4		
25					3.9		
26		Very dark greenish gray, Silty, f. SAND, black stain at top of section, black streaks throughout, naphthalene odor noted	59/60		1.8		
27					1.5		
28		Light grayish brown, Silty CLAY, thin brownish residual stringers at 27.4'-27.7', soft and malleable, some dark gray staining throughout			0.8		
29		Very dark greenish brown, Silty CLAY, very stiff, residual staining throughout, faint naphthalene odor noted			0.2		
30		Very dark greenish brown, Silty CLAY, very stiff, residual staining throughout, faint naphthalene odor noted			0.1		
31							

NOTES:

DRAFT

BOREHOLE LOG: CO172-SB031

DATE DRILLED: 5/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 31 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			89/72	N/A	0.3		
1					0.8		Nominal 6" Borehole
2					1.3		
3		Brownish black, silty, f. to c. gravel FILL (slag, fire brick, and rock), some coal fines throughout, some rusty iron, faint odor			0.8		
4					7.1		Portland Cement & Bentonite Grout
5					1.8		
6		Wet @ ~6.0'	105/120		0.9		
7					0.5		
8		Grayish brown, silty, f. to c. gravel FILL (slag, fire brick, and rock),			0.2		
9					0.9		
10					0.2		

NOTES:

DRAFT

BOREHOLE LOG: CO172-SB031

DATE DRILLED: 5/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 31 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
					0.3		
11		Grayish brown, silty, f. to c. gravel FILL (slag, fire brick, and rock), possible colorless product at 12.8' and 15.2', faint aromatic odor noted			1.3		
12					1.3		
13					0.9		
14					1.8		
15					1.0		
16		Very dark gray, c. sand and f. to v.c. slag FILL, ammonia odor at 16.0'-18.4'	101/120		5.2		
17					7.4		
18					4.6		
19		Dark greenish gray, native, Silty, f. SAND, some ammonia odor			8.9		
20					8.6		

NOTES:

DRAFT

BOREHOLE LOG: CO172-SB031

DATE DRILLED: 5/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 31 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
21		Dark greenish gray, Silty, f. SAND, some ammonia odor			20.4		
22					2.4		
23		Dark greenish gray, Silty, f. SAND, trace clay, 5% shell fragments, sour odor noted			17.4		
24					6.5		
25					0.0		
26		Dark greenish gray, Silty CLAY, 5% shell fragments	75/60		0.1		
27					0.2		
28		Dark greenish gray, Silty, f. to m. SAND			0.1		
29		Light greenish gray, Silty CLAY, few pockets of brownish silty sand, brown and black streaks with faint odor to 29.4', dark gray stains at 29.4'-30.0'			0.1		
30		Light greenish gray, plastic CLAY, dark gray stains present			0.0		
31							

NOTES:

DRAFT

BOREHOLE LOG: CO173-SB036

DATE DRILLED: 5/10/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, f. sand and f. to v.c. slag and rock FILL, trace to some clay, seams of coal fines with odor at 1.3'-1.7' and 5.6'-6.0', some coal fines present at 1.7'-5.6', residual product with aromatic odor in bands at 1.3'-2.1', 3.3'-4.7', and 5.0'-5.9'	87/72	N/A	0.1		Nominal 6" Borehole
1					27.2		
2					47.8		
3					49.9		
4					11.3		Portland Cement & Bentonite Grout
5					6.7		
6		Brownish black, silty, f. to c. rock, slag, and brick FILL, seam of residual product at 6.0'-7.0', aromatic odor noted	120/120		0.6		
7		Wet @ ~7.0'			1.3		
8		Brownish black, silty, f. to c. rock, slag, and brick FILL, seam of residual product at 9.5'-9.6', aromatic odor noted			5.8		
9					1.8		

NOTES:

DRAFT

BOREHOLE LOG: CO173-SB036

DATE DRILLED: 5/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10							
10-13		Brownish black, silty, f. to c. rock, slag, and brick FILL, seam of residual product at 10.5'-11.8', aromatic odor			2.0		
11					3.4		
12					8.0		
13		Water Table @ ~13.0'			7.0		
13-16		Brownish black, silty, f. to c. rock, slag, and brick FILL, trace to some clay, seam of residual product at 13.0'-16.0', aromatic odor			6.7		
15					8.5		
16-19		No Recovery (Top of Sample fell out of Core Barrel)			N/A		
17					N/A		
18			74/96		N/A		
19							

NOTES: DRAFT

BOREHOLE LOG: CO173-SB036

DATE DRILLED: 5/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
		V. dk greenish brown, silty, f. sandy FILL, some clay, black staining, ammonia odor			18.5		
20		Buff colored, f. sandy clay FILL, black staining, ammonia odor			30.6		
21		V. dk greenish brown, silty, f. sandy FILL, some clay, black stains, ammonia odor			6.7		
		Buff colored, f. sandy clay FILL, black staining, ammonia odor					
22					18.0		
23					7.9		
24		Brownish black, silty, f. to v.c. slag FILL, sheen noted, aromatic odor			34.6		
25					34.7		
26			70/60		0.4		
27		Buff colored, native, Silty CLAY, pockets of orange c. sand, trace shell fragmenst, stiff, iron oxide and dark gray staining at 26.0'-26.6'			0.3		
28					0.2		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO173-SB036

DATE DRILLED: 5/10/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 36 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
29		Buff colored, Silty, f. SAND, some bright yellowish orange post depositional stains			0.1		
30		Buff colored, Silty, f. SAND, some bright yellowish orange post-depositional stains			0.2		
		Buff colored, Silty CLAY, stiff					
31		Bright yellowish orange, Silty, f. SAND	66/60		0.1		
		Buff colored, Silty CLAY, stiff					
32		Buff colored, Silty, f. SAND, extensive bright yellowish orange staining , few "pockets" of orange c. sand			0.1		
33					0.1		
34					0.1		
35					0.2		
36							

NOTES:

DRAFT

BOREHOLE LOG: CO174-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Dark brownish gray, silty FILL, some f. to c. slag gravel	83/72	N/A	0.4		
1		Black FILL of f. to m. coal and coal fines, some m. gravel, trace clay			0.9		Nominal 6" Borehole
2					0.5		
3					0.6		
4					0.5		Portland Cement & Bentonite Grout
5					0.9		
6		Light gray, silt and slag FILL, colorless residual product at 7.0'-9.5', colorless free product at 9.5'-10.0', strong aromatic odor	105/120		2.6		
7					4.7		
8					36.0		
9					67.5		

NOTES:

DRAFT

BOREHOLE LOG: CO174-SB016

DATE DRILLED: 5/11/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Light gray, silt and slag FILL, colorless free product at 10.0'-10.1', brown residual product with very strong aromatic odor at 10.1'-16.0'			21.7		
11					96.7		
12					155.0		
13					994.0		
14					1402.0		
15					N/A		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO176-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0			82/72	N/A	11.1		
1		Blackish brown, silty, f. to c. slag FILL, some coal fines, aromatic odor noted			10.1		Nominal 6" Borehole
2					13.3		
3		Brown, silty, f. to v.c. slag FILL, iron oxide staining at 2.2' to 3.4', some bluish gray staining at 3.4'-3.8', residual product at 3.4'-3.8', strong aromatic odor			15.0		
4					37.9		Portland Cement & Bentonite Grout
5		Black, silty, f. to v.c. slag FILL, residual product, strong aromatic odor					
		White, chalk-like FILL			116.0		
		Gray, silty, f. to v.c. slag FILL, gray free product at 5.6'-6.0', v. strong aromatic odor					
6		Wet @ ~6.0'	123/120		136.0		
7					179.0		
8		Light gray, silty, f. to v.c. slag FILL with dark bluish gray staining, black residual product at 6.0'-7.1', colorless residual product at 7.1'-7.8'; brown residual product at 9.5'-10.0', very strong aromatic odor			299.0		
9					1156.0		

NOTES:

DRAFT

BOREHOLE LOG: CO176-SB016

DATE DRILLED: 5/12/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10–13.6		Light gray, silty, f. to v.c. slag FILL with dark bluish gray staining, brown residual product at 10.0'-11.2', residual product at 11.2'-13.6', very strong aromatic odor throughout			9281.0 4271.0 3799.0 1386.0		
13.6–16		Very dark bluish gray, f. granular FILL material, some white c. granules throughout, colorless residual product at 13.6'-14.4', very strong aromatic odor			786.0 116.0		

Depth scale: 10, 11, 12, 13, 14, 15, 16

NOTES:

DRAFT

BOREHOLE LOG: CO177-SB016

DATE DRILLED: 5/12/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, f. to v.c. slag FILL, some bluish gray staining, coal fines throughout at 1.0'-1.9', residual product at 1.9'-2.3'	62/72	N/A	1.2		Nominal 6" Borehole
1					1.1		
2					2.6		
3		Medium gray, silty, f. to v.c. slag FILL			2.1		
4					1.9		Portland Cement & Bentonite Grout
5					1.2		
6		Wet @ ~6.0' Dark gray, silty, f. to v.c. slag FILL, some iron oxide stains, residual product throughout	118/120		1.3		
7		Brown, silty, f. granular FILL material, some f. to m. slag, residual product at 7.4'-10.0', stong aromatic odor			4.0		
8					14.3		
9					13.9		

NOTES: DRAFT

BOREHOLE LOG: CO177-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10					20.9		
11		Brown, silty, f. granular FILL material, some f. to m. slag, residual product at 10.0'-11.3', brown residual product at 11.3'-12.2', brownish residual product at 12.2'-12.4', residual product at 12.4'-13.1', strong aromatic odor			54.2		
12					86.7		
13					201.0		
14		Dark grayish blue, silty, f. granular FILL material, brown residual product at 13.1'-15.0', sheen at 15.0'-16.0', very strong aromatic odor			392.0		
15					18.1		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO178-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Black FILL, coal fines, some f. to v.c. gravel, faint coal odor (0–6)	60/72	N/A	0.3		Nominal 6" Borehole
1					0.4		
2					0.3		
3					0.2		
4					0.2		Portland Cement & Bentonite Grout
5					1.2		
6		Rebar reinforced CONCRETE, dark grayish blue staining	5/6		0.1		
7		No Recovery			N/A		
8					N/A		
9					N/A		

NOTES: DRAFT

BOREHOLE LOG: CO178-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10–13		No Recovery	33/36		N/A, N/A, N/A		
13–15.2		CONCRETE pillar, grayish blue staining throughout			8.9, 63.3		
15.2–16		Black, silty, c. sand and f. to c. slag FILL, tarry free product, strong aromatic odor			55.2		

NOTES: DRAFT

BOREHOLE LOG: CO180-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Grayish brown, silty slag FILL, some brick fragments	89/72	N/A	0.1		Nominal 6" Borehole
1		Black FILL, coal and coal fines			0.2		
2		Dark gray, silty, gravel FILL, some coal fines			0.2		
3		Silty FILL with black, orange, orangish brown, light gray, and dark gray, f. to c. grains, trace clay, seam of coal fines at 2.6'-2.7', seam of tan chalk-like silt at 3.0'-3.7'			0.1		
4		Yellowish brown, silty, f. to c. slag FILL, some rock			0.1		Portland Cement & Bentonite Grout
5					0.1		
6		Wet @ ~6.0'	116/120		0.1		
7		Light gray, silty, f. to c. slag FILL, some brown silt at 6.6'-8.7', viscous black residual product at 6.8'			0.1		
8					0.2		
9					0.1		

NOTES: DRAFT

BOREHOLE LOG: CO180-SB016

DATE DRILLED: 5/12/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Light gray, silty, f. to c. slag FILL, some dark gray and brown stains throughout			0.1		
11					0.4		
12					0.4		
13					0.7		
14		Dark bluish gray, granular FILL material, some dark gray and brown stains throughout, aromatic odor noted			0.8		
15					5.7		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO181-SB016

DATE DRILLED: 5/18/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0-4		Brown, silty, f. to c. slag FILL, band of silt with iron oxide at 1.0'-1.1'	79/72	N/A	0.0 (0.4), 0.0 (1.4), 0.0 (2.4), 0.0 (3.4)		Nominal 6" Borehole
4-5		Gray, silty, f. to c. slag FILL, trace light blue staining			0.0 (4.4)		Portland Cement & Bentonite Grout
~5.0		Wet @ ~5.0'					
5-6		Gray, silty, f. to v.c. slag FILL, some light blue staining, brown stains with faint odor noted at 5.7'-6.0'			0.0 (5.4)		
6-10		Gray, silty, f. to c. slag FILL, trace light blue staining, brownish stains at 6.0'-6.4' and 6.9'-7.1' with faint aromatic odor, sheens noted at 8.0'-8.3', 8.5'-8.6', and 9.5'-10.0'	141/120		3.6 (6.4), 1.5 (7.4), 1.1 (8.4), 2.5 (9.4)		

NOTES:

DRAFT

BOREHOLE LOG: CO181-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Gray, silty, f. to c. slag FILL, brown residual product at 11.3'-13.3', colorless residual product at 13.3'-14.2', thin brown free product at 14.2'-14.8'; colorless residual product 14.8'-16.0', strong aromatic odor			1.3		
11					18.9		
12					27.1		
13					77.9		
14					140.0		
15					66.8		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO182-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0–1.2		Brown, silty, f. to m. slag FILL	50/72	N/A	0.0		Nominal 6" Borehole
1.2–1.9		Brown, silty FILL with brick and a high percentage of coal fines, faint coal odor			0.0		
1.9–6.8		Brown, silty, f. to c. slag FILL			1.2		Portland Cement & Bentonite Grout
					0.3		
					0.0		
					0.0		
			105/120		0.0		
6.8–7.1		Wet @ ~7.0'					
7.1–8.8		Brown, silty, f. to c. slag FILL			0.0		
					0.0		
8.8–10		Dark brownish gray, silty, f. to c. slag FILL			0.0		

NOTES:

DRAFT

BOREHOLE LOG: CO182-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10–12		Dark brownish gray, silty, f. to c. slag FILL, sheen, faint aromatic odor			0.0 2.3		
12–15.2		Brown, silty, f. to c. slag FILL, some grayish blue staining throughout, iron oxide staining at 11.9'-12.2', black residual product at 12.2'-12.7', brown staining at 14.1'-14.6', some aromatic odor noted			0.7 0.3 1.1		
15.2–16		Dark gray with trace blue staining, silty, granular FILL, some white c. granules, some aromatic odor			2.6		

NOTES: DRAFT

BOREHOLE LOG: CO183-SB016

DATE DRILLED: 5/18/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brown, silty, f. to v.c. slag FILL	68/72	N/A	0.4		Nominal 6" Borehole
1					7.3		
2		Dark gray to black, silty, f. to v.c. slag FILL, coal fines throughout, brick fragments at 5.0'-6.0'			71.9		
3					27.0		
4					15.9		Portland Cement & Bentonite Grout
5					11.1		
6		Wet @ ~6.0'					
		Dark gray to black, silty, v.c. brick FILL, coal fines throughout	102/120		16.2		
7					29.1		
8		Brownish black, silty, f. to v.c. slag and brick FILL, coal fines throughout, some odor noted			7.8		
9					4.7		

NOTES:

DRAFT

BOREHOLE LOG: CO183-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Brownish black, silty, f. to v.c. slag and brick FILL, coal fines throughout, residual product at 14.2'-16.0'			1.2		
11					17.4		
12					52.4		
13					47.0		
14					6.4		
15					9.8		
16							

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO185-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Brownish black to black, coal fines, silt, and f. to m. slag FILL	70.5/72	N/A	0.0		
1					0.2		Nominal 6" Borehole
2					0.0		
3					0.0		
4					0.0		Portland Cement & Bentonite Grout
5		Wet @ ~5.0'					
		Brownish black to black, coal fines, silt, and f. to m. slag FILL			0.0		
6		Dark brownish gray, silty, f. to c. slag FILL, seams of thick brown residual product at 7.2'-10.0', strong aromatic odor	137/120		0.0		
7					2.5		
8					11.1		
9					16.7		

NOTES:

DRAFT

KEY ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO185-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Dark brownish gray, silty, f. to c. slag FILL, lenses of residual product throughout, thick brown free product at 11.3'-12.9', strong aromatic odor			42.6		
11					31.5		
12					61.4		
13		Grayish blue, granular FILL material, few white c. granules, gummy texture, faint aromatic odor			13.8		
14					7.4		
15					5.4		
16							

NOTES:

DRAFT

BOREHOLE LOG: CO186-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Sample Description	Recov	Blow Count	PID	Completion Description
0		83/72	N/A	0.0	
1	Brown, silty, f. to c. slag FILL, some coal fines with depth			0.0	Nominal 6" Borehole
2	Yellowish brown, clayey silt FILL			0.0	
3	White chalk-like silt, black staining at top of section			0.0	
4	Gray, silty, f. to m. slag FILL			0.0	Portland Cement & Bentonite Grout
5				0.0	
6	Wet @ ~6.0'	119/120		0.0	
7				0.8	
8	Gray, silty, f. to m. slag FILL, 1.5" dark gray stain at 8.0', 1.5" brown stain at 9.2', 1.5" pinkish stain at 9.6'			0.4	
9				0.0	

NOTES: DRAFT

BOREHOLE LOG: CO186-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10		Gray, silty, f. to m. slag FILL, brown residual product at 11.0'-12.3', thick brown residual product at 12.3'-14.2', strong aromatic odor			2.1		
11					9.0		
12					58.1		
13					96.0		
14		Dark bluish gray, granular FILL material, thick brown residual product at 14.2'-14.6', aromatic odor			72.0		
15					14.8		
16							

NOTES:

DRAFT

ENVIRONMENTAL INCORPORATED

BOREHOLE LOG: CO187-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
0		Very dark brown, silty, semi-rounded, f. to m. gravel FILL	88/72	N/A	0.0		Nominal 6" Borehole
1					0.0		
2		Gray, silty, f. to v.c. slag FILL, some brick, seams of coal and fines at 3.1'-3.5' and 5.2'-5.4'			0.0		
3					0.0		
4					0.0		Portland Cement & Bentonite Grout
5					0.0		
6		Wet @ ~6.0'	132/120		0.0		
7		Dark gray, silty f. to v.c. gravel FILL (rock, brick concrete, and slag), trace clay, seam with coal fines at 7.8'-9.0'			0.0		
8					0.0		
9		Light gray, FILL of pieces of concrete pillar			0.0		

NOTES:

DRAFT

BOREHOLE LOG: CO187-SB016

DATE DRILLED: 5/18/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: TOC:
DATUM:	TOTAL DEPTH: 16 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
10					0.0		
11					0.0		
12					0.0		
13		Light gray, FILL of pieces of concrete pillar			0.0		
14					0.0		
15					0.0		
16							

NOTES:

DRAFT

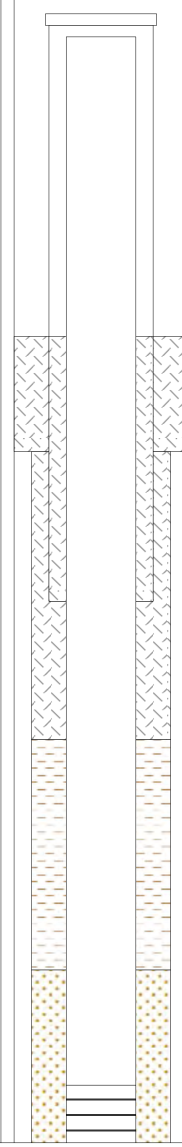
BOREHOLE LOG: CO188-SB016
WELL LOG: CO128-PZMXXX
DATE DRILLED: 5/19/15

KEY ENVIRONMENTAL INCORPORATED

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: ft TOC: ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Completion Description
4						
3						Steel Protective Cover
2						4" Sch 40 PVC Riser
1						Concrete Pad
0			82/72	N/A	1.1	Ground Surface
1		Brown grading to grayish brown, silty, f. to c. gravel FILL (slag, brick, and rock), some coal fines present at 1.3'-1.75', odor noted			1.0	Nominal 8" Borehole
2					3.6	
3					2.1	
4		Medium gray, silty, f. to v.c. slag FILL with possible residual product at 3.8'-5.5'			26.5	Bentonite Seal
5					23.1	
6			106/120		3.8	

Graphical Completion Log



NOTES:

DRAFT

BOREHOLE LOG: CO188-SB016
WELL LOG: CO128-PZMXXX
DATE DRILLED: 5/19/15

PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: SPARROWS POINT PDI	DRILLING CO: TERRA SONIC
SITE LOCATION: SPARROWS POINT, MD	DRILLER: GERALD SEELY
PROJECT NO: 14933	DRILLING RIG / METHOD: TSI 150T / SONIC
FIELD GEOLOGIST: B. HAMEL	HAMMER WT./DROP: N/A
PROJECT MANAGER: A. BRIGGS	SAMPLING METHOD: CONTINUOUS
COORDINATES: E: N:	ELEVATION: GND SURF: ft TOC: ft
DATUM: STATE PLANE MARYLAND NAD83/NAVD88	TOTAL DEPTH: 17 ft

Depth (ft-bgs)	Lithol Log	Sample Description	Recov	Blow Count	PID	Graphical Completion Log	Completion Description
7							#2 Quartz Sand
					31.7		
8							
					47.5		
9							
					59.0		
10		Light gray, silty, f. to c. slag FILL with possible residual or free product from 7.8'-10.5' and strong aromatic odor at 10.5'-13.3'					
					40.2		
11							
					63.1		4" Sch 40 PVC 20-Slot Screen
12							
					40.1		
13							
					58.0		
14							
		Bluish gray, granular FILL material packed hard at 15.6'-16', possible residual or free product			53.1		
15							
					14.9		
16		Interval not logged during well installation					
17							

NOTES:

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APPENDIX C

SMOLDERING TECHNOLOGY REPORT

Geosyntec consultants

10220 Old Columbia Rd.
Suite A
Columbia, Maryland 21046
PH: 410.381.4333
www.geosyntec.com

29 July 2015

Mr. Russ Becker
Mr. James Calenda
EnviroAnalytics Group, LLC
1650 Des Peres Road, Suite 303
Saint Louis, Missouri 63131

Subject: Report for Self-Sustaining Treatment for Active Remediation (STAR) Treatability Study at Cell 4 Area of the Former Sparrows Point Steel Mill, Sparrows Point, Maryland.

Dear Mr. Becker and Mr. Calenda:

Geosyntec Consultants (Geosyntec) has prepared this letter report for EnviroAnalytics, LLC in accordance with our proposal dated 20 January 2015. This report presents the laboratory-scale evaluation of self-sustaining treatment for active remediation (STAR) technology for treatment of dense non-aqueous phase liquid (DNAPL) in Cell 4/5 of the Coke Oven Area at the former Sparrows Point Steel Mill in Baltimore, Maryland (Site).

BACKROUND AND OBJECTIVES

EnviroAnalytics requested that a STAR bench-scale test be performed to evaluate efficacy of this technology in treating DNAPL-contaminated soils in Cell 4/5 of the Coke Oven Area (Figure 1 as provided by Key Environmental, Inc.). That area is constructed of filled land, primarily steel slag from the former operation, and is known to have both DNAPL and light non-aqueous phase liquid (LNAPL) source areas. Cell 4/5 is located in the southwestern corner of the Coke Oven Area in the vicinity of the former coal tar recovery operations. Historical impacts from dissolved phase constituents such as benzene, toluene, and naphthalene have been known to exist in this area. Recent (June 2014) monitoring has shown the concentrations of those constituents were approximately 5 mg/L, 4 mg/L, and 245 mg/L, respectively (Key Environmental, 2015). The naphthalene concentrations exceed its solubility by close to an order of magnitude and indicate the presence of DNAPL. Previously, bioaugmentation was implemented to treat the dissolved phase contaminants in this area, but that treatment was ineffective.

During the past few years an innovative technology, STAR, has been developed for in-situ or ex-situ treatment of hydrocarbon DNAPL including coal tar, creosote, and various hydrocarbon wastes and sludges. STAR is a thermal remediation technology in which NAPL is thermally oxidized (destroyed) via smoldering combustion. In this process, NAPL serves as a fuel, smoldering is initiated through a short-duration, low-energy ‘ignition event’, and smoldering is sustained via the addition of air. Active control of the combustion front is maintained by the air supply.

The STAR bench-scale test was performed to support the evaluation of effectiveness and efficiency of STAR in treating DNAPL in the Cell 4/5 area of the Site. The STAR bench testing was conducted on the soil core samples collected from the DNAPL source zone at locations C0166-SB036, C0167-SB031, and C0168-SB031 (Figure 1). The samples were subjected to smoldering combustion tests to evaluate the DNAPL-impacted soils for the following parameters:

1. Conditions (including ignition temperature and airflow rate) required to achieve self-sustaining smoldering combustion;
2. Peak temperature (including thermocouple profiles) and the smoldering front propagation velocity;
3. Concentrations of contaminants in subsurface geologic materials pre- and post-combustion; and
4. Principal components of gaseous emissions.

SAMPLE COLLECTION AND LITHOLOGY

Core samples for the STAR bench tests were collected on 8 May 2015 at locations C0166-SB036, C0167-SB31, and C0168-SB31 (Figure 1) at a depth interval of approximately 16 -19 feet below ground surface (bgs). The samples were collected as part of the drilling program that was being performed by Key Environmental, Inc. to delineate the DNAPL source zone. The soil borings were advanced using a rotosonic drilling method. Appendix A presents the daily field report and photolog Geosyntec developed for the field sampling activities that Geosyntec observed on 8 May 2015.

The subsurface lithology was observed to comprise of a heterogeneous mixture of slag and fill. DNAPL was observed at each of the three sampling locations at a depth interval of approximately 16 -19 feet bgs. Vertical migration of the DNAPL appeared to generally be limited by an underlying finer grained confining layer ranging in texture from very fine sand to clay, which was observed at approximately 20 feet bgs at the three sampling locations. The geologic material from C0168-SB031 appeared to have the most DNAPL of the three sampling locations.

Based on visual observation and photoionization detector (PID) screening of the soil cores at each of the three locations, geologic material containing DNAPL was collected into a 5-gallon paint pail. After the pail was full with the composite sample from the three locations, it was sealed and transported off site to Geosyntec's Columbia, MD office from where it was subsequently shipped under chain of custody to STAR test laboratory at University of Western Ontario, Canada.

STAR TEST OVERVIEW AND RESULTS

The STAR treatability test was performed at the University of Western Ontario in Canada, in close coordination with Savron (exclusive licensee of STAR technology patents - International PCT Filing PCT/GB2006/004591 and Granted Patents US 8,132,987 B2, CA 2,632,710, AU 2006323431 B9, JP4934832, and ZL 2006 8 0052554.X). Tests were performed for a 14-centimeter tall soil column using a convective ignition method to determine ignition temperature and air flow rate required for a self-sustaining smoldering combustion in the test sample. The full details of the STAR test experimental set-up, test conditions, sample analysis, and testing results are presented in Savron's treatability study report (Attachment B).

As described in Attachment B, the tests demonstrated that self-sustaining combustion of the Site materials occurred at a fixed flux rate of 5.0 centimeters/second and following approximately 160 minutes of heating at an injected air temperature of 160 ^{o}C. The peak temperature recorded was 742 ^{o}C and the front propagation velocity was estimated to be 8.6 feet per day. Nearly complete combustion of the contaminants occurred during testing, as evidenced by a reduction in the concentrations of total petroleum hydrocarbons (TPH) from 19,460 milligrams per kilogram to a non-detect level and an average percent decrease in detected organic compounds in pre- and post-test samples of 99.9 percent.

The concentrations of CO (0.06%) and CO_2 (0.8%) measured in the gaseous emission during the test were within the range of typical values for the types of contaminants and soils tested at a bench-scale. From the test sample, benzene was the only constituent that was detected marginally above 1 part per million by volume in the off-gas sample. However, it should be noted that LNAPL was not specifically included in the field sample collected and tested in this bench test. The presence of LNAPL, as identified within the Cell 4 area will require considerations regarding potentially additional emissions during a STAR field-scale implementation if and when the technology is to be applied in such an area.

Another notable observation made during the bench test was that the sample exhibited simultaneous combustion at multiple intervals within the test apparatus. The idealized STAR combustion pattern would generally propagate a combustion front from the bottom of the apparatus (at the heating element) to the top of the apparatus. The pattern observed in the Site sample was likely caused by heterogeneities in the sample and preferential air flow pathways through large materials and corresponding larger pore spaces in portions of the sample matrix. Such heterogeneity in the test apparatus could be an artifact of the way that the soil column was prepared or it could the characteristics of the field material collected for this bench test. The potential effects of soil heterogeneity and preferential air flow (and therefore preferential combustion) are factors that will need to be considered as part of a field pilot evaluation in order to assess the feasibility and expected performance of a full-scale STAR system.

Conclusions and Recommendations

The following are the primary conclusions drawn from the results of this STAR bench test:

1. The Site soils collected from the suspected DNAPL impacted zone at locations C0166-SB036, C0167-SB31, and C0168-SB31 support a self-sustained smoldering combustion reaction in the laboratory test apparatus.
2. Combustion of the Site samples was nearly complete and significant reductions in contaminant concentrations were observed between the pre- and post-test soil samples.
3. The bench-scale test was successful at determining the smoldering characteristics of DNAPL-impacted soils in Cell 4 area of the Site and off-gas samples showed relatively low concentrations of select air pollutants.
4. Because the combustion occurred at multiple intervals in the sampling apparatus simultaneously, likely due to preferential air flow pathways caused by heterogeneities in the sample matrix, the effect

of matrix heterogeneity on front propagation and radius of influence should be determined during a pilot test and/or supplemental pre-design investigation.

Based on the data gathered during the bench-scale test, a STAR remedy may be effective at the Cell 4 area. To further assess the suitability of this technology, Geosyntec recommends that a field-scale pilot test be performed. The pilot test would be developed to provide additional data to: (i) assess the effect of Site specific matrix heterogeneities on STAR performance; (ii) identify design parameters to support the design of a full-scale application

Path Forward and Potential Costs

As described above, based on the successful results of the self-sustaining combustion and the contaminant mass reductions that were observed in the bench-scale test, a field-scale pilot test is recommended to further assess the suitability of the STAR technology at the Site and to obtain valuable and integral data that are needed to design a full-scale STAR system. Based on our experience at other, similar sites, we anticipate the cost of a pilot test, including limited supplemental characterization for pilot test design, to range between $275,000 and $420,000.

The estimate of a field-scale pilot test is based on our current understanding of the conceptual site model, in which, a laterally continuous DNAPL body of at least two feet in thickness is located within a granular fill atop a fine grained native confining layer. Accordingly, we have assumed that a pilot test using a single ignition well could be performed at a test depth of approximately 20-feet bgs and a conventional, vertical-well soil vapor extraction (SVE) system with granular activated carbon treatment would be required to capture and treat the gaseous emissions. The conceptualized pilot test set-up would also include the installation of two stainless steel test wells (a primary well and backup well). The test wells could be used as both ignition points and air injection points. The test set-up would also include a skid mounted compressor and blower system and thermocouple arrays in multiple boreholes, at multiple depths and distances from the ignition/air-injection points. It is assumed that the active operation period for the pilot test is 10 days.

When scaling up the treatment to a full-scale application, it is likely that additional investigations, including a more complete, higher resolution delineation of the NAPL body would be necessary, along with limited additional geotechnical and/or hydrogeological testing. Based on our experience at other sites, a preliminary cost estimate for a conceptual full-scale STAR remediation at the Site would be $3.9M (-10% / +50%) for a one-acre area of 20-foot base depth and continuous NAPL with thickness ranging from 2 - 8 feet. As a high-level, conceptual approach, we have assumed that STAR may be applied to a single zone (DNAPL) at the Site. We have assumed for the purposes of this estimate a radius of influence of 10-feet per ignition point, and a smoldering propagation rate of 2 feet per day. Select assumptions (among others) include:

- No sheet piling is required;
- All permitting performed by others;
- Waste disposal performed and paid by others;
- Sufficient power is available at the Site; an assumed electricity cost of $0.09 per kilowatt-hour has been included;

Geosyntec consultants

- Site is accessible and secured by others;
- No asphalt cap;
- Source utilities available on Site for use, or set up by others;
- Utility clearances performed by others;
- Removal of any drilling obstructions (foundations, utilities, wells, etc.) by others; and
- Pre- and post- characterization by others and at levels sufficient for remedial design.

Based on the assumptions, the full-scale remedy for a one-acre area is estimated to take between 4 - 6 months of active operation. Please note that the preliminary estimates are based on current assumptions that may differ from actual conditions depending on the results of field-scale pilot test and additional pre-design characterizations. In particular, the cost for full-scale implementation will depend heavily on the actual radius of influence and smoldering propagation rate for the Site, which are generally determined during a field-scale pilot test.

CLOSING

Geosyntec appreciates the opportunity to submit this report. If you would like to discuss this report, please do not hesitate to contact either of the undersigned.

Very truly yours,

GEOSYNTEC CONSULTANTS

Paul Botek, P.G.
Associate

James Wang, Ph.D., P.E.
Associate

Attachments

Geosyntec consultants

Figure

Figure 1: STAR Treatability Testing Sampling Locations

N

LEGEND

SOIL BORING LOCATION

NOTE:
1. CELL 4/5 BORINGS INSTALLED AS DNAPL RECOVERY WELLS WITH 10–FOOT SUMPS (I.E., CO166, CO167, CO168).

Magellan GPS Coordinates		
ID Number	Northing	Easting
Soil Boring Locations		
CO166-SB036	561591.180	1457393.880
CO167-SB031	561597.246	1457445.740
CO168-SB031	561586.020	1457356.020
CO169-SB036	561697.628	1457300.330
CO170-SB026	561728.934	1457457.130
CO171-SB031	561619.100	1457585.930
CO172-SB031	561426.879	1457386.780
CO173-SB036	561561.208	1457236.010
Maryland State Plane Coordinates NAD83		

DRAFT COPY

0 200 400
FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 07/24/15
CHKD:	DATE:
APPD:	DATE:
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE–DESIGN INVESTIGATION
SPARROWS POINT, MARYLAND

REV #	DATE	DESCRIPTION	APPD

REFERENCE: THE GEOREFERENCED DIGITAL AERIAL PHOTOGRAPH WAS OBTAINED BY LINKING TO THE USGS EROS ORTHO IMAGE SERVER ON DECEMBER 1, 2014 (HTTP://RASTER.NATIONALMAP.GOV/ARCGIS/REST/SERVICES/ORTHOIMAGERY/USGS_EROS_ORTHO/IMAGESERVER). THIS AERIAL IMAGERY WAS COLLECTED FOR THE USGS ON SEPTEMBER 30, 2008.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

NEW SOIL BORING LOCATIONS

PROJECT NO: 14–933

FIGURE 1

y:\sparrows point\coke oven area drawings\14-933\figures for meeting\figure 2 cell 4-5 new boring locations.dwg Last Saved By: Scomer 7/24/2015 12:13 PM Plotted By: Shelly Comer 7/27/2015 2:55 PM Scale: 1:1

Geosyntec consultants

Attachment A

Daily Field Report and Photolog from Field Sampling

Geosyntec consultants

DAILY FIELD REPORT

PROJECT NO.: MR1249 **PHASE NO.:** 01 **DATE:** 5/08/2015 **PAGE 1 of 1**

CLIENT NAME: EnviroAnalytics Group, LLC **GEOSYNTEC REP.:** ARW and PJB

LOCATION: Sparrows Point LLC North Point Blvd, Sparrows Point, Maryland 21219

HEALTH AND SAFETY ISSUES: Potential exposure to contaminated soil and contaminant vapor; heat stress, slip, trips, and fall; heavy equipment

WEATHER: Sunny, high of around 80^{o}F

TIME OF ARRIVAL ON-SITE: 07:00

TIME OF DEPARTURE FROM SITE: 17:00

TOTAL HOURS WORKED ON-SITE: 9

TOTAL HOURS WORKED OFF-SITE: none **1 hour lunch**

WORK COMPLETED:

During the drilling program by Key Environmental Inc. in the Cell 4/5 area, direct the collection of a composite geologic sample containing free product for STAR bench-test. The geologic material containing free product was collected from 16 - 19 feet bgs at three locations - C0166-SB036, C0167-SB031, and C0168-SB031 - in a 5-gallon paint pail. The geologic material from location C0168-SB031 appeared to have the most DNAPL. After the pail was full with the composite sample, it was sealed and transported off site to Geosyntec's Columbia, MD office for shipping to STAR test laboratory.

PROBLEMS/DELAYS ENCOUNTERED: None

MODIFICATIONS TO PLANNED SCOPE OF WORK: None

COPY TO: Paul J. Botek **GEOSYNTEC REP.:** Amar R. Wadhawan; Paul J. Botek

HRS: 9

REVIEWED BY: Paul J. Botek

GEOSYNTEC CONSULTANTS
Photographic Record

Client: EnviroAnalytics Group, LLC	Project Number: MR1249
Site Name: Sparrows Point, LLC.	Site Location: North Point Blvd, Sparrows Point, MD 21219

Photograph # 1

Date: 08 May 2015

Direction: Southeast

Drilling and core logging for sample ID C0166-SB036 between C0115-PZM006 and C0108-PZM

Photograph # 2

Date: 08 May 2015

Direction: South

STAR test material from sample ID C0166-SB036

GEOSYNTEC CONSULTANTS

Photographic Record

Client:	EnviroAnalytics Group, LLC	Project Number:	MR1249
Site Name:	Sparrows Point, LLC.	Site Location:	North Point Blvd, Sparrows Point, MD 21219

Photograph # 3

Date: 08 May 2015

Direction: East

Drilling for sample ID C0167-SB031

Photograph # 4

Date: 08 May 2014

Direction: South

STAR test material from sample ID C0167-SB031

GEOSYNTEC CONSULTANTS

Photographic Record

Client:	EnviroAnalytics Group, LLC	Project Number:	MR1249
Site Name:	Sparrows Point, LLC.	Site Location:	North Point Blvd, Sparrows Point, MD 21219

Photograph # 5

Date: 08 May 2015

Direction: West

Drilling for sample ID C0168-SB031. The yellow arrow points to the white flag that shows sample ID C0167-SB031

Photograph # 6

Date: 06 May 2014

Direction: East

Core logging for sample ID C0168-SB031.

GEOSYNTEC CONSULTANTS
Photographic Record

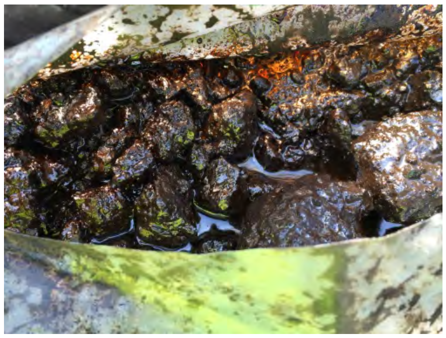
Client:	EnviroAnalytics Group, LLC	Project Number:	MR1249
Site Name:	Sparrows Point, LLC.	Site Location:	North Point Blvd, Sparrows Point, MD 21219

Photograph # 7

Date: 08 May 2015

Direction: N/A

STAR material from sample ID C0168-SB031



Photograph # 8

Date: 08 May 2015

Direction: N/A

STAR material for bench test

Geosyntec consultants

Attachment B

Savron STAR Treatability Testing Report

July 14, 2015

Paul Botek, P.G.
Geosyntec Consultants, Inc.
10220 Old Columbia Road, Suite A
Columbia, Maryland 21046
via email: pbotek@geosyntec.com

Subject: Treatability Testing of the Self-sustaining Treatment for Active Remediation (STAR) Technology to Treat Non Aqueous Phase Liquid (NAPL) Contaminated Soils at the Former Sparrow's Point Steel Mill in Baltimore, Maryland.

Dear Paul:

A treatability study for the application of Self-sustaining Treatment for Active Remediation (STAR) to treat Non Aqueous Phase Liquid (NAPL) contaminated soils at the Former Sparrow's Point Steel Mill in Baltimore, Maryland (the "Site") was conducted. This report presents a brief description of the scope of work, the results of treatability testing, and recommendations for future phases of work.

SCOPE OF WORK

The proposed scope of work including the soil and gas emissions sampling and analysis was conducted as presented in the Geosyntec proposal to EnviroAnalytics Group, LLC dated 20 January 2015 with the following exceptions:

- The collected material contained large gravel-sized stones and iron slag which were screened out of the test sample using a 2 centimeter (cm) by 1 cm screen to allow for the placement of the test sample in the test column;
- A convective ignition method was used during this study (analogous to the method currently used in field applications of STAR); and
- A 14 cm contaminated soil pack height (versus 12 cm as proposed) was used.

RESULTS

Ignition Protocol and Smoldering Characteristics

A convective ignition source injecting air at a fixed flux rate of 5.0 centimeters per second (cm/s) was used to initiate the STAR process during this test. As indicated in Figure 1, combustion was initiated after approximately 160 minutes of heating using an injected air temperature (as measured by the "plenum" thermocouple) of approximately 480°C. Hundreds of columns studies have demonstrated that these ignition conditions are typical of soils contaminated with coal tar and / or petroleum hydrocarbons. Actual ignition parameters will vary in the field as a result of the scale of operation and the equipment used, with air flow rates anticipated to be significantly lower during ignition and increasing throughout the process as the combustion front propagates away from the point of ignition.

The combustion test demonstrated self-sustaining smoldering behavior; that is, temperatures at each location within the experimental apparatus continued to increase and “cross-over” temperatures at the preceding monitoring interval following the termination of the heating element (Figure 1). However, the pattern of the overlapping temperature profiles suggests that simultaneous burning at multiple depths was occurring at a given time within the apparatus, and that a distinct migrating combustion front was not established. This is likely due to preferential air flow pathways through the larger pore spaces created by the presence of large stones and particles of iron slag. These larger pore spaces could affect the propagation distance of a smoldering combustion reaction during field implementation; however, this can only be determined during a field pilot test or Pre-Design Evaluation (PDE).

The peak temperature recorded for the sample was approximately 724°C and the smoldering front propagation velocity was estimated to be 0.18 centimeters per minute (cm/min) (or 8.6 feet per day [ft/d]). Propagation velocities are correlated to aquifer properties and the mass of contaminants present in the pore space and will vary during field implementation as a function of soil concentrations / NAPL saturations.

Soil Analytical Results

The pre- and post-STAR treatment concentrations of petroleum hydrocarbons (BTEX and C6-C50 hydrocarbons) and Polycyclic Aromatic Hydrocarbons (PAHs) are presented in Table 1. ‘Before’ concentrations of total petroleum hydrocarbons were approximately 19,460 milligrams per kilogram (mg/kg) and ‘After’ STAR treatment concentrations were non detect. Only trace levels of PAHs were detected in the ‘After’ sample with an average percent concentration decrease for detected compounds of greater than 99.9%.

Concentration reductions during field implementation are anticipated to be similar to those observed in this study. Photographs, presented as Plate 1, showing the ‘Before’ and ‘After’ samples provide visual evidence of contaminant destruction.

Principle Components of Gaseous Emissions

Average concentrations of CO and CO_2 (combustion gases) measured during the test were 0.06% and 0.8%, respectively. These combustion gas concentrations are within the range of typical values for the types of contaminants and soils examined at the laboratory bench scale. Their presence is primarily viewed as an indicator of the occurrence of combustion. It is anticipated that combustion gas concentrations captured during a field trial or during full-scale field applications will be significantly higher (CO greater than 1,000 parts per million and CO_2 in the 3% to 8% range) to allow for both confirmation of the occurrence of combustion and estimation of contaminant mass destroyed via STAR in the subsurface.

Volatile compounds detected in the vapor phase above 1 part per million by volume (ppmv) in the test include benzene (1.66 ppmv) and 1,1,2-trichloroethane (40.8 ppmv); however, 1,1,2-trichloroethane is a suspected lab contaminant is not believed to be emitted by the sample.

Condensate samples were not collected by the vapor capture and cooling system to allow for the analysis of volatile compounds in condensate. However, if a condensate was formed, we would anticipate that it would contain the same compounds present in the vapor phase with their concentrations following Henry's Law.

Vapor concentrations during a laboratory bench test are anticipated to over-estimate the fraction of volatile emissions (relative to mass destroyed via smoldering) due to the large air flow rates used and the scale of the apparatus. However, these vapor data provide important information about the constituents than can be anticipated to be generated during STAR operation in the field and will be used to design a suitable vapor capture and treatment system for any subsequent field pilot testing. The compounds identified in vapors are consistent with the types of compounds typically identified in STAR laboratory bench scale tests involving the contaminants and soils types examined.

RECOMMENDATIONS

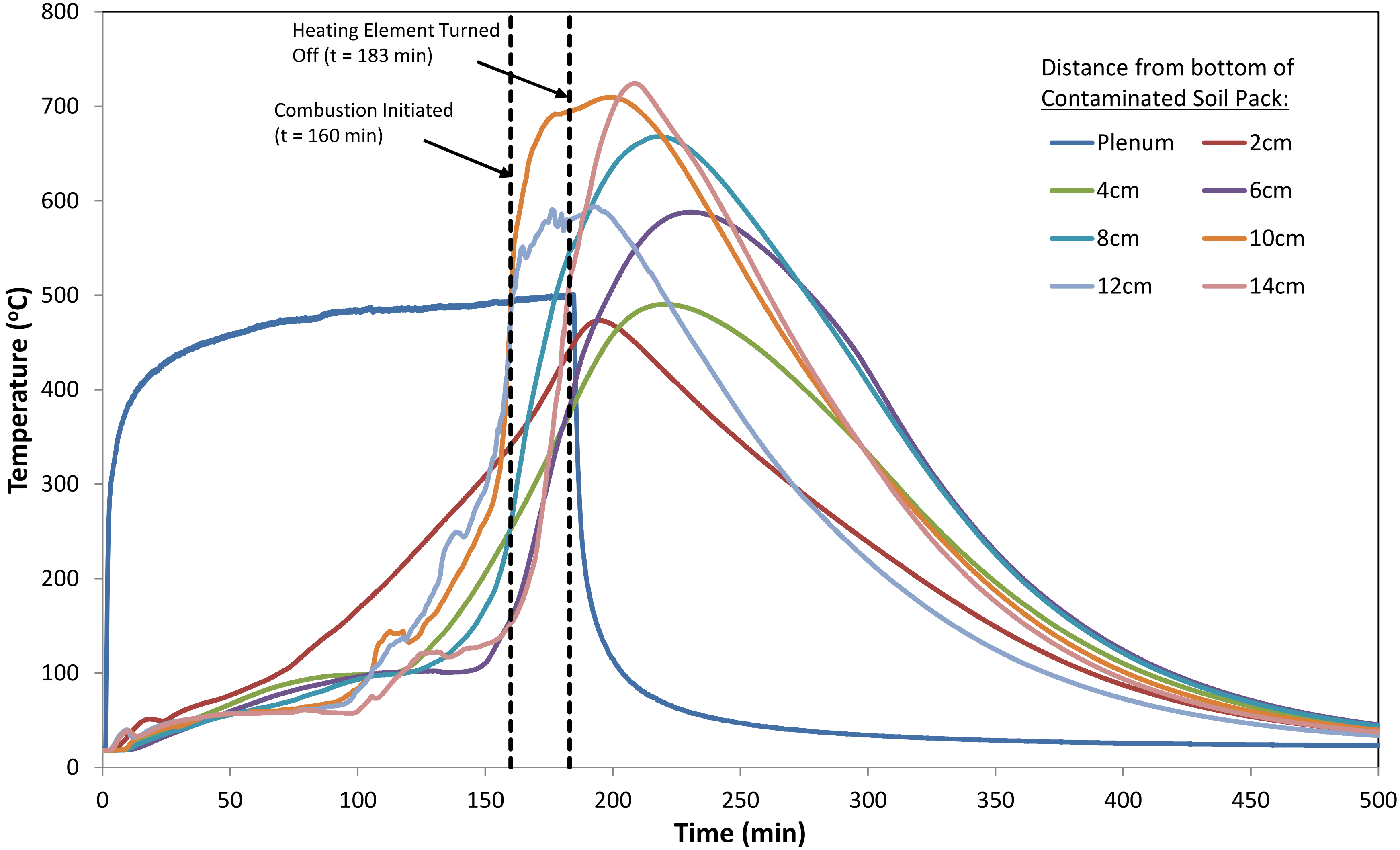
Self-sustaining smoldering combustion was observed for the soil sample tested. The remediation efficiency as observed in Plate 1 along with the concentration reductions observed through laboratory analysis (Table 1) and the calculated smoldering propagation velocity suggests that STAR could be successfully applied at the Site. A field pilot test or PDE should be carried out to evaluate key design parameters for a full-scale STAR system such as propagation rate and radius of influence and to evaluate the potential influence of large particles of stone and iron slag on the process.

If you have any questions or require additional information regarding this report, please contact me at 1-519-515-0852.

Sincerely,

Gavin Grant, Ph.D., P.Eng.
Operations Manager

David Major, Ph.D.
Managing Director



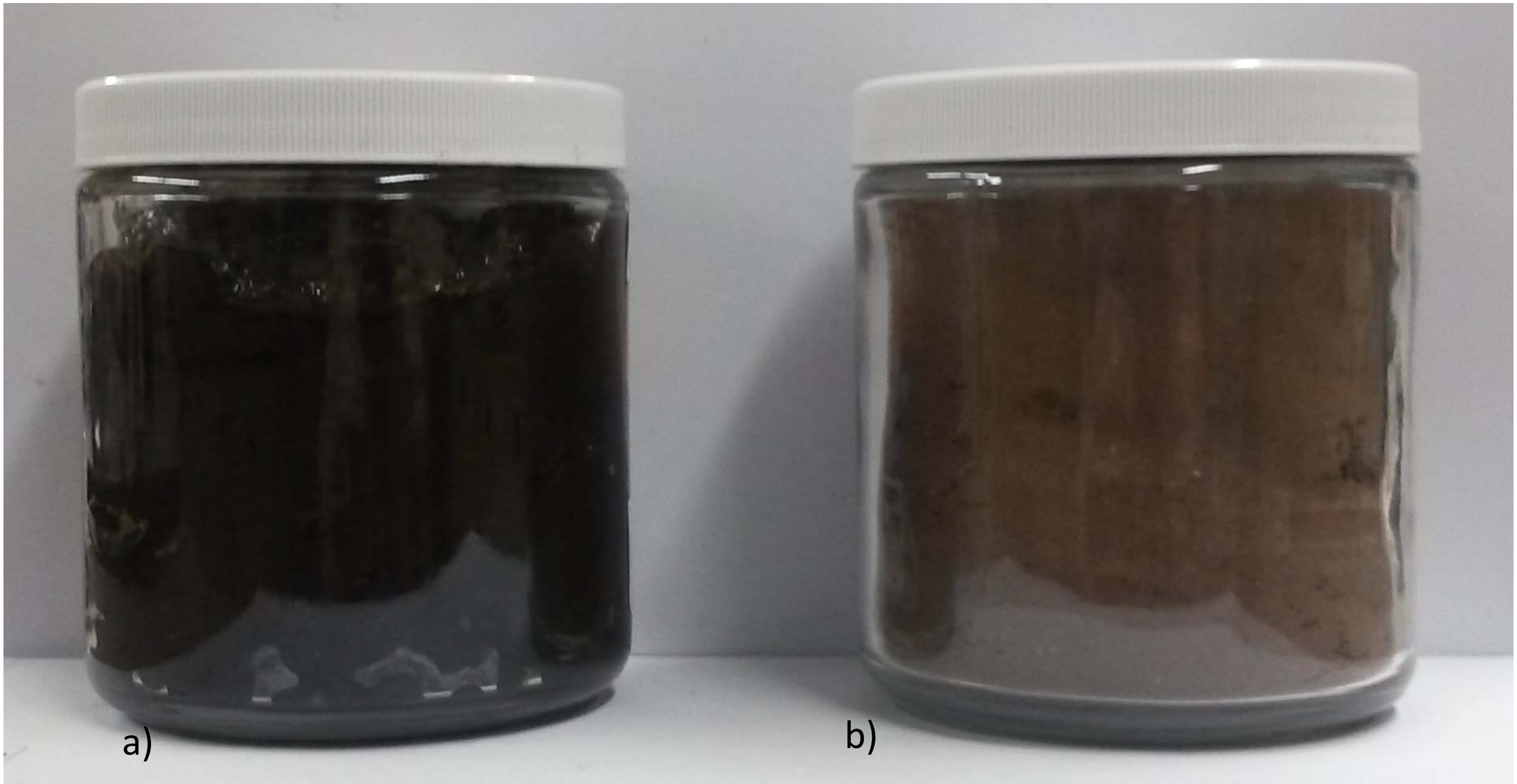
Notes:
1) Colored lines represent temperatures at various heights within the contaminated soil pack
2) Heating element turned on at T = 0 minutes to define the start of the test

STAR Temperature Profiles Former Sparrows Point Steel Mill, Maryland MR1249	
savron	July 2015
	Figure 1

Table 1
Concentrations of BTEX, Petroleum Hydrocarbons (C6-C50), and Polycyclic Aromatic Hydrocarbons in Soils
Former Sparrows Point Steel Mill, Maryland

Compound	Units	'Before' STAR Treatment		'After' STAR Treatment	
		RDL	Concentration In Soil	RDL	Concentration In Soil
Physical Tests					
Moisture	%	0.10	26.1	0.10	ND
Petroleum Hydrocarbons					
Benzene	ug/g	0.0068	10.2	0.0068	ND
Toluene	ug/g	0.018	2.78	0.018	ND
Ethylbenzene	ug/g	0.080	42.5	0.080	ND
o-Xylene	ug/g	0.020	32.1	0.020	ND
p+m-Xylene	ug/g	0.030	82.6	0.030	ND
Total Xylenes	ug/g	0.050	115	0.050	ND
F1 (C6-C10)	ug/g	5.0	370	5.0	ND
F1 (C6-C10) - BTEX	ug/g	5.0	200	5.0	ND
F2 (C10-C16 Hydrocarbons)	ug/g	10	10000	10	ND
F3 (C16-C34 Hydrocarbons)	ug/g	50	7540	50	ND
F4 (C34-C50 Hydrocarbons)	ug/g	50	1550	50	ND
F4G-SG (GHH-Silica)	ug/g	250	6660	250	ND
Total Hydrocarbons (C6-C50)	ug/g	72	19460	72	ND
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	ug/g	0.050	66	0.050	ND
Acenaphthylene	ug/g	0.050	971	0.050	ND
Acridine	ug/g	0.800	ND	0.800	ND
Anthracene	ug/g	0.050	369	0.050	ND
Benzo(a)anthracene	ug/g	0.050	392	0.050	ND
Benzo(a)pyrene	ug/g	0.020	286	0.020	ND
Benzo(b)fluoranthene	ug/g	0.050	319	0.050	ND
Benzo(g,h,i)perylene	ug/g	0.050	100	0.050	ND
Benzo(k)fluoranthene	ug/g	0.020	148	0.020	ND
Chrysene	ug/g	0.050	324	0.050	ND
Dibenzo(ah)anthracene	ug/g	0.050	ND	0.050	ND
Fluoranthene	ug/g	0.050	908	0.050	0.187
Fluorene	ug/g	0.050	629	0.050	ND
Indeno(1,2,3-cd)pyrene	ug/g	0.050	134	0.050	ND
1-Methylnaphthalene	ug/g	0.050	498	0.050	ND
2-Methylnaphthalene	ug/g	0.050	1150	0.050	ND
Naphthalene	ug/g	0.010	8840	0.010	0.019
Phenanthrene	ug/g	0.030	1350	0.030	0.237
Pyrene	ug/g	0.050	607	0.050	0.098
Quinoline	ug/g	0.050	ND	0.050	ND

Notes:
ND - non detect
ug/g - micrograms per gram
RDL - Reported Detection Limit



Notes:
a) Soil before STAR treatment
b) Soil after STAR treatment

Untreated and Post-STAR Treatment Soil **Former Sparrows Point Steel Mill, Maryland** MR1249	
savron	**July 2015**
	Plate 1

APPENDIX D

SURVEY DOCUMENTATION

August 5, 2015

Mr. James Calenda
EnviroAnalytis Group, LLC
1650 Des Peres Road, Suite 303
St. Louis, MO 63131

Re: Sparrows Point Well Survey
Sparrows Point, MD
Triad Engineering Job No. 03-15-0343

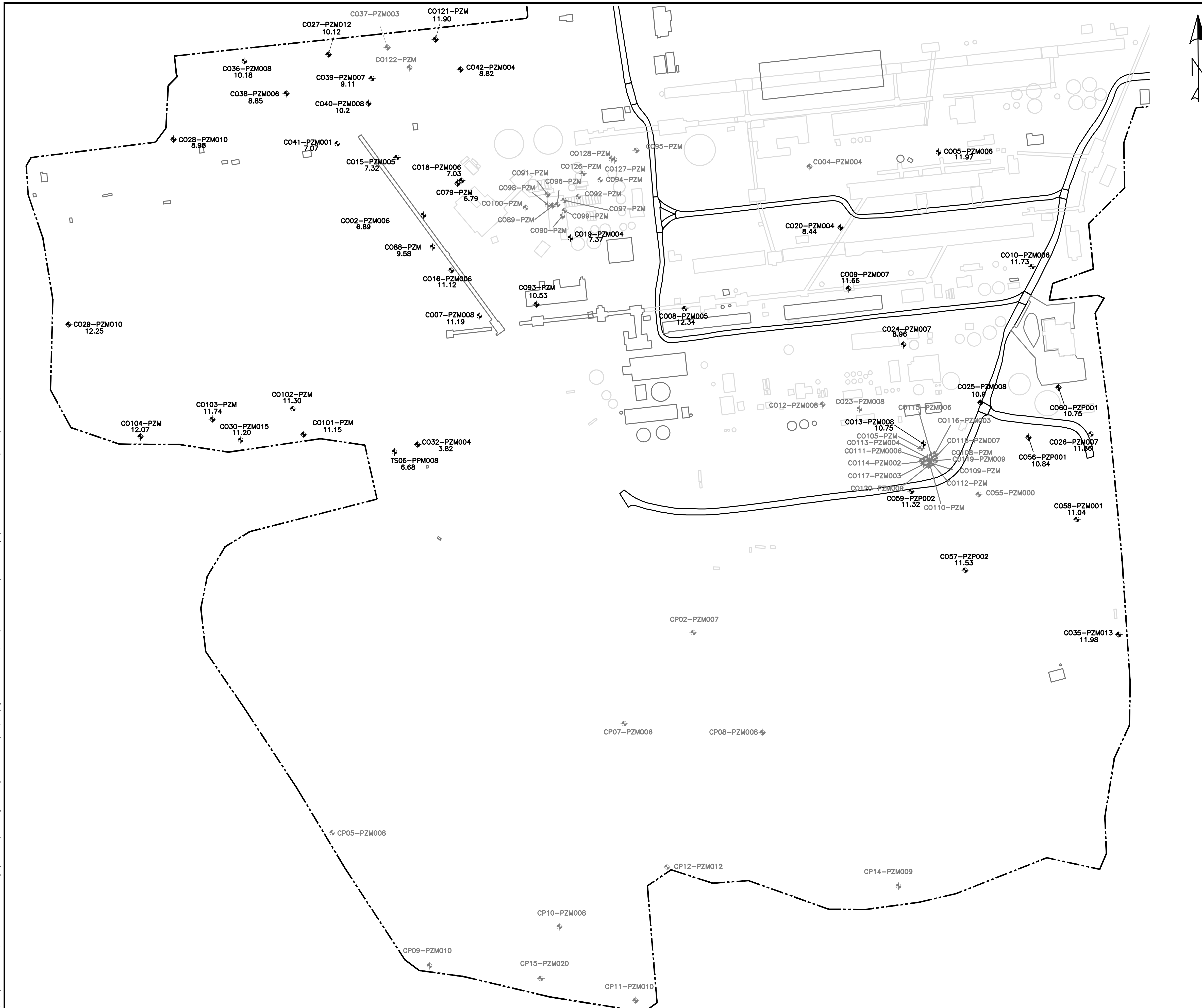
Mr. Calenda:
Below are the specified surveyed wells, date of last field work completed on August 3, 2015. The coordinate values shown were derived from G.P.S. observations based on National Geodetic Surveys stations “GIS 1”, PID AC7684 and “GIS 2”, PID AC7685 which purport to be on NAD83(2011) Maryland Grid coordinate system and NAVD88 elevations.

DESCRIPTION	NORTHING	EASTING	TOP CASING ELEVATION	GROUND AT WELL ELEVATION
CO81-PZM	562679.18	1455467.19	13.90	11.11
CO83-PZM	562703.40	1455455.63	13.48	11.24
CO84-PZM	562690.89	1455431.32	14.15	11.36
CO85-PZM	562667.04	1455440.46	13.52	10.86
CO86-PZM	562686.54	1455446.61	13.96	11.10
CO88-PZM	562452.16	1455339.41	14.07	11.69
CO89-PMZ	562619.27	1455837.02	13.46	10.69
CO90-PMZ	562576.01	1455876.59	13.32	10.55
CO91-PMZ	562664.82	1455812.91	13.21	10.35
CO92-PZM	562655.65	1455942.45	14.69	11.83
CO93-PZM	562511.91	1455769.43	12.12	9.94
CO94-PZM	562724.81	1456032.31	14.32	11.64
CO95-PZM	562846.24	1456180.11	15.60	11.36
CO96-PMZ	562623.28	1455855.84	13.64	11.12
CO97-PMZ	562641.10	1455884.25	14.11	11.62
CO98-PMZ	562621.86	1455816.85	11.49	9.49
CO99-PMZ	562598.12	1455885.15	11.80	10.25
CO100-PMZ	562610.55	1455726.50	12.27	9.98
CO101-PZM	561680.07	1454815.22	12.39	10.38
CO102-PZM	561785.09	1454771.31	12.88	10.84
CO103-PZM	561741.99	1454440.73	13.48	11.57
CO104-PZM	561670.74	1454145.53	13.29	11.31

CO105-PZM	561622.48	1457348.86	14.90	12.34
CO107-PZM	561602.10	1457364.30	14.40	11.84
CO109-PZM	561561.44	1457392.87	14.94	12.35
CO110-PZM	561567.60	1457381.91	15.43	12.52
CO112-PZM	561575.14	1457382.40	14.94	12.59
CO121-PZM	563301.93	1455356.12	11.87	8.93
CO122-PZM	563185.36	1455250.14	19.42	16.42
CO123-PZM	561584.33	1457395.77	15.06	12.01
CO124-PZM	561592.12	1457446.48	14.83	11.74
CO125-PZM	561587.03	1457359.84	14.98	11.98
CO126-PZM	562750.98	1455962.01	14.65	11.54
CO127-PZM	562807.24	1456091.19	14.55	11.58
CO121-SB075	563318.68	1455360.01	8.32	N/A
CO123-SB072	563223.02	1454470.69	5.37	N/A
CO124-SB073	562716.57	1454325.69	9.17	N/A
CO125-SB087	562906.50	1455116.40	9.55	N/A
CP05-PZM	560046.65	1454928.81	10.33	7.68
CP16-PZM	559874.69	1456782.83	18.52	15.35
CP18-PZM	560179.47	1456746.26	20.79	18.08
CP19-PZM	560297.30	1456461.66	22.55	19.78
CP20-PZM	560467.73	1457004.72	14.34	11.44
CP21-PZM	560847.25	1456709.07	15.08	12.04
RW22-PZM	571968.28	1456057.32	14.19	11.45
RW23-PZM	572001.04	1456249.52	14.11	11.81
RW24-PZM	572054.52	1456353.05	14.05	11.21
CO30-PZM015	561656.39	1454556.56	12.30	10.09
C030-PZM060	561656.18	1454552.79	13.29	10.00
CP02-PZM007	560865.88	1456414.16	22.42	18.92

APPENDIX E

INDICATOR PARAMETER MAPS



LEGEND

PROPERTY BOUNDARY

EXISTING BUILDINGS

FORMER BUILDINGS

ROADS

C010–PZM006 — COKE OVEN AREA MONITORING WELL LOCATION

CP14–PZM009 — COKE POINT LANDFILL MONITORING WELL LOCATION

11.98 — pH (S.U.)

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/28/15
CHKD: RJH	DATE: 08/31/15
APPD:	DATE:
SCALE:	AS SHOWN

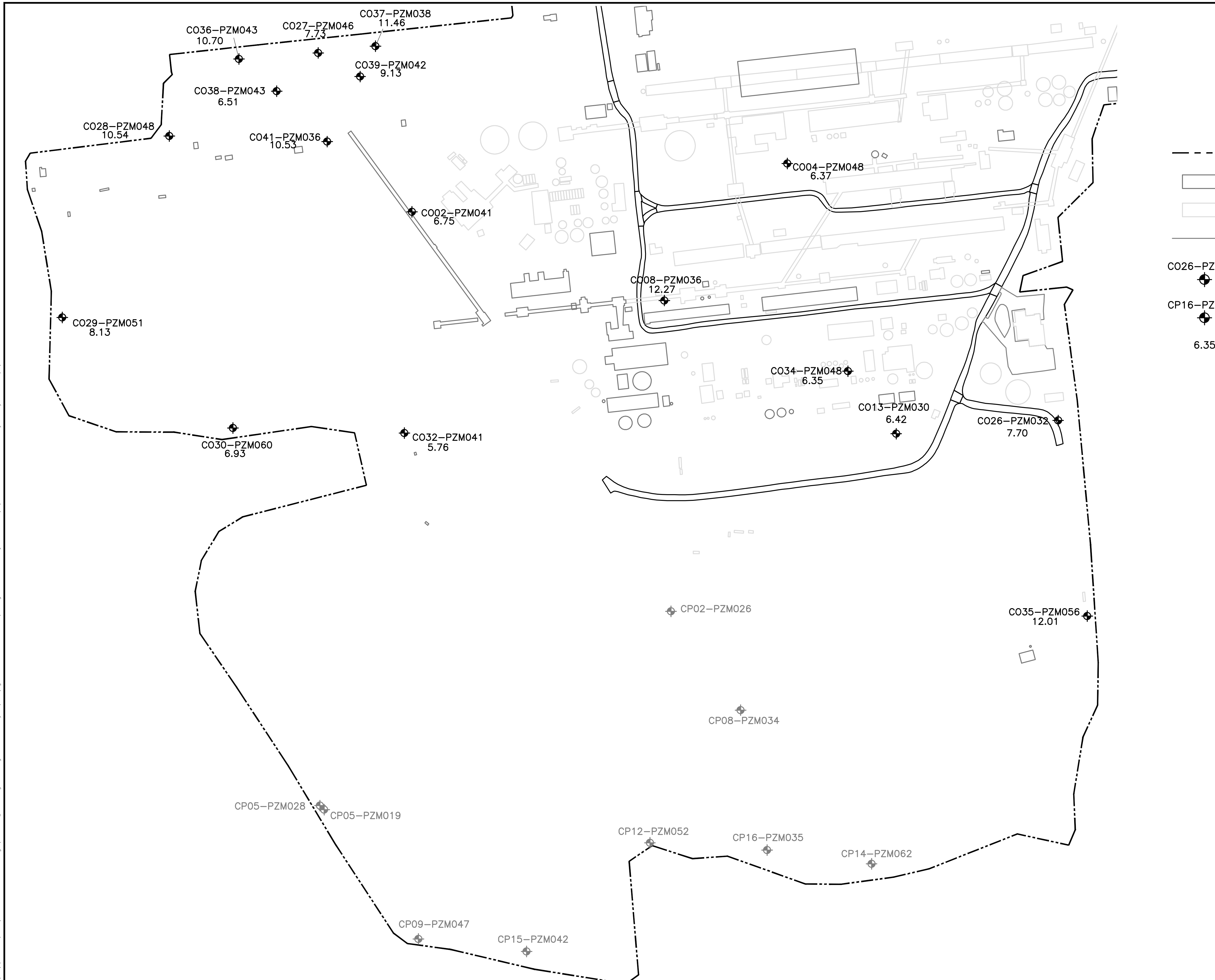
KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

pH RESULTS
SHALLOW ZONE

PROJECT NO: 14–933

FIGURE E–1



LEGEND

	PROPERTY BOUNDARY
	EXISTING BUILDINGS
	FORMER BUILDINGS
	ROADS
C026–PZM032	COKE OVEN AREA MONITORING WELL LOCATION
CP16–PZM035	COKE POINT LANDFILL MONITORING WELL LOCATION
6.35	pH (S.U.)

DRAFT

0 400 800 FEET

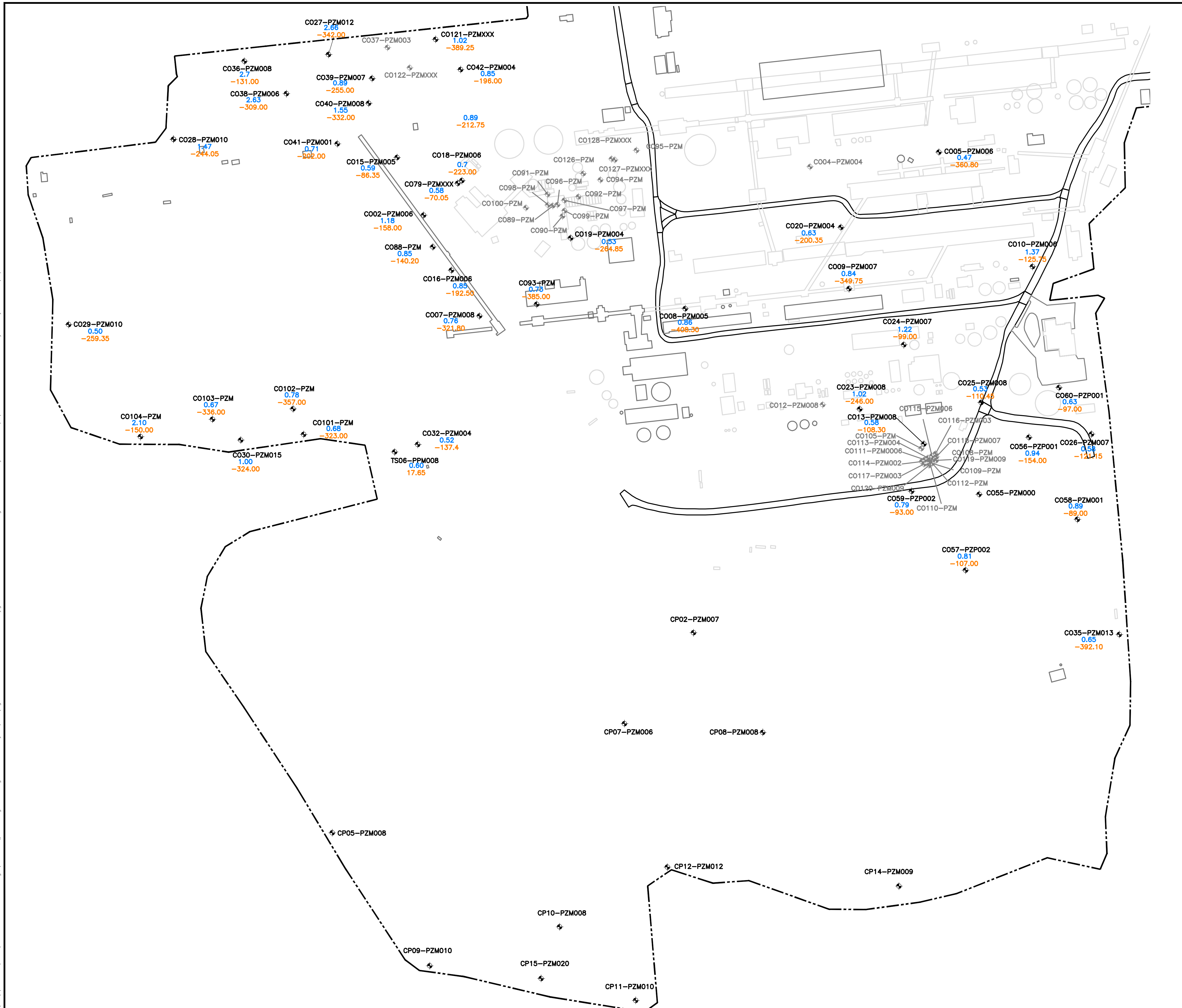
ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/28/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

pH RESULTS
INTERMEDIATE ZONE

PROJECT NO: 14–933
FIGURE E–2



LEGEND

PROPERTY BOUNDARY

EXISTING BUILDINGS

FORMER BUILDINGS

ROADS

CO10-PZM006 — COKE OVEN AREA MONITORING WELL LOCATION

CP14-PZM009 — COKE POINT LANDFILL MONITORING WELL LOCATION

0.63 — DISSOLVED OXYGEN CONCENTRATIONS (

-97.00 — OXIDATION-REDUCTION POTENTIAL (mV)

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/28/15
CHKD: RJH	DATE: 09/02/15
APPD:	DATE:
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

DISSOLVED OXYGEN CONCENTRATION AND OXIDATION REDUCTION POTENTIAL SHALLOW ZONE

PROJECT NO: 14-933

FIGURE E-3

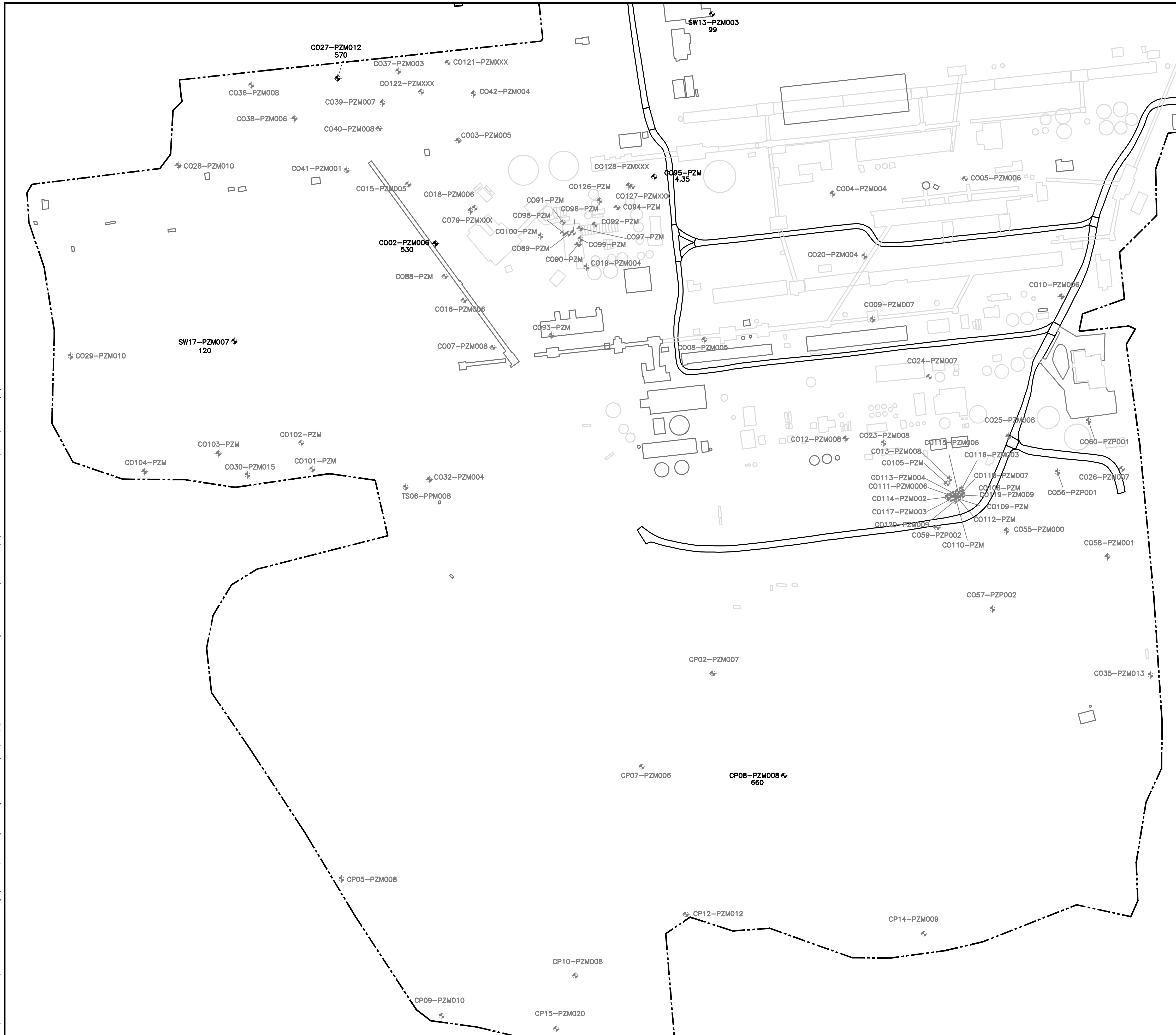
ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/28/15	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 09/02/15	
APPD:	DATE:	
SCALE:	AS SHOWN	

COKE OVEN AREA
PRE–DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

DISSOLVED OXYGEN CONCENTRATION AND OXIDATION REDUCTION POTENTIAL INTERMEDIATE ZONE

PROJECT NO: 14–933
FIGURE E–4



LEGEND

PROPERTY BOUNDARY

EXISTING BUILDINGS

FORMER BUILDINGS

ROADS

C010-PZM006 — COKE OVEN AREA MONITORING WELL LOCATION

CP14-PZM009 — COKE POINT LANDFILL MONITORING WELL LOCATION

660 — SULFATE CONCENTRATIONS (MG/L)

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/28/15
CHKD: RJH	DATE: 09/02/15
APPD:	DATE:
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

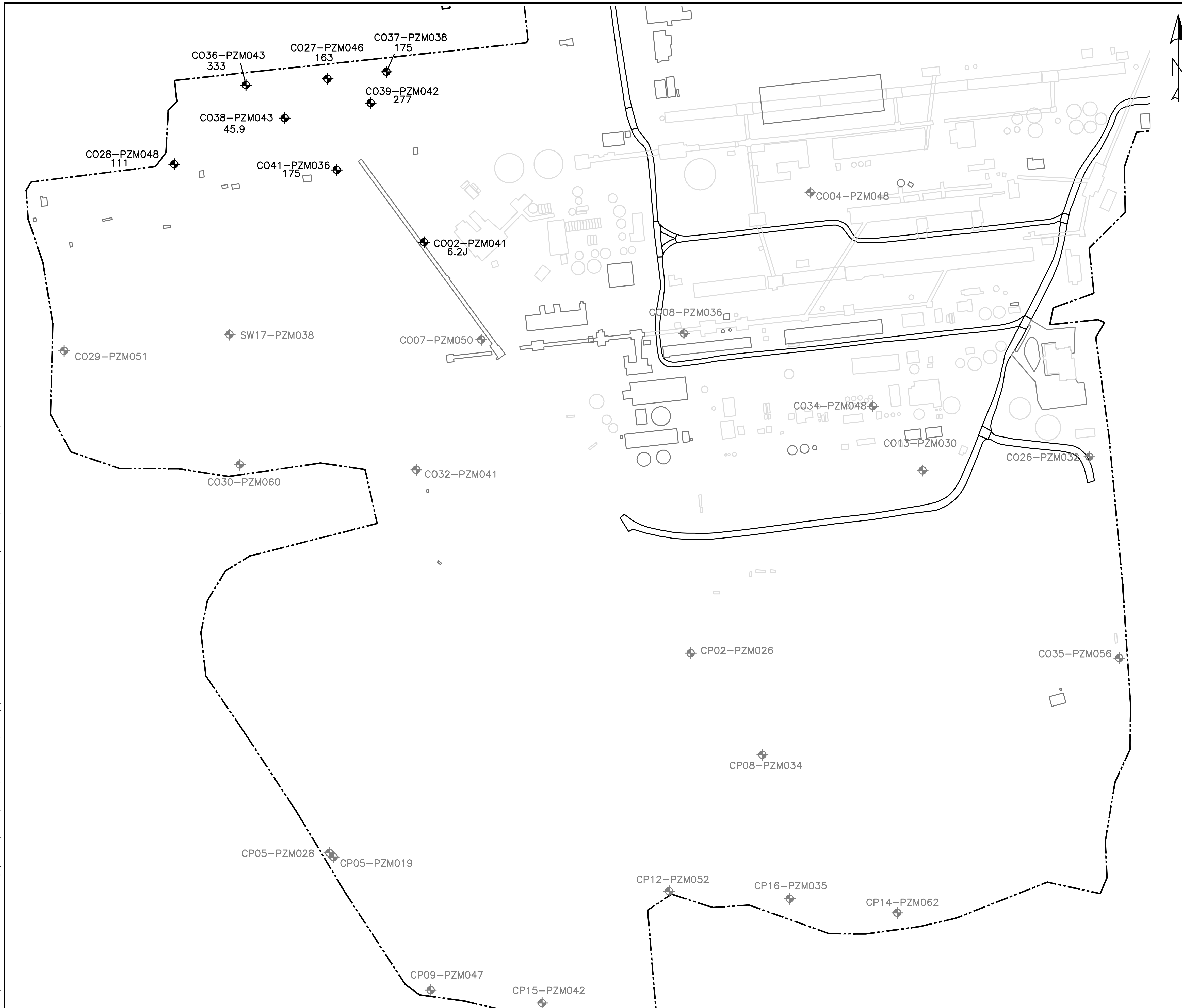
COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

SULFATE CONCENTRATIONS
SHALLOW ZONE

PROJECT NO: 14-933

FIGURE E-5

y:\etl\sparrows point\coke oven area drawings\14-933\pre-design investigation summary report\figure e-5 shallow sulfate.dwg Last Saved By: Scomer 9/2/2015 9:18 AM Plotted By: Shelly Comer 9/2/2015 1:14 PM Scale: 1:1



LEGEND

	PROPERTY BOUNDARY
	EXISTING BUILDINGS
	FORMER BUILDINGS
	ROADS
C026-PZM032	COKE OVEN AREA MONITORING WELL LOCATION
CP16-PZM035	COKE POINT LANDFILL MONITORING WELL LOCATION
175	SULFATE CONCENTRATIONS (MG/L)
	J – ESTIMATED VALUE

DRAFT

0 400 800 FEET

ENVIROANALYTICS GROUP

DRWN: SCC	DATE: 08/28/15
CHKD: RJH	DATE: 09/02/15
APPD:	DATE:
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

COKE OVEN AREA
PRE-DESIGN INVESTIGATION SUMMARY REPORT
SPARROWS POINT, MARYLAND

SULFATE CONCENTRATIONS
INTERMEDIATE ZONE

PROJECT NO: 14-933

FIGURE E-6