***AN AMERICAN RECOVERY AND REINVESTMENT ACT FUNDED PROJECT ***

PHASE II ENVIRONMENTAL SITE ASSESSMENT REPORT FOR THE NEIGHBORHOOD PROGRESS INCORPORATED REIMAGINING CLEVELAND PROJECT CLEVELAND, CUYAHOGA COUNTY, OHIO

Prepared for
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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ACRONYM LIST

ACM	Asbestos Containing Material
ARRA	American Recovery and Reinvestment Act
CARB	California Air Resource Board
COCs	Contaminants of Concern
EMSL	EMSL Analytical, Inc.
ESA	Environmental Site Assessment
Ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
H&S	Health and Safety
IDW	Investigation Derived Waste
LBP	Lead-Based Paint
NPI	Neighborhood Progress, Inc.
NRMRL	National Risk Management Research Lab
OEPA	Ohio Environmental Protection Agency
OSC	On-Scene Coordinator
OSU	Ohio State University
Pace	Pace Analytical Laboratory Services, Inc.
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
PID	Photoionization Detector
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOW	Scope of Work
START	Superfund Technical Assessment and Response Team
TBA	Targeted Brownfields Assessment
U.S. EPA	United States Environmental Protection Agency
VAP	Voluntary Action Program
VOCs	Volatile Organic Compounds
VSP	Visual Sampling Plan
WESTON	Weston Solutions, Inc.
XRF	X-ray Fluorescence

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1.0 Introduction

This Phase II Environmental Site Assessment (ESA) Report summarizes data collection and reporting activities, and associated quality assurance/quality control (QA/QC) measures specific to the properties identified by Neighborhood Progress, Inc. (NPI) as high- and medium-priority Cleveland Land Bank properties in Cleveland, Cuyahoga County, Ohio (**Figure 1**).

Weston Solutions, Inc. (WESTON®) has prepared this Phase II ESA Report describing activities completed under a Targeted Brownfields Assessments (TBA) grant using American Recovery and Reinvestment Act (ARRA) funds at the high- and medium-priority Cleveland Land Bank Properties (Sites). This work was completed for the United States Environmental Protection Agency (U.S. EPA) in response to a request from NPI and the Ohio State University (OSU) Agricultural Extension Office. Work was completed to delineate the nature and extent of environmental degradation (with emphasis on soil media), to facilitate redevelopment of the Sites for use as urban agricultural gardens, phytoremediation sites, and greening projects.

The scope of work (SOW) was developed based on discussions between U.S. EPA, NPI, OSU Agricultural Extension Office, and WESTON personnel in January and February 2010, as well as WESTON's review of available information and previous analytical reports that related to some of the Sites.

This ESA was conducted in accordance with the *Sampling and Analysis Plan* (SAP) dated March 22, 2010, the QA requirements described in the *Targeted Brownfields Assessment Grant Program Quality Assurance Project Plan (Generic QAPP) dated October 2009, and the QAPP Addendum for the Region 5 Targeted Brownfields Assessment Project – Cleveland Land Bank Properties Brownfield Assessment*, dated March 22, 2010.

The *Generic QAPP* was referenced for tasks common to all data collection activities with respect to this Phase II ESA including routine procedures for sampling and analysis, sample documentation, equipment decontamination, sample handling, data management, assessment, and data review. Site-specific procedures and/or modifications to procedures described in the *Generic QAPP* are further described in the site-specific *QAPP Addendum* and in the *SAP*.

The U.S. EPA, NPI, and WESTON prioritized a list of 25 NPI Project Sites (NPI Project Numbers in the tables that follow) consisting of 54 separate parcels to maximize the number of parcels that could be assessed within the project budget, while meeting the project's utilization schedule. Eight Sites consisting of a total of 29 parcels were designated as "high-priority" since the parcels are expected to involve the participation of children in the planting and management of the proposed agricultural urban gardens. The Sites were also designated as "high-priority" if they were located near or adjacent to known commercial/industrial operations and/or major transportation corridors. Selected photographs of some of the "high-priority" Sites are included in **Appendix A**. The "high-priority" Sites consist of the following:

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NPI Project No.	Parcel(s) Number	Address
8	Non-Responsive	Non-Responsive
9	Non-Responsive	Non-Responsive
29	Non-Responsive	Non-Responsive
41	Non-Responsive	Non-Responsive
41	Non-Responsive	Non-Responsive
42	Non-Responsive	Non-Responsive
53	Non-Responsive	Non-Responsive
96	105-33-036, 105-33-037, 105-33-038	7709/7717 Superior Avenue
100	Non-Responsive	Non-Responsive

Six Sites consisting of a total of 10 parcels were assigned a designation of "medium-priority." A "medium-priority" designation was assigned to these sites mainly because a lesser degree of participation by children was expected. Sites located near or adjacent to known commercial/industrial operations and/or major transportation corridors were also classified as "medium-priority." Selected photographs of some of the "medium-priority" Sites are included in **Appendix A.** The "medium-priority" Sites consisted of the following:

NPI Project No.	Parcel(s) Number	Address
11	Non-Responsive	Naples Avenue
11	Non-Responsive	Ohio Avenue
19	Non-Responsive	Non-Responsive
32	Non-Responsive	Non-Responsive
48	Non-Responsive	Non-Responsive
61	Non-Responsive	Non-Responsive
102	Non-Responsive	Non-Responsive

1.1 Project Team

The following personnel were involved in planning and/or technical activities performed for this data collection activity:

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Notes:
H&S – Health and Safety
QA – Quality Assurance
START – Superfund Technical Assessment and Response Team
TBA – Targeted Brownfields Assessment
U.S. EPA – United States Environmental Protection Agency

1.2 Problem Definition, Site Background, and Project Planning

1.2.1 Problem Definition

The overall objective of the U.S. EPA investigation was to identify potential environmental contamination that may adversely impact efforts to develop the high- and medium-priority sites that had been acquired through the City of Cleveland Land Bank program for use as urban agricultural gardens.

According to the available historical information reviewed, the suspected contaminants of concern (COCs) in soil at all of the Sites were identified as possible building material-related contaminants, including lead-based paint (LBP), asbestos-containing material (ACM) (i.e. insulation, roofing/siding shingles, floor tile) and polycyclic aromatic hydrocarbons (PAHs) related to previous residential owner activities (i.e. resulting from building fires). Another COC was polychlorinated biphenyls (PCBs) related to the presence of pole-mounted transformers, which were located adjacent to several of the Sites. The land surrounding the majority of the Sites consists primarily of residential buildings; however, several of the parcels are bordered by industrial/commercial buildings and/or major transportation corridors whose operations may have had an impact on the Sites' surface soil. These specific COCs were identified after site-

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specific research had been completed for those Sites with adjacent or nearby current or historic industrial operations.

The Sites are planned to be developed as urban agricultural gardens, phytoremediation sites, and greening projects, which will involve plants with relatively shallow root systems (8 to 12 inches in depth). Because of their shallow root systems, the urban garden vegetation will rely solely on direct precipitation and water trapped in the soil's vadose zone for hydration as opposed to the underlying groundwater table. As a result, this ESA investigation did not attempt to identify or determine the extent of potential groundwater contamination caused by past on-site and surrounding property operations.

The scope of this ESA consisted of the following:

- For parcels in which the residential building footprint was no longer visually evident, the sample locations were selected based upon random sample selection following the patterns identified in the example Visual Sampling Plan (VSP), which is further explained in Subsection 2.2. VSP output models, which include the size of the sample area, grid size, number of samples, and type of sampling design, etc., for all of the NPI Project Site parcels sampled are presented in **Appendix B**. For parcels in which the residential building footprint was visually evident, WESTON collected two to three additional samples biased toward the perimeter of the former structure if these areas were not previously covered by the VSP sampling pattern.
- Field screening of the collected soil samples with a photoionization detector (PID) for volatile organic compounds (VOCs).
- Collection of surface soil samples (sampled to a depth of 12 inches) and screening of each sample with an Innov-X® X-ray fluorescence (XRF) metals analyzer for total metals. Samples were collected through the use of a hand auger or shovel based on individual site conditions and debris encountered.
- At the majority of the "high-priority" sites, three of the collected surface soil samples (per parcel) were selected for confirmatory total metals analysis based on the XRF field screening results. The soil samples selected for confirmatory total metals analysis were sent to the U.S. EPA Laboratory in Cincinnati, Ohio, for analysis. Because of a mechanical problem with the XRF, surface soil samples collected at all of the "medium-priority" sites and three of the "high-priority" site parcels (Parcel Nos. 118-18-077 and 118-19-076 – NPI Site No. 42 and Parcel No. 118-27-011 – NPI Site No. 41) could not be field screened; therefore, all of the soil samples were sent to the U.S. EPA laboratory for total metals analysis.
- Collection of composite soil samples (sampled to a depth of 12 inches) for submittal to EMSL Analytical, Inc. (EMSL) and Pace Analytical, Inc. (Pace) in Indianapolis, Indiana, for analysis of ACM and PAHs, respectively.
- Based on a review of historic Sanborn maps and field visits to each Site, WESTON

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identified the presence of pole-mounted transformers adjacent to a number of the Sites. WESTON flagged the soil sample collected from a predetermined location nearest the transformer(s) for PCB analysis. Soil samples selected for PCB analysis were shipped to Pace.

- WESTON retained the option in the SAP for additional laboratory analysis for those Sites with adjacent or nearby industrial operations. Specifically, if VOC headspace screening indicated the presence of elevated concentrations of VOCs in the soil, WESTON submitted the soil sample with the highest headspace reading to Pace for confirmatory VOC laboratory analysis. No elevated headspace readings were identified during the field investigation sampling activities; however, one surface soil sample was collected and submitted for laboratory analysis. The VOC sample collected at NPI Site No. 9 was a preplanned sample based upon the initial field visit. The sample location was chosen because of its proximity to a manufacturing facility and the fact that drums were being staged between the facility building and the chosen sample location.

1.2.2 Site and Project Background

As shown in the two tables included in Section 1, the Sites investigated for this Phase II ESA consists of a total of 39 parcels (14 NPI Project Sites). The Sites are located within the City of Cleveland in primarily residential areas, although some properties are located adjacent to or near industrial/commercial/retail areas and/or major transportation corridors.

Topography observed in the general area is a reflection of glacial depositional processes. Surficial soils in the subject area are classified by the United States Department of Agriculture - Natural Resources Conservation Service (formerly the Soil Conservation Service) as Urban land-Elnora complex, nearly level. This soil map unit consists of areas of Urban land and a deep, nearly level, moderately well-drained Elnora soil. The Elnora soil has a surface soil layer of very dark grayish brown, very friable loamy fine sand approximately 9 inches thick. The subsoil, approximately 23 inches thick, is yellowish brown, very friable loamy fine sand that is mottled in the lower part. The subsoil is strongly or medium acidic. Most of the areas of this soil map unit, including the Sites, are artificially drained by sewer systems and gutters.

According to historical information, the residential properties in the area of the Sites were developed in the 1920s through 1950s. From the 1990s to the present, the Sites were acquired by the City of Cleveland's Land Bank program. NPI and the OSU Extension Office have been working with various nonprofit community groups to identify and redevelop favorable foreclosed parcels into urban agricultural gardens, phytoremediation sites, and greening projects. The goal of the NPI project is to develop the Sites with a more sustainable future in mind, which includes supporting economic stabilization, improving residential quality of life, and fostering a sense of community for those who live and work in these Cleveland neighborhoods.

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2.0 Summary of Phase II ESA Activities

2.1 Project Planning

The U.S. EPA, WESTON, and NPI agreed that the first round of sampling would include the 14 high- and medium-priority Sites identified in the tables in Section 1; therefore, this Phase II ESA details the first round of soil sampling conducted between March 24 and April 6 2010.

Prior to conducting the field activities, WESTON completed the following:

- Prepared and obtained approval for SAP and QAPP addendum.
- Developed a statistical sampling approach utilizing the VSP for parcels where the building footprint was not visually evident. Information about the VSP is provided in Subsection 2.2 and VSP output models are included in **Appendix B**.
- Uploaded geographic information system (GIS) shape files/parcel coordinates provided by the City of Cleveland's Land Bank Office to WESTON's field global positioning system (GPS) equipment, to ensure that only the selected Sites would be accessed and sampled by field personnel. In addition, the GIS coordinates were used to locate predetermined sampling points within each Site.
- Prepared a site-specific Health and Safety Plan that included the determination based on Site activities and COCs that Level D personal protective equipment (PPE) would be appropriate during field activities.
- Prepared bid specifications for and procured analytical laboratories. The laboratories, except the U.S. EPA laboratory, were selected through a competitive bidding process. Pace was selected to analyze the soil samples for PAH, PCBs, and VOCs and EMSL was selected to analyze the soil samples for ACM. The U.S. EPA laboratory in Cincinnati, Ohio, conducted the confirmatory total metal analysis of soil samples prescreened with the XRF and those samples collected from the "medium-priority and high-priority" Sites that could not be prescreened with the XRF because of mechanical issue with the unit.
- Reviewed available Sanborn fire insurance maps to determine whether commercial/industrial operations that may have exerted a negative impact had been historically located near or adjacent to any of the Site parcels. This review also helped WESTON to determine whether there were any PCB sources (i.e., pole-mounted transformers located on or adjacent to any of the Site parcels in the past, indicating the need to analyze the soil samples for PCBs in addition to the planned PAH and ACM analyses).

During the ESA process, WESTON utilized an approach that allowed the use of field screening measurements to guide the sampling effort, thus maximizing the effectiveness of the field

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mobilization. This approach allowed for adjustments in the SOW if supported by field observations and/or screening results.

2.2 Sample Location/Number of Samples Determination - VSP

For the Sites where the residential building footprint was not visually evident, the sample locations on each parcel were selected based upon statistical sampling using VSP for a typical parcel layout. **Figure 2** depicts an example sample placement (and calculated number of samples) with a random start location. For each Site in which the residential building footprint was visually evident, WESTON collected two to three additional samples biased toward the perimeter of the former structure. For these parcels, one sample was collected on the right side and left side of the former house just outside the edge of the footprint. In the front and back of the house, WESTON moved the sample locations approximately 5 ft beyond the former building footprint, taking into account the former location of potential porches and roof drip lines. WESTON then collected one sample in the right and left side yards halfway between the house and the parcel line. Soil samples were also collected in the front yard closer to the street and in the back yard between the house and the parcel line. An example of this sample collection scheme is depicted on **Figure 3**.

The VSP is based on detecting a "hot spot" (local areas of elevated concentration) with a 15-ft radius and a 95% confidence probability. This sampling approach requires systematic grid sampling with a random start. Except for one parcel, the result of this method yielded a sampling grid of 12 or fewer sample points, based upon the inputs described below. The algorithm used to calculate the grid size (and hence the number of samples) is based on work by Singer and Wickman for locating geologic deposits (see Singer and Wickman [1969] and Hassig et al. [2004] for details). Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot.

The specific inputs to the algorithm that result in the grid size and selection of the sample locations are as follows:

Primary objective of design: Detect the presence of a hot spot that has a 15-ft radius and circular shape.

Type of sampling: Design hot spot.

Sample placement (location) in the field: Systematic (hot spot) with a random start location (see **Figure 3**).

Formula for calculating number of sampling locations: Singer and Wickman algorithm.

Calculated total number of samples: 10 (This number differs from the calculated number because of grid edge effects).

Type of samples: Point samples.

Number of samples on map: This will vary depending upon the size of the parcel (see example in **Figure 3**).

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Number of selected sample areas: One (These sample areas contain the locations where samples are collected).

Specified sampling area: This will be dependent upon the size of the parcel to be sampled. (The sampling area is the total surface area of the selected sample area on the map of the site.)

Grid pattern: Triangular.

Size of grid/Area of grid: This was dependent upon the size of the Sites to be sampled. (This parameter gives the linear and square dimensions of the grid spacing used to systematically place samples.)

Table 1 lists the number of sample locations projected (and actually collected) using VSP and evidence of the residential building footprint (for bias sample placement) per Site.

2.3 Project Description and Schedule

2.3.1 Project Description

The project included the following primary tasks:

- Collecting surface soil samples from each Site. Subsection 2.4.1 describes the sample collection procedures used.
- Following sample drying, screening each sample using the XRF. Three samples per parcel were then selected (except the high- and medium-priority NPI Site samples described in earlier sections) for confirmatory analysis for total metals at the U.S. EPA laboratory in Cincinnati, Ohio.
- Submit the surface soil samples to the laboratories for ACM and PAH analysis in accordance with the SAP. A portion of the samples was also analyzed for PCBs, VOCs (one sample), and total metals.
- Preparing figures and tables depicting regulatory exceedances and presenting them to U.S. EPA and NPI.
- Presenting the findings in this technical report.

2.4 Sample Collection

Soil sampling activities commenced on March 26, 2010, upon receiving U.S. EPA approval of the SAP and QAPP addendum and approved access to the Sites from the City of Cleveland.

WESTON conducted an inspection of each property to confirm the proposed sampling locations. The on-site inspections were designed to identify additional sample locations, or cause adjustments to the proposed sample locations, based on observed Site conditions. Similarly, field observation or screening measurements, recorded during the field activities were also

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designed to determine whether additional analysis of the samples would be required. For example, if a pole-mounted transformer was located immediately adjacent to the Site, WESTON would select the soil sample closest to the pole-mounted transformer for PCB analysis.

2.4.1 Sample Collection Methods

Prior to mobilizing to the field, WESTON completed individual sample location figures for each Site utilizing shape files provided by the City of Cleveland's Land Bank Office and uploaded the sample coordinates to a Trimble GPS unit allowing for navigation to each of the proposed sample locations in the field.

Using the GPS, WESTON navigated to each predetermined sample location, and collected soil samples through the use of a hand auger or shovel to a maximum depth of 12 inches below ground surface. Each soil sample location was logged based on physical observations and PID screening measurements recorded by the field geologist. Representative soil from each sample location was screened in the field with a PID utilizing the "headspace" method of screening in accordance with the SAP. A new plastic bag was used at each sample location. One surface soil sample was collected from each of the sample borings for laboratory analysis. Laboratory sample jars were filled directly from the hand-auger sampling device or shovel.

In addition, representative soil from each sample location was placed into a Ziploc® bag, labeled and zipped closed for submittal to the U.S. EPA's Westlake, Ohio, office for homogenization and drying in the laboratory. An XRF measurement was then taken in the U.S. EPA's laboratory by a U.S. EPA on-scene coordinator (OSC) once the soil's moisture content had been lowered with the use of an oven, to a point where it would not cause interference with the XRF's ability to correctly measure the soil's metal concentration. Upon collection of the XRF data, the OSC selected a total of three soil samples (per parcel) for confirmatory (QC) laboratory analysis of total metals. Surface soils were selected for laboratory analysis based on the following criteria: 1) a sample with the highest XRF reading for lead, 2) a sample with lowest XRF reading, and 3) a sample with a mid-range XRF reading. The samples were then placed in a 4-ounce glass jar for analysis by the U.S. EPA's NRMRL in Cincinnati, Ohio. Because of a mechanical issue with the XRF, surface soil samples collected from the "medium-priority" Sites (and those high-priority sites mentioned previously) were not screened with the XRF after drying. Instead, all of the surface soil samples collected from the "medium-priority" Sites were analyzed for total metals by the U.S. EPA's NRMRL.

In addition to the total metals samples, one sample was collected for laboratory analysis of VOCs based on the sample location's proximity to a manufacturing facility storing drums on-site. The majority of the surface soil samples collected was sent to the laboratory for analysis of PAHs and ACM. For Sites where a pole-mounted transformer was located immediately adjacent to the Site, WESTON selected the sample location closest to the pole-mounted transformer for PCB analysis in addition to the PAH and ACM analyses.

Immediately following sample collection, the reusable sampling equipment was decontaminated (between discrete sampling locations) in accordance with the requirements outlined in Subsection 7.2 of WESTON's U.S. EPA approved site-specific SAP dated March 22, 2010.

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2.4.2 Summary of Samples Collected

The analytical parameters and methods, sample containers, volumes, preservation requirements, and number of samples (for each parameter) submitted for laboratory analyses per Site are summarized in **Table 1.**

The soil sample collected for VOC analysis was placed into new, clean, laboratory-supplied 4-ounce glass jars and preserved with methanol. Soil samples collected for laboratory analysis of PAHs and PCBs were placed into new, clean, laboratory-supplied 4-ounce sample jars. Upon collection, VOC, PAH, and PCB samples were preserved on ice by cooling to a temperature of approximately 4° C. ACM samples were placed into cleaned, laboratory-supplied 4-ounce glass jars (preservative not required).

All samples were handled, shipped, tracked, and maintained under chain of custody in accordance with the *Generic QAPP*.

2.5 Surveying

WESTON used a Trimble Pro XR GPS to assign sample coordinates for mapping purposes to the XRF screening/sampling locations. The GPS, capable of sub-meter accuracy, was used to establish a northing and easting coordinate at all locations.

2.6 Sample Numbering System

All samples submitted for analysis, including QA samples, were assigned a unique sample number. The sample numbers were recorded in the field logbook, on the chain-of-custody paperwork, and on the shipment documents. The project samples were identified using the numbering format detailed in the SAP.

2.7 Management of Investigation-Derived Wastes

Investigation-derived wastes (IDW) are defined as any byproduct of the field activities that is suspected or known to be contaminated with hazardous substances. The performance of field activities produced spent PPE and sampling supplies. All of this type of IDW was double bagged and discarded as general solid waste. The field activities did not generate any additional solid waste (i.e. soil). Any soil not collected for submittal to the laboratory for analysis or XRF screening was returned to the hole from which it had been collected. The soil remaining after drying and XRF screening was picked up by WESTON personnel, and transported back to and placed at the NPI site from which it had been collected.

2.8 Decontamination Procedures

General decontamination procedures are described in the *Generic QAPP* for each Site sampled.

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3.0 Results and Discussion

3.1 Analytical Results Summary

This subsection presents a summary of the analytical results from samples collected during the Phase II ESA including investigative surface soil samples screened utilizing the XRF for metals, the associated confirmatory metals samples analyzed by the U.S. EPA's NRMRL laboratory, and the ACM, PAH, and PCB samples analyzed by EMSL and Pace, respectively. **Table 1** lists all of the samples analyzed by media. **Appendix C** contains the tables and **Appendix D** contains the figures summarizing the data for each individual Site organized by NPI Project Number (see tables in Section 1) beginning with the "high- priority" Sites. Full laboratory analytical reports will be provided on compact disc. Corresponding data validation reports, are provided in **Appendix E**.

Detected constituents (total metals, PAHs, VOCs, and PCBs) were compared to the Ohio EPA's (OEPA) Voluntary Action Program (VAP) Residential Direct Contact Cleanup Standards 3745-300-08(3) (b). In the event that a sample exceeded the OEPA Residential Direct Contact Cleanup Standards, data was also compared to OEPA's Commercial/Industrial Direct Contact Cleanup Standards 3745-300-08 (3) (c).

The asbestos samples were analyzed using the California Air Resource Board (CARB) 435 method. The CARB 435 method is a specialized method used for testing asbestos content in the serpentine aggregate storage piles, on conveyer belts, and on covered surfaces such as roads, play-yards, shoulders and parking lots. The method includes crushing the sample using a mill to produce a sample size of less than 200 tyler mesh (75 microns) and then reporting the asbestos content by performing a 400 point count technique which has a detection limit of 0.25%. No regulatory cleanup standards for asbestos in soil currently exist. As a result, the ACM results will only be used to confirm whether ACM is present in the soil.

Site-specific plan-view maps illustrating sample detections and OEPA screening criteria exceedances are presented in **Appendix D**.

3.1.1 Investigative Surface Soil Results

This subsection provides a general summary of the surface soil results obtained from the samples collected at both the high-and-medium priority Sites. More specific data (data per NPI Project Site) – a table and figure for each Site, both presenting Site-specific data are provided in **Appendix C** and **Appendix D**, respectively.

For the 14 NPI Project Sites the bulleted list presented below details the constituents detected above OEPA's VAP Generic Residential Direct Contact Criteria. Concentration ranges exceeding the Criteria are summarized below:

- Benzo(a)pyrene – 1,050 to 6,250 parts per billion (ppb) (Criteria = 1,100 ppb)
- Benzo(a) anthracene – 11,900 to 13,900 ppb (Criteria = 11,000 ppb)

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- Benzo(b)fluoranthene – 18,600 to 38,400 ppb (Criteria = 11,000 ppb)
- Dibenzo(a)anthracene – 1,140 to 2,440 ppb (Criteria = 1,100 ppb)
- Indeno(1,2,3-cd)pyrene – 11,400 to 25,200 ppb (Criteria = 11,000 ppb)
- Antimony – 65.9 to 96 parts per million (ppm) (Criteria = 30 ppm)
- Arsenic – 16.8 to 77 ppm (Criteria = 6.7 ppm)
- Cadmium – 74 to 94 ppm (Criteria = 72 ppm)
- Lead – 417 to 1800 ppm (Criteria = 400 ppm)
- Thallium – 10.4 ppm (Criteria = 6.1 ppm)

The constituents and range of concentrations that exceeded OEPA's VAP Generic Industrial/Commercial (and Residential) Direct Contact Criteria including the ranges of exceedances are as follows:

- Benzo(a)pyrene – 7,770 to 32,800 ppb (Criteria = 7,700 ppb)
- Dibenzo(a)anthracene – 7,890 to 9,200 ppb (Criteria = 7,700 ppb)
- Arsenic – 85 to 230 ppm (Criteria = 82 ppm)
- Lead – 1,862 to 5,450 ppm (Criteria = 1,800 ppm)

At the following NPI high and medium priority Project Sites, samples exceeded only OEPA's VAP Generic Residential Direct Contact Criteria:

- NPI Site No. 8 (high-priority Site)
- NPI Site No. 53 (high-priority Site)
- NPI Site No. 100 (high-priority Site)
- NPI Site No. 11 (medium-priority Site)
- NPI Site No. 32 (medium-priority Site)
- NPI Site No. 48 (medium-priority Site)
- NPI Site No. 61 (medium-priority Site)
- NPI Site No. 102 (medium-priority Site)

The remainder of the NPI high and medium priority Sites contained one or more parameters exceeding both the Residential and Industrial/Commercial OEPA VAP Direct Contact Criteria:

- NPI Site No. 9 (high-priority Site)
- NPI Site No. 29 (high-priority Site)
- NPI Site No. 41 (high-priority Site)
- NPI Site No. 42 (high-priority Site)
- NPI Site No. 96 (high-priority Site)
- NPI Site No. 19 (medium-priority Site)

All of the 14 NPI high and medium priority Project Sites contained at least one constituent that exceeded the Residential and/or Industrial/Commercial OEPA Direct Contact Criteria.

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In addition, one VOC sample was collected at NPI Site No. 9; however, no VOCs were detected above the associated laboratory detection limits. One PCB sample was collected at each of the following NPI Sites 8, 41, 96, 11, 19, 32, 48, 61, and 102; however, PCBs were not detected in any of the surface soil samples above the associated laboratory detection limits. All samples (from all NPI Sites) were also analyzed for ACM; however, only one sample contained detectable ACM. One surface soil sample collected from NPI Site No. 42 had detectable ACM. See **Appendix D** for a figure depicting the location of the ACM detection.

3.1.2 Investigative Surface Soil Results Versus XRF Surface Soil Results

As stated, because of a mechanical issue with the XRF equipment, only those surface soil samples collected at the "high-priority" Sites could be screened. All surface soil samples collected at the "medium-priority" Sites were sent to the U.S. EPA NRMRL.

Scatter plots for each of the metals for which there was both XRF and Total Metals laboratory results are included in **Appendix F**. In general, some metals results, including those for cadmium, copper, lead, manganese, and zinc, seemed to correlate better with the XRF results than any of the other metals. XRF results for titanium were significantly higher than the metals results obtained from the laboratory. In addition, the following metals were (in almost all cases) not detected by the XRF, but were detected in the associated confirmatory laboratory samples: antimony, barium, chromium, cobalt, selenium, and tin.

4.0 Conclusions and Recommendations

Based on the data summarized above, a limited number of PAH constituents (benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a)anthracene, and Indeno(1,2,3-cd)pyrene) and metal constituents (antimony, arsenic, cadmium, lead, and thallium) exceed the OEPA VAP Generic Residential Direct Contact Criteria. Furthermore, when comparing the same constituents to the OEPA VAP Generic Industrial/Commercial Direct Contact Criteria, the number of PAH and metal constituents exceeding criteria is cut in half (benzo(a)pyrene, dibenzo(a)anthracene, arsenic, and lead). In addition, three of the eight high-priority NPI Project Sites (NPI Site Nos. 8, 53, and 100) and five of the six medium-priority NPI Project Sites (NPI Site Nos. 11, 32, 48, 61, and 62) have detectable concentrations of constituents that exceed only the Residential OEPA Direct Contact Criteria. The remaining five high-priority NPI Project Sites (NPI Site Nos. 9, 29, 41, 42, and 96) and one medium-priority NPI Site (NPI Project Site No. 19) contain one or more constituents that exceed both the Residential and Industrial/Commercial OEPA Direct Contact Criteria.

In general, all future property owners and planned uses should comply with the regulations and guidance provided by OEPA to protect both human health and the environment. In addition, the Site owners may want to consider the following:

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- Given the likely future use of the Sites as urban agricultural gardens, phytoremediation sites, and greening projects, limited soil excavation or the use of raised garden beds may be required to address the surface soil direct contact exceedances.

The U.S. EPA understands that the use of abandoned properties for urban agriculture is on the upswing. Currently, traditional state and federal brownfield cleanup programs including OEPA's VAP and the U.S. EPA Regional Screening Levels (RSLs) have not developed standards or screening levels to address the protection of human health for urban agriculture and gardens. As a result, the OEPA VAP residential and commercial/industrial land use category generic direct contact soil standards were used for comparison purposes to discuss the surface soil sampling results obtained during this Phase II ESA.

The U.S. EPA and OEPA are in the process of completing a document titled *Cleveland Neighborhood Progress, Inc. Project: Assessment of Properties for Urban Agriculture and Urban Gardens*. This document will provide guidance on developing human health screening levels along with risk management practices for assessing the future use of properties for urban agriculture and gardens. Since it is recognized that U.S. EPA along with many states currently use the U.S. EPA RSLs, the RSLs are being applied along with potential urban agriculture and garden specific exposure assumption changes. To date, the residential RSLs are generally considered safe, conservative concentrations of contaminants for urban gardening. The RSLs are frequently updated by U.S. EPA (twice a year) and can be easily accessed and downloaded. Urban agriculture land use specific modifications to appropriate RSL exposure assumptions may be a potential tool to readily assess the safety of urban gardens. As a result, more urban agriculture specific comparisons may be conducted in the future on the NPI properties.

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TABLES

Table 1
List of Sample Quantities and Analytical Parameters
Cleveland Land Bank Properties
High and Medium Priority Sites
Targeted Brownfields Assessment
March - April 2010 Phase II ESA Investigation

NPI Project #	Address	Tax Parcel #	Number of Parcels	Number of Sample Locations	Analytical Parameters *					
					PAHs	ACM	XRF Metals	RCRA Metals	PCBs	VOCs
8	Non-Responsive	Non-Responsive	1	16	16	16	16	3	1	
53	Non-Responsive	Non-Responsive	1	4	4	4	4	3		
100	Non-Responsive	Non-Responsive	1	8	8	8	8	3		
9	Non-Responsive	Non-Responsive	1	8	8	8	8	3		1
96	Non-Responsive	Non-Responsive	1	6	6	5	6	3	1	
		Non-Responsive	1	6	6	6	6	3		
		Non-Responsive	1	5	5	5	5	3		
42	Non-Responsive	Non-Responsive	1	9	9	9	9	3		
		Non-Responsive	1	9	9	9	9	3		
		Non-Responsive	1	9	9	9	9	3		
		Non-Responsive	1	9	9	9	9	3		
		Non-Responsive	1	10	10	10		10		
		Non-Responsive	1	9	9	9	9	3		
		Non-Responsive	1	6	6	6	6	3		
		Non-Responsive	1	8	8	8	8	3		
		Non-Responsive	1	7	7	7	7	3		
		Non-Responsive	1	6	6	6	6	3		
		Non-Responsive	1	7	7	7	7	3		
		Non-Responsive	1	8	8	8	8	3		
		Non-Responsive	1	8	8	8		8		
41	Non-Responsive	Non-Responsive	1	5	5	5		5	1	
41	Non-Responsive	Non-Responsive	1	8	8	8	8	3		
		Non-Responsive	1	12	12	12	12	3		
		Non-Responsive	1	6	6	6	6	3		
		Non-Responsive	1	6	6	6	6	3		
		Non-Responsive	1	5	5	5	5	3		
		Non-Responsive	1	5	5	5	5	3		
		Non-Responsive	1	5	5	5	5	3		
29	Non-Responsive	Non-Responsive	1	5	5	5	5	3		
61	Non-Responsive	Non-Responsive	1	8	8	8		8	1	
102	Non-Responsive	Non-Responsive	2	5	5	5		5	1	
		Non-Responsive		6	6	6		6		
32	Non-Responsive	Non-Responsive	1	9	9	9		9	1	
48	Non-Responsive	Non-Responsive	2	12	12	12		12	1	
		Non-Responsive		9	9	9		8		
19	Non-Responsive	Non-Responsive	2	6	6	6		6	1	
		Non-Responsive		6	6	6		6		
11	**Naples Avenue**	Non-Responsive	1	4	4	4		4	1	
11	**Ohio Avenue**	Non-Responsive	1	5	5	5		5		
		Total Number of Parcels	**39**							
	Total Number of Sample Points			285						
	High & Medium Priority Parcels Sample #				285	285	192	170	9	1

Analytical Methods	**Containers**	**Holding Times**	**Preservation**
VOCs: SW846 8260B	Soil: 2-4 ounce jars/Water: 3-40 ml vials	14 Days	Soil: Methanol/Water: HCL
Metals: SW846 6010/6020	Soil: 1-8 ounce glass jar/Water: 1 ltr poly	6 Months	Soil: Cool to 4^oC/Water: HNO_3
PAHs: SW846 8310	Soil: 1-8 ounce glass jar/Water: 2 ltr amber	14 Days	Cool to 4^oC
PCBs: SW846 8020	Soil: 1-8 ounce glass jar/Water: 2 ltr amber	14 days	Cool to 4^oC
ACM: CARB 435 method	Soil: 1-4 ounce glass jar	N/A	

Notes:
* Does not include quality control samples
Shaded NPI Sites (in table) are High Priority Sites
ACM - Asbestos containing material
PAHs - Polycyclic aromatic hydrocarbons
PCBs - Polychlorinated biphenyls
RCRA - Resource Conservation Recovery Act
VOCs - Volatile Organic Compounds
XRF - X-ray Fluorescence screened samples (for metals)

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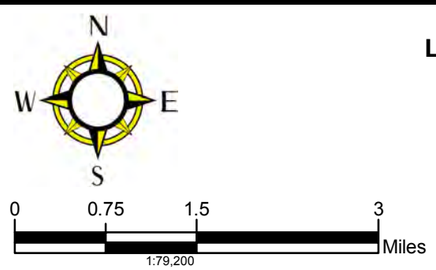
FIGURES

Non-Responsive



LEGEND

SITE LOCATION

Image Source: ESRI / Bing Street Map Service

Figure: 1

Prepared for:
U.S. EPA REGION V
Contract No: EP-S5-06-04

TDD No.: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared by:
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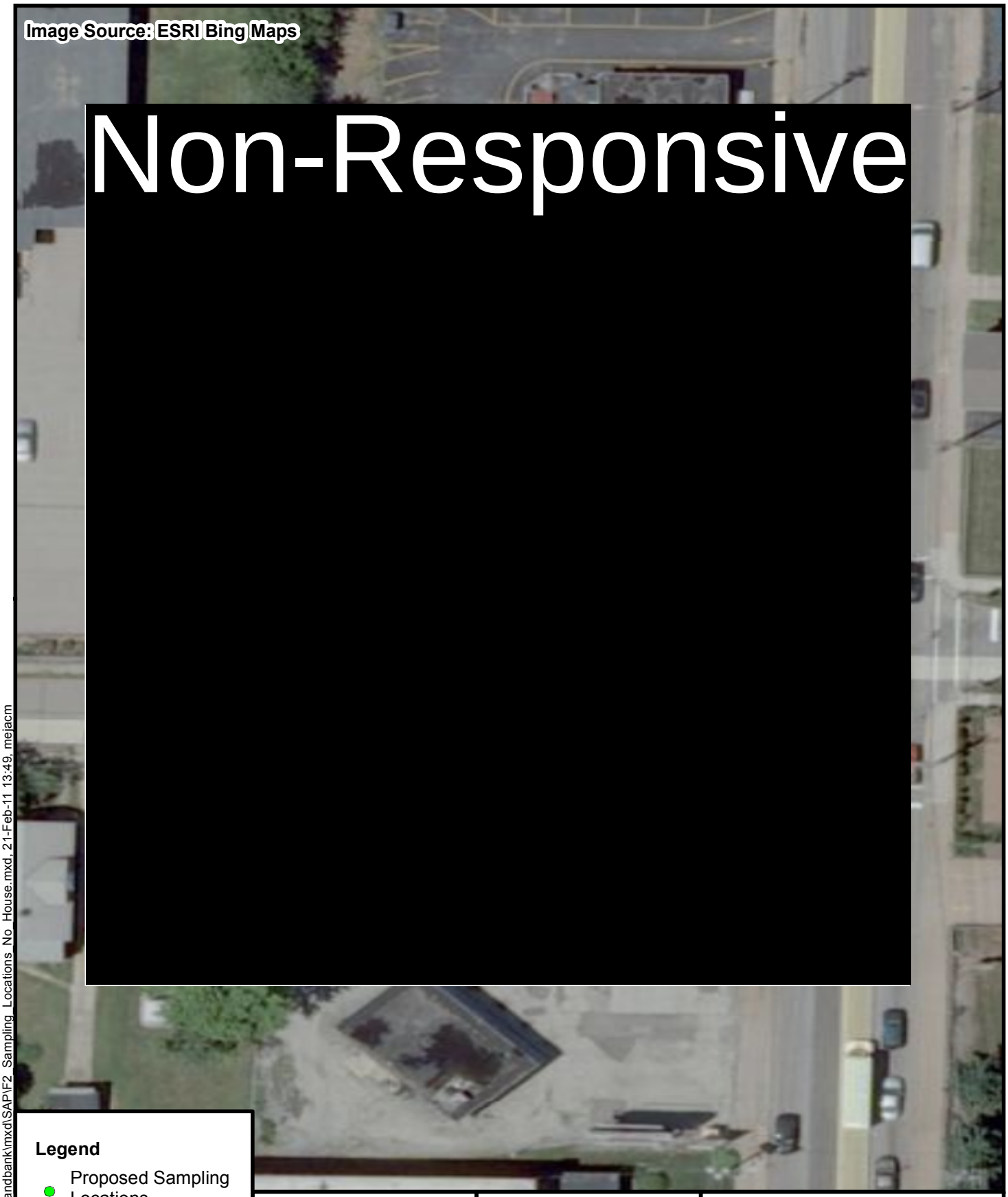
6779 Engle Road
Building 2, Suite 1
Middleburg Hts, Ohio 44130

STREET MAP
NPI Project High and Medium Priority Sites
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio
February 2011

File: D:\GIS_Projects\START\Cleveland_Land_Bank\mxds\20110220\Figure 1 - Site Locations.mxd, 20-Feb-11 22:03, BROWNK



Legend

- Proposed Sampling Locations
- Approximate Parcel Boundaries

N

0 50 Feet

Prepared for:
U.S. EPA REGION V

Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

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WESTON SOLUTIONS, INC

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Building 2, Suite I
Middleburg Hts, Ohio 44130

Figure 2
Example Sampling Locations Map for Parcels without Former House Location
Cleveland Landbank Properties
Cleveland, Cuyahoga County, Ohio

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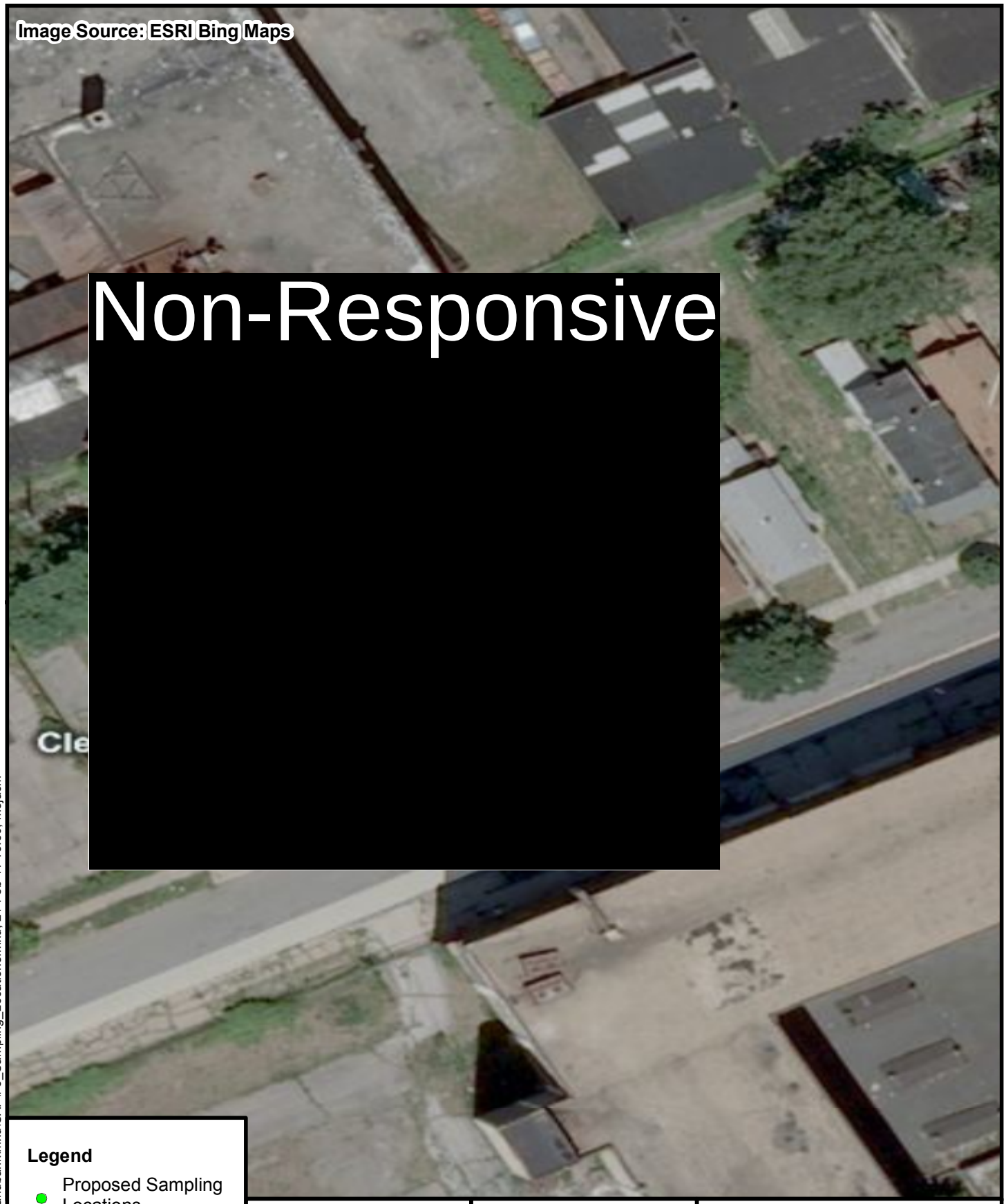

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Legend

- Proposed Sampling Locations
- Approximate Parcel Boundary

0 50 Feet

N

Prepared for:
U.S. EPA REGION V

Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

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Figure 3
Example Sampling Locations Map
for Parcels with Former House Location
Cleveland Landbank Properties
Cleveland, Cuyahoga County, Ohio

APPENDIX A
PHOTOLOG

Site: Cleveland Land Bank Properties **Date:** 03/01/10
Photograph No.: 1 **Photographer:** Mike Blair
Direction: East
Subject: NPI High Priority Site #9 Non-Responsive .

Site: Cleveland Land Bank Properties **Date:** 01/28/10
Photograph No.: 2 **Photographer:** Katie Mooney
Direction: South
Subject: NPI High Priority Site #41 (Multiple Parcels) Non-Responsive
Non-Respon

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Site: Cleveland Land Bank Properties **Date:** 03/01/10
Photograph No.: 3 **Photographer:** Mike Blair
Direction: South
Subject: NPI High Priority Site # 100 ([redacted] Non-Responsive [redacted]
Non-Responsive [redacted]

Site: Cleveland Land Bank Properties **Date:** 03/01/10
Photograph No.: 4 **Photographer:** Mike Blair
Direction: Southwest
Subject: NPI Medium Priority Site # 19 Non-Responsive [redacted] Non-Responsive [redacted] [redacted] [redacted].

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Site: Cleveland Land Bank Properties **Date:** 03/01/10
Photograph No.: 5 **Photographer:** Mike Blair
Direction: North
Subject: NPI Medium Priority Site #48 ([redacted]) located [redacted]

Site: Cleveland Land Bank Properties **Date:** 03/01/10
Photograph No.: 6 **Photographer:** Mike Blair
Direction: South
Subject: NPI Medium Priority Site #102 [redacted]

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APPENDIX B
INFORMATION REGARDING THE DEVELOPMENT OF A VSP

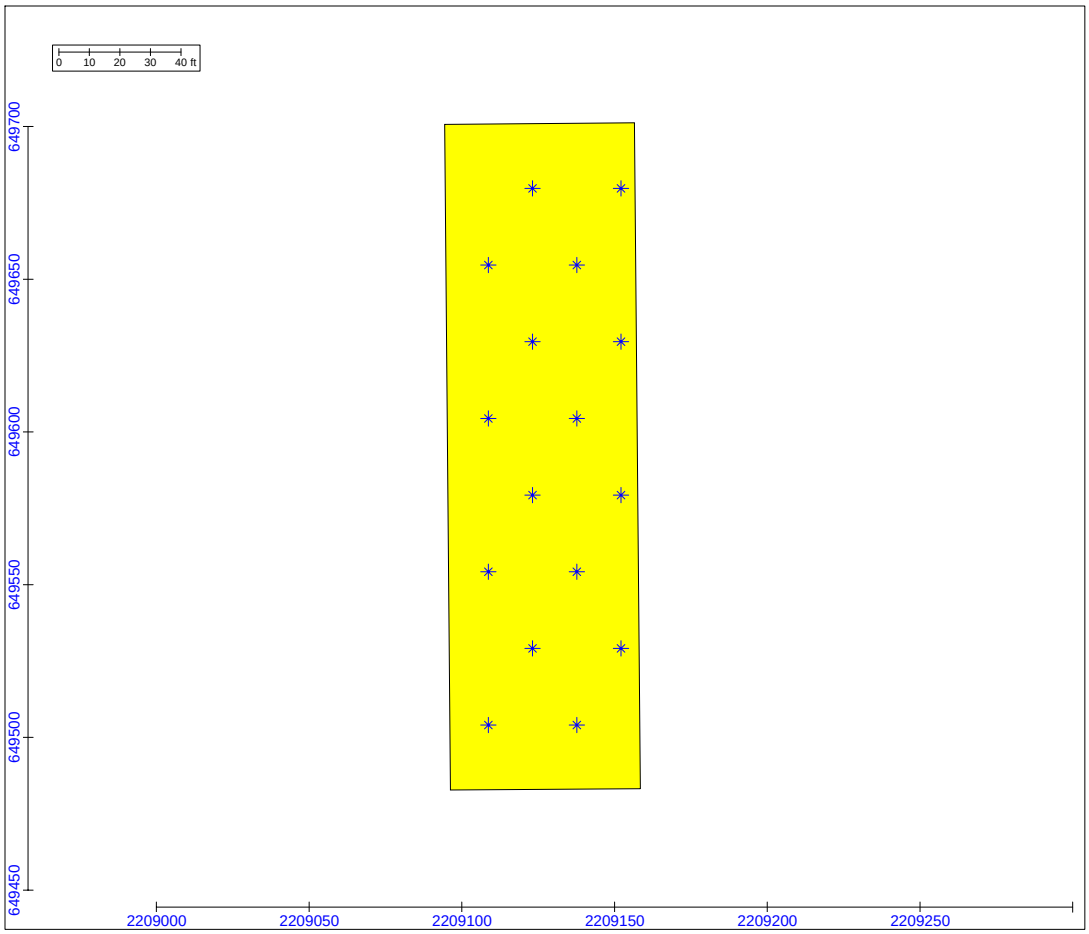
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	19
Type of samples	Point Samples
Number of samples on map [a]	16
Number of selected sample areas [b]	1
Specified sampling area [c]	13551.59 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$19.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P8 (134-08-014)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2209108.6659	649504.0518	P8 (134-08-014)-1		Hotspot	
2209137.6466	649504.0518	P8 (134-08-014)-2		Hotspot	
2209123.1562	649529.1498	P8 (134-08-014)-3		Hotspot	
2209152.1369	649529.1498	P8 (134-08-014)-4		Hotspot	
2209108.6659	649554.2479	P8 (134-08-014)-5		Hotspot	
2209137.6466	649554.2479	P8 (134-08-014)-6		Hotspot	
2209123.1562	649579.3459	P8 (134-08-014)-7		Hotspot	
2209152.1369	649579.3459	P8 (134-08-014)-8		Hotspot	
2209108.6659	649604.4439	P8 (134-08-014)-9		Hotspot	
2209137.6466	649604.4439	P8 (134-08-014)-10		Hotspot	
2209123.1562	649629.5420	P8 (134-08-014)-11		Hotspot	
2209152.1369	649629.5420	P8 (134-08-014)-12		Hotspot	
2209108.6659	649654.6400	P8 (134-08-014)-13		Hotspot	
2209137.6466	649654.6400	P8 (134-08-014)-14		Hotspot	
2209123.1562	649679.7381	P8 (134-08-014)-15		Hotspot	
2209152.1369	649679.7381	P8 (134-08-014)-16		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

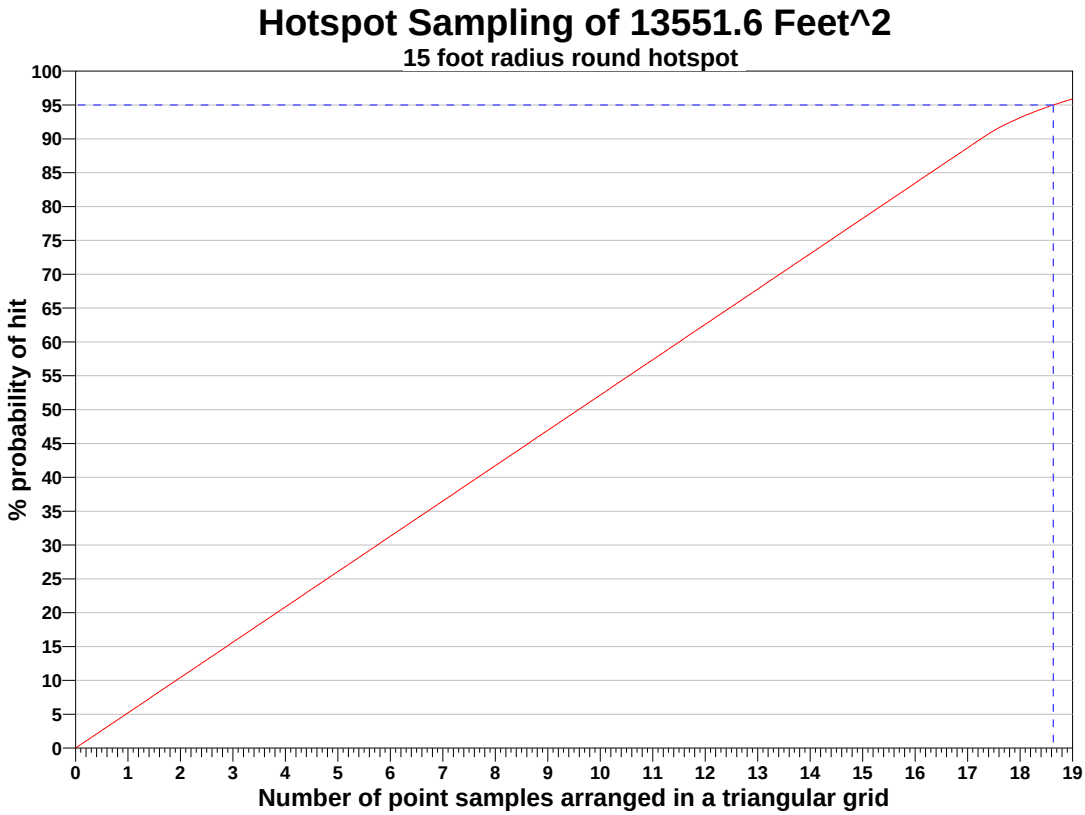
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	13551.59 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	18.6312
Cost	Total cost of sampling	$19.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	91	23	11
	Shp=0.9	78	20	9
	Shp=1	70	18	8
1-β=95	**Shp=0.8**	99	25	11
	Shp=0.9	85	22	10
	Shp=1	75	19	9

1-β=100	**Shp=0.8**	120	30	14
	Shp=0.9	104	26	12
	Shp=1	93	24	11

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $19.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**19 Samples**
Field collection costs		$1.00	$19.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$19.00**
Fixed planning and validation costs			$0.00
Total cost			**$19.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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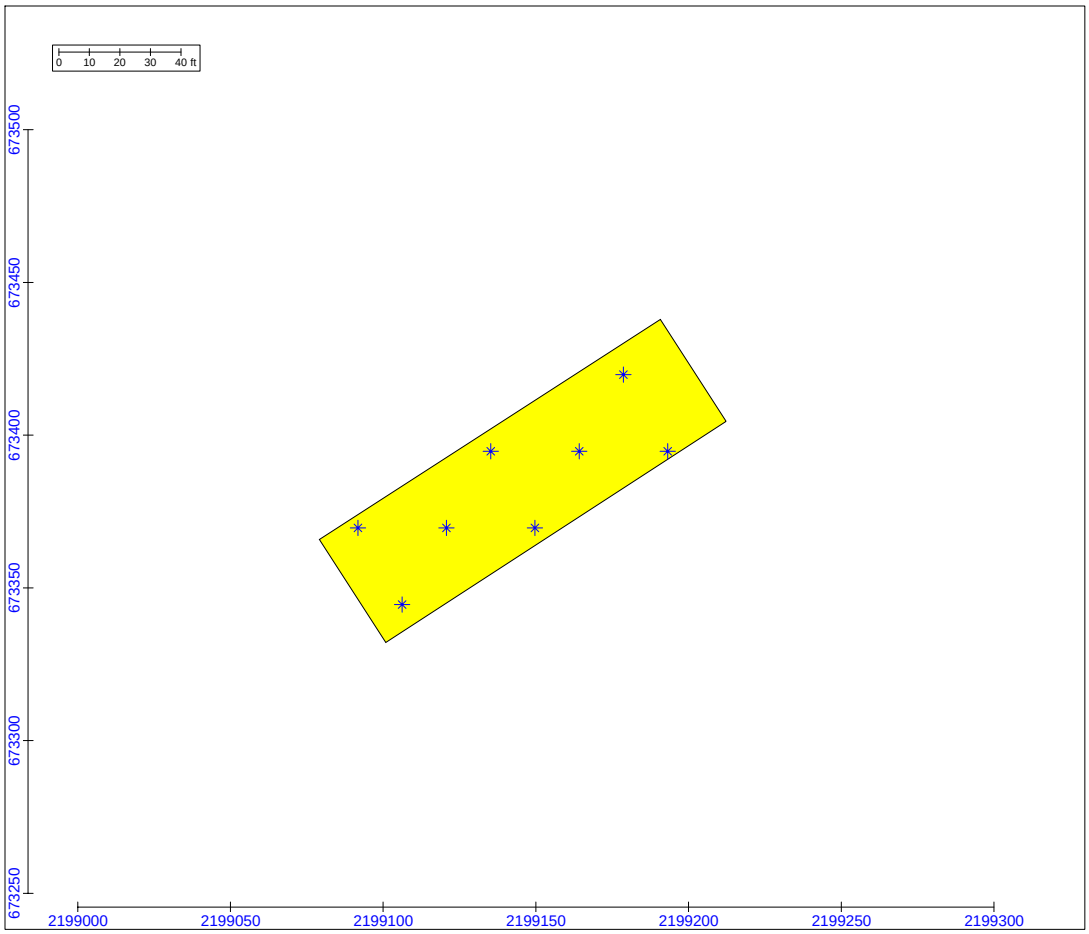
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	8
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5304.53 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$8.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P9 (104-27-089)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2199106.2270	673344.5162	P9 (104-27-089)-1		Hotspot	
2199091.7366	673369.6143	P9 (104-27-089)-2		Hotspot	
2199120.7173	673369.6143	P9 (104-27-089)-3		Hotspot	
2199149.6981	673369.6143	P9 (104-27-089)-4		Hotspot	
2199135.2077	673394.7123	P9 (104-27-089)-5		Hotspot	
2199164.1884	673394.7123	P9 (104-27-089)-6		Hotspot	
2199193.1691	673394.7123	P9 (104-27-089)-7		Hotspot	
2199178.6788	673419.8104	P9 (104-27-089)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot,

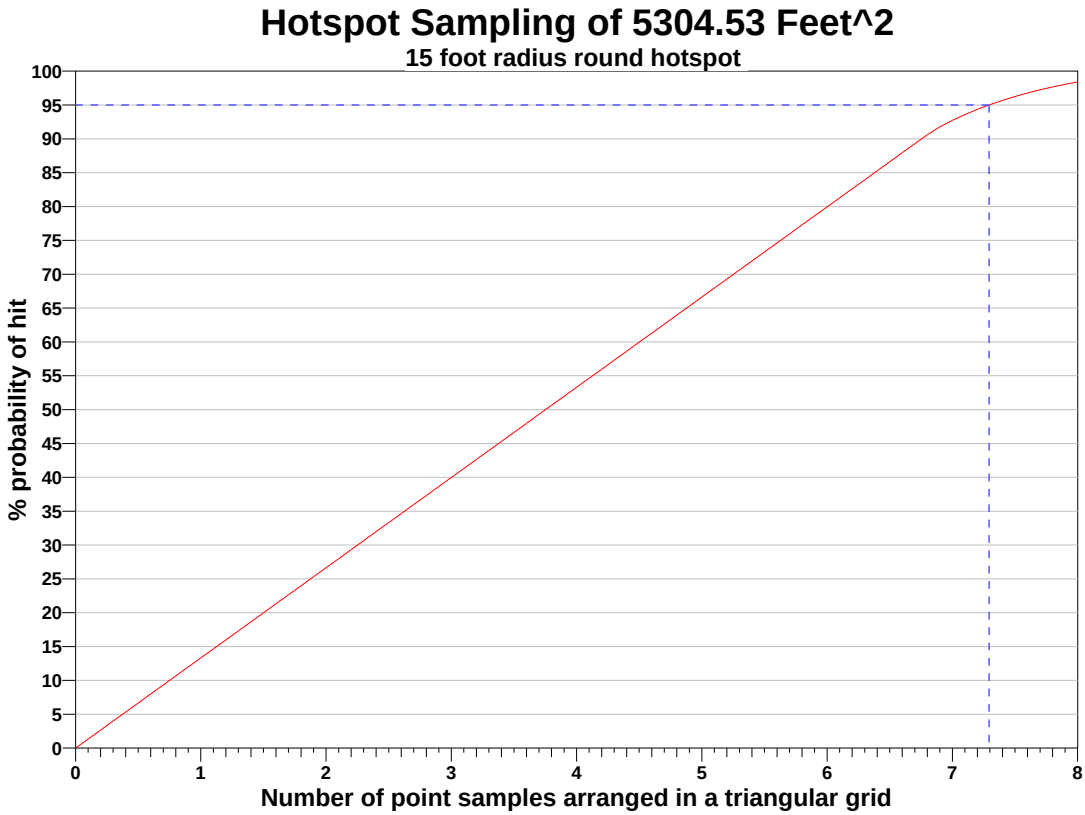
the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5304.53 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	7.29286
Cost	Total cost of sampling	$8.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	36	9	4
	Shp=0.9	31	8	4
	Shp=1	28	7	4
1-β=95	**Shp=0.8**	39	10	5
	Shp=0.9	34	9	4
	Shp=1	30	8	4

1-β=100	**Shp=0.8**	47	12	6
	Shp=0.9	41	11	5
	Shp=1	37	10	5

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $8.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**8 Samples**
Field collection costs		$1.00	$8.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$8.00**
Fixed planning and validation costs			$0.00
Total cost			**$8.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
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Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

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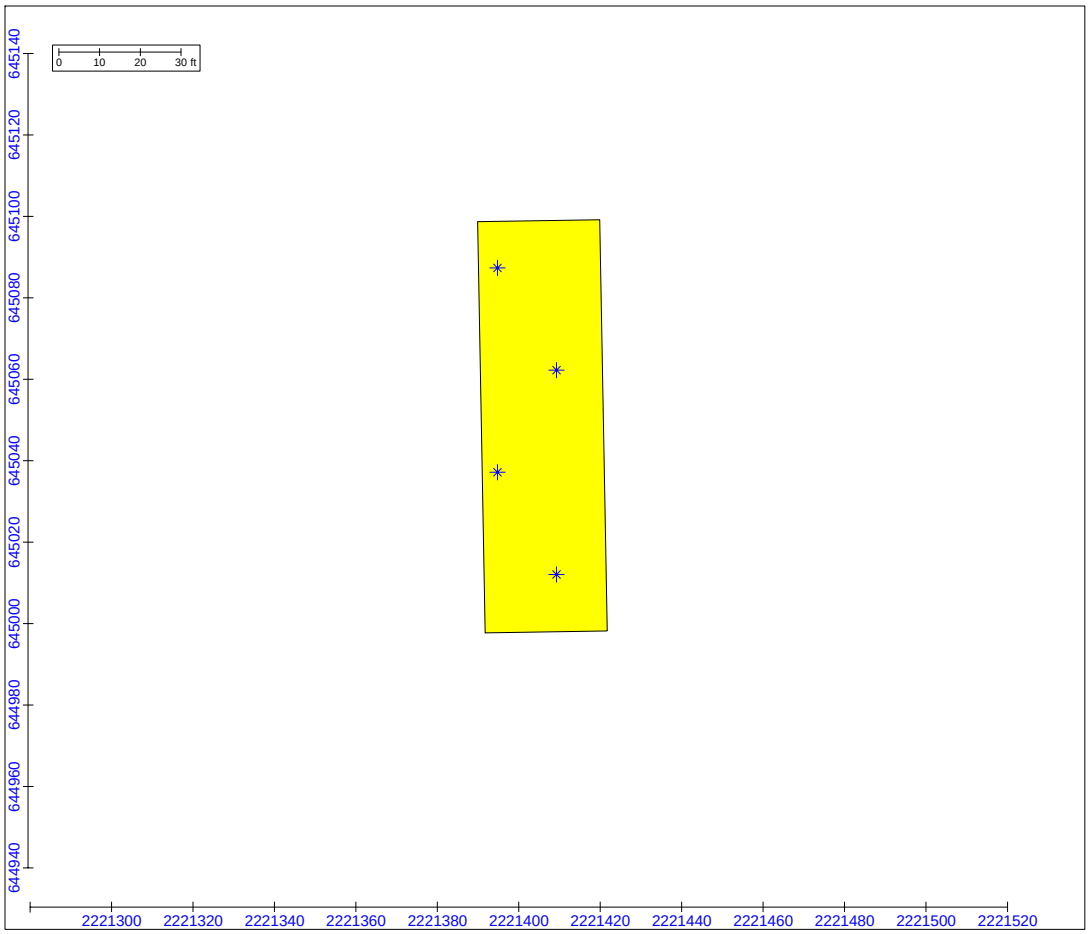
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	5
Type of samples	Point Samples
Number of samples on map [a]	4
Number of selected sample areas [b]	1
Specified sampling area [c]	3029.92 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$5.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P11 (142-25-131)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2221409.2451	645012.0539	P11 (142-25-131)-1		Hotspot	
2221394.7548	645037.1520	P11 (142-25-131)-2		Hotspot	
2221409.2451	645062.2500	P11 (142-25-131)-3		Hotspot	
2221394.7548	645087.3480	P11 (142-25-131)-4		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

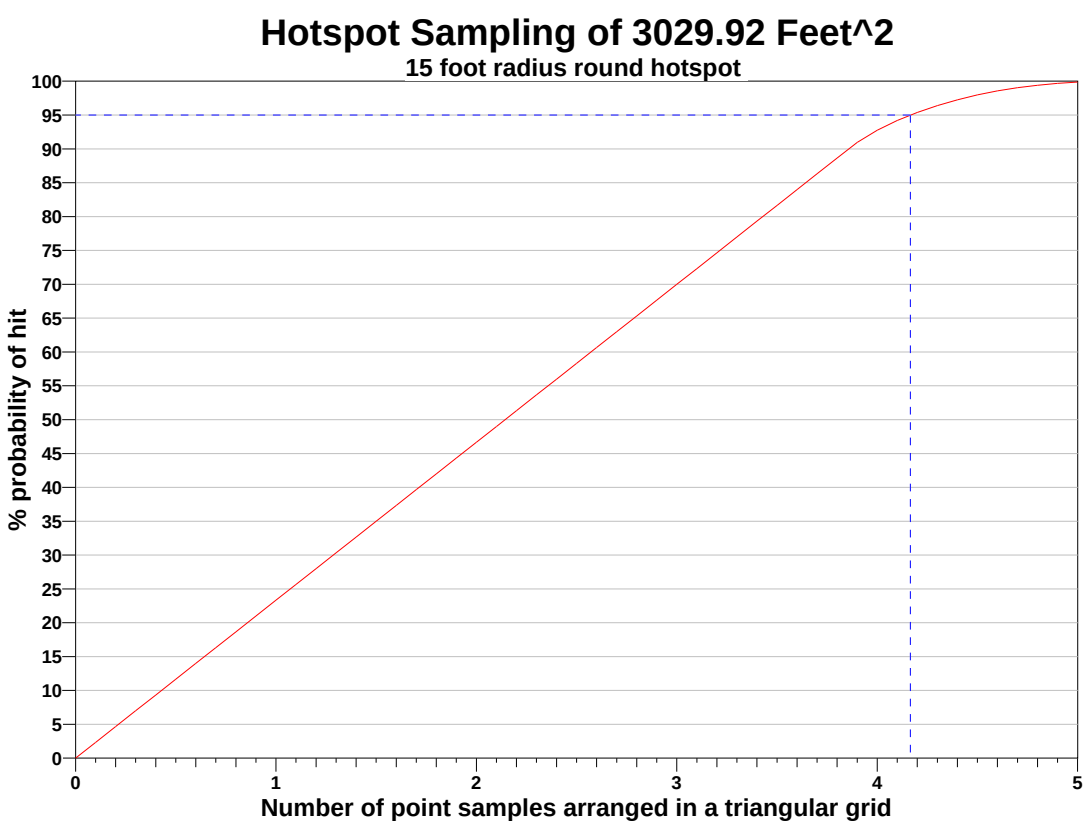
The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value

Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3029.92 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	4.16564
Cost	Total cost of sampling	$5.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.

3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
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9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	21	6	3
	Shp=0.9	18	5	2
	Shp=1	16	4	2
1-β=95	**Shp=0.8**	23	6	3
	Shp=0.9	19	5	3
	Shp=1	17	5	2
1-β=100	**Shp=0.8**	27	7	3
	Shp=0.9	24	6	3
	Shp=1	21	6	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $5.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**5 Samples**
Field collection costs		$1.00	$5.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$5.00**
Fixed planning and validation costs			$0.00
Total cost			**$5.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve

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Systematic sampling locations for detecting an area of elevated values (hot spot)

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The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	5
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	3076.67 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$5.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
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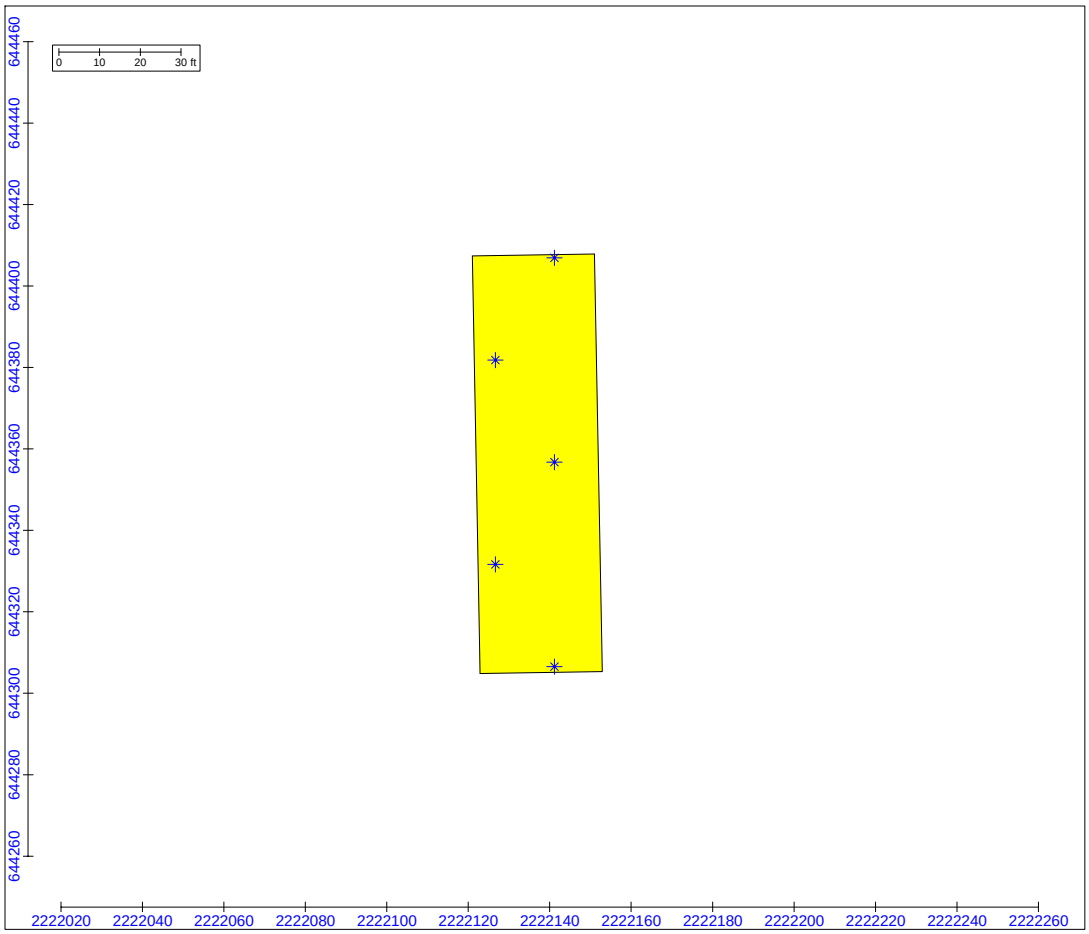


Area: P11 (142-27-156)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2222141.1579	644306.5427	P11 (142-27-156)-1		Hotspot	
2222126.6675	644331.6408	P11 (142-27-156)-2		Hotspot	
2222141.1579	644356.7388	P11 (142-27-156)-3		Hotspot	
2222126.6675	644381.8368	P11 (142-27-156)-4		Hotspot	
2222141.1579	644406.9349	P11 (142-27-156)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

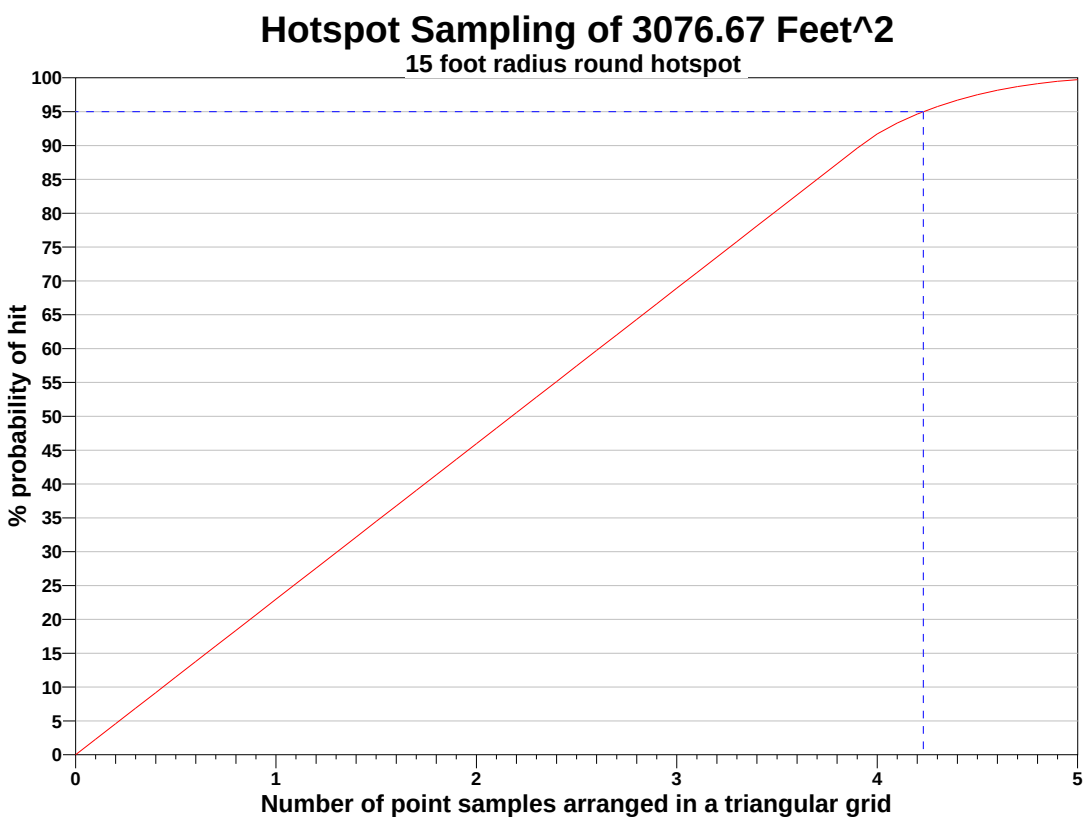
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3076.67 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	4.22991
Cost	Total cost of sampling	$5.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

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Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	21	6	3
	Shp=0.9	18	5	2
	Shp=1	16	4	2
1-β=95	**Shp=0.8**	23	6	3
	Shp=0.9	20	5	3
	Shp=1	17	5	2
1-β=100	**Shp=0.8**	28	7	4
	Shp=0.9	24	6	3
	Shp=1	21	6	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

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Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$5.00**
Fixed planning and validation costs			$0.00
Total cost			**$5.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The

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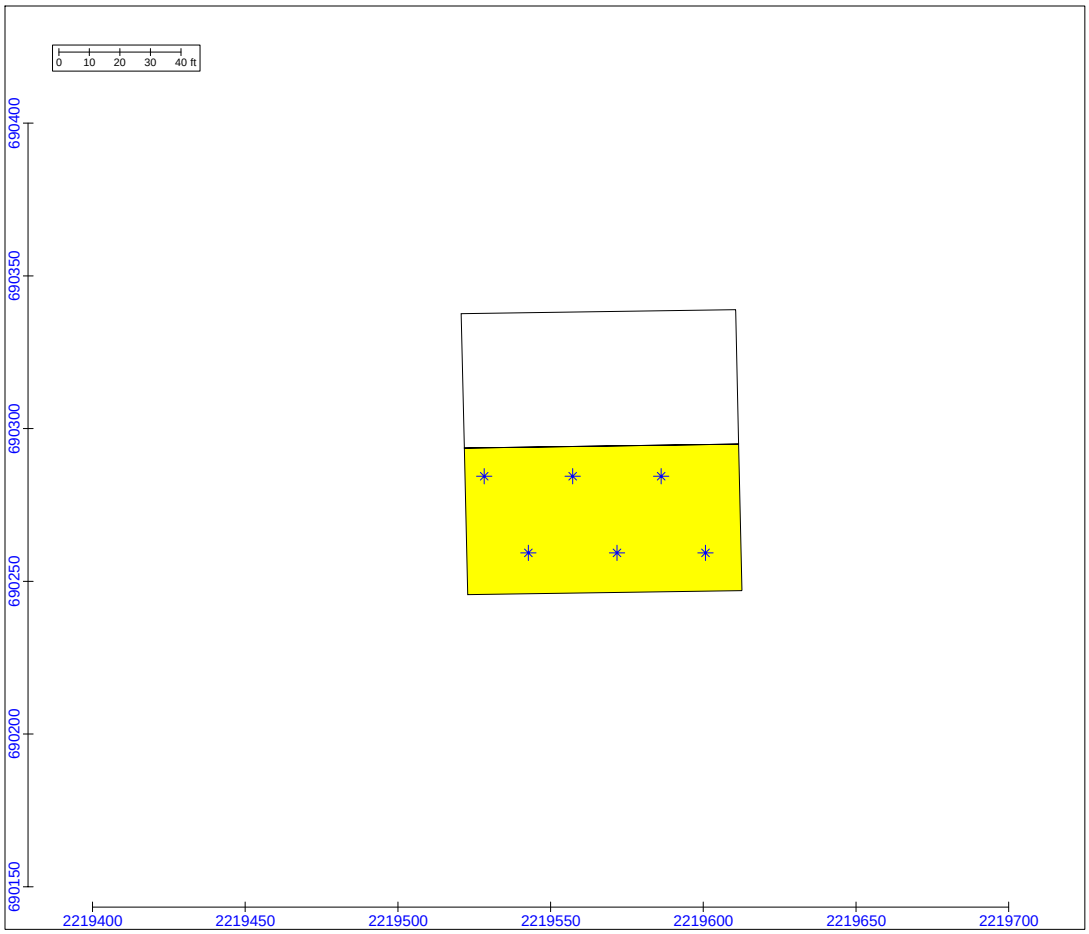
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	4310.96 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P19 (115-01-027)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2219542.7405	690259.3264	P19 (115-01-027)-1		Hotspot	
2219571.7212	690259.3264	P19 (115-01-027)-2		Hotspot	
2219600.7019	690259.3264	P19 (115-01-027)-3		Hotspot	
2219528.2501	690284.4245	P19 (115-01-027)-4		Hotspot	
2219557.2309	690284.4245	P19 (115-01-027)-5		Hotspot	
2219586.2116	690284.4245	P19 (115-01-027)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

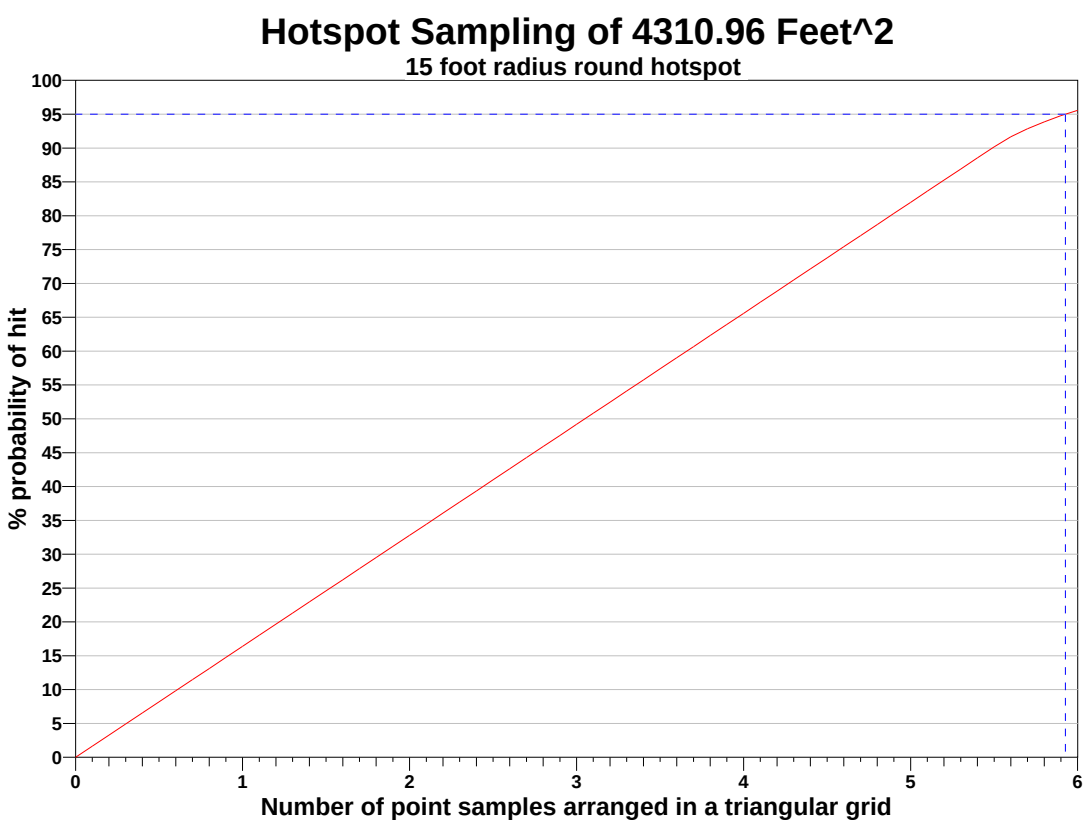
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	4310.96 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.92686
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	29	8	4
	Shp=0.9	25	7	3
	Shp=1	22	6	3
1-β=95	**Shp=0.8**	32	8	4
	Shp=0.9	27	7	3
	Shp=1	24	6	3
1-β=100	**Shp=0.8**	39	10	5
	Shp=0.9	33	9	4
	Shp=1	30	8	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References

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The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	3952.78 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
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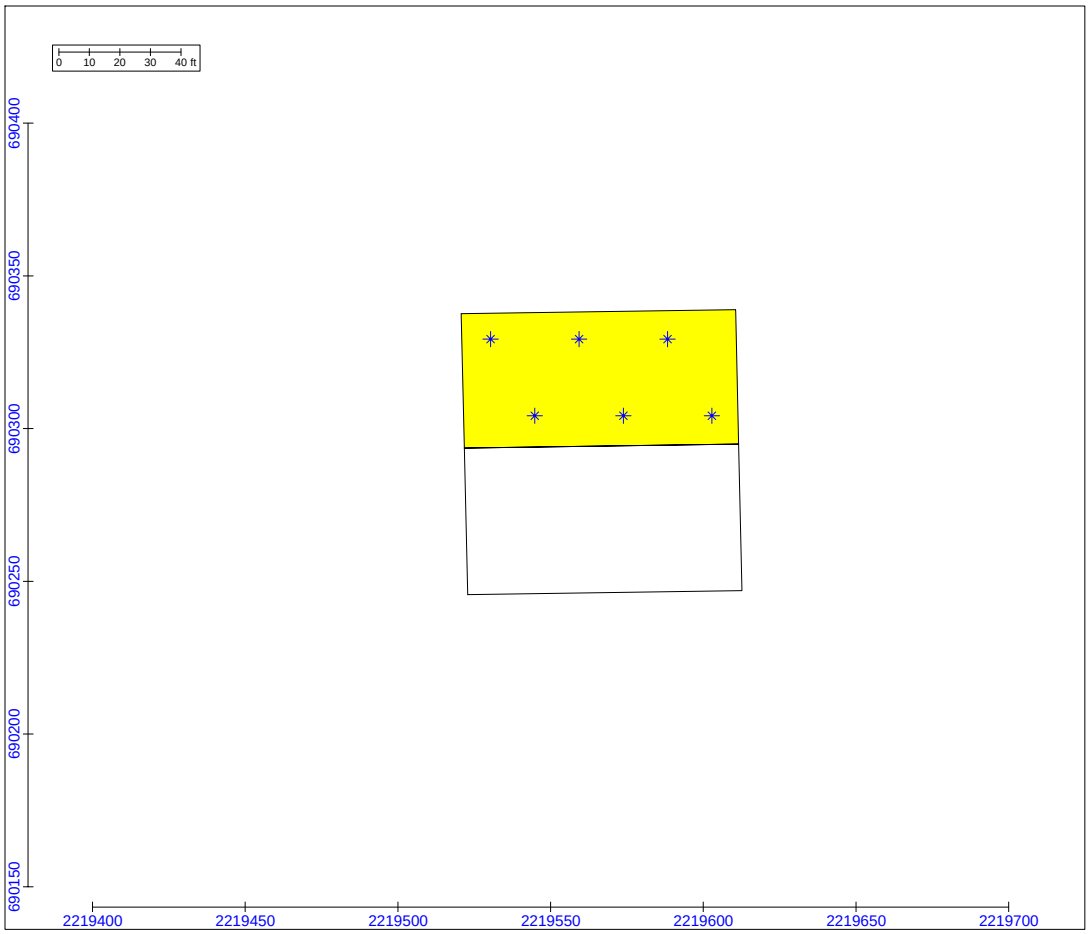


Area: P19 (115-01-028)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2219544.8278	690304.1962	P19 (115-01-028)-1		Hotspot	
2219573.8085	690304.1962	P19 (115-01-028)-2		Hotspot	
2219602.7892	690304.1962	P19 (115-01-028)-3		Hotspot	
2219530.3374	690329.2942	P19 (115-01-028)-4		Hotspot	
2219559.3181	690329.2942	P19 (115-01-028)-5		Hotspot	
2219588.2989	690329.2942	P19 (115-01-028)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

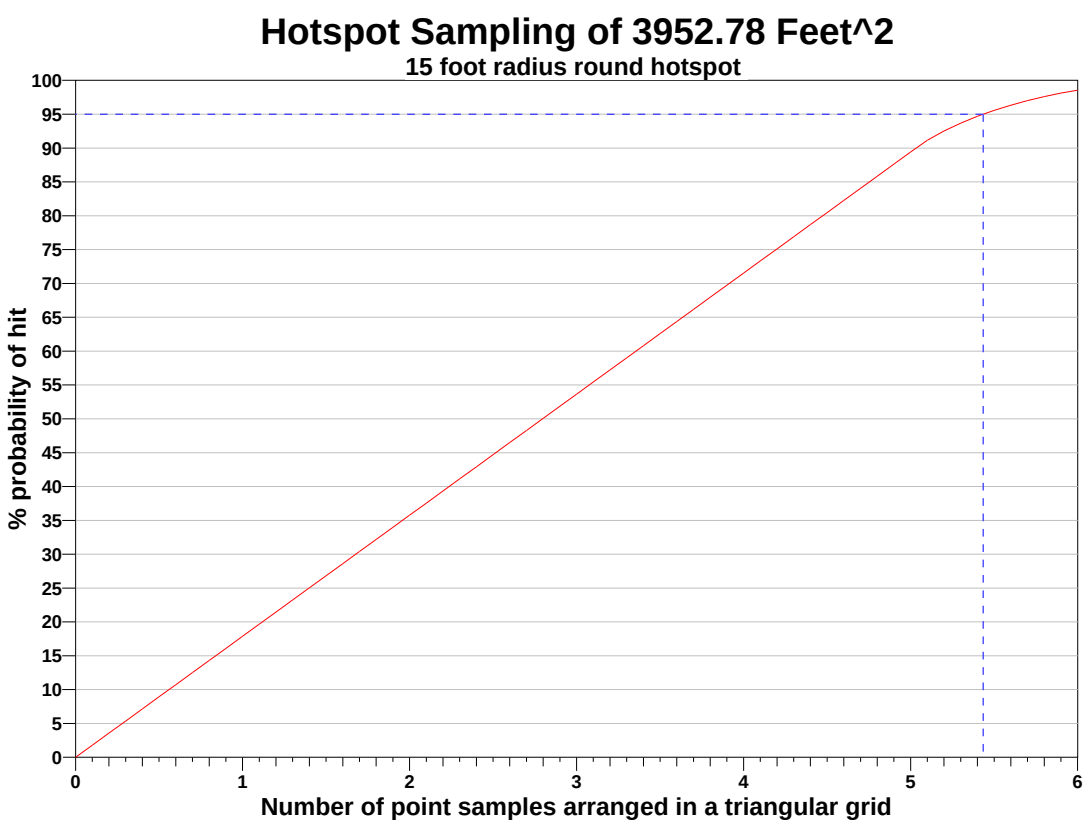
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3952.78 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.43443
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
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Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	27	7	3
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	Shp=1	21	6	3
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Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

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Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

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Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	4354.25 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
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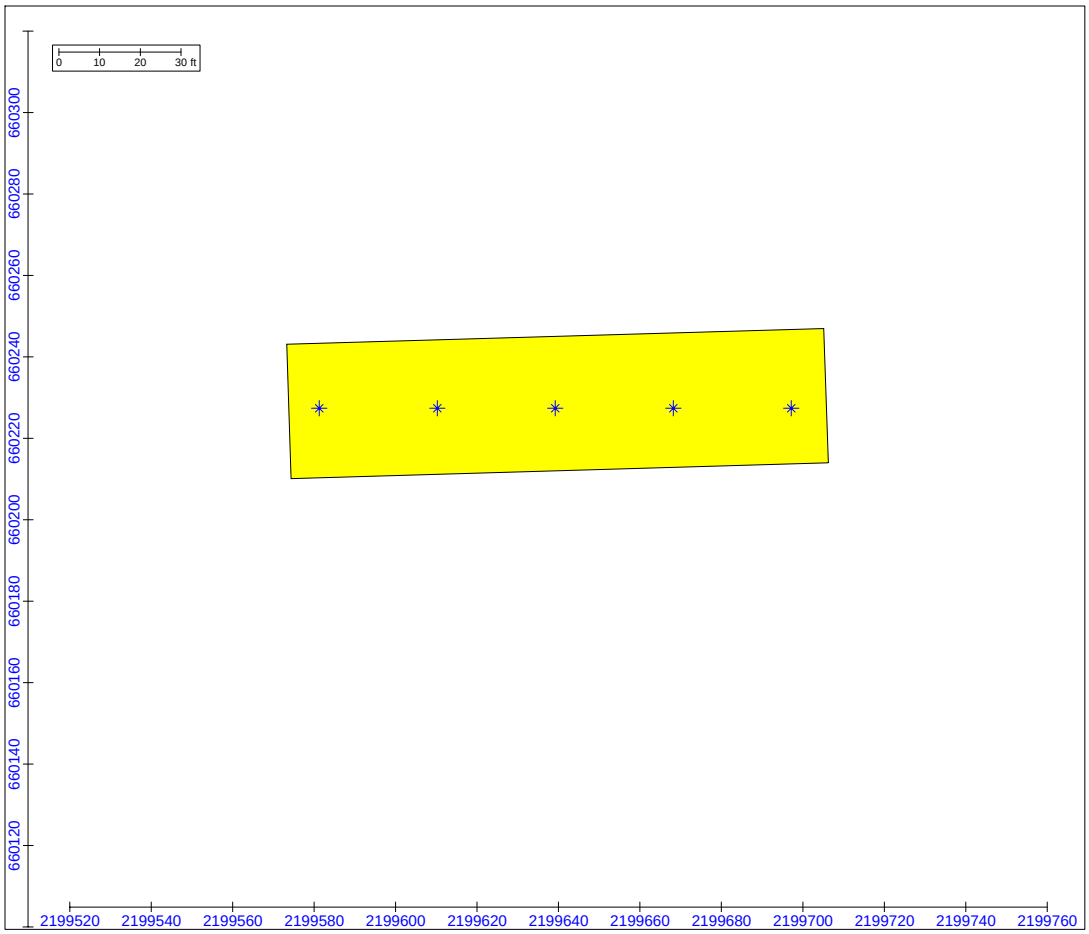

Area: P29 (123-20-020)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2199581.2471	660227.3773	P29 (123-20-020)-1		Hotspot	
2199610.2278	660227.3773	P29 (123-20-020)-2		Hotspot	
2199639.2086	660227.3773	P29 (123-20-020)-3		Hotspot	
2199668.1893	660227.3773	P29 (123-20-020)-4		Hotspot	
2199697.1700	660227.3773	P29 (123-20-020)-5		Hotspot	

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The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

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Sampling Area	Total area to sample	4354.25 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
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Samples [b]	Optimum number of samples	5.98638
Cost	Total cost of sampling	$6.00

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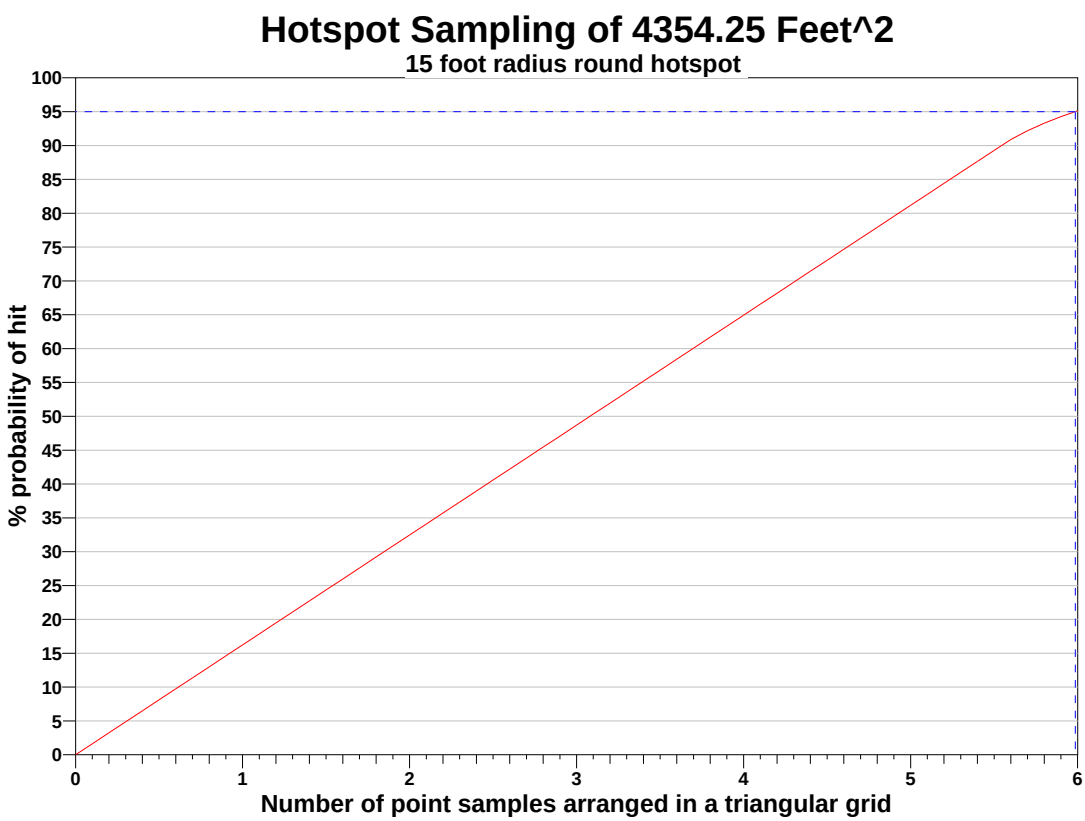

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Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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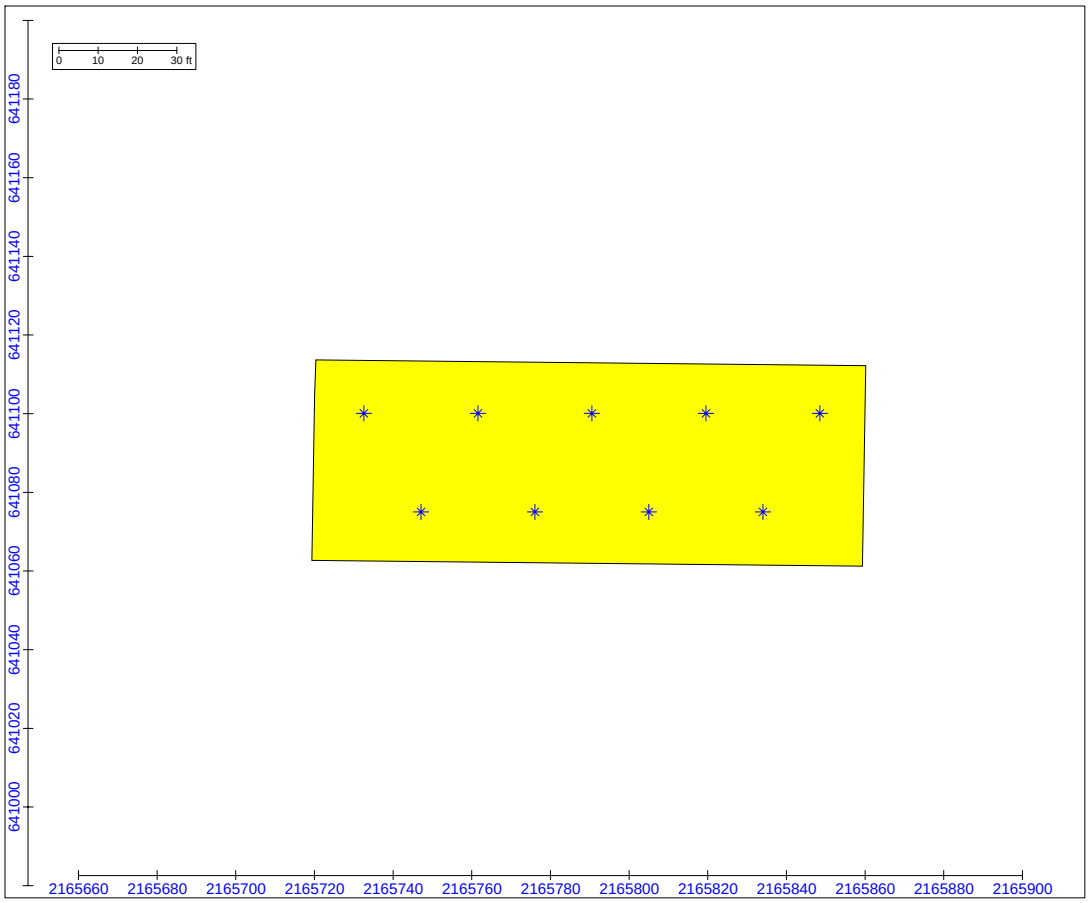
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	10
Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	7138.70 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$10.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P32 (020-06-013)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2165747.0776	641074.9998	P32 (020-06-013)-1		Hotspot	
2165776.0583	641074.9998	P32 (020-06-013)-2		Hotspot	
2165805.0390	641074.9998	P32 (020-06-013)-3		Hotspot	
2165834.0198	641074.9998	P32 (020-06-013)-4		Hotspot	
2165732.5872	641100.0979	P32 (020-06-013)-5		Hotspot	
2165761.5680	641100.0979	P32 (020-06-013)-6		Hotspot	
2165790.5487	641100.0979	P32 (020-06-013)-7		Hotspot	
2165819.5294	641100.0979	P32 (020-06-013)-8		Hotspot	
2165848.5101	641100.0979	P32 (020-06-013)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the

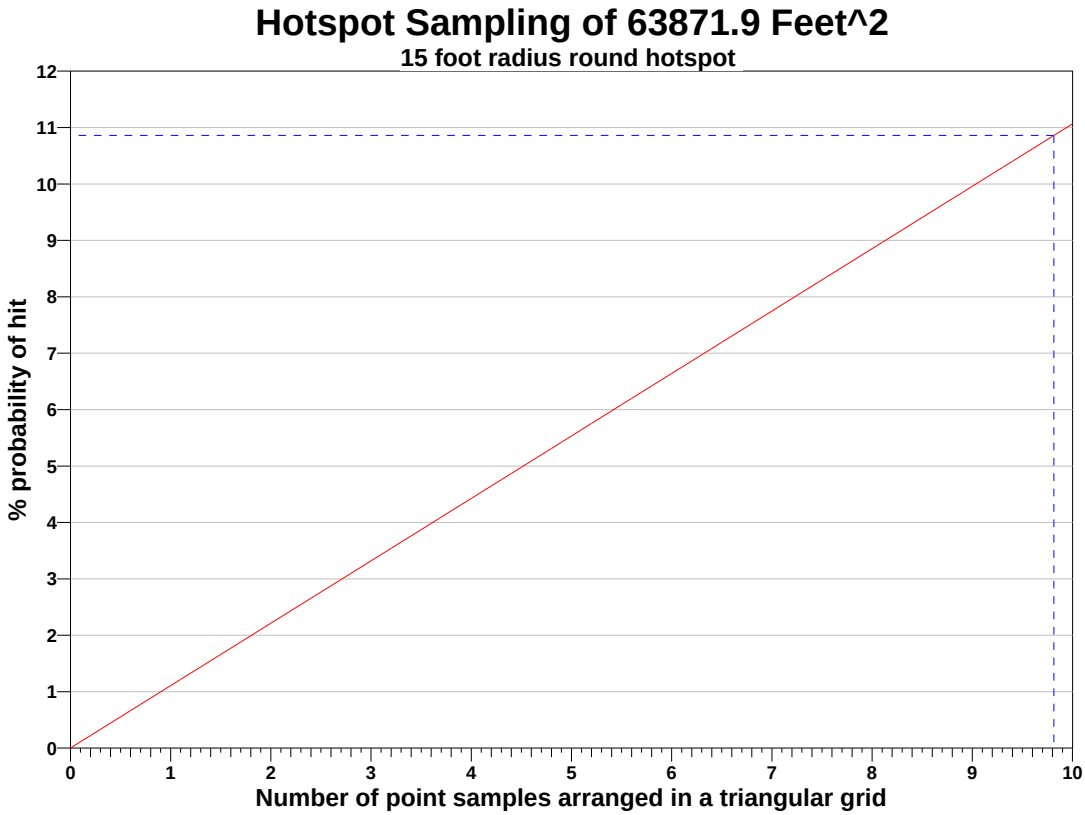
algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	7138.70 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	9.81454
Cost	Total cost of sampling	$10.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	48	12	6
	Shp=0.9	42	11	5
	Shp=1	37	10	5
1-β=95	**Shp=0.8**	53	14	6
	Shp=0.9	45	12	5
	Shp=1	40	10	5

1-β=100	**Shp=0.8**	64	16	8
	Shp=0.9	55	14	7
	Shp=1	49	13	6

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $10.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**10 Samples**
Field collection costs		$1.00	$10.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$10.00**
Fixed planning and validation costs			$0.00
Total cost			**$10.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

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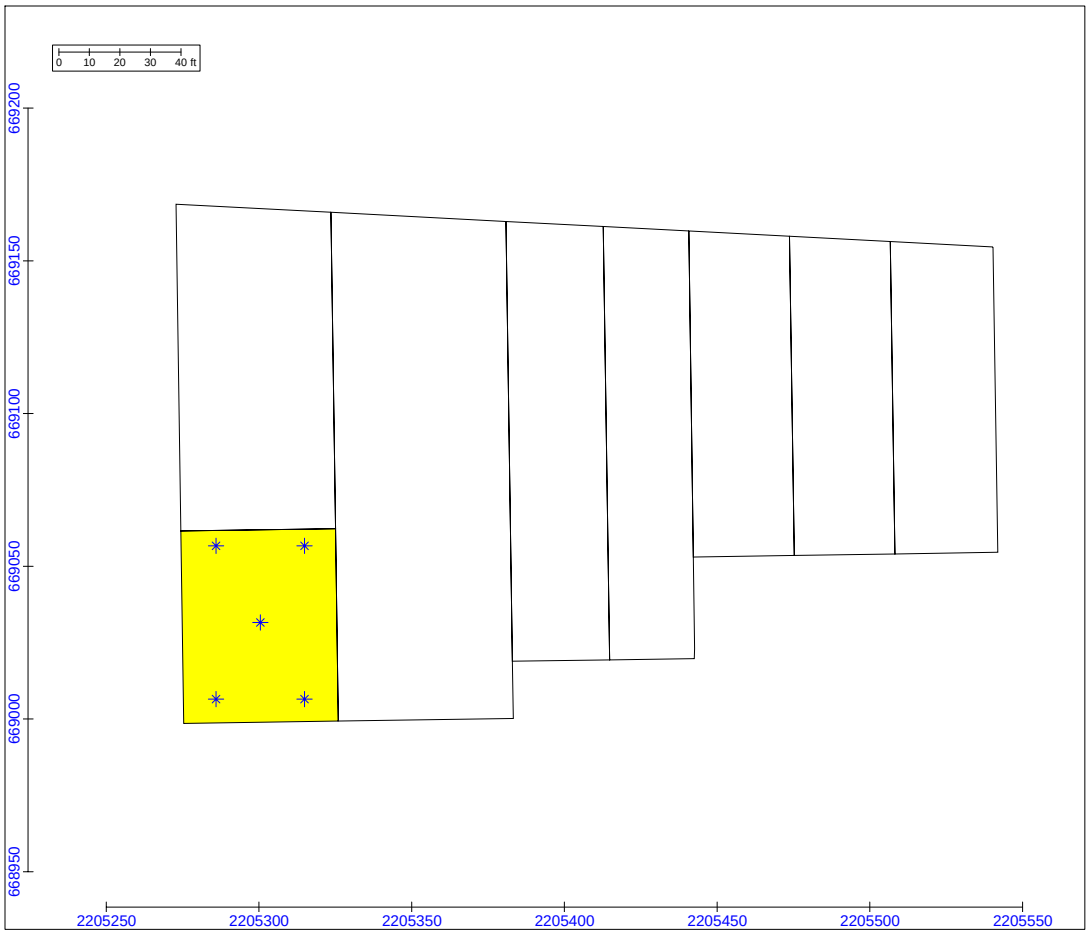
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	5
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	3190.98 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$5.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-011)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205285.9500	669006.5086	P41 (118-27-011)-1		Hotspot	
2205314.9307	669006.5086	P41 (118-27-011)-2		Hotspot	
2205300.4404	669031.6066	P41 (118-27-011)-3		Hotspot	
2205285.9500	669056.7047	P41 (118-27-011)-4		Hotspot	
2205314.9307	669056.7047	P41 (118-27-011)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

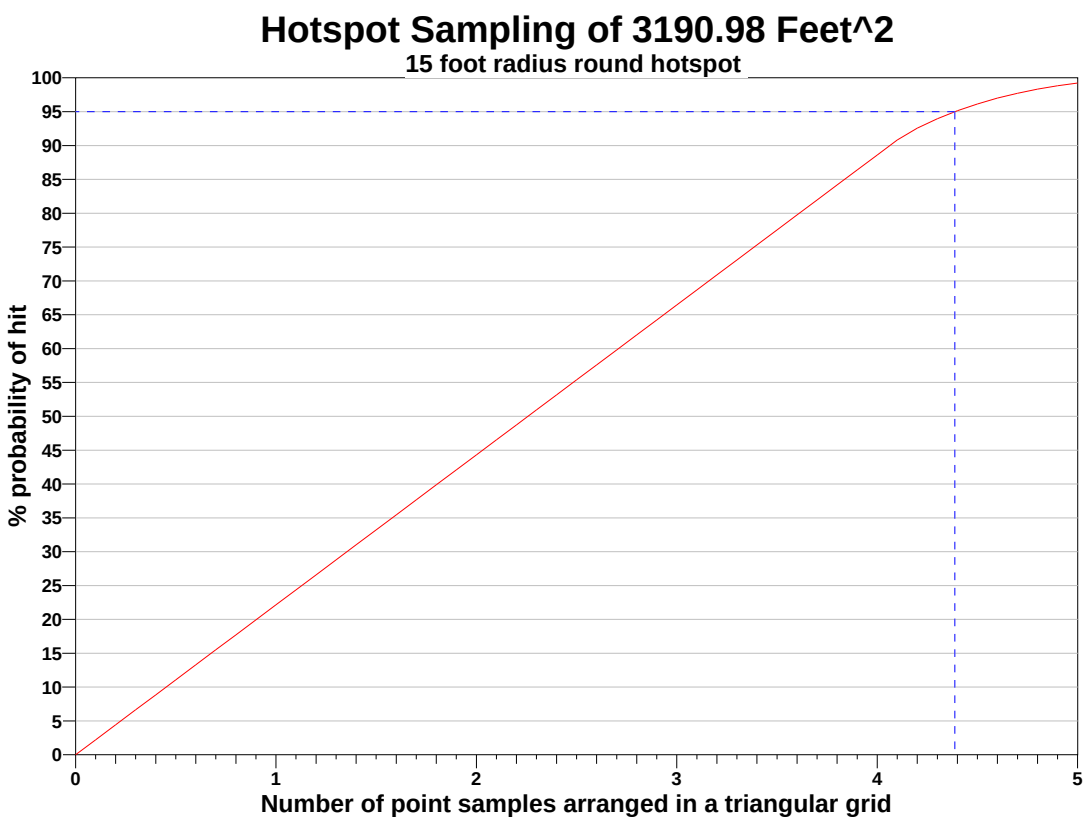
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3190.98 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	4.38708
Cost	Total cost of sampling	$5.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
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9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	22	6	3
	Shp=0.9	19	5	3
	Shp=1	17	5	2
1-β=95	**Shp=0.8**	24	6	3
	Shp=0.9	20	5	3
	Shp=1	18	5	2
1-β=100	**Shp=0.8**	29	8	4
	Shp=0.9	25	7	3
	Shp=1	22	6	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $5.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**5 Samples**
Field collection costs		$1.00	$5.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$5.00**
Fixed planning and validation costs			$0.00
Total cost			**$5.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The

data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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Systematic sampling locations for detecting an area of elevated values (hot spot)

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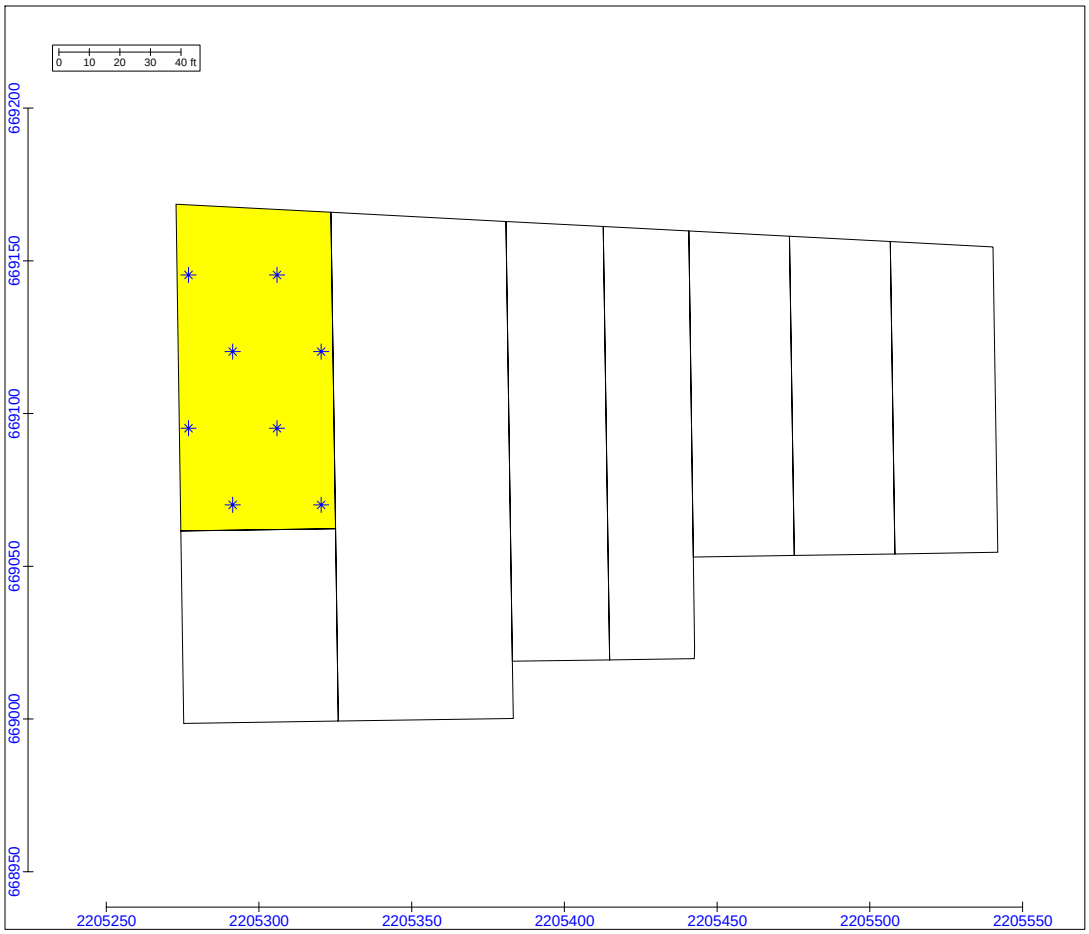
The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	8
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5333.57 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$8.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-012)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205291.4031	669070.0861	P41 (118-27-012)-1		Hotspot	
2205320.3838	669070.0861	P41 (118-27-012)-2		Hotspot	
2205276.9127	669095.1842	P41 (118-27-012)-3		Hotspot	
2205305.8935	669095.1842	P41 (118-27-012)-4		Hotspot	
2205291.4031	669120.2822	P41 (118-27-012)-5		Hotspot	
2205320.3838	669120.2822	P41 (118-27-012)-6		Hotspot	
2205276.9127	669145.3802	P41 (118-27-012)-7		Hotspot	
2205305.8935	669145.3802	P41 (118-27-012)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot,

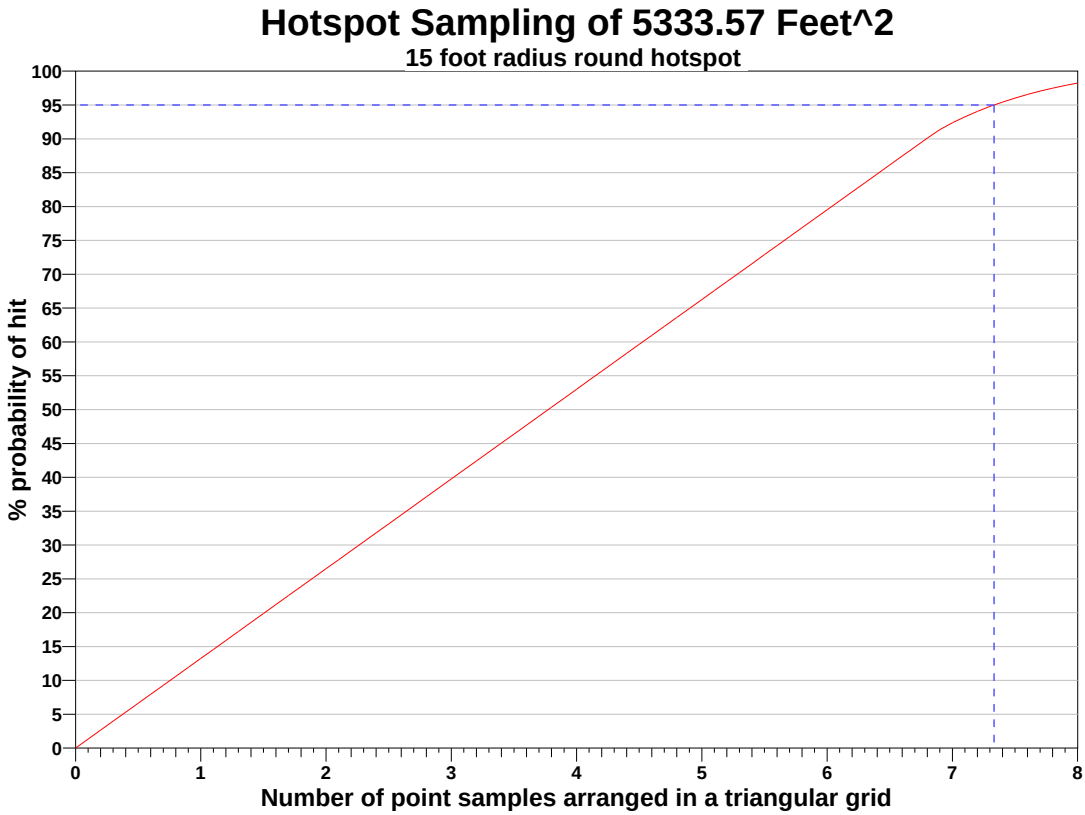
the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5333.57 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	7.33278
Cost	Total cost of sampling	$8.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
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9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	36	9	4
	Shp=0.9	31	8	4
	Shp=1	28	7	4
1-β=95	**Shp=0.8**	39	10	5
	Shp=0.9	34	9	4
	Shp=1	30	8	4

1-β=100	**Shp=0.8**	48	12	6
	Shp=0.9	41	11	5
	Shp=1	37	10	5

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $8.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**8 Samples**
Field collection costs		$1.00	$8.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$8.00**
Fixed planning and validation costs			$0.00
Total cost			**$8.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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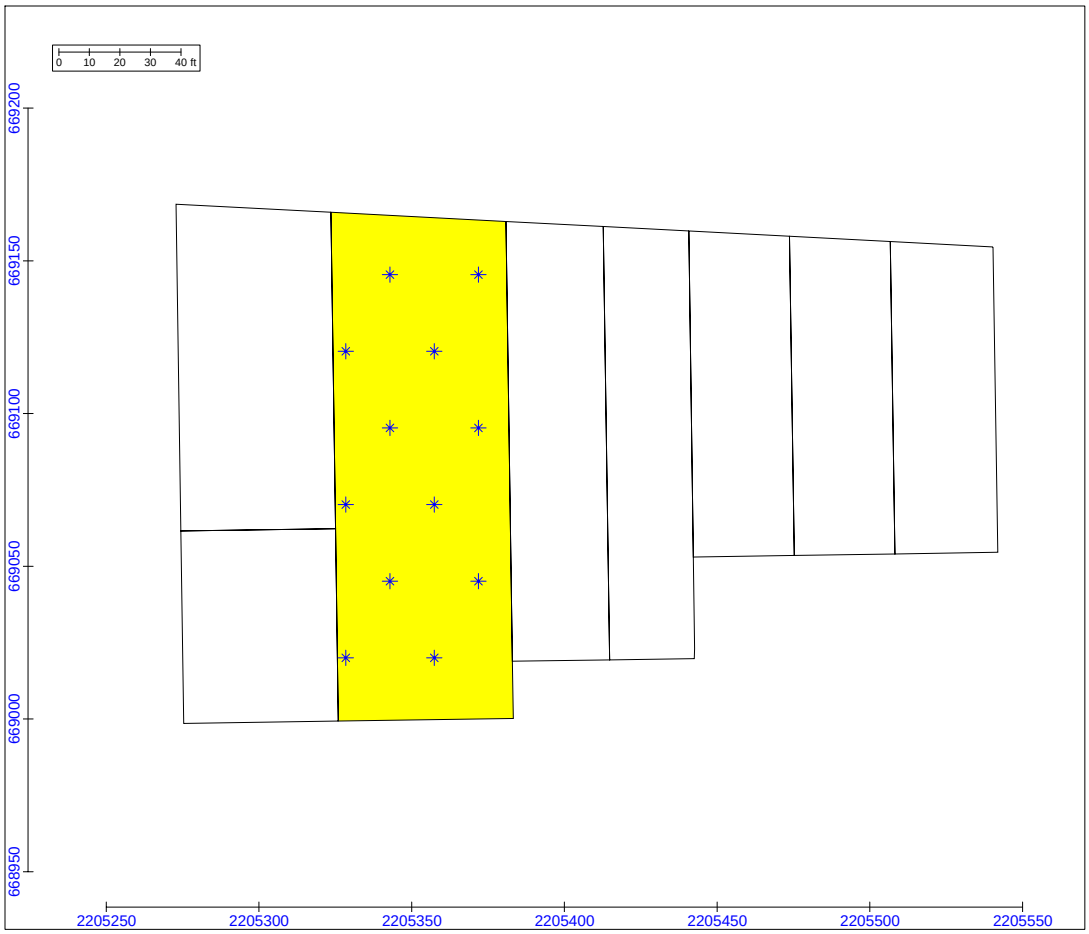
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	13
Type of samples	Point Samples
Number of samples on map [a]	12
Number of selected sample areas [b]	1
Specified sampling area [c]	9431.59 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$13.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-013)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205328.4103	669019.9922	P41 (118-27-013)-1		Hotspot	
2205357.3910	669019.9922	P41 (118-27-013)-2		Hotspot	
2205342.9006	669045.0903	P41 (118-27-013)-3		Hotspot	
2205371.8813	669045.0903	P41 (118-27-013)-4		Hotspot	
2205328.4103	669070.1883	P41 (118-27-013)-5		Hotspot	
2205357.3910	669070.1883	P41 (118-27-013)-6		Hotspot	
2205342.9006	669095.2864	P41 (118-27-013)-7		Hotspot	
2205371.8813	669095.2864	P41 (118-27-013)-8		Hotspot	
2205328.4103	669120.3844	P41 (118-27-013)-9		Hotspot	
2205357.3910	669120.3844	P41 (118-27-013)-10		Hotspot	
2205342.9006	669145.4824	P41 (118-27-013)-11		Hotspot	
2205371.8813	669145.4824	P41 (118-27-013)-12		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the

probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

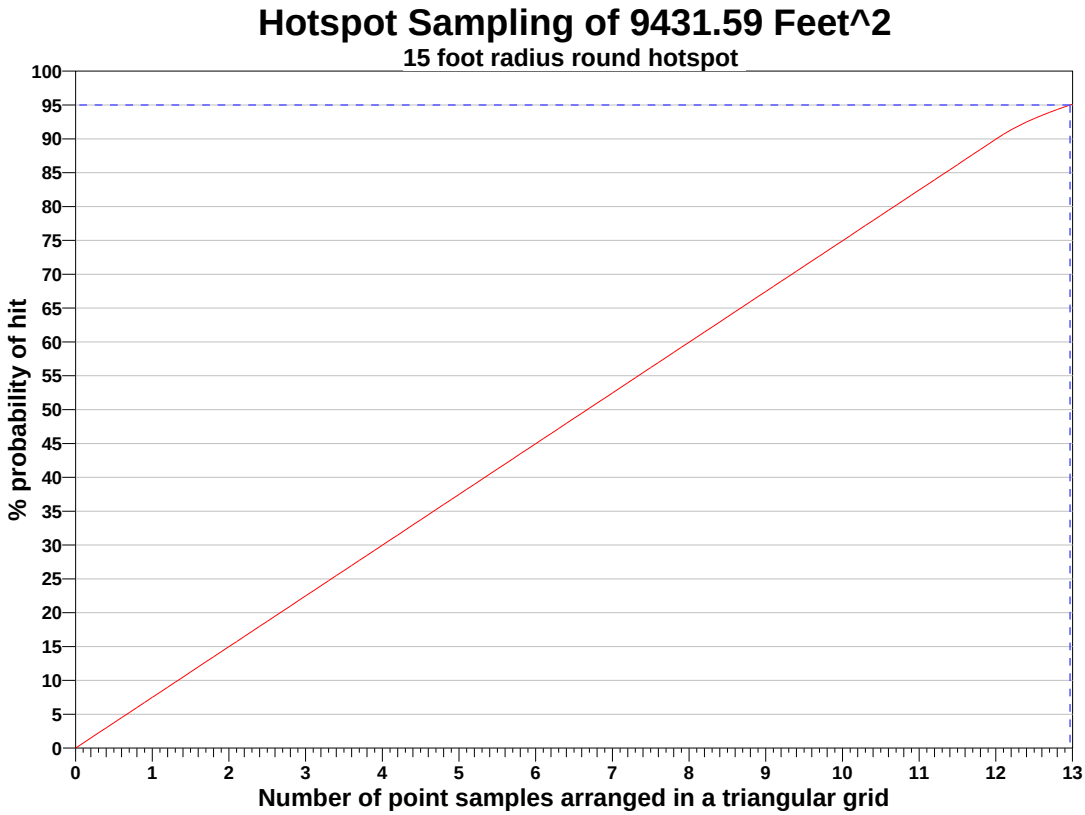
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	9431.59 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	12.9669
Cost	Total cost of sampling	$13.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	63	16	7
	Shp=0.9	55	14	7
	Shp=1	49	13	6
1-β=95	**Shp=0.8**	69	18	8
	Shp=0.9	60	15	7
	Shp=1	52	13	6

1-β=100	**Shp=0.8**	84	21	10
	Shp=0.9	73	19	9
	Shp=1	65	17	8

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $13.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**13 Samples**
Field collection costs		$1.00	$13.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$13.00**
Fixed planning and validation costs			$0.00
Total cost			**$13.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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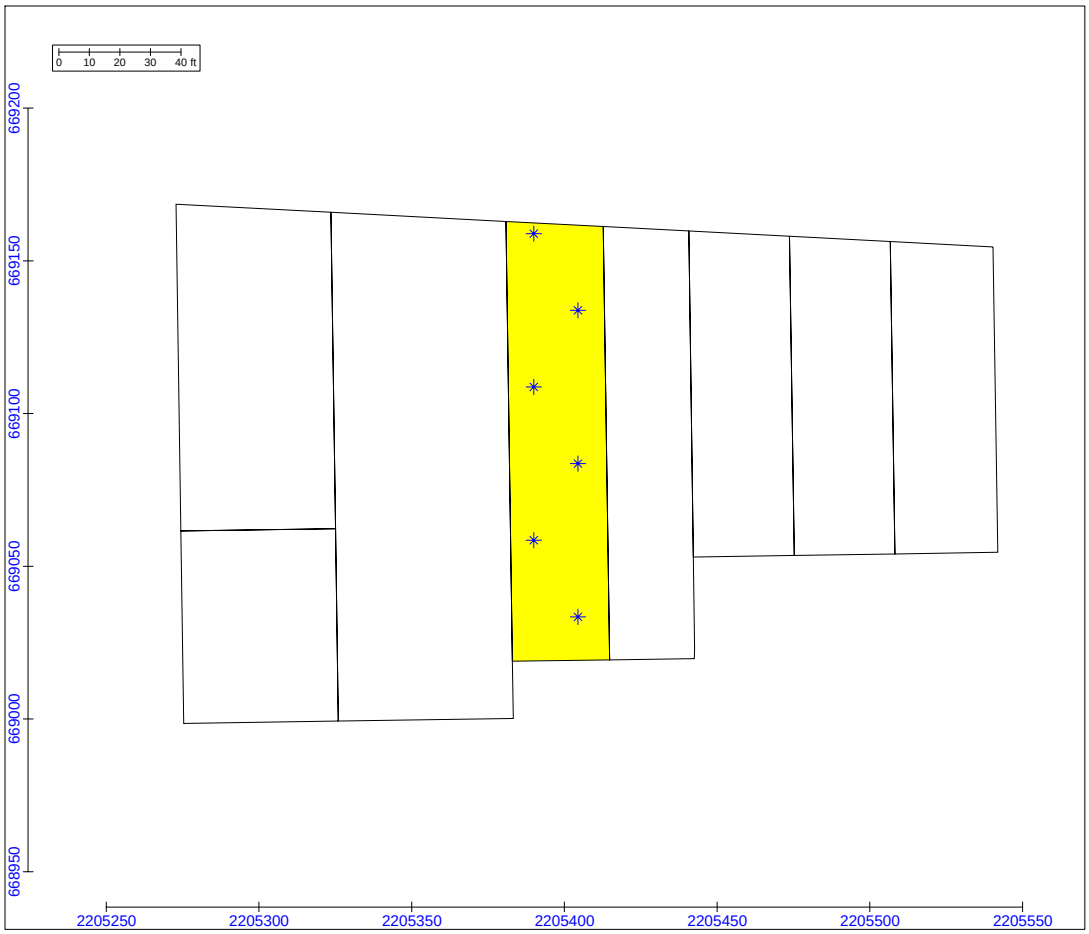
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	4550.03 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-014)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205404.4510	669033.4208	P41 (118-27-014)-1		Hotspot	
2205389.9606	669058.5189	P41 (118-27-014)-2		Hotspot	
2205404.4510	669083.6169	P41 (118-27-014)-3		Hotspot	
2205389.9606	669108.7149	P41 (118-27-014)-4		Hotspot	
2205404.4510	669133.8130	P41 (118-27-014)-5		Hotspot	
2205389.9606	669158.9110	P41 (118-27-014)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

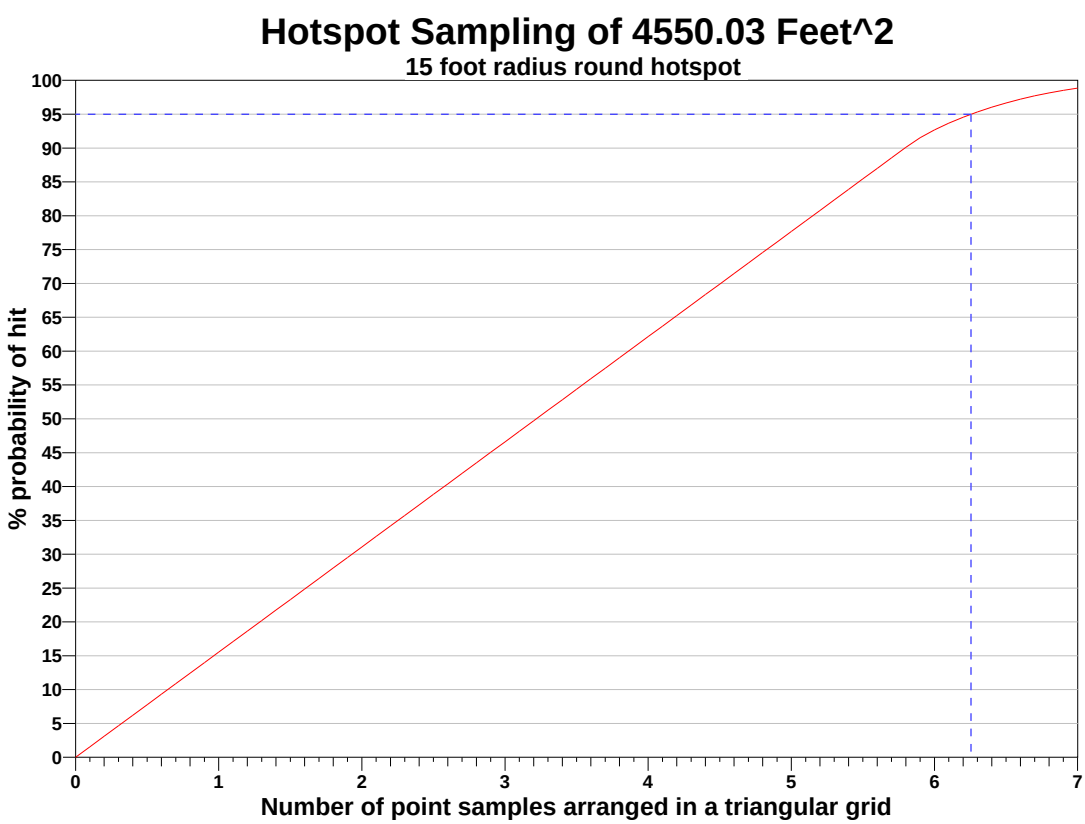
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	4550.03 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.25555
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
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8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	31	8	4
	Shp=0.9	27	7	3
	Shp=1	24	6	3
1-β=95	**Shp=0.8**	34	9	4
	Shp=0.9	29	8	4
	Shp=1	26	7	3
1-β=100	**Shp=0.8**	41	11	5
	Shp=0.9	35	9	4
	Shp=1	32	8	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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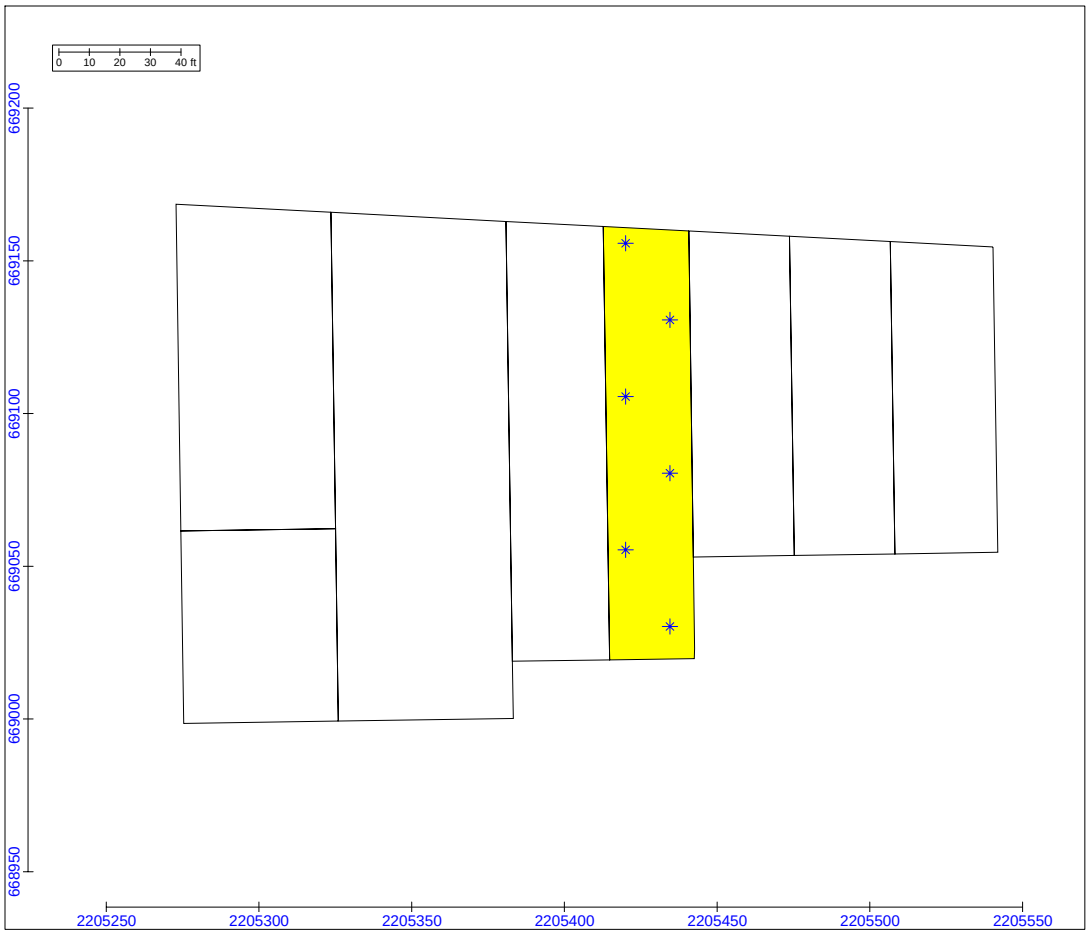
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	3936.45 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-015)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205434.5498	669030.2702	P41 (118-27-015)-1		Hotspot	
2205420.0595	669055.3683	P41 (118-27-015)-2		Hotspot	
2205434.5498	669080.4663	P41 (118-27-015)-3		Hotspot	
2205420.0595	669105.5643	P41 (118-27-015)-4		Hotspot	
2205434.5498	669130.6624	P41 (118-27-015)-5		Hotspot	
2205420.0595	669155.7604	P41 (118-27-015)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

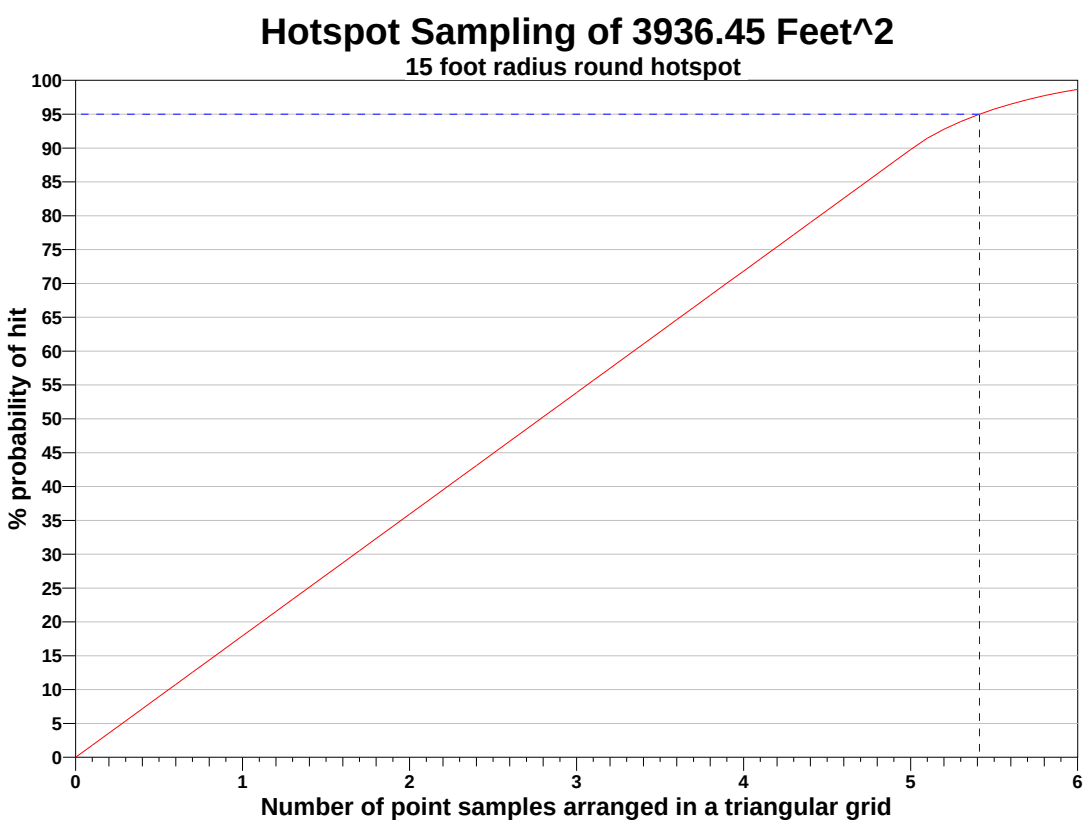
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3936.45 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.41198
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
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9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	27	7	3
	Shp=0.9	23	6	3
	Shp=1	21	6	3
1-β=95	**Shp=0.8**	29	8	4
	Shp=0.9	25	7	3
	Shp=1	22	6	3
1-β=100	**Shp=0.8**	35	9	4
	Shp=0.9	31	8	4
	Shp=1	27	7	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References

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Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

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Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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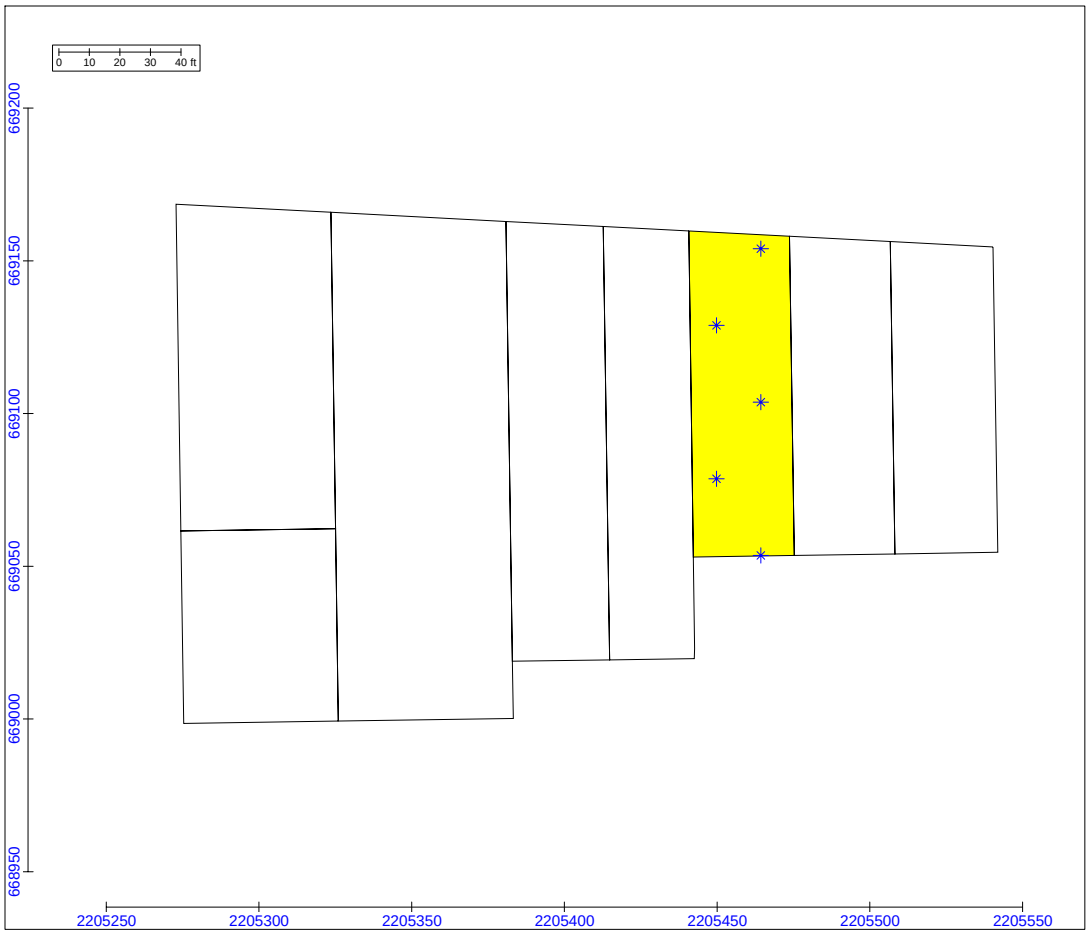
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	5
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	3484.48 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$5.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-016)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205464.3139	669053.5585	P41 (118-27-016)-1		Hotspot	
2205449.8236	669078.6565	P41 (118-27-016)-2		Hotspot	
2205464.3139	669103.7546	P41 (118-27-016)-3		Hotspot	
2205449.8236	669128.8526	P41 (118-27-016)-4		Hotspot	
2205464.3139	669153.9507	P41 (118-27-016)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

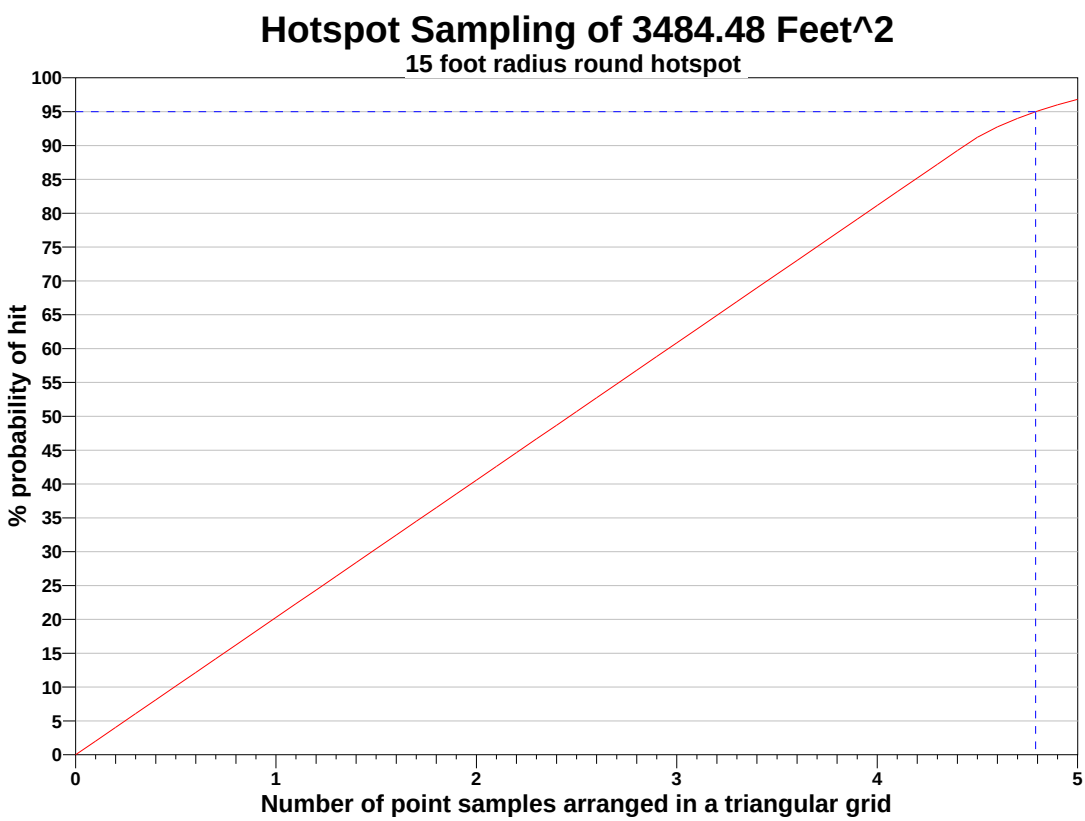
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3484.48 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	4.79059
Cost	Total cost of sampling	$5.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	24	6	3
	Shp=0.9	21	6	3
	Shp=1	18	5	2
1-β=95	**Shp=0.8**	26	7	3
	Shp=0.9	22	6	3
	Shp=1	20	5	3
1-β=100	**Shp=0.8**	31	8	4
	Shp=0.9	27	7	3
	Shp=1	24	6	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $5.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**5 Samples**
Field collection costs		$1.00	$5.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$5.00**
Fixed planning and validation costs			$0.00
Total cost			**$5.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The

data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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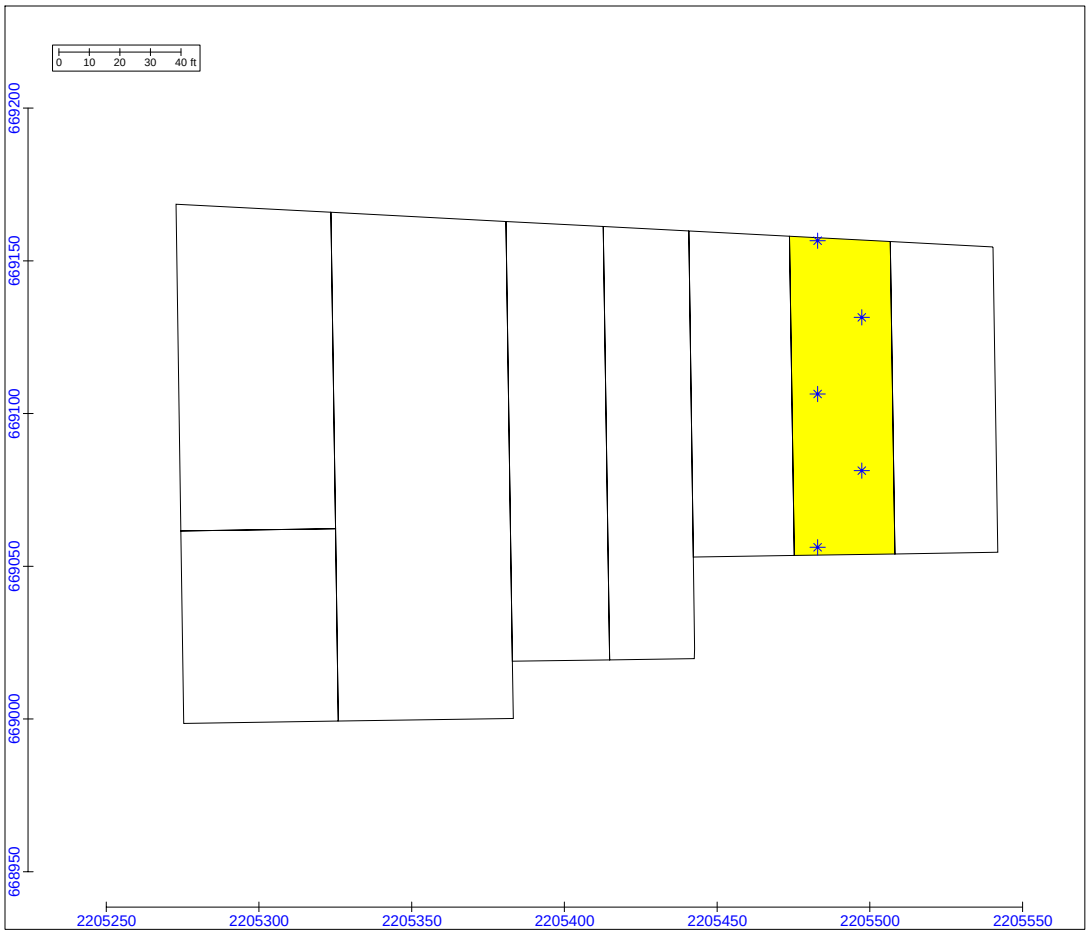
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	5
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	3408.27 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$5.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-017)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205482.8980	669056.2089	P41 (118-27-017)-1		Hotspot	
2205497.3884	669081.3069	P41 (118-27-017)-2		Hotspot	
2205482.8980	669106.4049	P41 (118-27-017)-3		Hotspot	
2205497.3884	669131.5030	P41 (118-27-017)-4		Hotspot	
2205482.8980	669156.6010	P41 (118-27-017)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

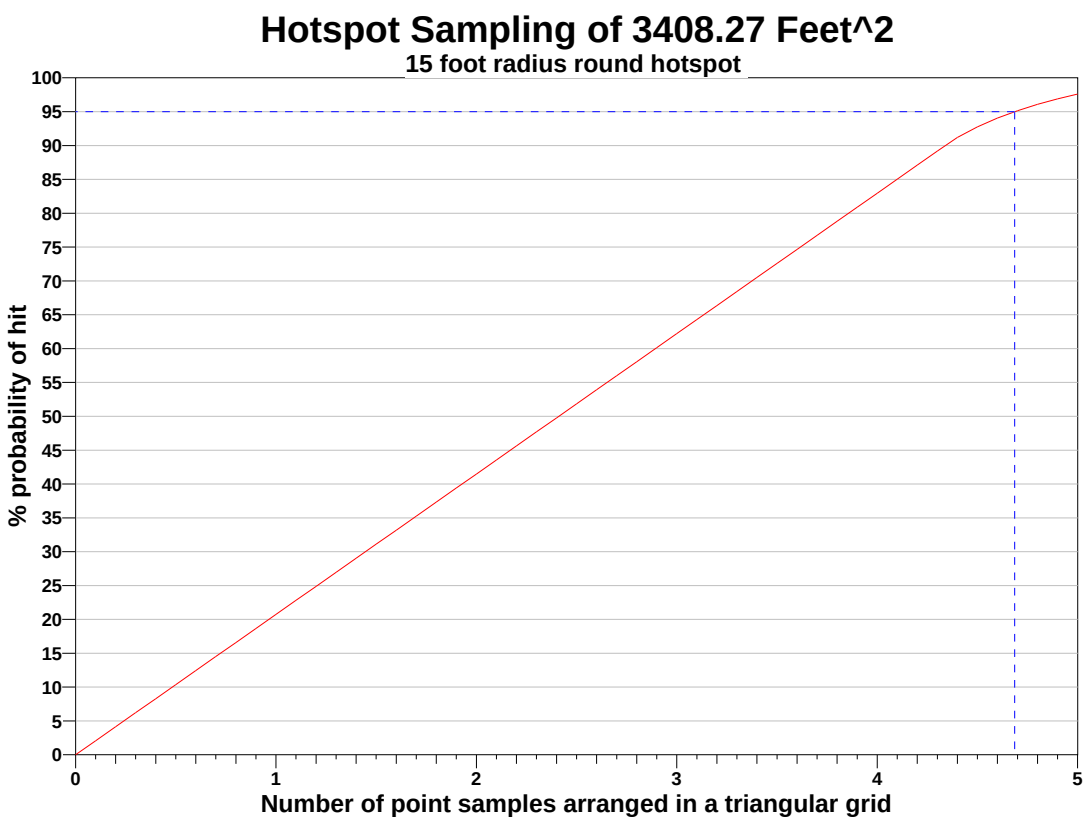
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3408.27 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	4.68582
Cost	Total cost of sampling	$5.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	23	6	3
	Shp=0.9	20	5	3
	Shp=1	18	5	2
1-β=95	**Shp=0.8**	25	7	3
	Shp=0.9	22	6	3
	Shp=1	19	5	3
1-β=100	**Shp=0.8**	31	8	4
	Shp=0.9	27	7	3
	Shp=1	24	6	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $5.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**5 Samples**
Field collection costs		$1.00	$5.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$5.00**
Fixed planning and validation costs			$0.00
Total cost			**$5.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The

data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References

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Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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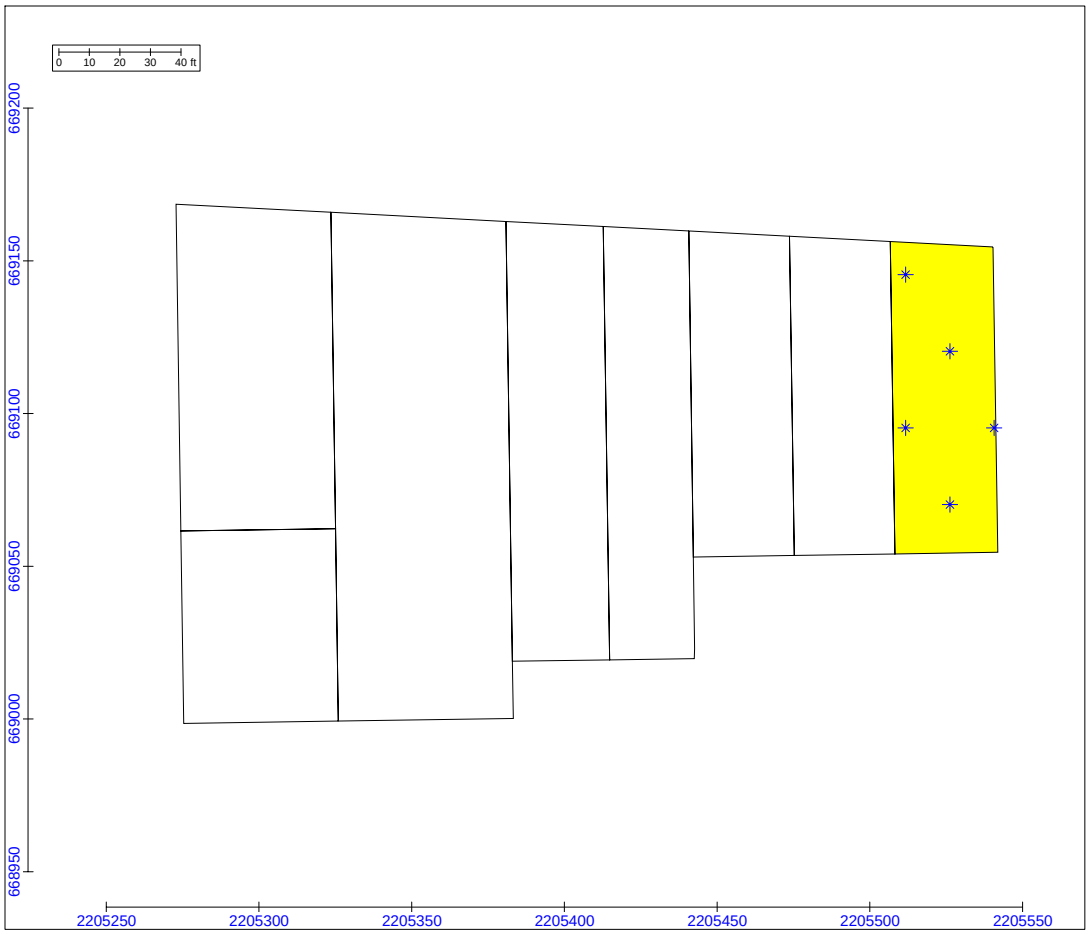
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	5
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	3405.86 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$5.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P41 (118-27-018)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205526.2270	669070.1816	P41 (118-27-018)-1		Hotspot	
2205511.7366	669095.2796	P41 (118-27-018)-2		Hotspot	
2205540.7173	669095.2796	P41 (118-27-018)-3		Hotspot	
2205526.2270	669120.3777	P41 (118-27-018)-4		Hotspot	
2205511.7366	669145.4757	P41 (118-27-018)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

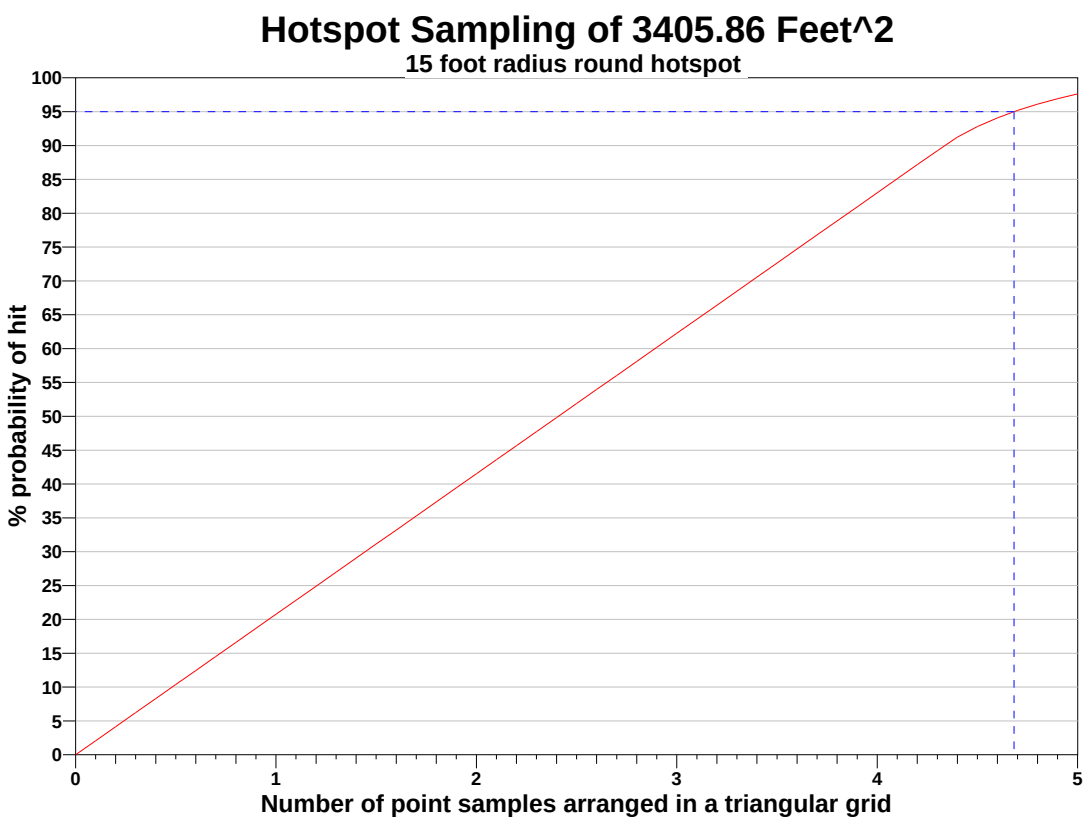
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3405.86 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	4.6825
Cost	Total cost of sampling	$5.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



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1. The shape of the hot spot of concern is circular or elliptical.
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Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	23	6	3
	Shp=0.9	20	5	3
	Shp=1	18	5	2
1-β=95	**Shp=0.8**	25	7	3
	Shp=0.9	22	6	3
	Shp=1	19	5	3
1-β=100	**Shp=0.8**	31	8	4
	Shp=0.9	27	7	3
	Shp=1	24	6	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $5.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**5 Samples**
Field collection costs		$1.00	$5.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$5.00**
Fixed planning and validation costs			$0.00
Total cost			**$5.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The

data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References

EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

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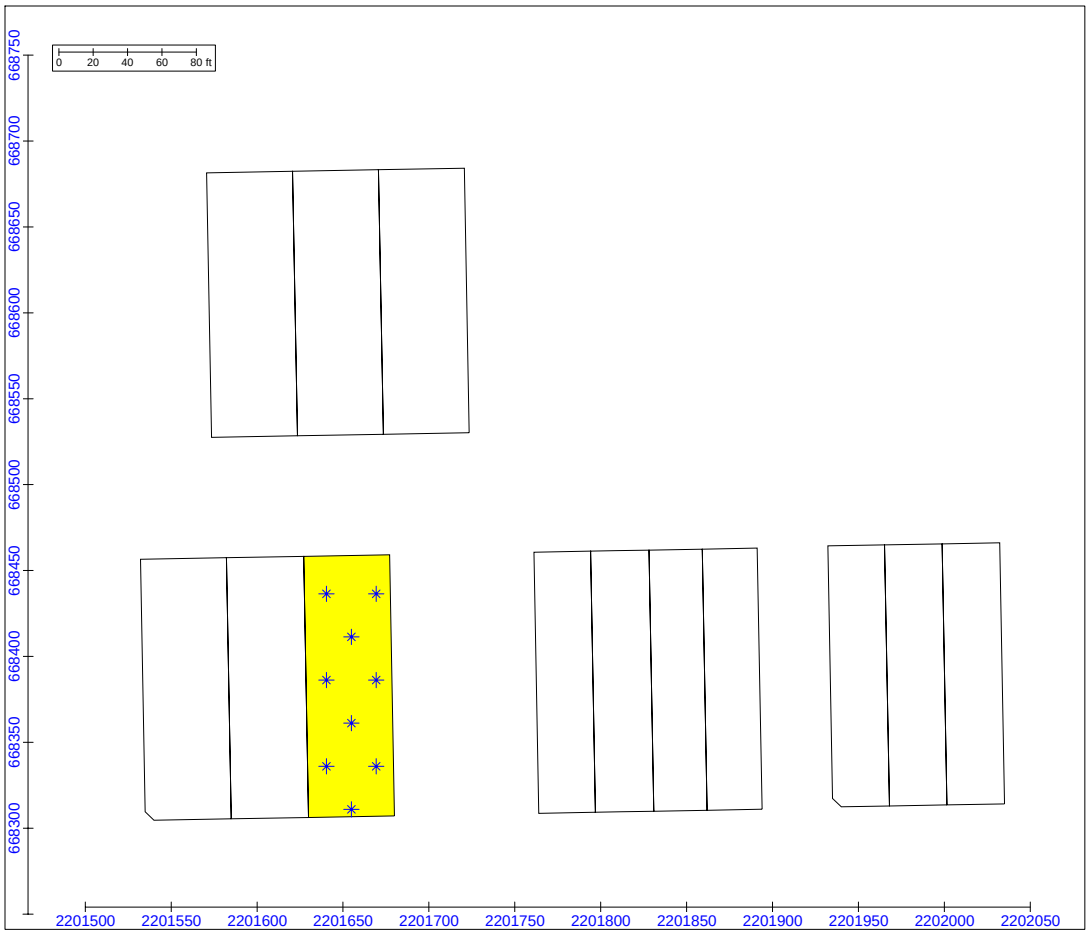
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	11
Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	7600.12 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$11.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-18-053)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201654.8762	668310.9694	P42 (118-18-053)-1		Hotspot	
2201640.3858	668336.0675	P42 (118-18-053)-2		Hotspot	
2201669.3666	668336.0675	P42 (118-18-053)-3		Hotspot	
2201654.8762	668361.1655	P42 (118-18-053)-4		Hotspot	
2201640.3858	668386.2635	P42 (118-18-053)-5		Hotspot	
2201669.3666	668386.2635	P42 (118-18-053)-6		Hotspot	
2201654.8762	668411.3616	P42 (118-18-053)-7		Hotspot	
2201640.3858	668436.4596	P42 (118-18-053)-8		Hotspot	
2201669.3666	668436.4596	P42 (118-18-053)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and

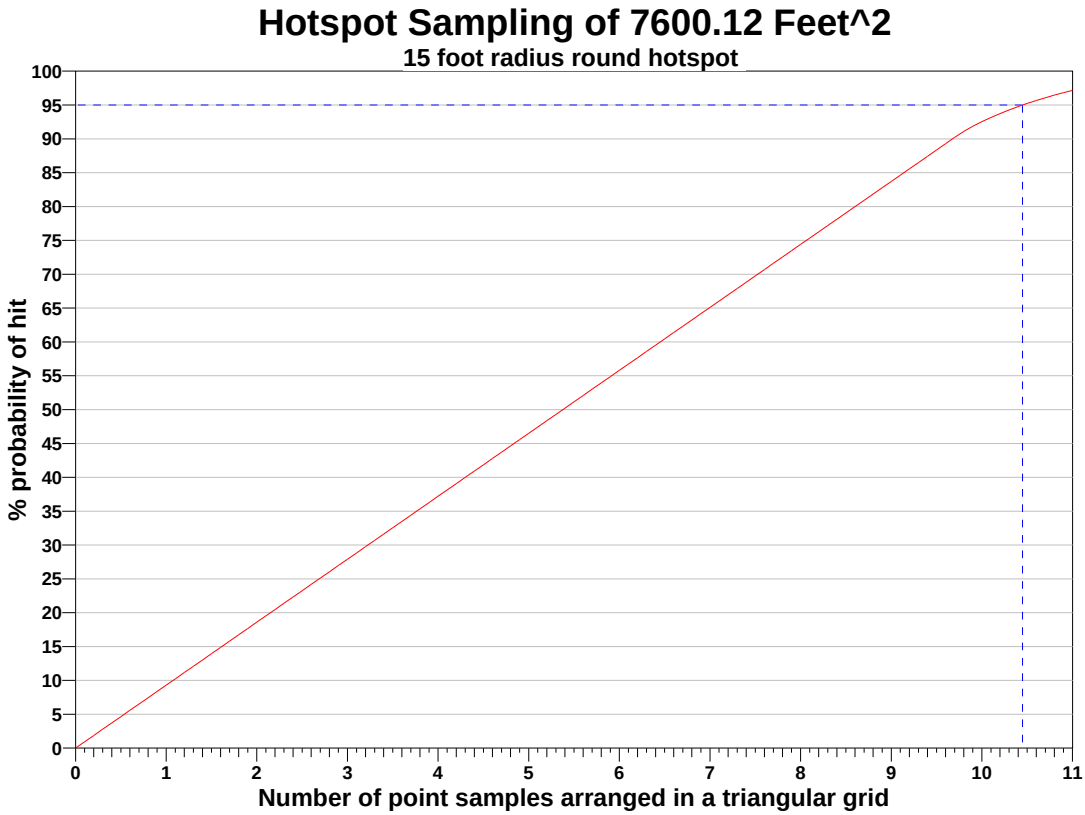
Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	7600.12 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	10.4489
Cost	Total cost of sampling	$11.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	51	13	6
	Shp=0.9	44	11	5
	Shp=1	39	10	5
1-β=95	**Shp=0.8**	56	14	7
	Shp=0.9	48	12	6
	Shp=1	42	11	5

1-β=100	**Shp=0.8**	68	17	8
	Shp=0.9	59	15	7
	Shp=1	52	13	6

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $11.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**11 Samples**
Field collection costs		$1.00	$11.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$11.00**
Fixed planning and validation costs			$0.00
Total cost			**$11.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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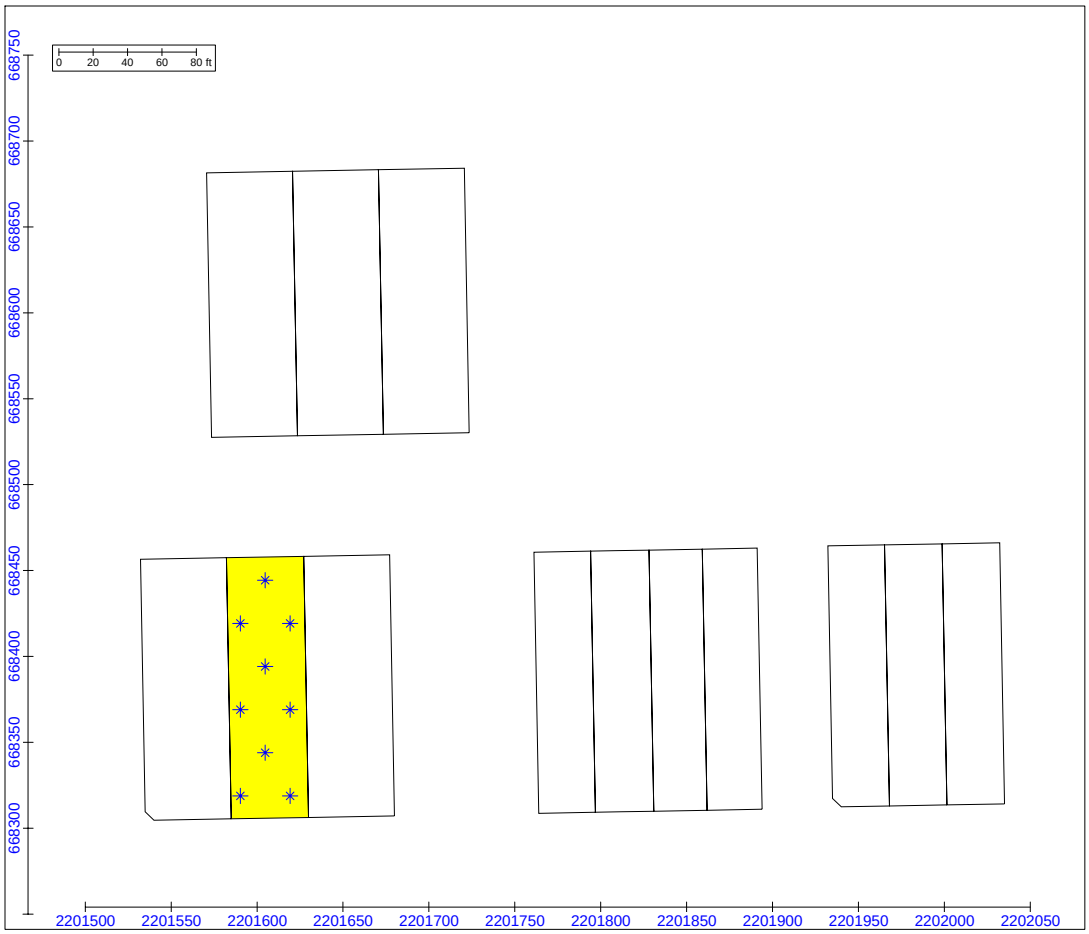
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	10
Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	6840.09 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$10.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-18-054)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201590.2440	668318.8317	P42 (118-18-054)-1		Hotspot	
2201619.2247	668318.8317	P42 (118-18-054)-2		Hotspot	
2201604.7343	668343.9297	P42 (118-18-054)-3		Hotspot	
2201590.2440	668369.0278	P42 (118-18-054)-4		Hotspot	
2201619.2247	668369.0278	P42 (118-18-054)-5		Hotspot	
2201604.7343	668394.1258	P42 (118-18-054)-6		Hotspot	
2201590.2440	668419.2238	P42 (118-18-054)-7		Hotspot	
2201619.2247	668419.2238	P42 (118-18-054)-8		Hotspot	
2201604.7343	668444.3219	P42 (118-18-054)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and

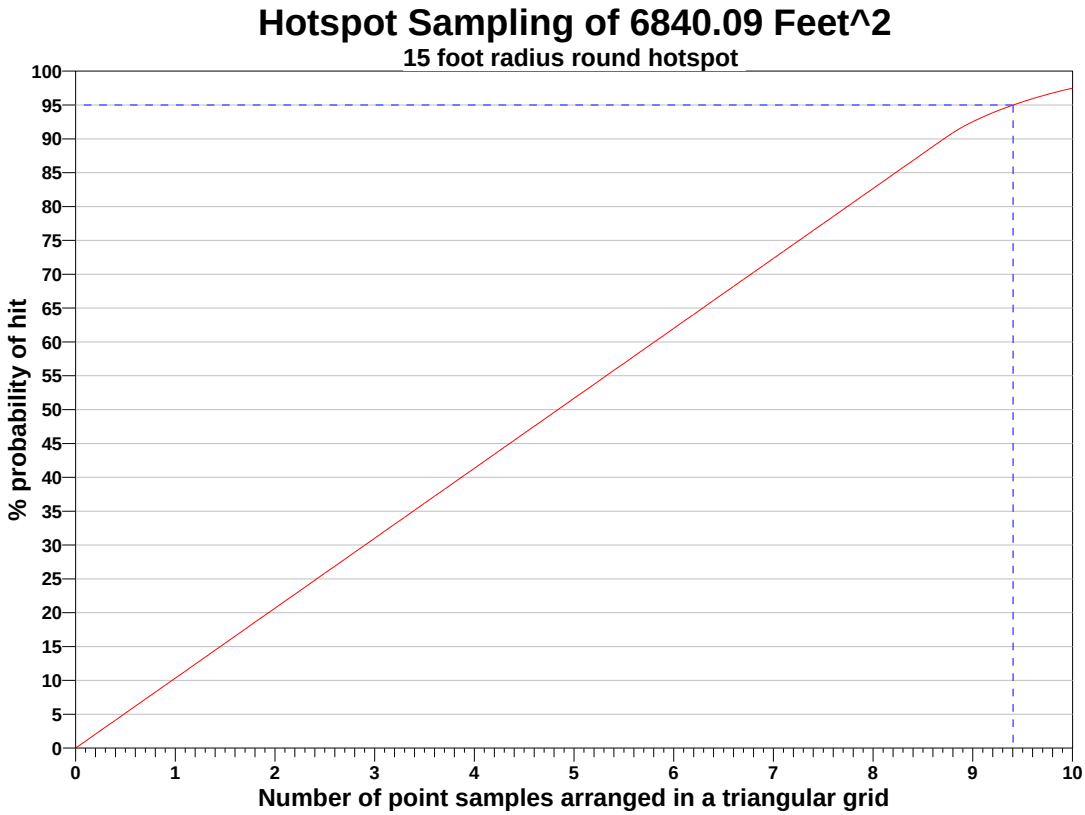
Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	6840.09 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	9.40401
Cost	Total cost of sampling	$10.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	46	12	6
	Shp=0.9	40	10	5
	Shp=1	35	9	4
1-β=95	**Shp=0.8**	50	13	6
	Shp=0.9	43	11	5
	Shp=1	38	10	5

1-β=100	**Shp=0.8**	61	16	7
	Shp=0.9	53	14	6
	Shp=1	47	12	6

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $10.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**10 Samples**
Field collection costs		$1.00	$10.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$10.00**
Fixed planning and validation costs			$0.00
Total cost			**$10.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
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Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

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Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	11
Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	7587.56 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$11.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.

Area: P42 (118-18-055)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201542.9376	668322.0157	P42 (118-18-055)-1		Hotspot	
2201571.9183	668322.0157	P42 (118-18-055)-2		Hotspot	
2201557.4280	668347.1137	P42 (118-18-055)-3		Hotspot	
2201542.9376	668372.2117	P42 (118-18-055)-4		Hotspot	
2201571.9183	668372.2117	P42 (118-18-055)-5		Hotspot	
2201557.4280	668397.3098	P42 (118-18-055)-6		Hotspot	
2201542.9376	668422.4078	P42 (118-18-055)-7		Hotspot	
2201571.9183	668422.4078	P42 (118-18-055)-8		Hotspot	
2201557.4280	668447.5058	P42 (118-18-055)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and

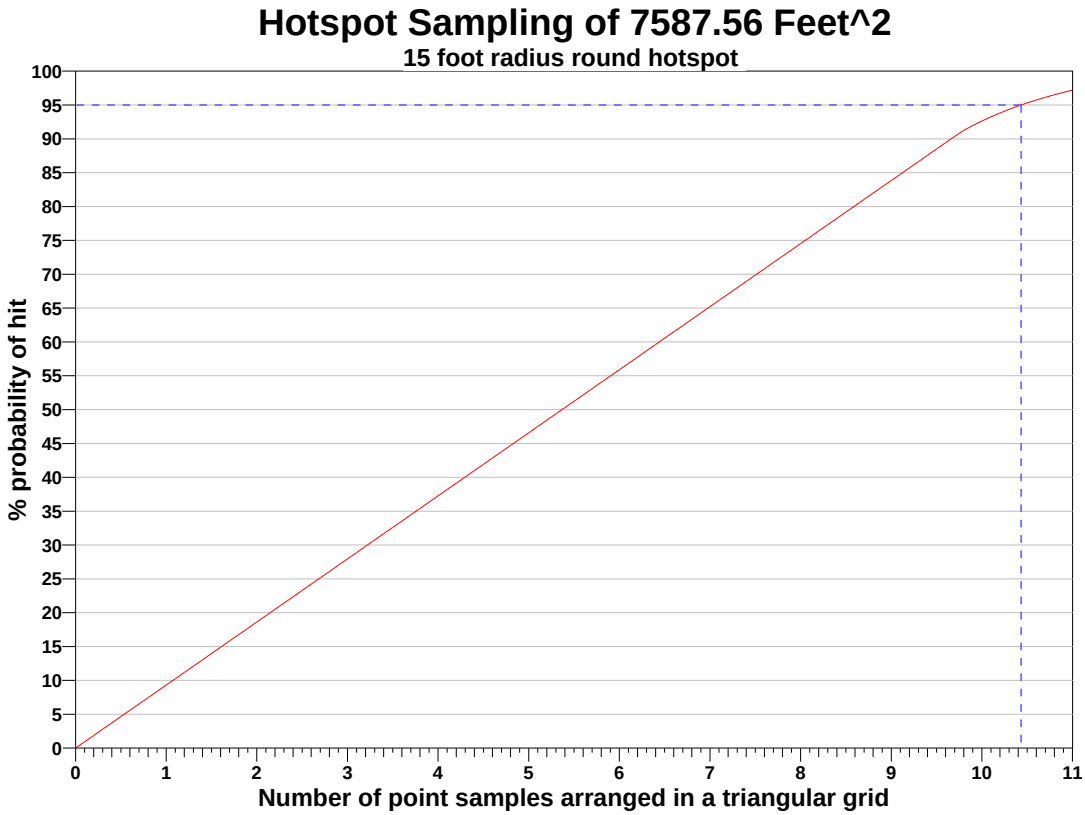
Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	7587.56 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	10.4317
Cost	Total cost of sampling	$11.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	51	13	6
	Shp=0.9	44	11	5
	Shp=1	39	10	5
1-β=95	**Shp=0.8**	56	14	7
	Shp=0.9	48	12	6
	Shp=1	42	11	5

1-β=100	**Shp=0.8**	68	17	8
	Shp=0.9	59	15	7
	Shp=1	52	13	6

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $11.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**11 Samples**
Field collection costs		$1.00	$11.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$11.00**
Fixed planning and validation costs			$0.00
Total cost			**$11.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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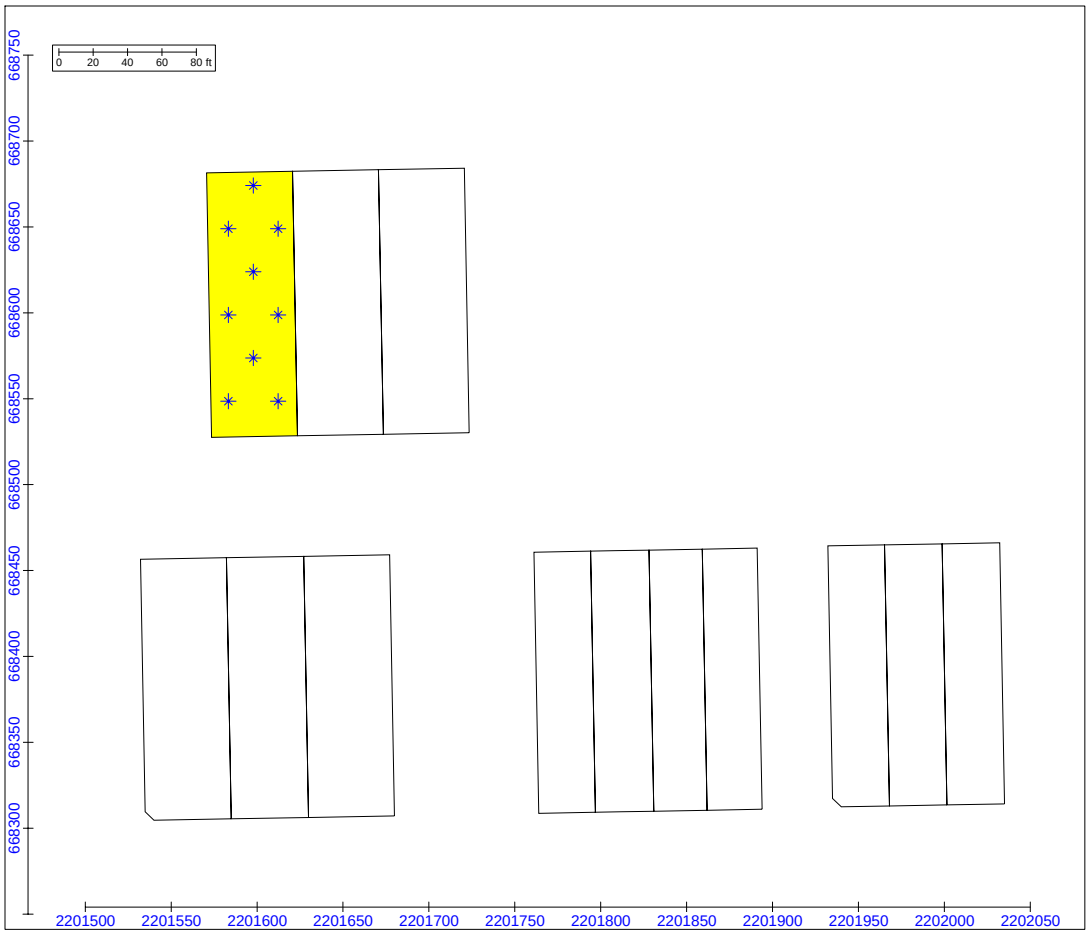
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	11
Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	7700.15 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$11.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-18-076)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201583.2938	668548.5745	P42 (118-18-076)-1		Hotspot	
2201612.2745	668548.5745	P42 (118-18-076)-2		Hotspot	
2201597.7842	668573.6725	P42 (118-18-076)-3		Hotspot	
2201583.2938	668598.7706	P42 (118-18-076)-4		Hotspot	
2201612.2745	668598.7706	P42 (118-18-076)-5		Hotspot	
2201597.7842	668623.8686	P42 (118-18-076)-6		Hotspot	
2201583.2938	668648.9667	P42 (118-18-076)-7		Hotspot	
2201612.2745	668648.9667	P42 (118-18-076)-8		Hotspot	
2201597.7842	668674.0647	P42 (118-18-076)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and

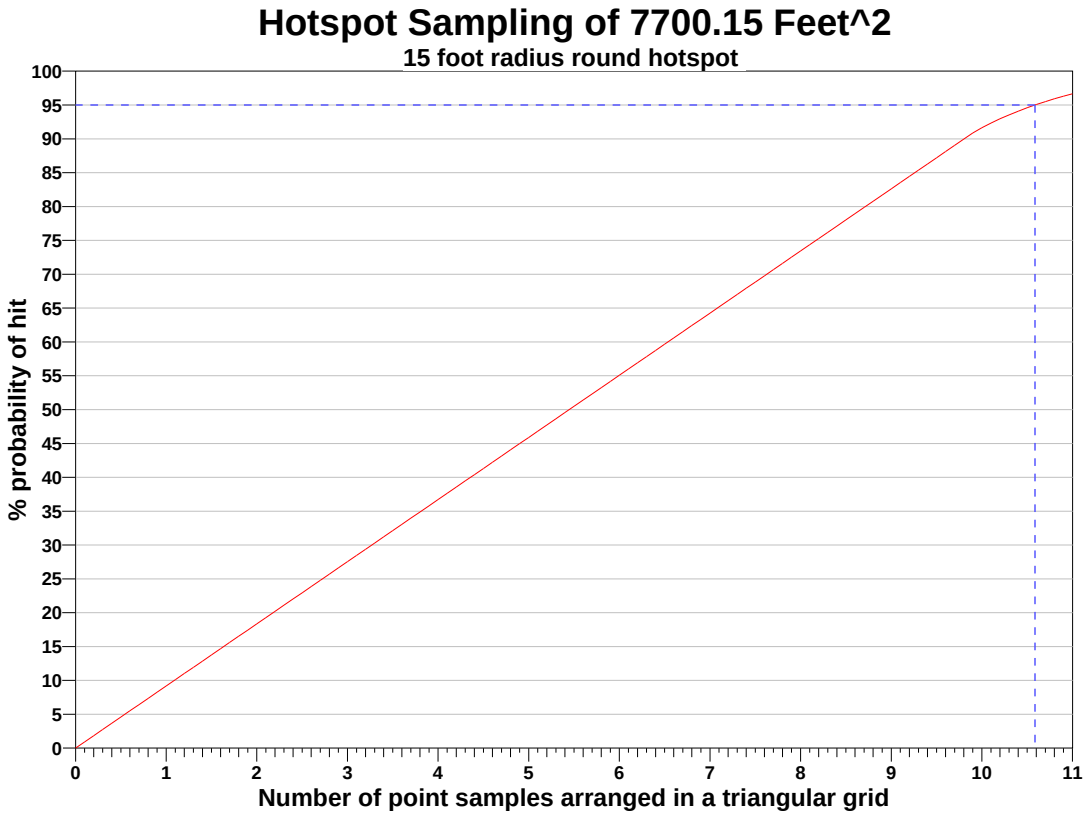
Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	7700.15 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	10.5864
Cost	Total cost of sampling	$11.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	52	13	6
	Shp=0.9	45	12	5
	Shp=1	40	10	5
1-β=95	**Shp=0.8**	57	15	7
	Shp=0.9	49	13	6
	Shp=1	43	11	5

1-β=100	**Shp=0.8**	69	18	8
	Shp=0.9	59	15	7
	Shp=1	53	14	6

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $11.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**11 Samples**
Field collection costs		$1.00	$11.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$11.00**
Fixed planning and validation costs			$0.00
Total cost			**$11.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	11
Type of samples	Point Samples
Number of samples on map [a]	10
Number of selected sample areas [b]	1
Specified sampling area [c]	7700.17 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$11.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
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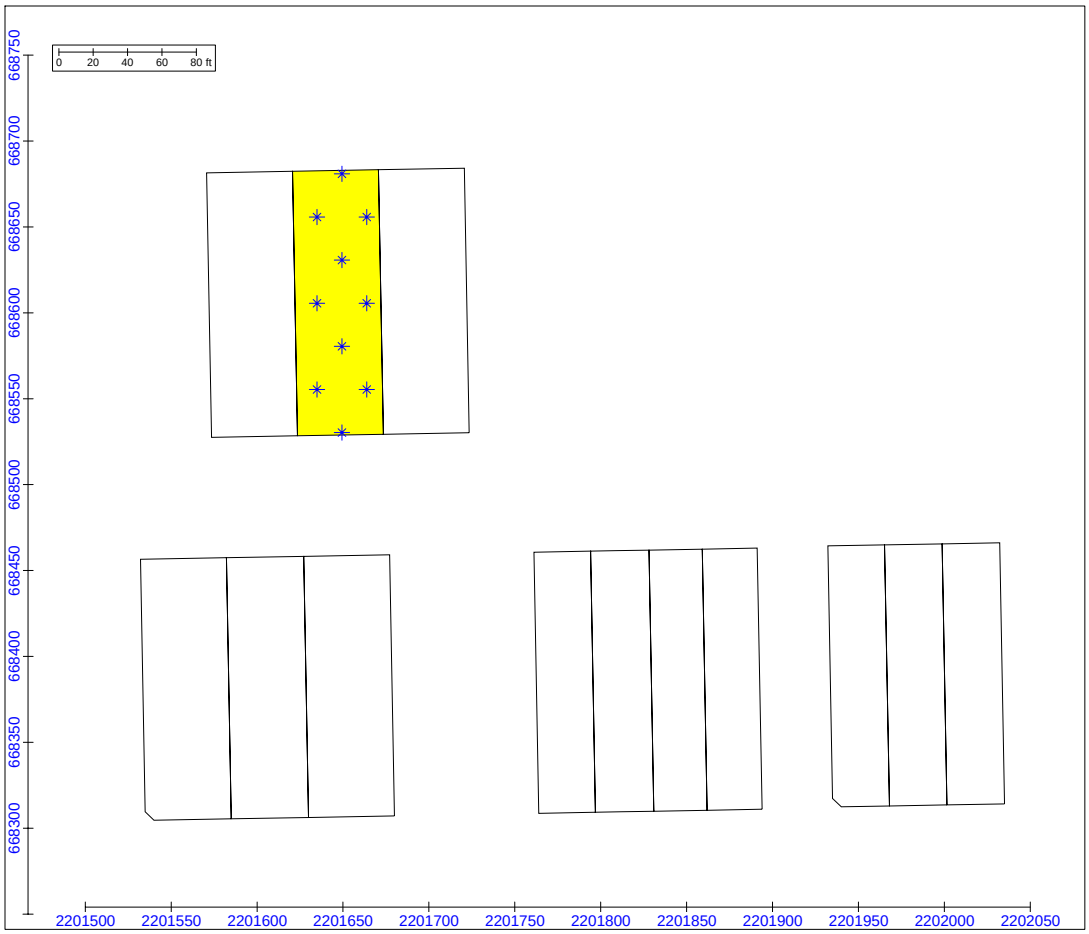

Area: P42 (118-18-077)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201649.3544	668530.2856	P42 (118-18-077)-1		Hotspot	
2201634.8641	668555.3837	P42 (118-18-077)-2		Hotspot	
2201663.8448	668555.3837	P42 (118-18-077)-3		Hotspot	
2201649.3544	668580.4817	P42 (118-18-077)-4		Hotspot	
2201634.8641	668605.5797	P42 (118-18-077)-5		Hotspot	
2201663.8448	668605.5797	P42 (118-18-077)-6		Hotspot	
2201649.3544	668630.6778	P42 (118-18-077)-7		Hotspot	
2201634.8641	668655.7758	P42 (118-18-077)-8		Hotspot	
2201663.8448	668655.7758	P42 (118-18-077)-9		Hotspot	
2201649.3544	668680.8738	P42 (118-18-077)-10		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and

Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	7700.17 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	10.5865
Cost	Total cost of sampling	$11.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
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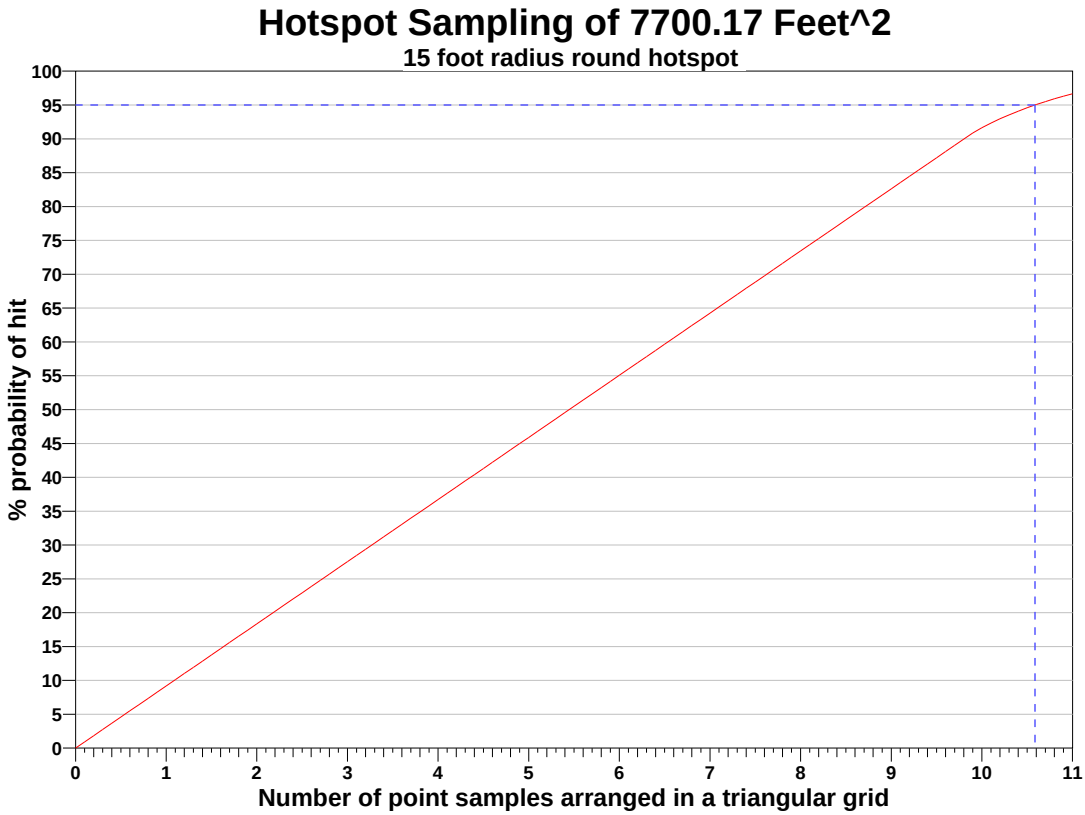

Assumptions that Underlie the VSP Locating a Hot Spot Design Method

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	Shp=0.9	49	13	6
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Cost of Sampling
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Cost Details	**Per Analysis**	**Per Sample**	**11 Samples**
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Sum of Field & Analytical costs		**$1.00**	**$11.00**
Fixed planning and validation costs			$0.00
Total cost			**$11.00**

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Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	7700.15 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$11.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
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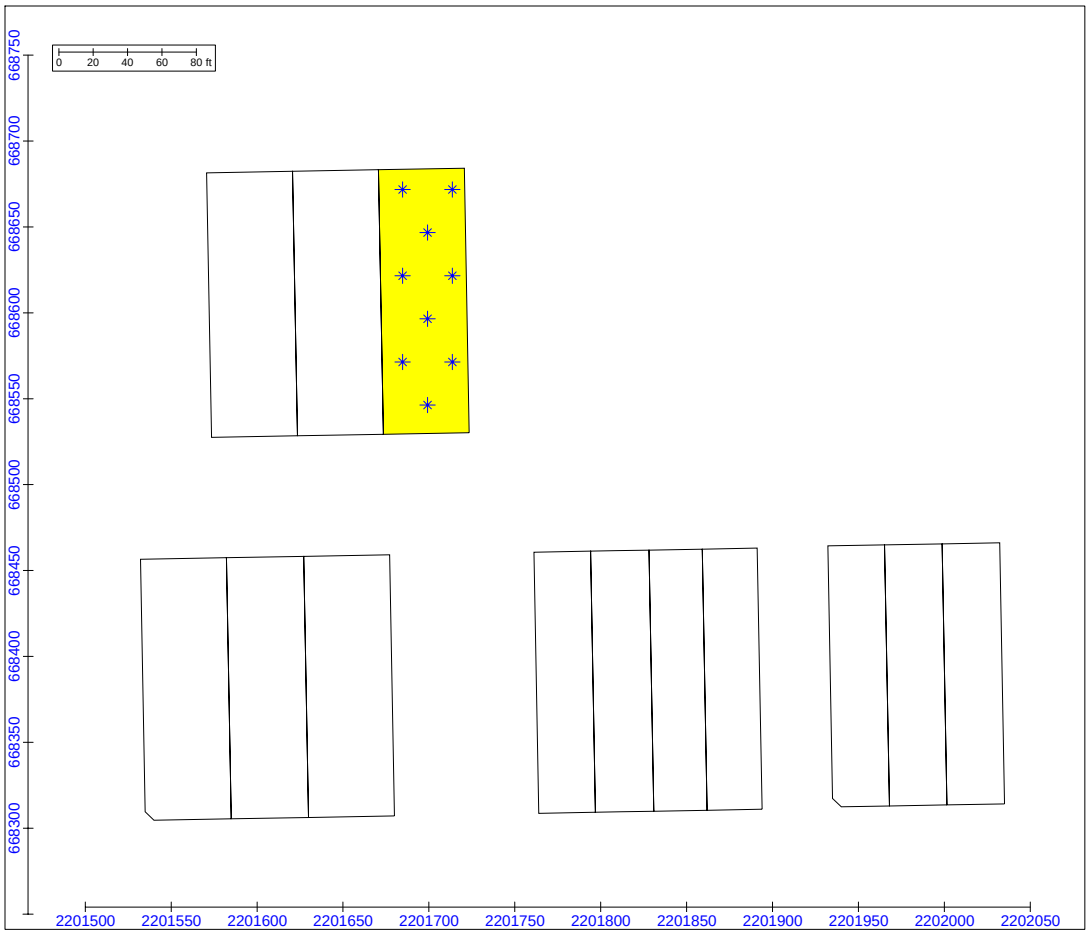

Area: P42 (118-18-078)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201699.1977	668546.3224	P42 (118-18-078)-1		Hotspot	
2201684.7073	668571.4204	P42 (118-18-078)-2		Hotspot	
2201713.6880	668571.4204	P42 (118-18-078)-3		Hotspot	
2201699.1977	668596.5184	P42 (118-18-078)-4		Hotspot	
2201684.7073	668621.6165	P42 (118-18-078)-5		Hotspot	
2201713.6880	668621.6165	P42 (118-18-078)-6		Hotspot	
2201699.1977	668646.7145	P42 (118-18-078)-7		Hotspot	
2201684.7073	668671.8125	P42 (118-18-078)-8		Hotspot	
2201713.6880	668671.8125	P42 (118-18-078)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

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The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
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Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
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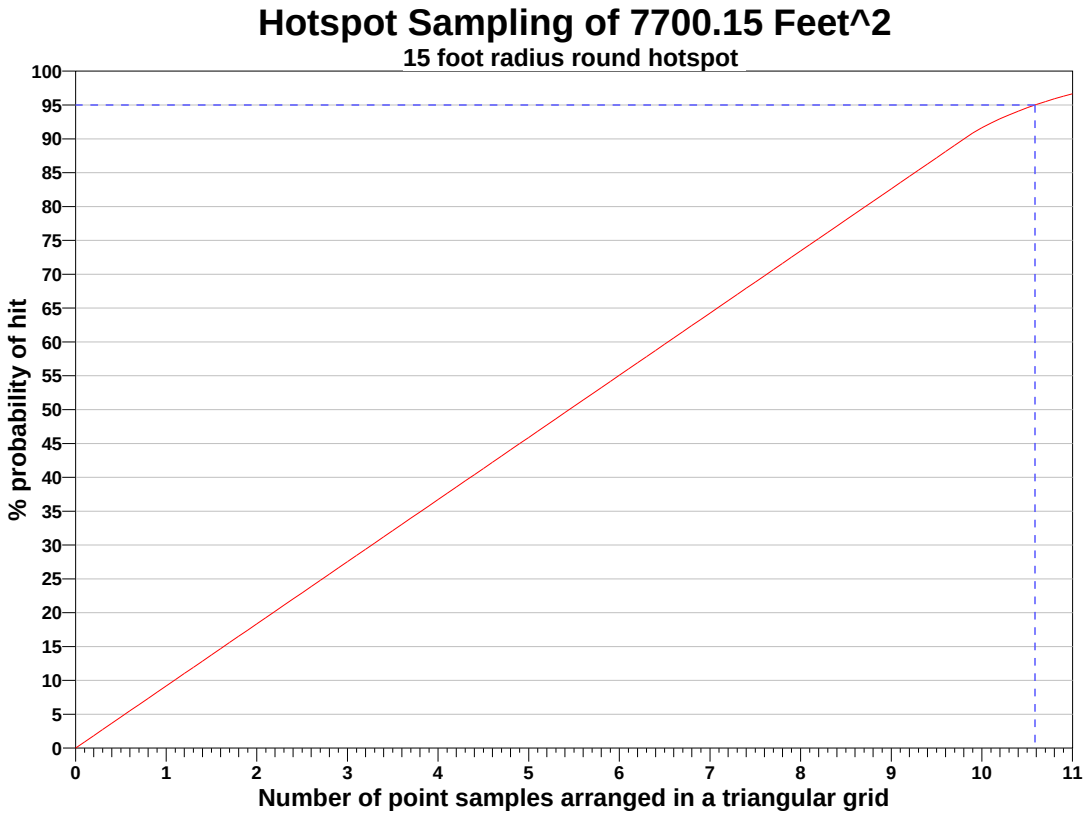
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	7700.15 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	10.5864
Cost	Total cost of sampling	$11.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	52	13	6
	Shp=0.9	45	12	5
	Shp=1	40	10	5
1-β=95	**Shp=0.8**	57	15	7
	Shp=0.9	49	13	6
	Shp=1	43	11	5

1-β=100	**Shp=0.8**	69	18	8
	Shp=0.9	59	15	7
	Shp=1	53	14	6

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $11.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**11 Samples**
Field collection costs		$1.00	$11.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$11.00**
Fixed planning and validation costs			$0.00
Total cost			**$11.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

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Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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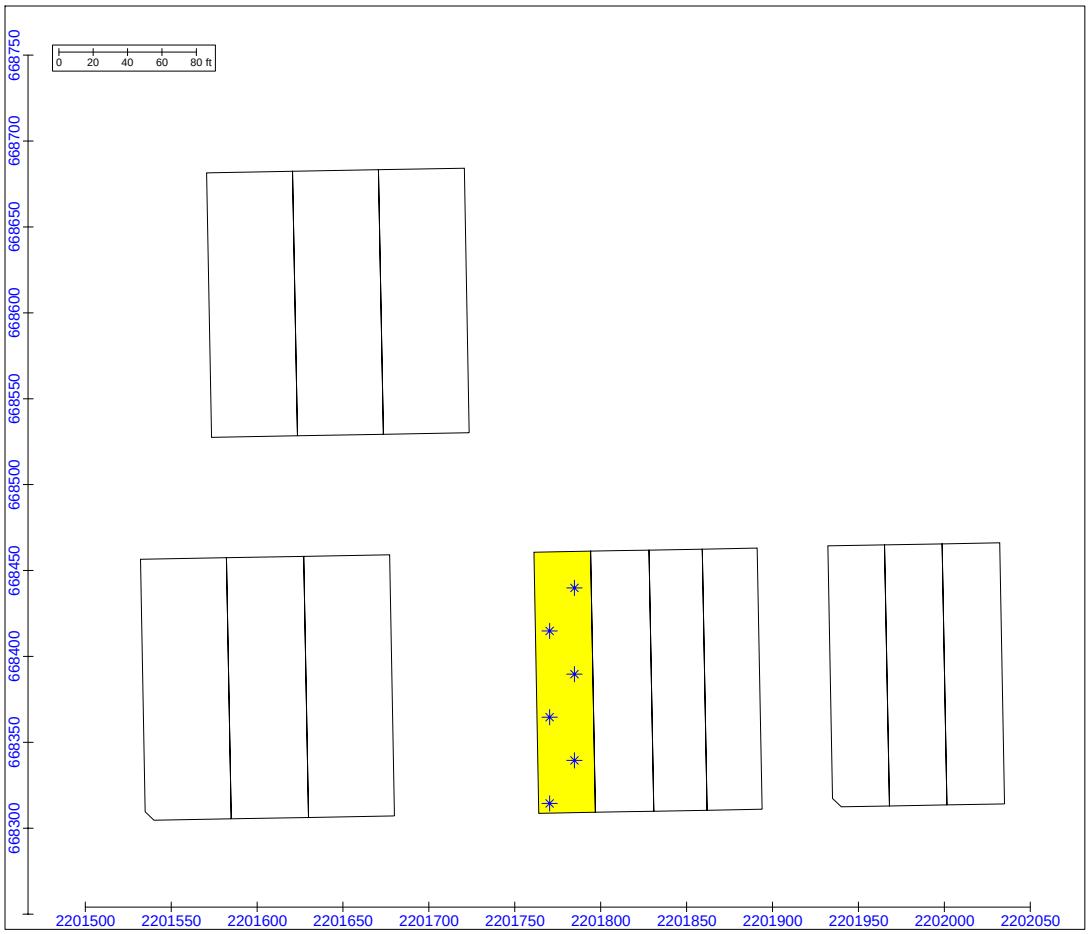
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	5016.10 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-069)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201770.2468	668314.3960	P42 (118-19-069)-1		Hotspot	
2201784.7372	668339.4940	P42 (118-19-069)-2		Hotspot	
2201770.2468	668364.5920	P42 (118-19-069)-3		Hotspot	
2201784.7372	668389.6901	P42 (118-19-069)-4		Hotspot	
2201770.2468	668414.7881	P42 (118-19-069)-5		Hotspot	
2201784.7372	668439.8861	P42 (118-19-069)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

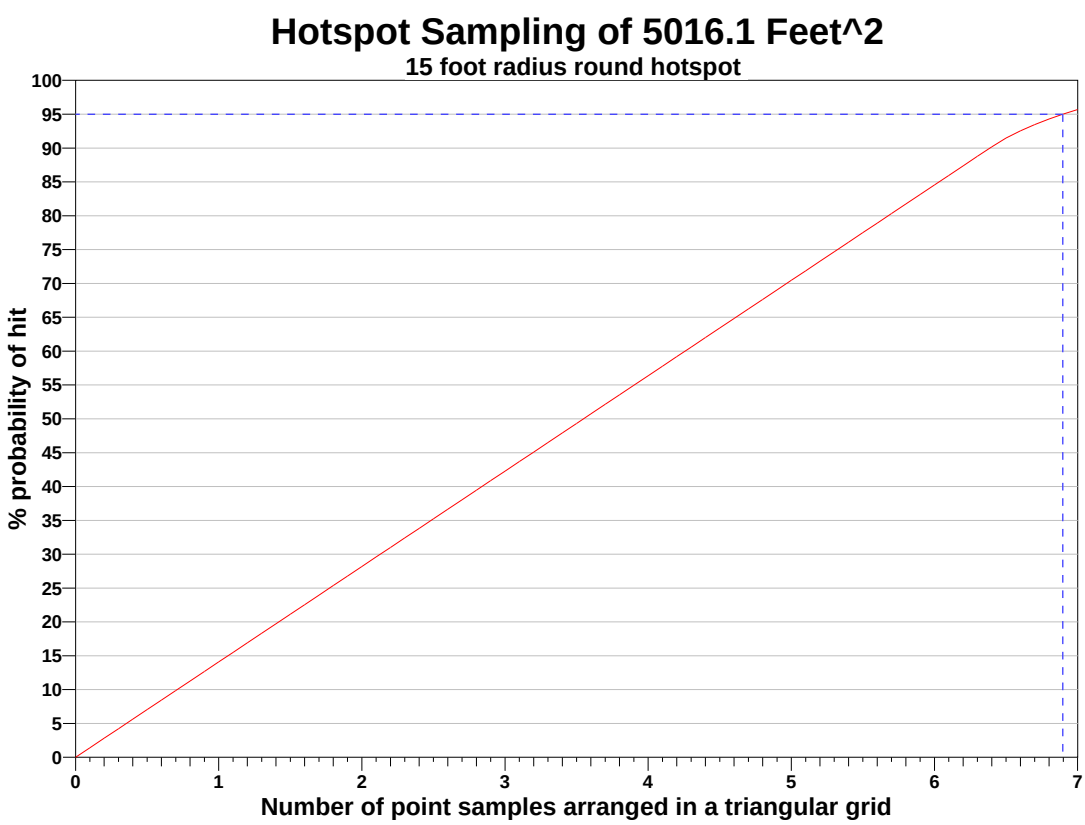
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5016.10 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.89632
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	34	9	4
	Shp=0.9	29	8	4
	Shp=1	26	7	3
1-β=95	**Shp=0.8**	37	10	5
	Shp=0.9	32	8	4
	Shp=1	28	7	4
1-β=100	**Shp=0.8**	45	12	5
	Shp=0.9	39	10	5
	Shp=1	35	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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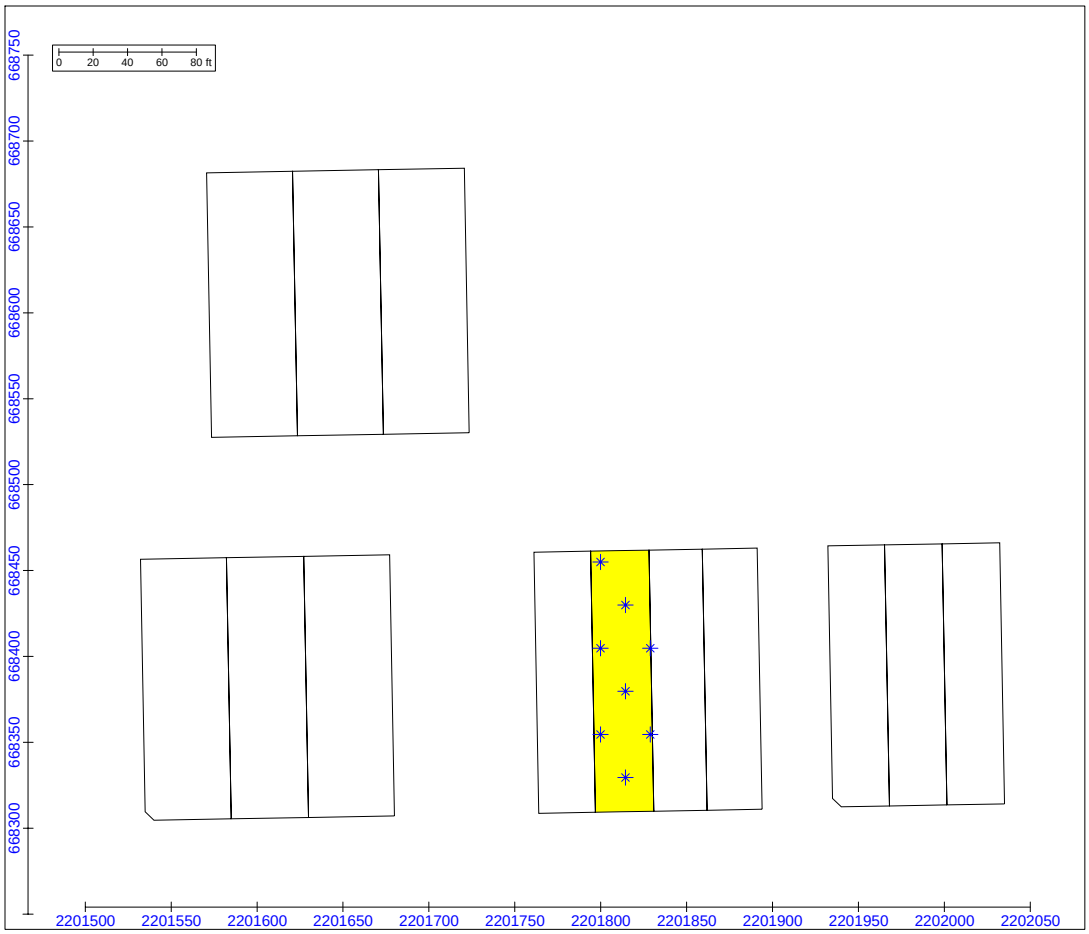
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	8
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5168.11 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$8.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-070)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201814.3942	668329.5208	P42 (118-19-070)-1		Hotspot	
2201799.9039	668354.6189	P42 (118-19-070)-2		Hotspot	
2201828.8846	668354.6189	P42 (118-19-070)-3		Hotspot	
2201814.3942	668379.7169	P42 (118-19-070)-4		Hotspot	
2201799.9039	668404.8149	P42 (118-19-070)-5		Hotspot	
2201828.8846	668404.8149	P42 (118-19-070)-6		Hotspot	
2201814.3942	668429.9130	P42 (118-19-070)-7		Hotspot	
2201799.9039	668455.0110	P42 (118-19-070)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot,

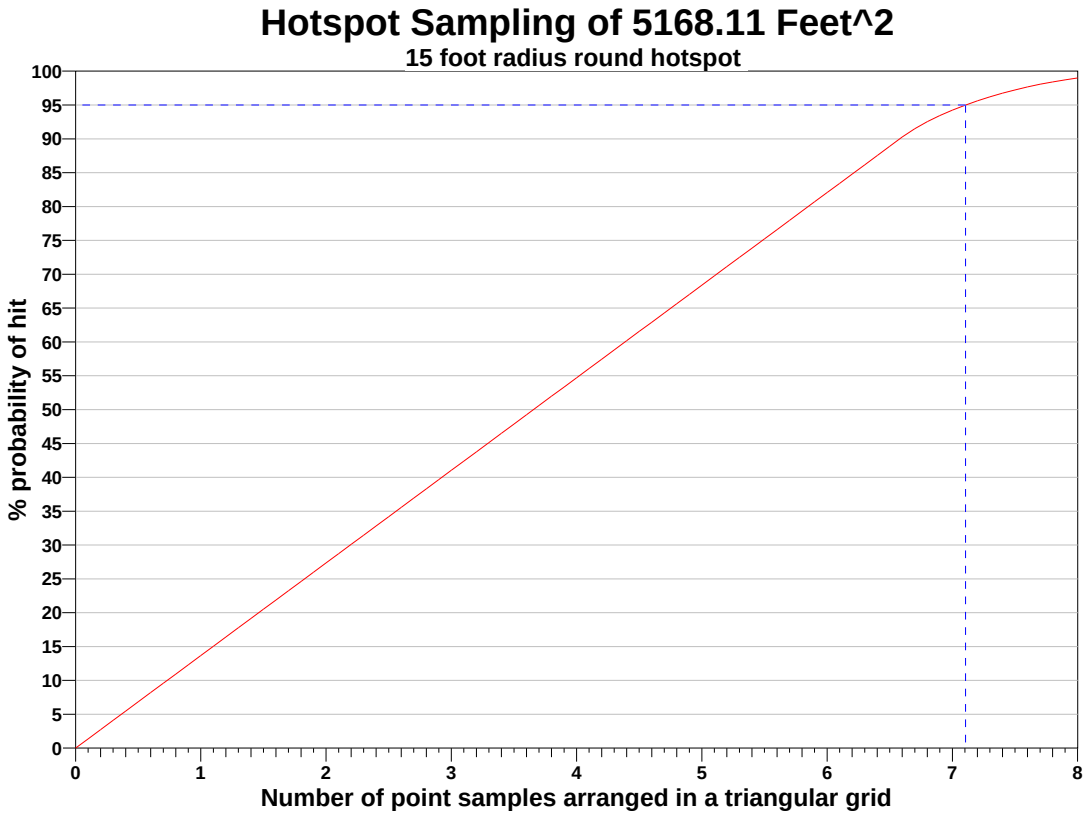
the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5168.11 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	7.10531
Cost	Total cost of sampling	$8.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
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9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	35	9	4
	Shp=0.9	30	8	4
	Shp=1	27	7	3
1-β=95	**Shp=0.8**	38	10	5
	Shp=0.9	33	9	4
	Shp=1	29	8	4

1-β=100	**Shp=0.8**	46	12	6
	Shp=0.9	40	10	5
	Shp=1	36	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $8.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**8 Samples**
Field collection costs		$1.00	$8.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$8.00**
Fixed planning and validation costs			$0.00
Total cost			**$8.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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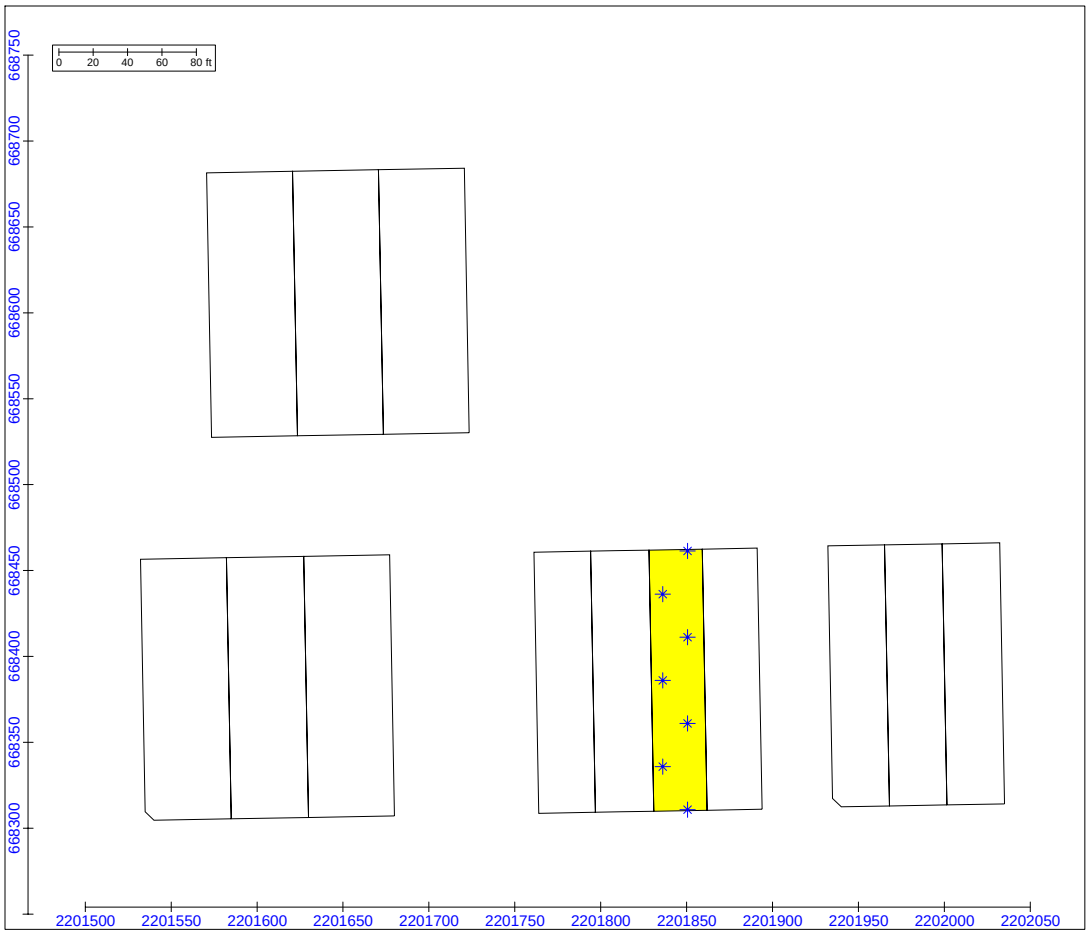
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	7
Number of selected sample areas [b]	1
Specified sampling area [c]	4712.00 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-071)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201850.5888	668310.7878	P42 (118-19-071)-1		Hotspot	
2201836.0984	668335.8858	P42 (118-19-071)-2		Hotspot	
2201850.5888	668360.9839	P42 (118-19-071)-3		Hotspot	
2201836.0984	668386.0819	P42 (118-19-071)-4		Hotspot	
2201850.5888	668411.1799	P42 (118-19-071)-5		Hotspot	
2201836.0984	668436.2780	P42 (118-19-071)-6		Hotspot	
2201850.5888	668461.3760	P42 (118-19-071)-7		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the

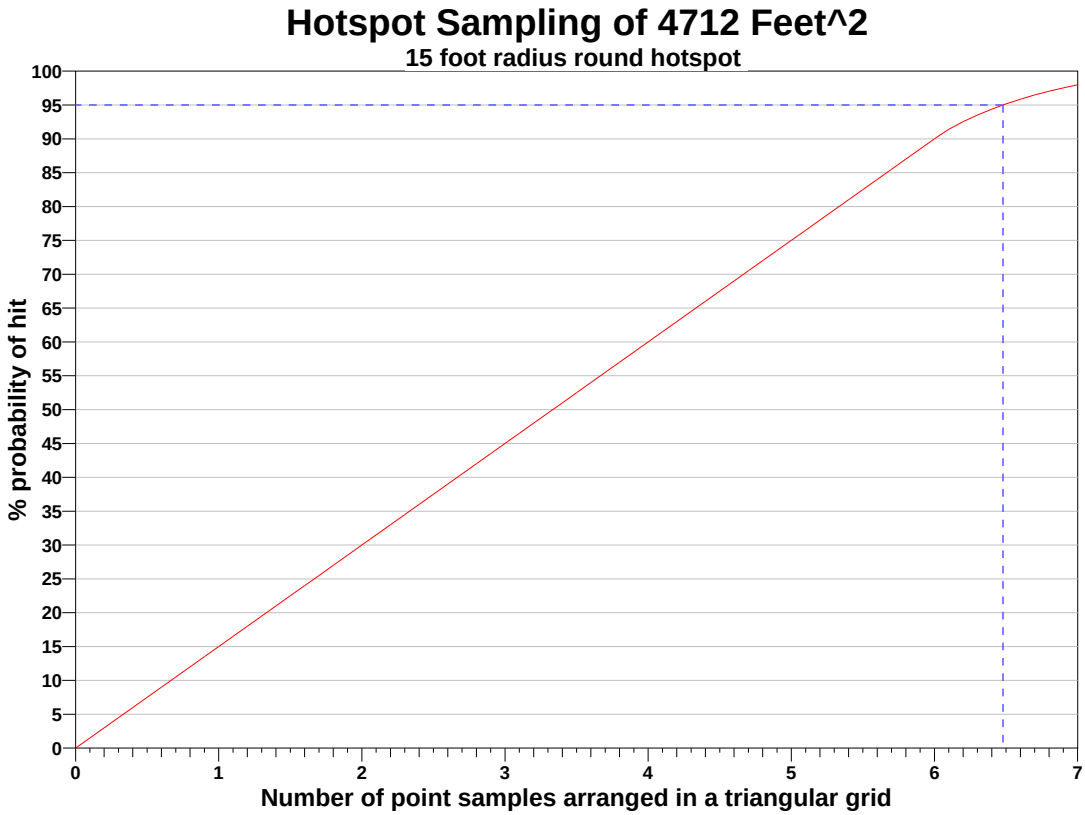
given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	4712.00 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.47824
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	32	8	4
	Shp=0.9	28	7	4
	Shp=1	24	6	3
1-β=95	**Shp=0.8**	35	9	4
	Shp=0.9	30	8	4
	Shp=1	26	7	3

1-β=100	**Shp=0.8**	42	11	5
	Shp=0.9	37	10	5
	Shp=1	33	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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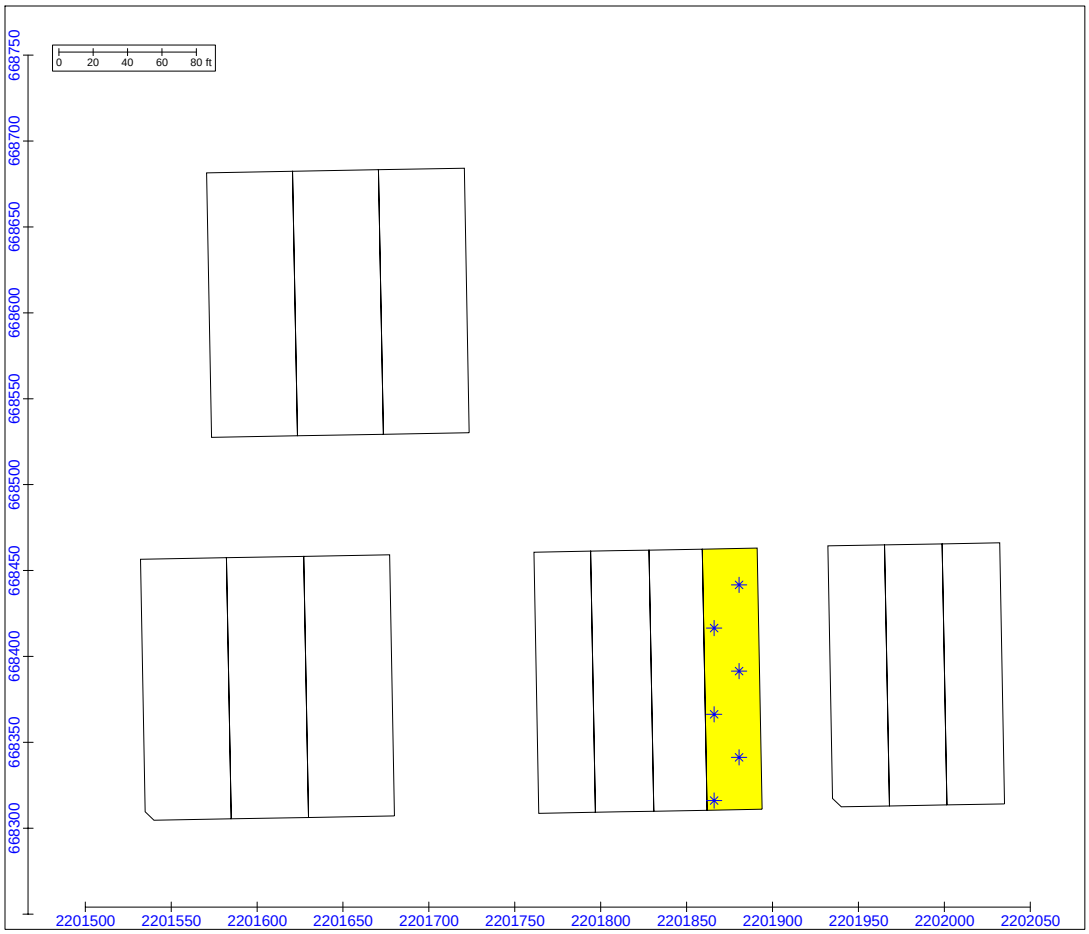
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	4864.13 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-072)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201866.0513	668316.1303	P42 (118-19-072)-1		Hotspot	
2201880.5417	668341.2284	P42 (118-19-072)-2		Hotspot	
2201866.0513	668366.3264	P42 (118-19-072)-3		Hotspot	
2201880.5417	668391.4244	P42 (118-19-072)-4		Hotspot	
2201866.0513	668416.5225	P42 (118-19-072)-5		Hotspot	
2201880.5417	668441.6205	P42 (118-19-072)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

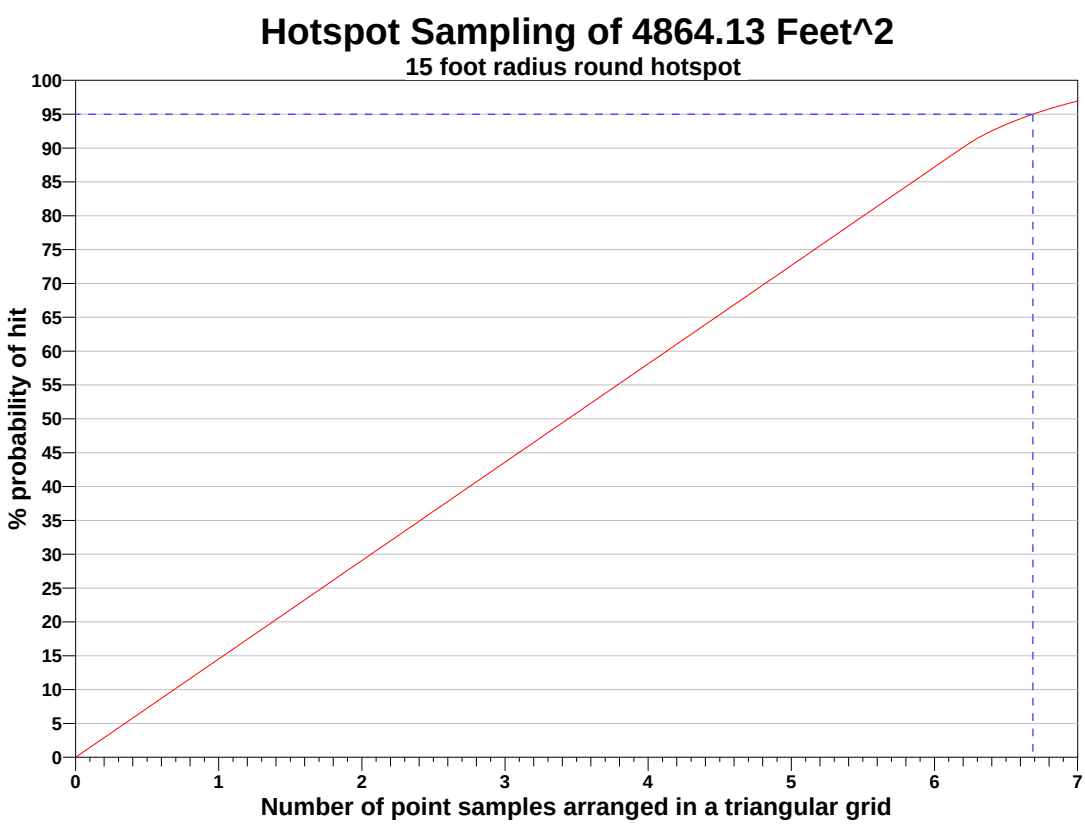
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	4864.13 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.68739
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	33	9	4
	Shp=0.9	28	7	4
	Shp=1	25	7	3
1-β=95	**Shp=0.8**	36	9	4
	Shp=0.9	31	8	4
	Shp=1	27	7	3
1-β=100	**Shp=0.8**	44	11	5
	Shp=0.9	38	10	5
	Shp=1	34	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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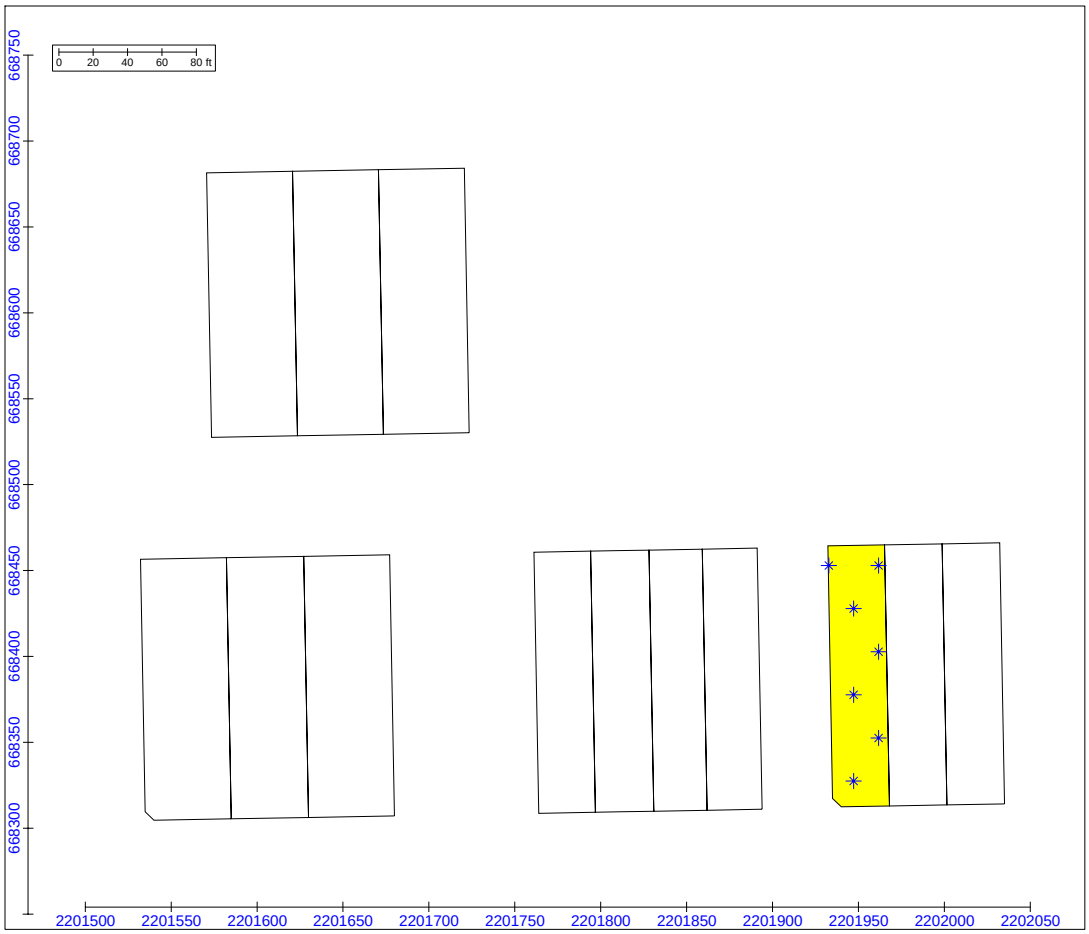
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	7
Number of selected sample areas [b]	1
Specified sampling area [c]	5003.59 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-074)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201947.2683	668327.4673	P42 (118-19-074)-1		Hotspot	
2201961.7586	668352.5653	P42 (118-19-074)-2		Hotspot	
2201947.2683	668377.6634	P42 (118-19-074)-3		Hotspot	
2201961.7586	668402.7614	P42 (118-19-074)-4		Hotspot	
2201947.2683	668427.8594	P42 (118-19-074)-5		Hotspot	
2201932.7779	668452.9575	P42 (118-19-074)-6		Hotspot	
2201961.7586	668452.9575	P42 (118-19-074)-7		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the

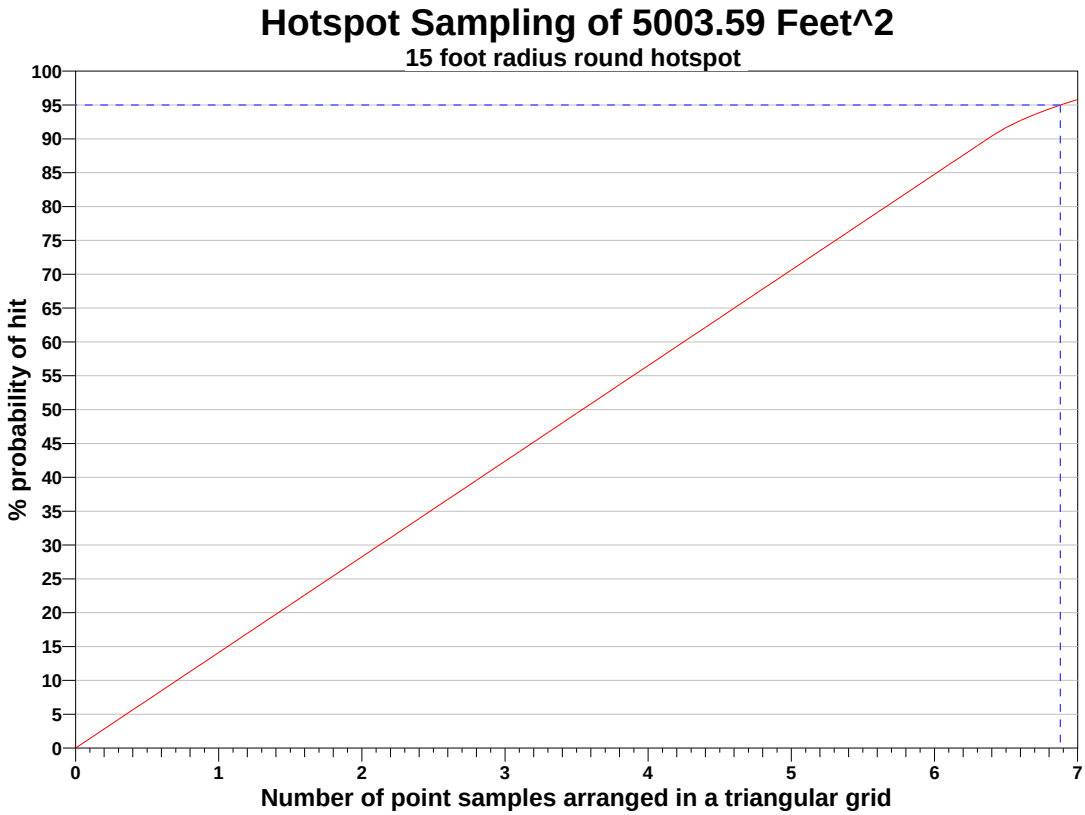
given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5003.59 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.87912
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
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Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	34	9	4
	Shp=0.9	29	8	4
	Shp=1	26	7	3
1-β=95	**Shp=0.8**	37	10	5
	Shp=0.9	32	8	4
	Shp=1	28	7	4

1-β=100	**Shp=0.8**	45	12	5
	Shp=0.9	39	10	5
	Shp=1	35	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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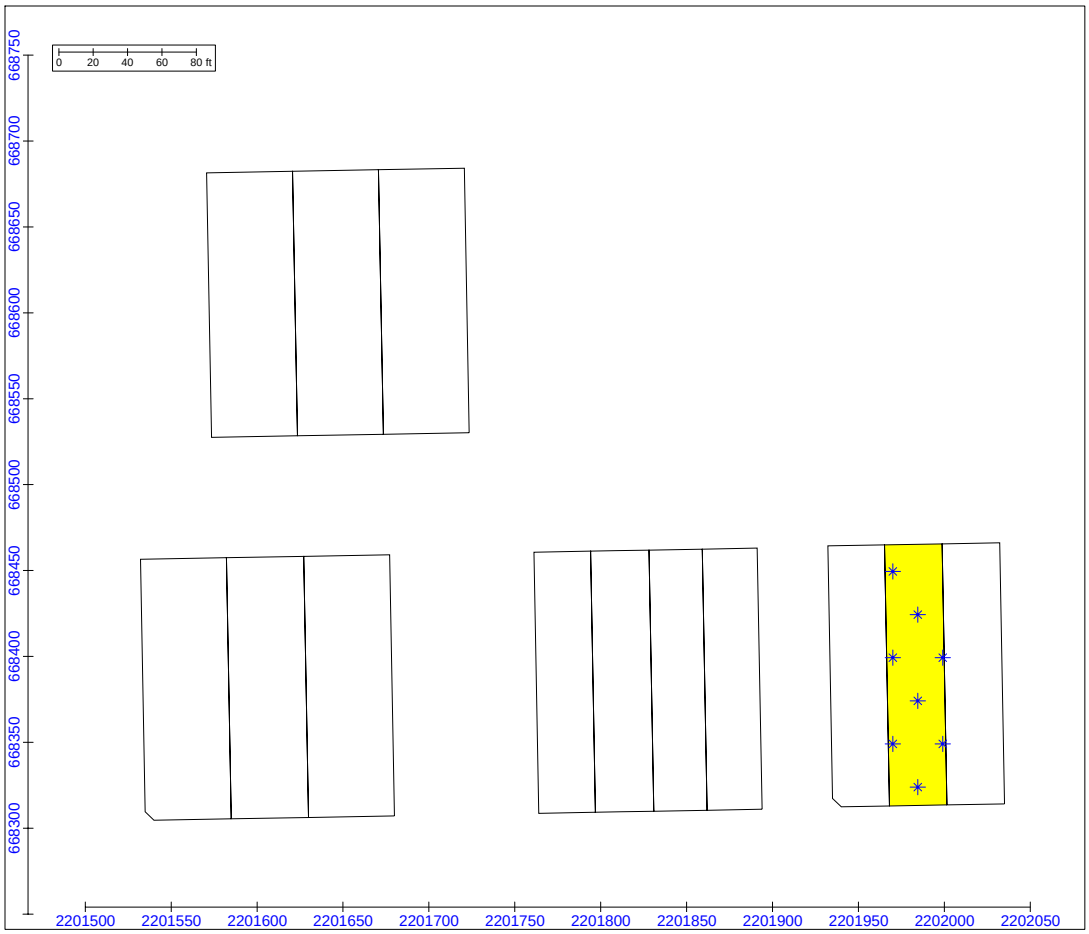
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	8
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5092.07 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$8.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-075)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2201984.5670	668323.9654	P42 (118-19-075)-1		Hotspot	
2201970.0766	668349.0634	P42 (118-19-075)-2		Hotspot	
2201999.0573	668349.0634	P42 (118-19-075)-3		Hotspot	
2201984.5670	668374.1614	P42 (118-19-075)-4		Hotspot	
2201970.0766	668399.2595	P42 (118-19-075)-5		Hotspot	
2201999.0573	668399.2595	P42 (118-19-075)-6		Hotspot	
2201984.5670	668424.3575	P42 (118-19-075)-7		Hotspot	
2201970.0766	668449.4556	P42 (118-19-075)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot,

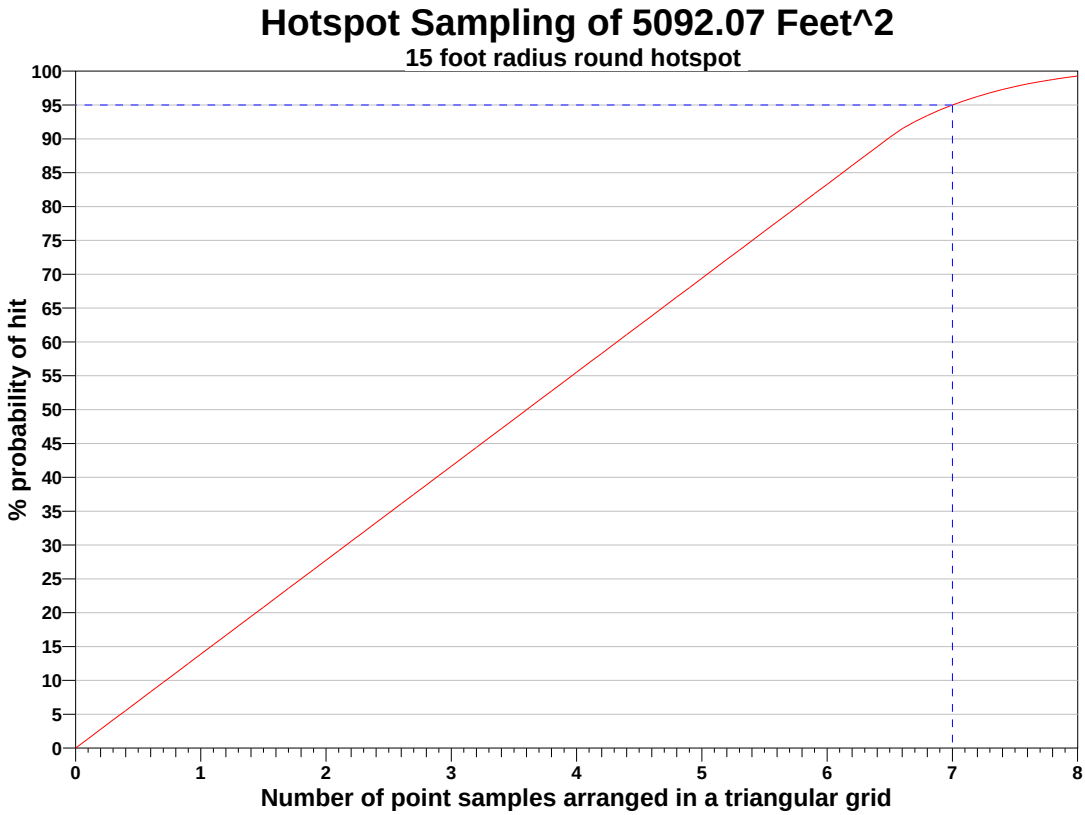
the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5092.07 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	7.00077
Cost	Total cost of sampling	$8.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	34	9	4
	Shp=0.9	30	8	4
	Shp=1	26	7	3
1-β=95	**Shp=0.8**	38	10	5
	Shp=0.9	32	8	4
	Shp=1	29	8	4

1-β=100	**Shp=0.8**	46	12	6
	Shp=0.9	39	10	5
	Shp=1	35	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $8.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**8 Samples**
Field collection costs		$1.00	$8.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$8.00**
Fixed planning and validation costs			$0.00
Total cost			**$8.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
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Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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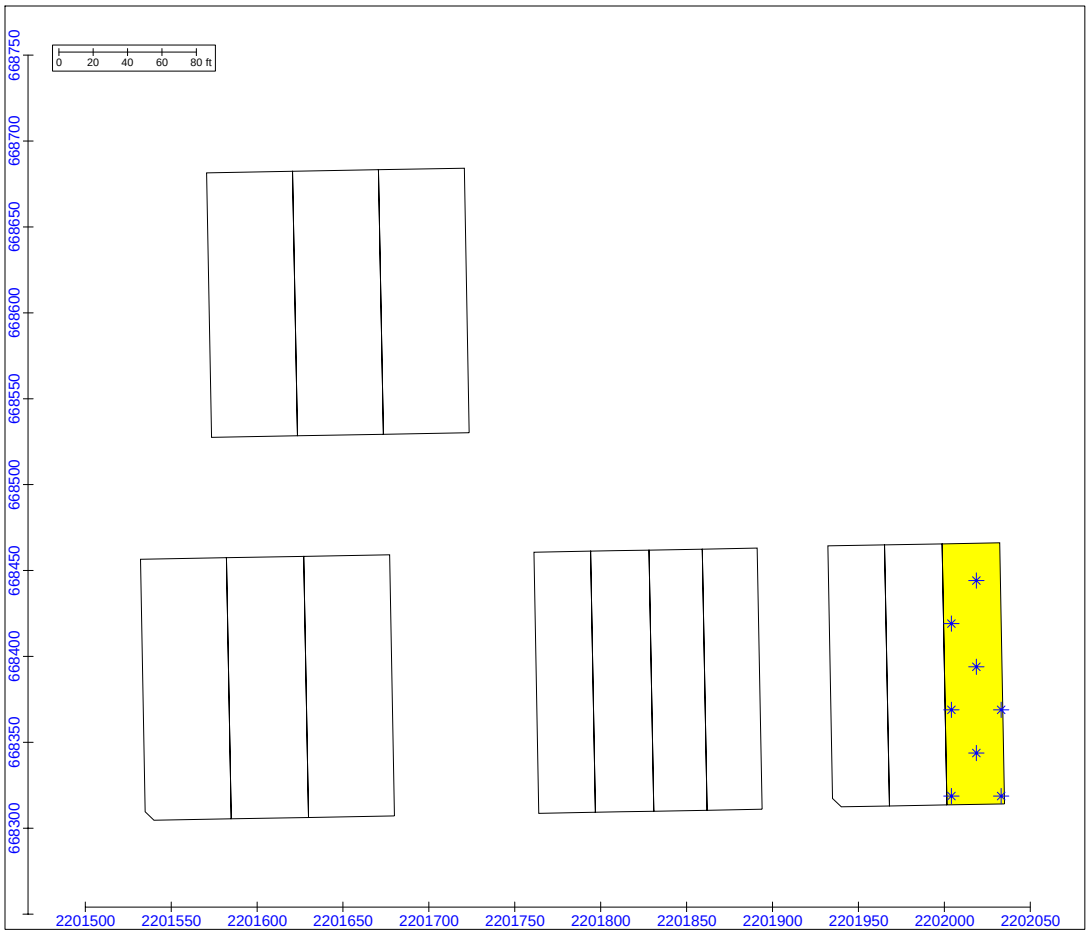
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	8
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5092.07 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$8.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P42 (118-19-076)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2202004.1264	668318.6875	P42 (118-19-076)-1		Hotspot	
2202033.1071	668318.6875	P42 (118-19-076)-2		Hotspot	
2202018.6167	668343.7855	P42 (118-19-076)-3		Hotspot	
2202004.1264	668368.8836	P42 (118-19-076)-4		Hotspot	
2202033.1071	668368.8836	P42 (118-19-076)-5		Hotspot	
2202018.6167	668393.9816	P42 (118-19-076)-6		Hotspot	
2202004.1264	668419.0797	P42 (118-19-076)-7		Hotspot	
2202018.6167	668444.1777	P42 (118-19-076)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot,

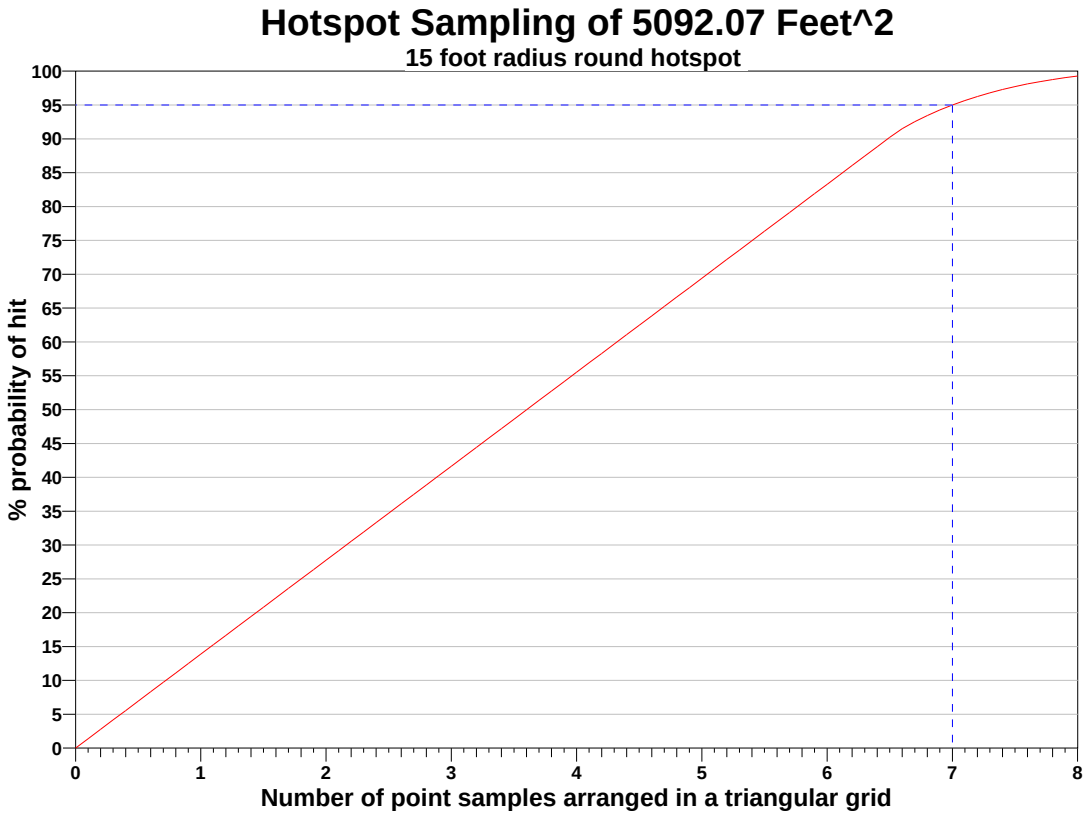
the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5092.07 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	7.00077
Cost	Total cost of sampling	$8.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
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7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	34	9	4
	Shp=0.9	30	8	4
	Shp=1	26	7	3
1-β=95	**Shp=0.8**	38	10	5
	Shp=0.9	32	8	4
	Shp=1	29	8	4

1-β=100	**Shp=0.8**	46	12	6
	Shp=0.9	39	10	5
	Shp=1	35	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $8.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**8 Samples**
Field collection costs		$1.00	$8.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$8.00**
Fixed planning and validation costs			$0.00
Total cost			**$8.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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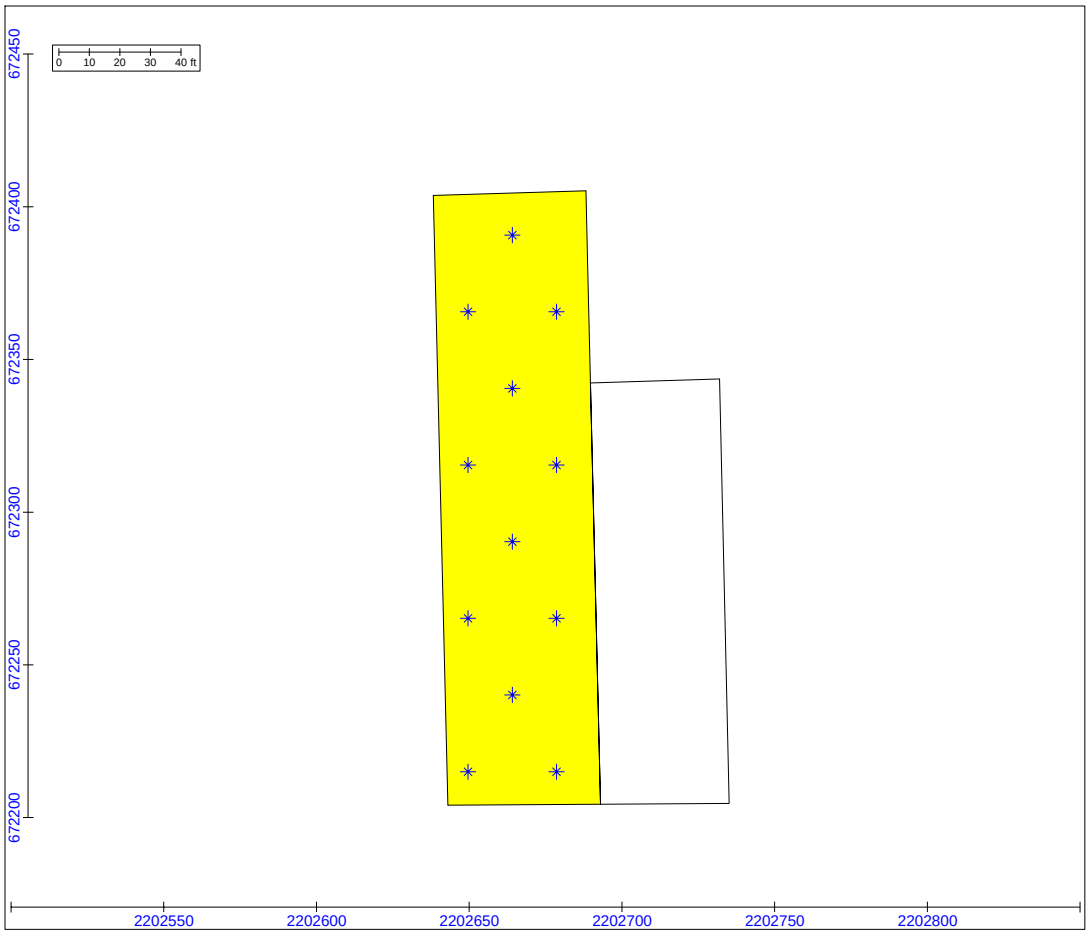
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	14
Type of samples	Point Samples
Number of samples on map [a]	12
Number of selected sample areas [b]	1
Specified sampling area [c]	10015.37 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$14.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P48 (106-14-014)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2202649.6271	672215.0292	P48 (106-14-014)-1		Hotspot	
2202678.6078	672215.0292	P48 (106-14-014)-2		Hotspot	
2202664.1174	672240.1272	P48 (106-14-014)-3		Hotspot	
2202649.6271	672265.2252	P48 (106-14-014)-4		Hotspot	
2202678.6078	672265.2252	P48 (106-14-014)-5		Hotspot	
2202664.1174	672290.3233	P48 (106-14-014)-6		Hotspot	
2202649.6271	672315.4213	P48 (106-14-014)-7		Hotspot	
2202678.6078	672315.4213	P48 (106-14-014)-8		Hotspot	
2202664.1174	672340.5193	P48 (106-14-014)-9		Hotspot	
2202649.6271	672365.6174	P48 (106-14-014)-10		Hotspot	
2202678.6078	672365.6174	P48 (106-14-014)-11		Hotspot	
2202664.1174	672390.7154	P48 (106-14-014)-12		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the

probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

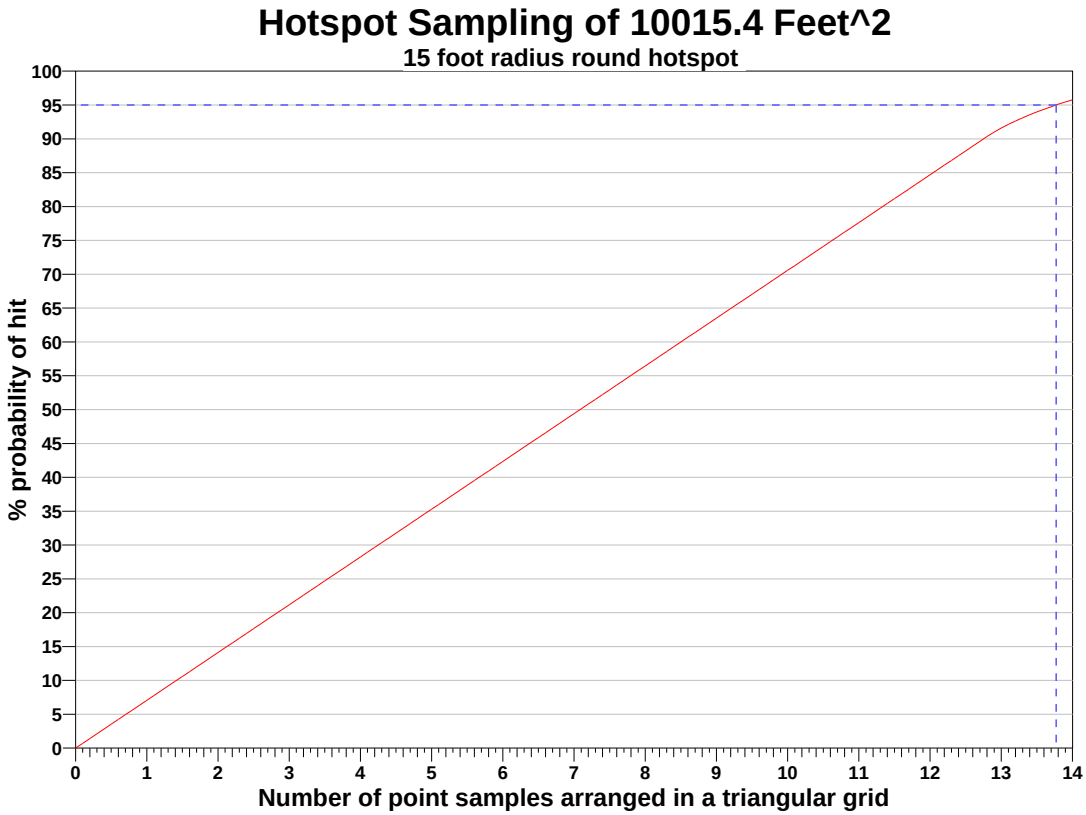
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	10015.37 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	13.7695
Cost	Total cost of sampling	$14.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
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Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	67	17	8
	Shp=0.9	58	15	7
	Shp=1	52	13	6
1-β=95	**Shp=0.8**	73	19	9
	Shp=0.9	63	16	7
	Shp=1	56	14	7

1-β=100	**Shp=0.8**	89	23	10
	Shp=0.9	77	20	9
	Shp=1	69	18	8

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $14.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**14 Samples**
Field collection costs		$1.00	$14.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$14.00**
Fixed planning and validation costs			$0.00
Total cost			**$14.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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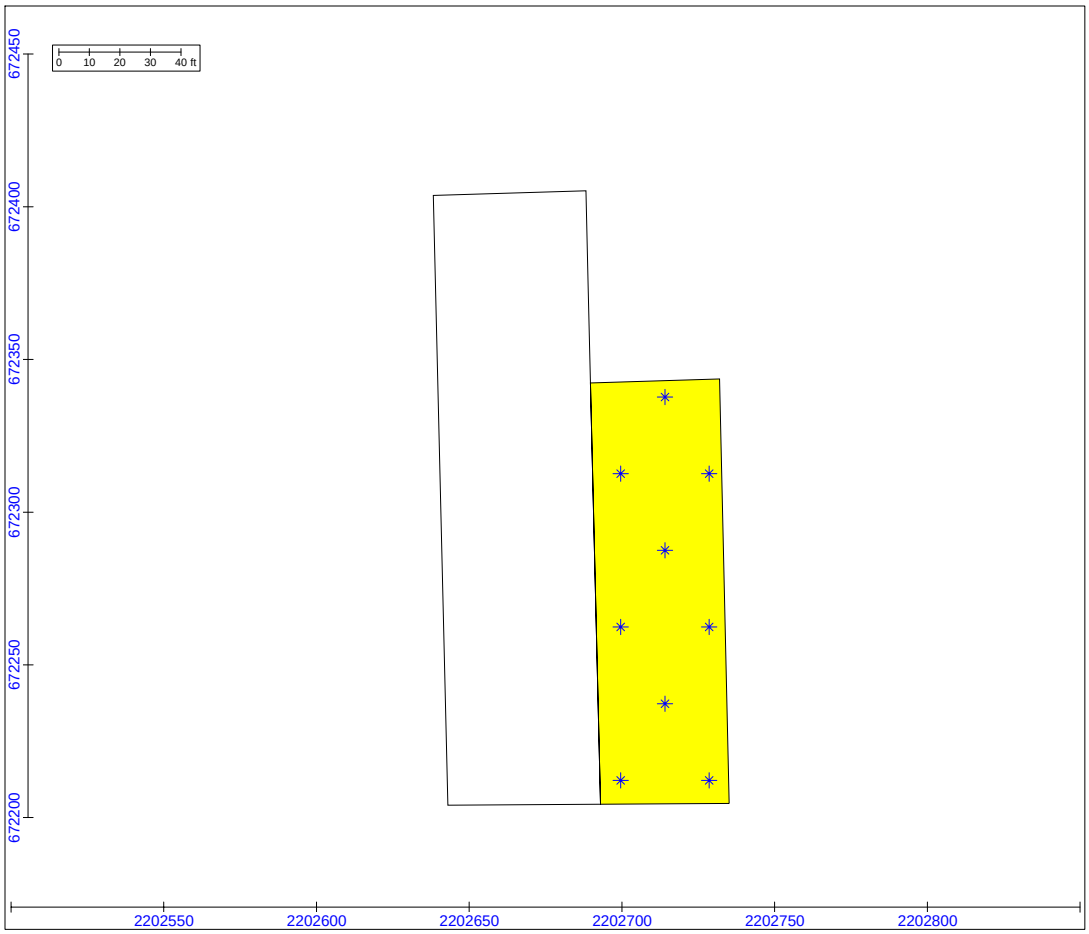
The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	9
Type of samples	Point Samples
Number of samples on map [a]	9
Number of selected sample areas [b]	1
Specified sampling area [c]	5842.65 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$9.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P48 (106-14-015)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2202699.5893	672212.1981	P48 (106-14-015)-1		Hotspot	
2202728.5700	672212.1981	P48 (106-14-015)-2		Hotspot	
2202714.0796	672237.2961	P48 (106-14-015)-3		Hotspot	
2202699.5893	672262.3941	P48 (106-14-015)-4		Hotspot	
2202728.5700	672262.3941	P48 (106-14-015)-5		Hotspot	
2202714.0796	672287.4922	P48 (106-14-015)-6		Hotspot	
2202699.5893	672312.5902	P48 (106-14-015)-7		Hotspot	
2202728.5700	672312.5902	P48 (106-14-015)-8		Hotspot	
2202714.0796	672337.6883	P48 (106-14-015)-9		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and

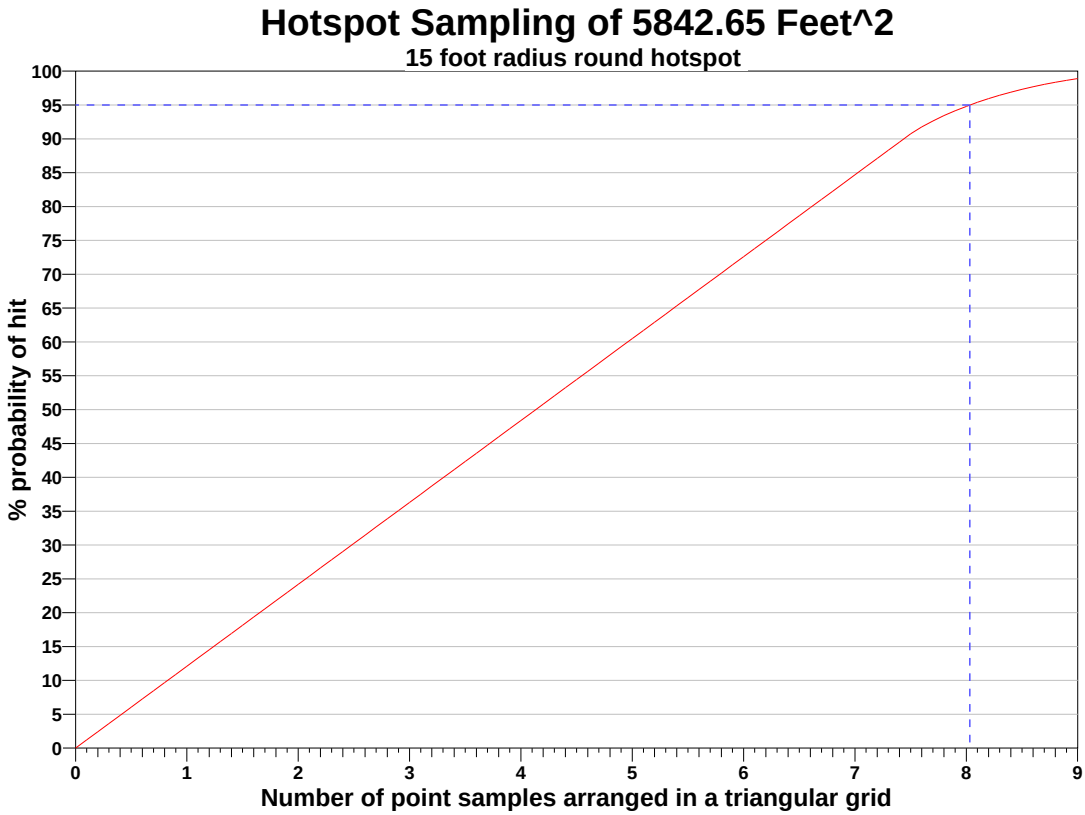
Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5842.65 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	8.03269
Cost	Total cost of sampling	$9.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	39	10	5
	Shp=0.9	34	9	4
	Shp=1	30	8	4
1-β=95	**Shp=0.8**	43	11	5
	Shp=0.9	37	10	5
	Shp=1	33	9	4

1-β=100	**Shp=0.8**	52	13	6
	Shp=0.9	45	12	5
	Shp=1	40	10	5

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $9.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**9 Samples**
Field collection costs		$1.00	$9.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$9.00**
Fixed planning and validation costs			$0.00
Total cost			**$9.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
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Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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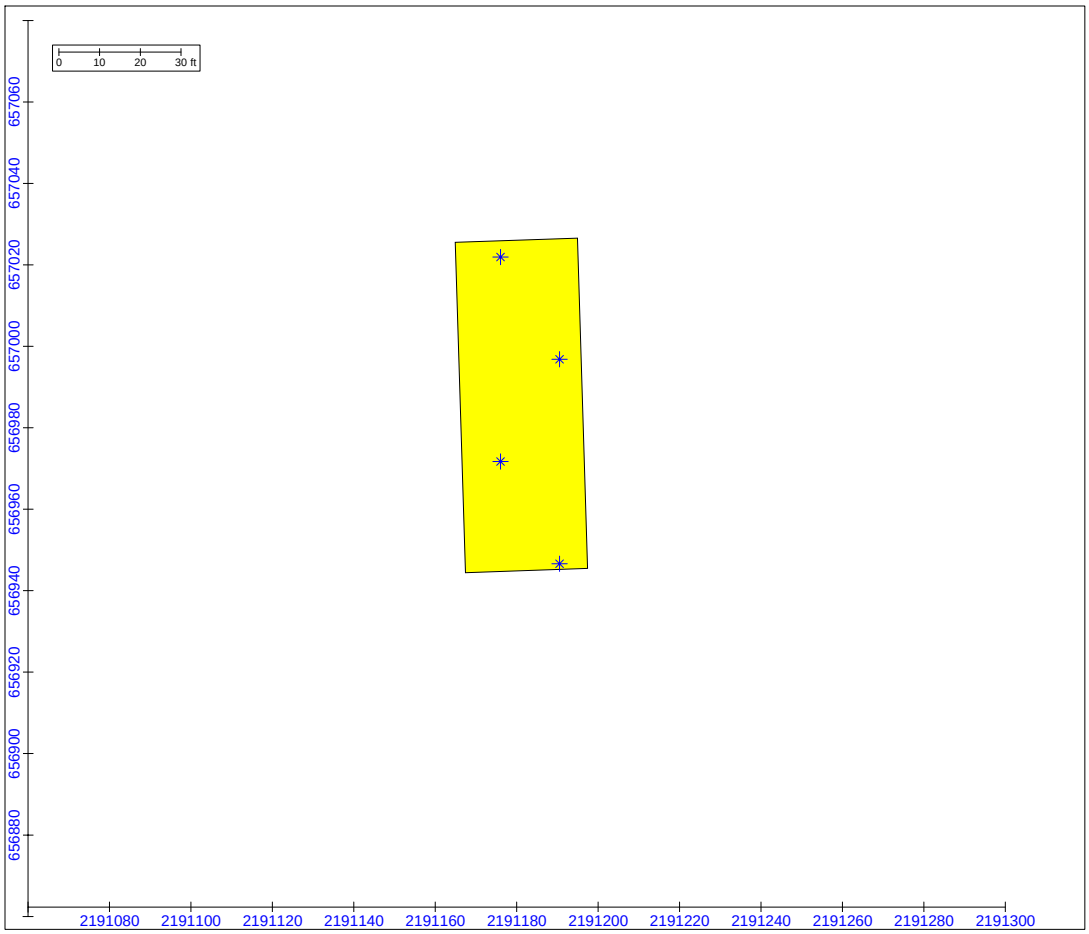
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	4
Type of samples	Point Samples
Number of samples on map [a]	4
Number of selected sample areas [b]	1
Specified sampling area [c]	2434.66 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$4.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P53 (008-14-072)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2191190.5450	656946.6275	P53 (008-14-072)-1		Hotspot	
2191176.0547	656971.7255	P53 (008-14-072)-2		Hotspot	
2191190.5450	656996.8236	P53 (008-14-072)-3		Hotspot	
2191176.0547	657021.9216	P53 (008-14-072)-4		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

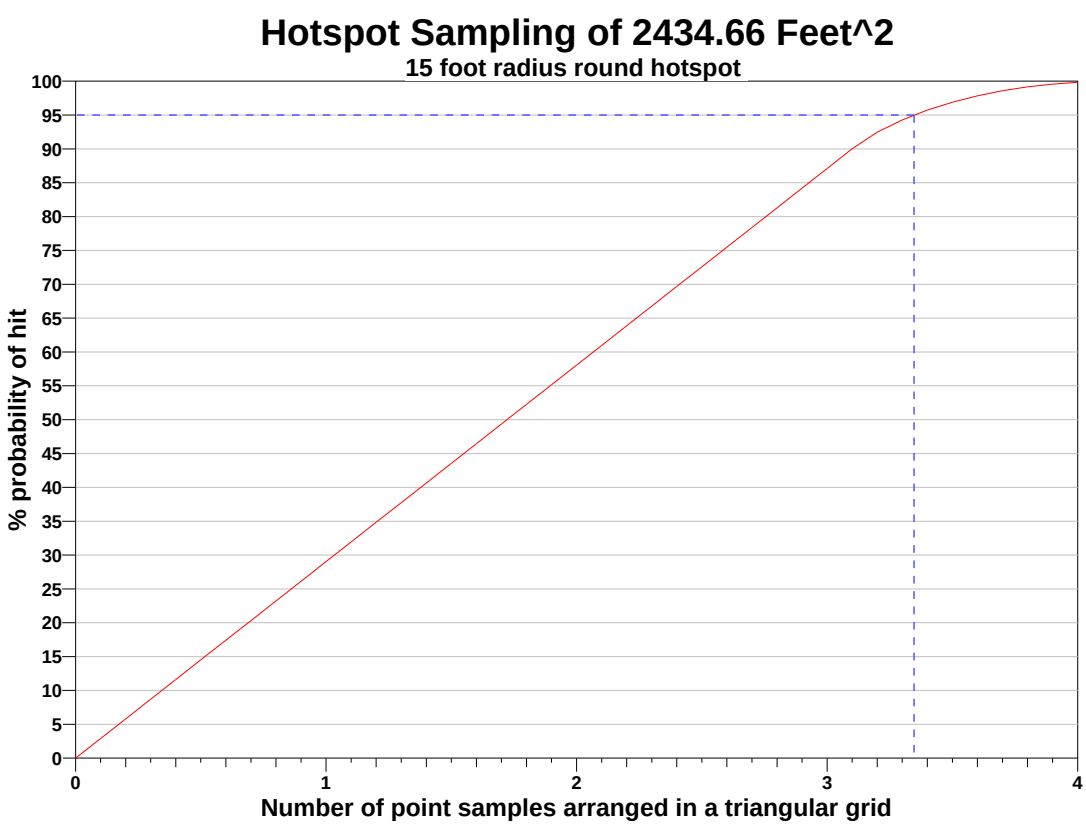
The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value

Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	2434.66 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	3.34725
Cost	Total cost of sampling	$4.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.

3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	17	5	2
	Shp=0.9	15	4	2
	Shp=1	13	4	2
1-β=95	**Shp=0.8**	18	5	2
	Shp=0.9	16	4	2
	Shp=1	14	4	2
1-β=100	**Shp=0.8**	22	6	3
	Shp=0.9	19	5	3
	Shp=1	17	5	2

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $4.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**4 Samples**
Field collection costs		$1.00	$4.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$4.00**
Fixed planning and validation costs			$0.00
Total cost			**$4.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve

a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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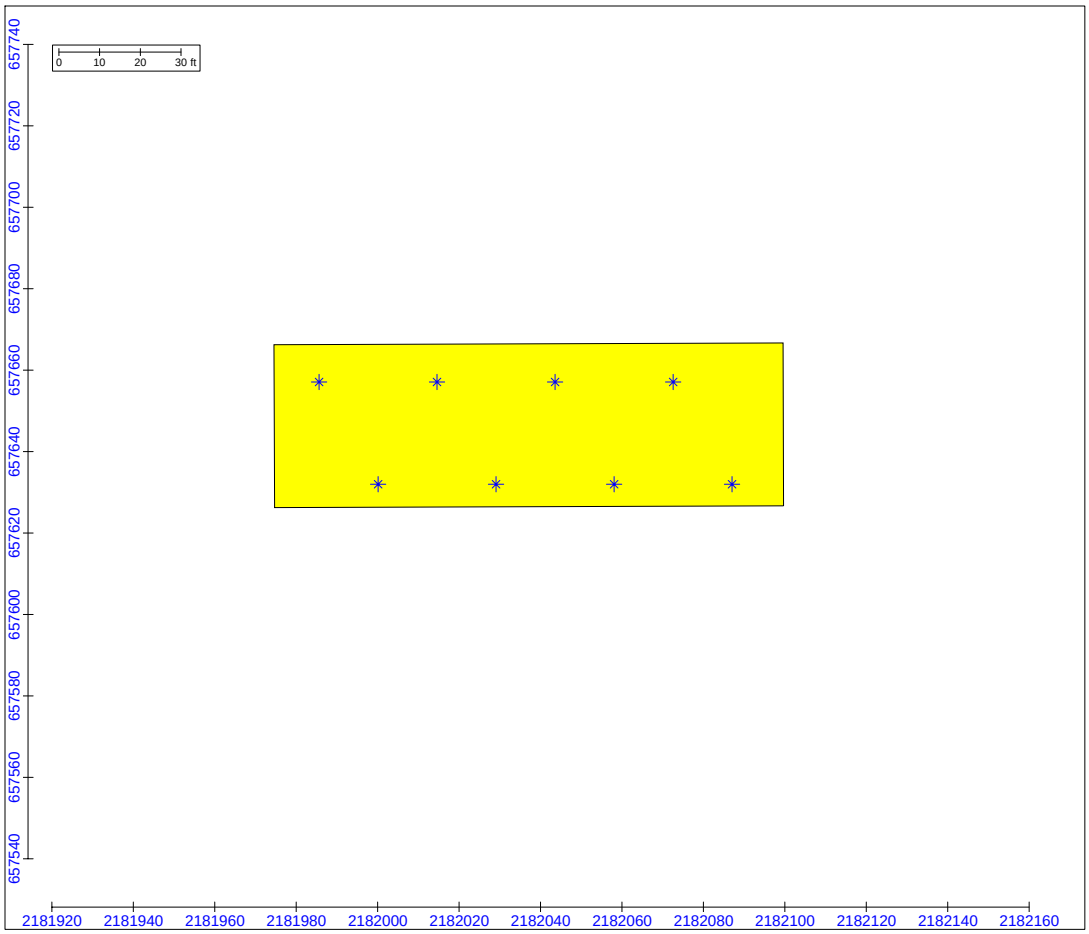
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5000.11 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P61 (016-14-017)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2182000.1056	657631.9755	P61 (016-14-017)-1		Hotspot	
2182029.0863	657631.9755	P61 (016-14-017)-2		Hotspot	
2182058.0670	657631.9755	P61 (016-14-017)-3		Hotspot	
2182087.0477	657631.9755	P61 (016-14-017)-4		Hotspot	
2181985.6152	657657.0736	P61 (016-14-017)-5		Hotspot	
2182014.5959	657657.0736	P61 (016-14-017)-6		Hotspot	
2182043.5766	657657.0736	P61 (016-14-017)-7		Hotspot	
2182072.5573	657657.0736	P61 (016-14-017)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot,

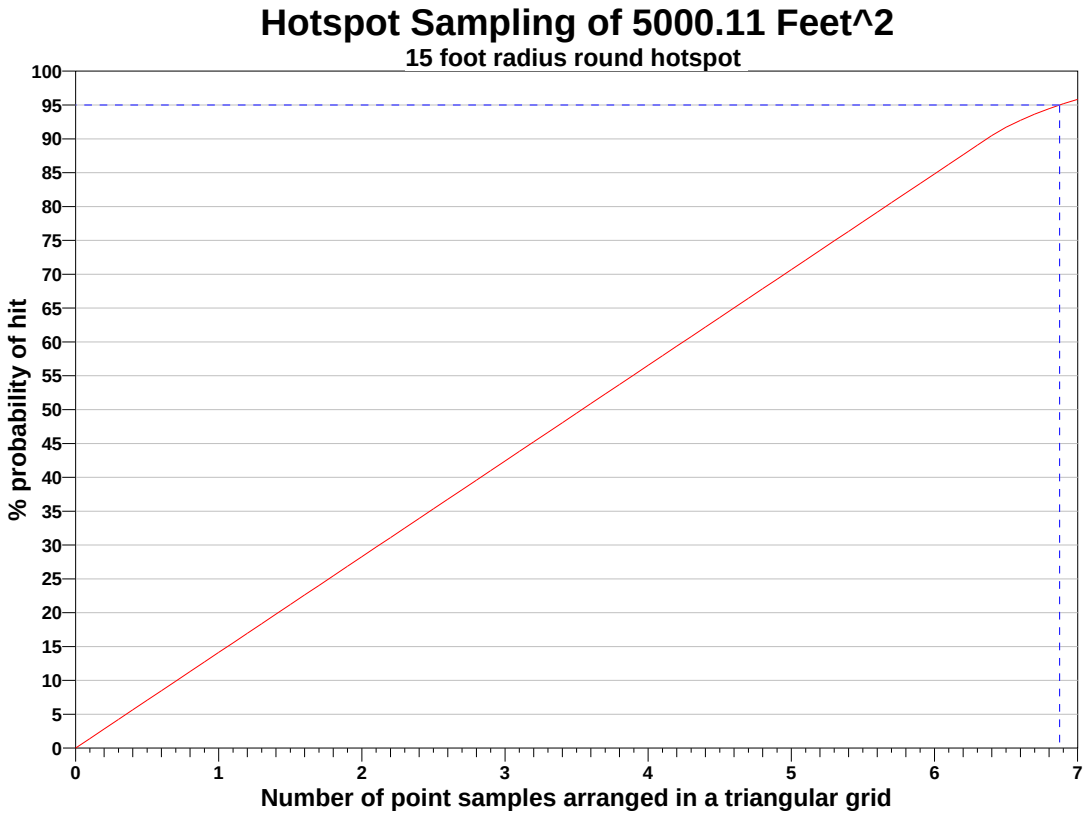
the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	**Description**	**Value**
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5000.11 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.87434
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
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Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	34	9	4
	Shp=0.9	29	8	4
	Shp=1	26	7	3
1-β=95	**Shp=0.8**	37	10	5
	Shp=0.9	32	8	4
	Shp=1	28	7	4

1-β=100	**Shp=0.8**	45	12	5
	Shp=0.9	39	10	5
	Shp=1	35	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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Systematic sampling locations for detecting an area of elevated values (hot spot)

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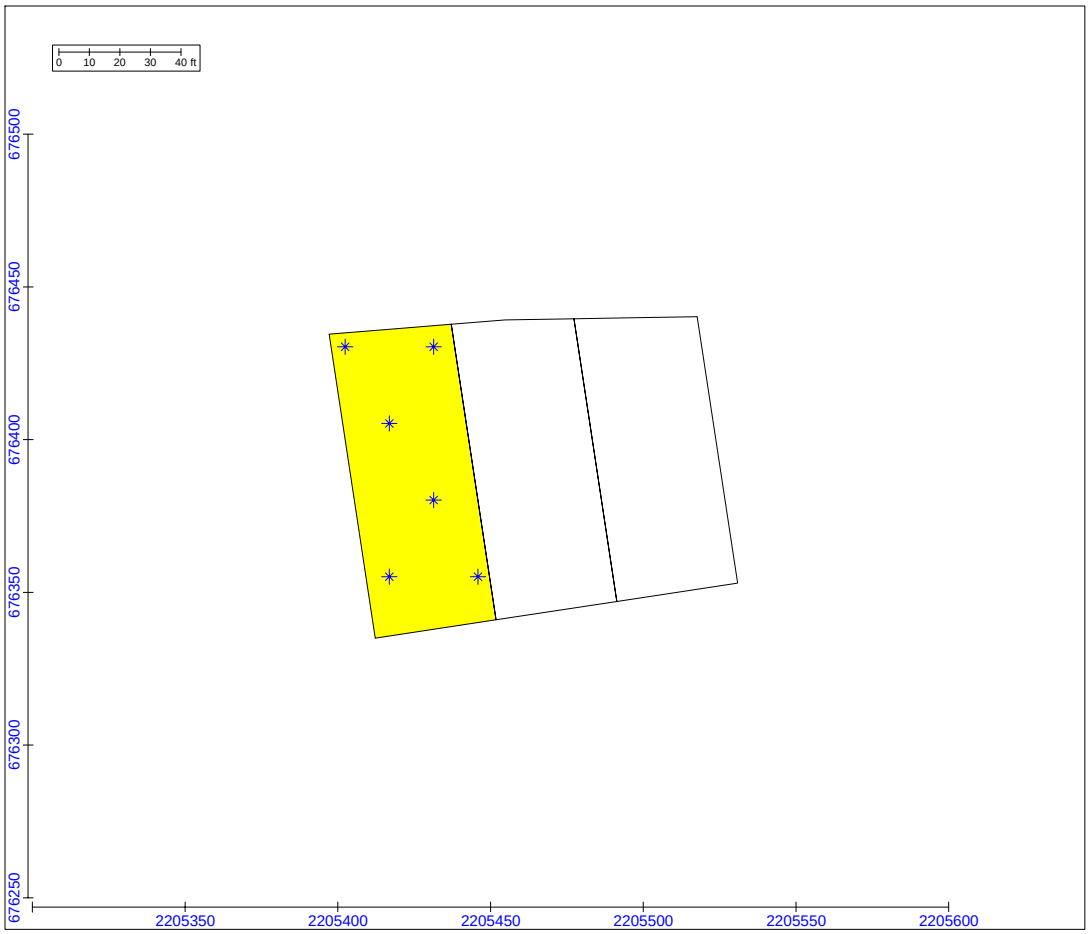
The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	3970.05 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P96 (105-33-035)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205416.8785	676355.1138	P96 (105-33-035)-1		Hotspot	
2205445.8592	676355.1138	P96 (105-33-035)-2		Hotspot	
2205431.3689	676380.2119	P96 (105-33-035)-3		Hotspot	
2205416.8785	676405.3099	P96 (105-33-035)-4		Hotspot	
2205402.3881	676430.4079	P96 (105-33-035)-5		Hotspot	
2205431.3689	676430.4079	P96 (105-33-035)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

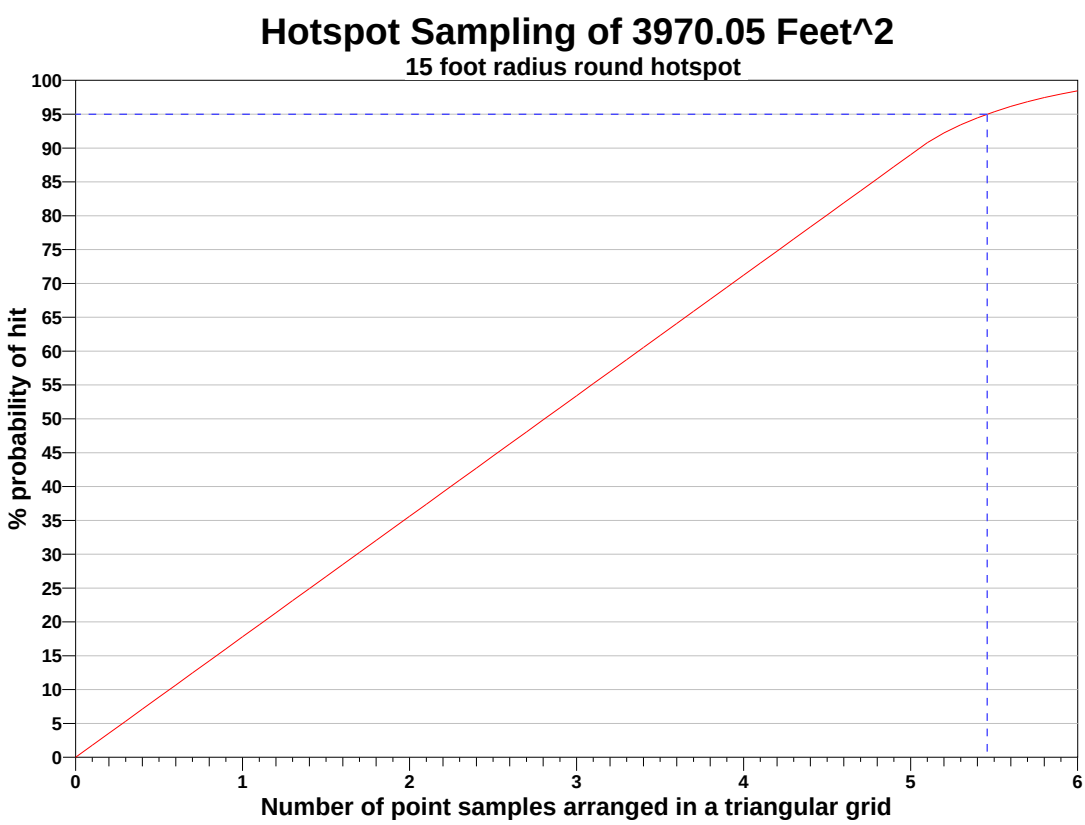
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3970.05 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.45817
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	27	7	3
	Shp=0.9	23	6	3
	Shp=1	21	6	3
1-β=95	**Shp=0.8**	29	8	4
	Shp=0.9	25	7	3
	Shp=1	22	6	3
1-β=100	**Shp=0.8**	36	9	4
	Shp=0.9	31	8	4
	Shp=1	28	7	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

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Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

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Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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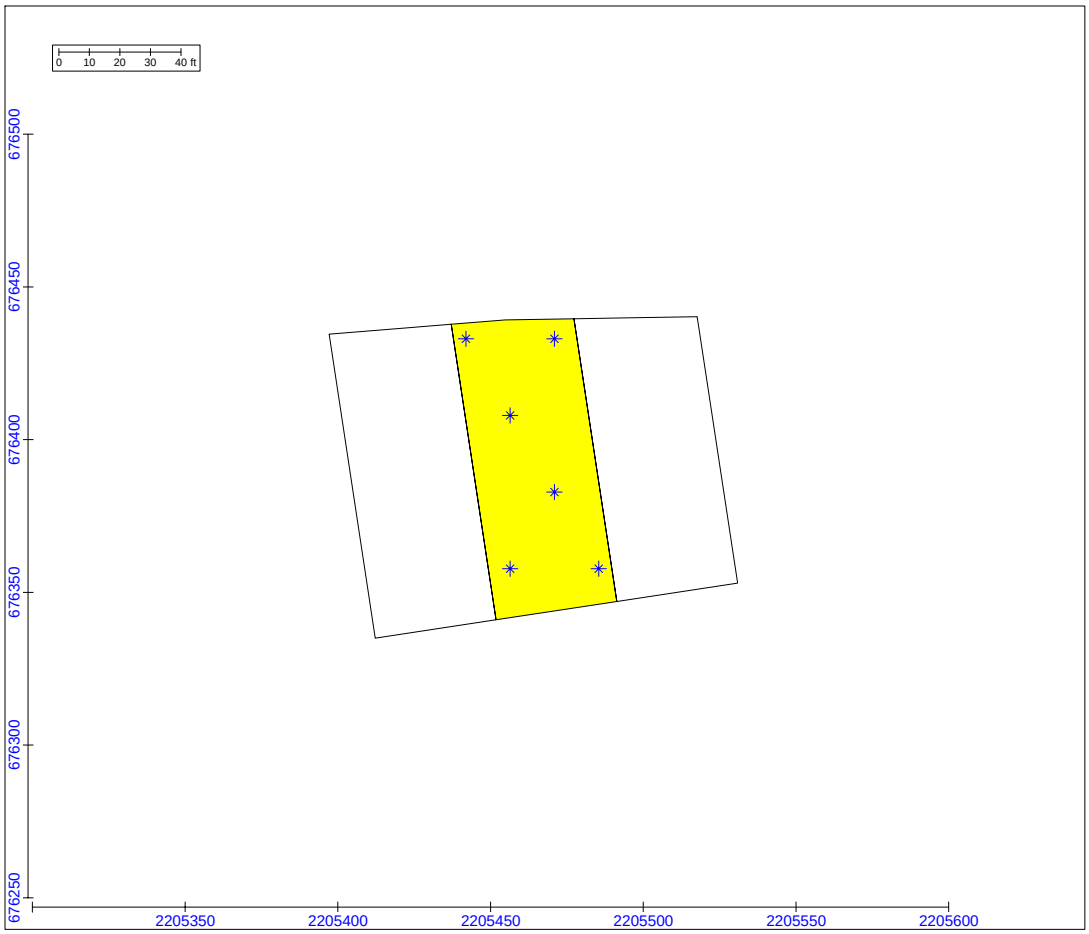
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	3842.10 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P96 (105-33-036)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205456.4329	676357.7251	P96 (105-33-036)-1		Hotspot	
2205485.4136	676357.7251	P96 (105-33-036)-2		Hotspot	
2205470.9232	676382.8231	P96 (105-33-036)-3		Hotspot	
2205456.4329	676407.9211	P96 (105-33-036)-4		Hotspot	
2205441.9425	676433.0192	P96 (105-33-036)-5		Hotspot	
2205470.9232	676433.0192	P96 (105-33-036)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

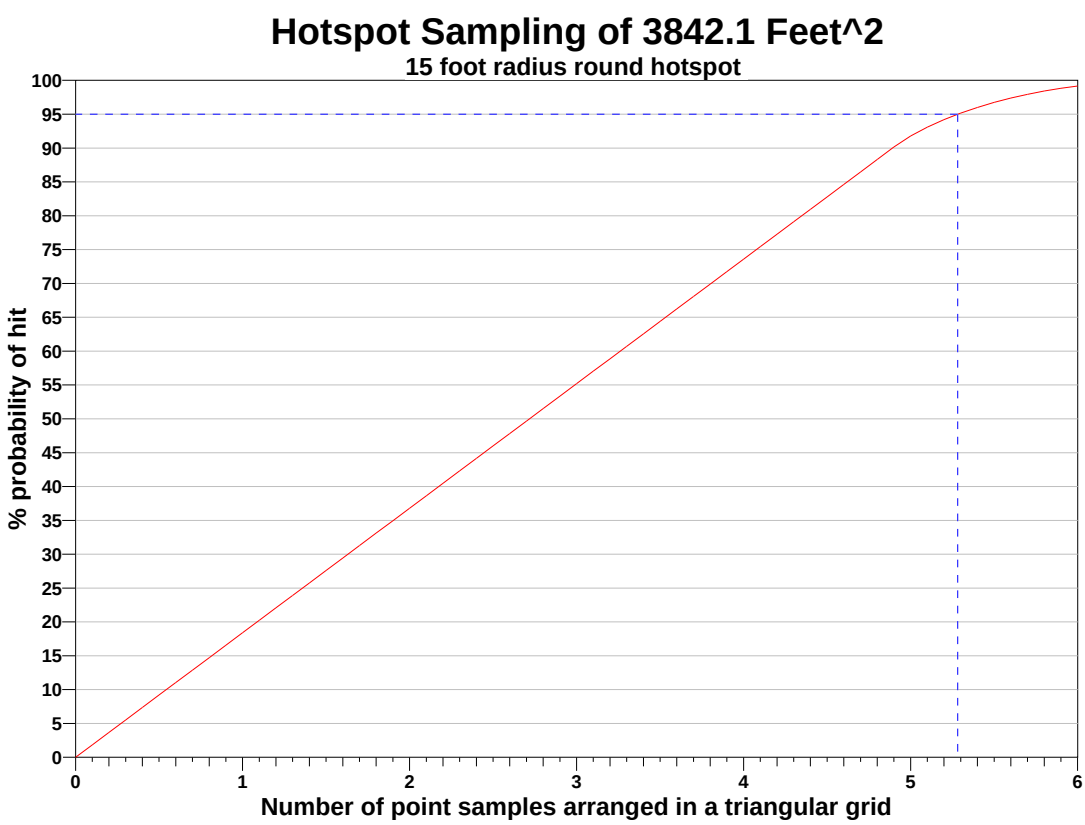
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3842.10 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.28226
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
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7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	26	7	3
	Shp=0.9	23	6	3
	Shp=1	20	5	3
1-β=95	**Shp=0.8**	28	7	4
	Shp=0.9	25	7	3
	Shp=1	22	6	3
1-β=100	**Shp=0.8**	35	9	4
	Shp=0.9	30	8	4
	Shp=1	27	7	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

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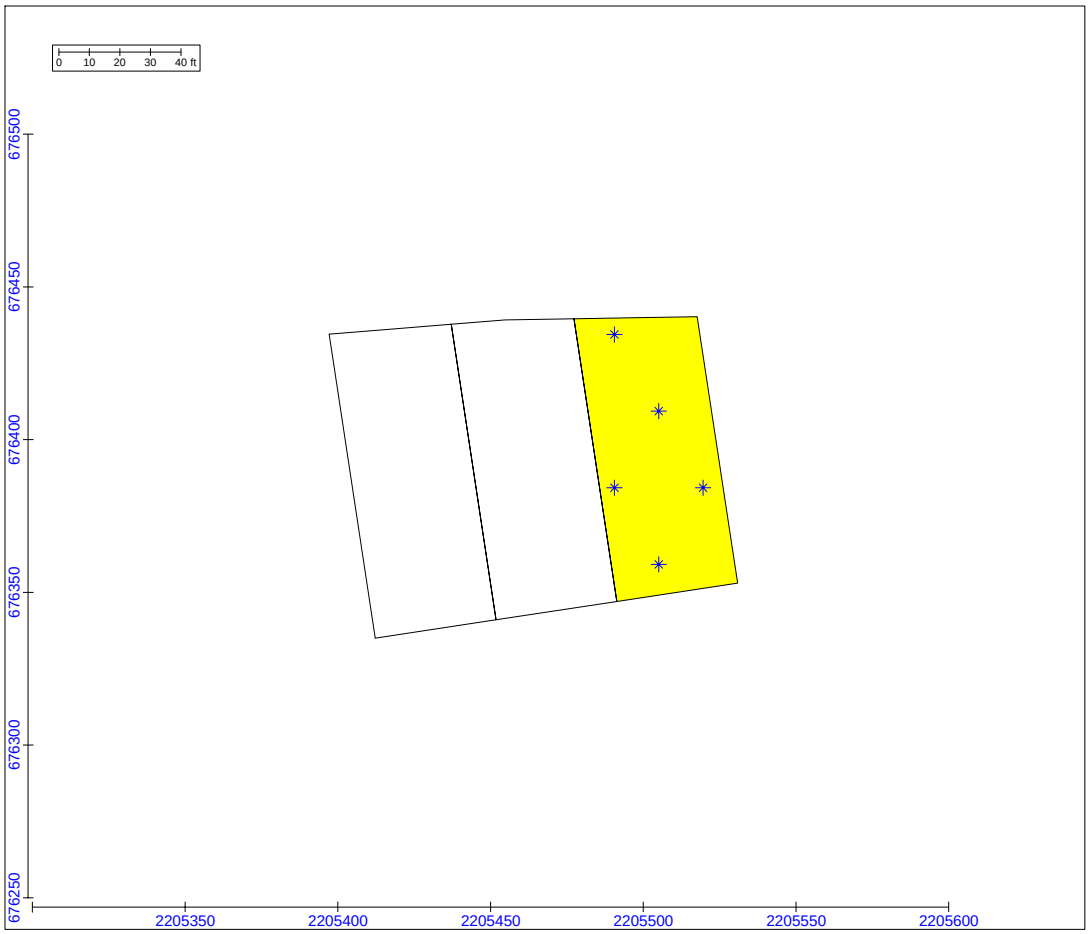
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	3637.33 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P96 (105-33-037)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2205505.0800	676359.1505	P96 (105-33-037)-1		Hotspot	
2205490.5896	676384.2485	P96 (105-33-037)-2		Hotspot	
2205519.5703	676384.2485	P96 (105-33-037)-3		Hotspot	
2205505.0800	676409.3466	P96 (105-33-037)-4		Hotspot	
2205490.5896	676434.4446	P96 (105-33-037)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

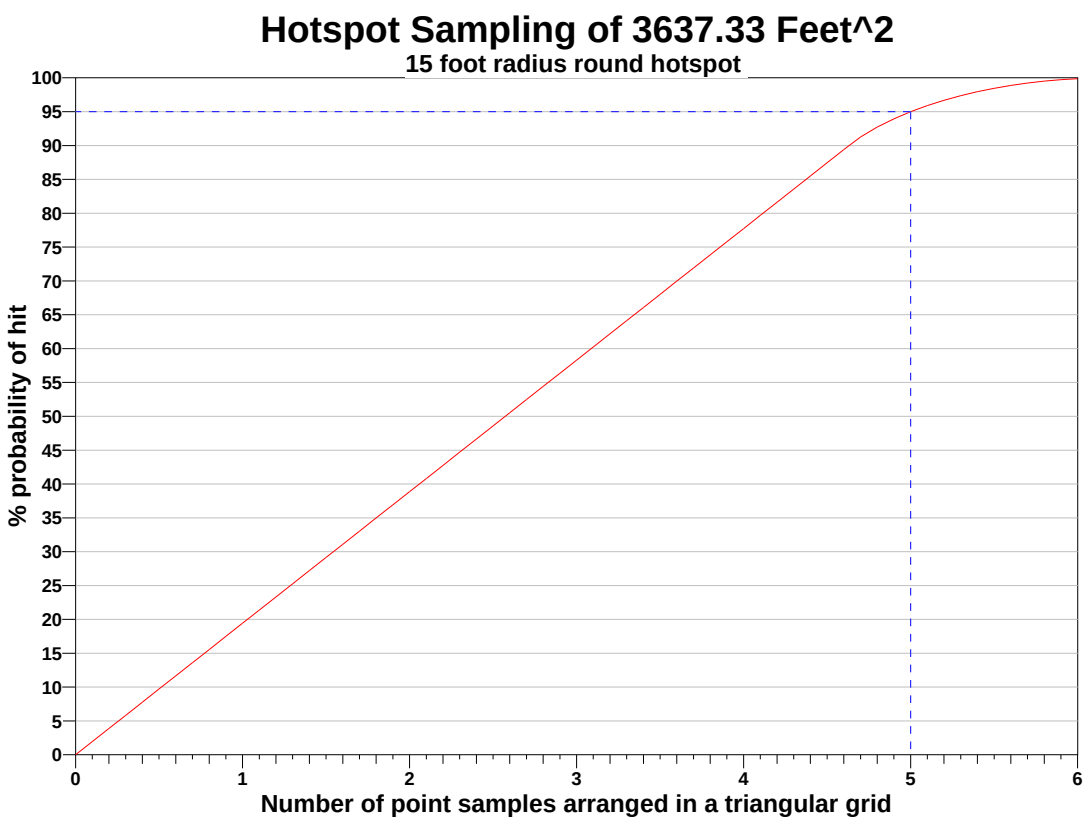
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	3637.33 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.00074
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
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Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	25	7	3
	Shp=0.9	21	6	3
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	Shp=0.9	23	6	3
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	Shp=0.9	28	7	4
	Shp=1	25	7	3

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The

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Systematic sampling locations for detecting an area of elevated values (hot spot)

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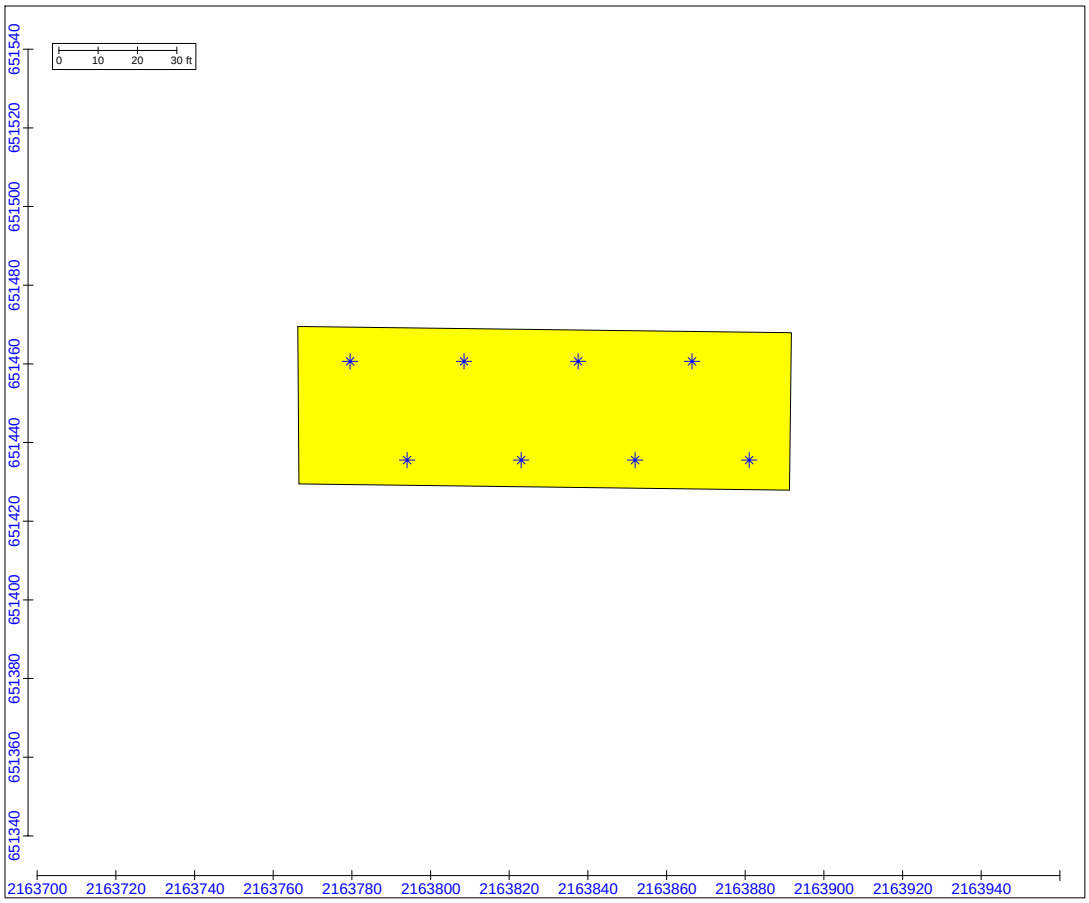
The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	7
Type of samples	Point Samples
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	5004.75 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$7.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P100 (022-04-039)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2163794.0347	651435.5409	P100 (022-04-039)-1		Hotspot	
2163823.0154	651435.5409	P100 (022-04-039)-2		Hotspot	
2163851.9961	651435.5409	P100 (022-04-039)-3		Hotspot	
2163880.9768	651435.5409	P100 (022-04-039)-4		Hotspot	
2163779.5443	651460.6390	P100 (022-04-039)-5		Hotspot	
2163808.5250	651460.6390	P100 (022-04-039)-6		Hotspot	
2163837.5058	651460.6390	P100 (022-04-039)-7		Hotspot	
2163866.4865	651460.6390	P100 (022-04-039)-8		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the

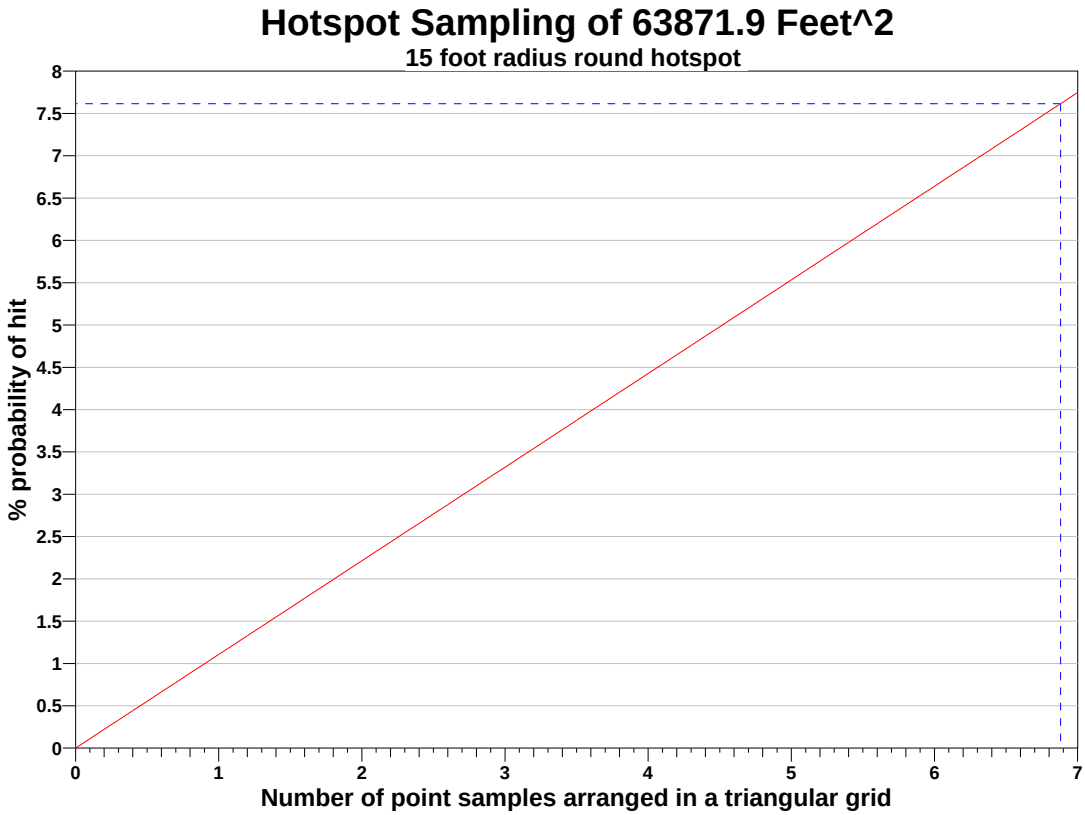
given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	5004.75 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	6.88071
Cost	Total cost of sampling	$7.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	34	9	4
	Shp=0.9	29	8	4
	Shp=1	26	7	3
1-β=95	**Shp=0.8**	37	10	5
	Shp=0.9	32	8	4
	Shp=1	28	7	4

1-β=100	**Shp=0.8**	45	12	5
	Shp=0.9	39	10	5
	Shp=1	35	9	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $7.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**7 Samples**
Field collection costs		$1.00	$7.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$7.00**
Fixed planning and validation costs			$0.00
Total cost			**$7.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References
EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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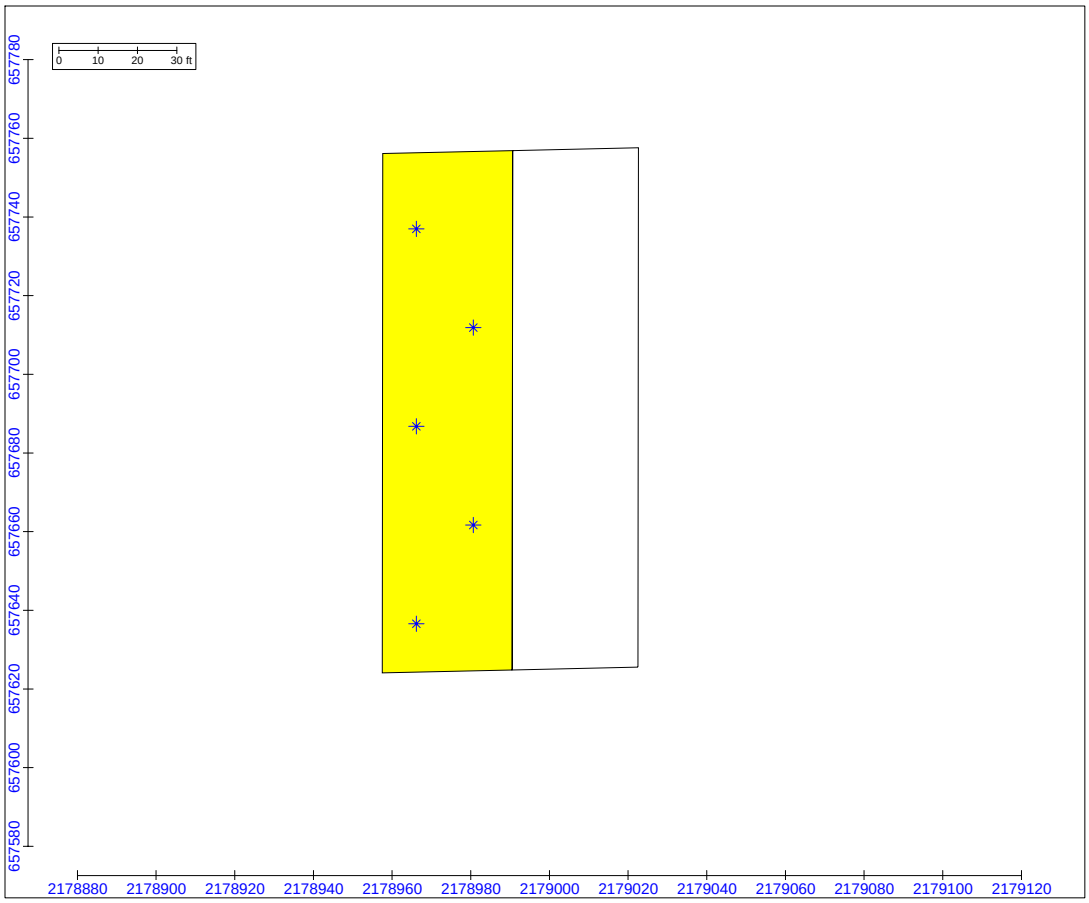
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	5
Number of selected sample areas [b]	1
Specified sampling area [c]	4357.31 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P102 (006-30-009)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2178966.1522	657636.6097	P102 (006-30-009)-1		Hotspot	
2178980.6425	657661.7077	P102 (006-30-009)-2		Hotspot	
2178966.1522	657686.8058	P102 (006-30-009)-3		Hotspot	
2178980.6425	657711.9038	P102 (006-30-009)-4		Hotspot	
2178966.1522	657737.0018	P102 (006-30-009)-5		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

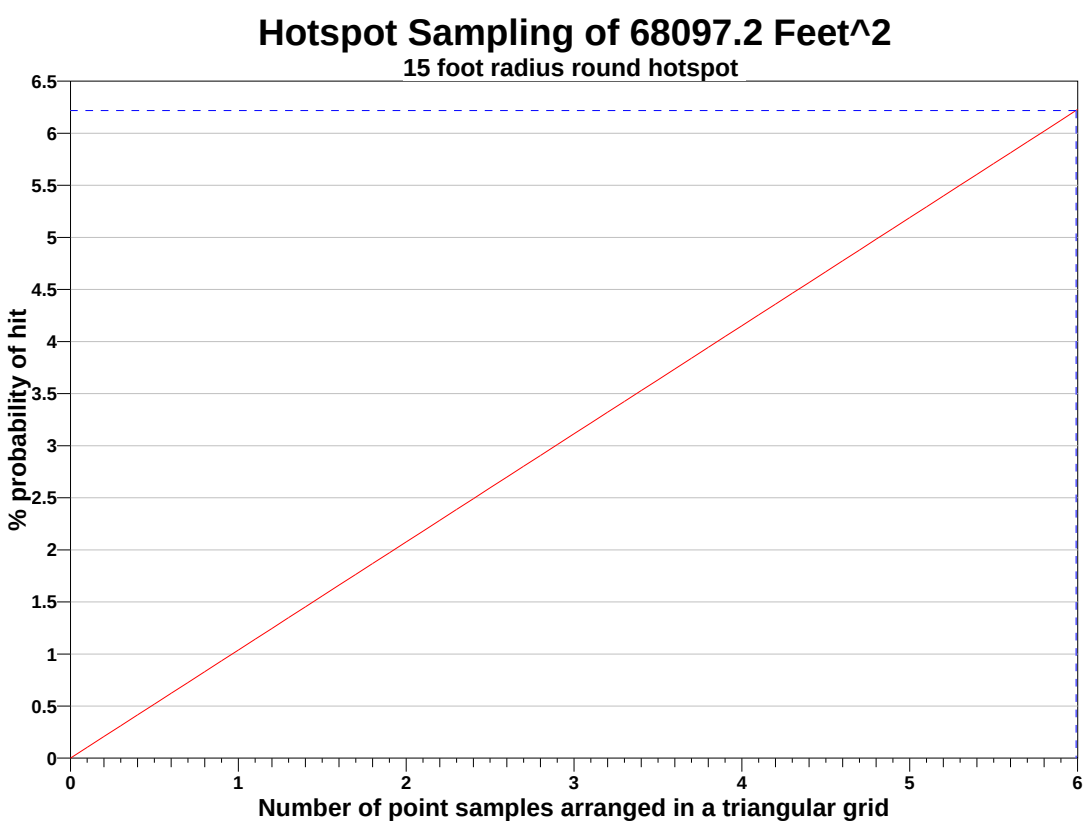
The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value

Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	4357.31 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.99059
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.

3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis
The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	29	8	4
	Shp=0.9	26	7	3
	Shp=1	23	6	3
1-β=95	**Shp=0.8**	32	8	4
	Shp=0.9	28	7	4
	Shp=1	24	6	3
1-β=100	**Shp=0.8**	39	10	5
	Shp=0.9	34	9	4
	Shp=1	30	8	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve

a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References

EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets*. Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

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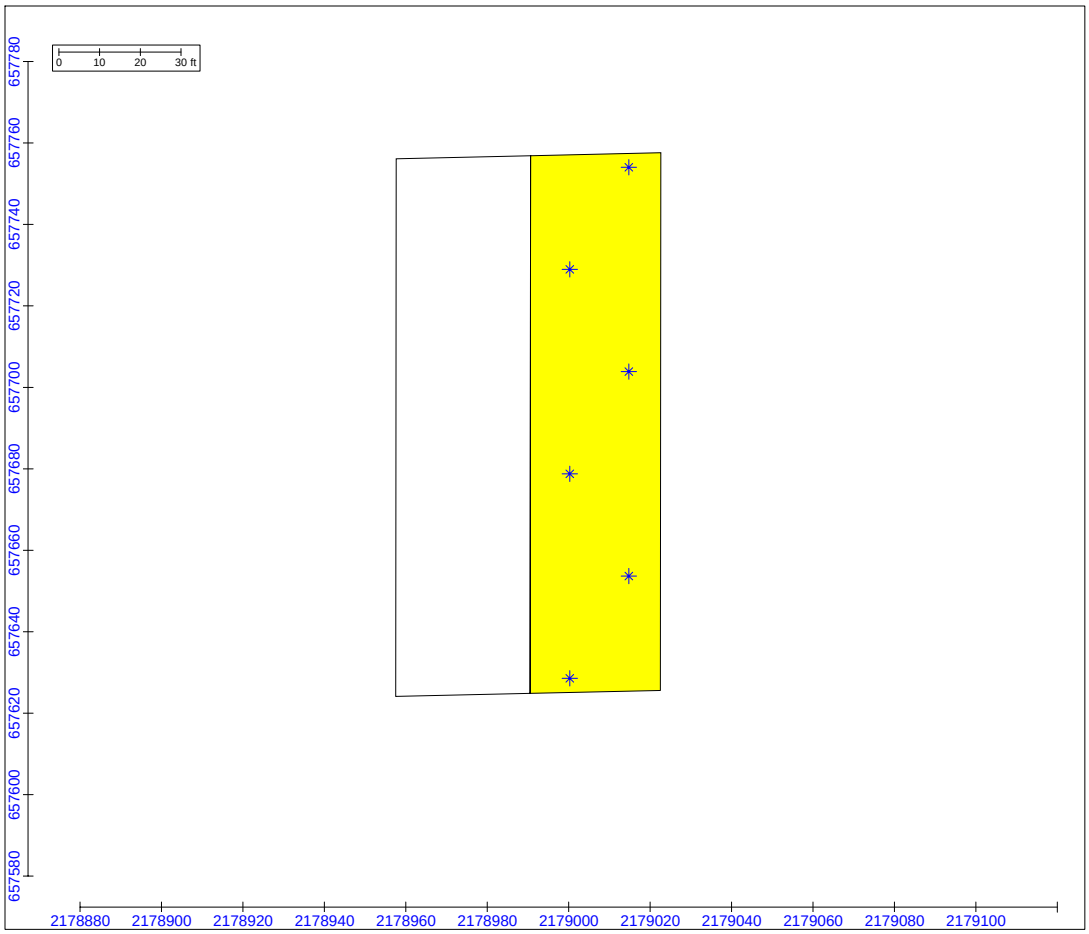
Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	6
Type of samples	Point Samples
Number of samples on map [a]	6
Number of selected sample areas [b]	1
Specified sampling area [c]	4225.26 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	28.9807 feet / 727.359 ft^2
Total cost of sampling [e]	$6.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: P102 (006-30-010)					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
2179000.2978	657628.5670	P102 (006-30-010)-1		Hotspot	
2179014.7882	657653.6650	P102 (006-30-010)-2		Hotspot	
2179000.2978	657678.7631	P102 (006-30-010)-3		Hotspot	
2179014.7882	657703.8611	P102 (006-30-010)-4		Hotspot	
2179000.2978	657728.9591	P102 (006-30-010)-5		Hotspot	
2179014.7882	657754.0572	P102 (006-30-010)-6		Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

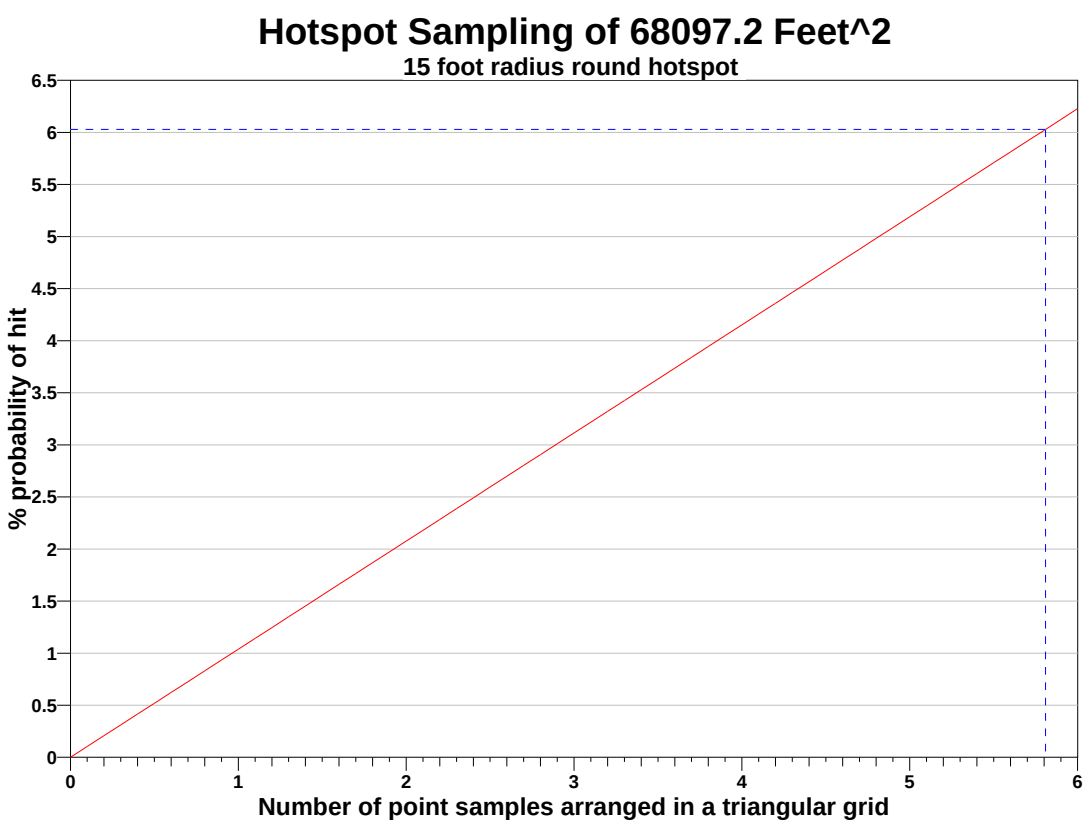
Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	15 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	706.858 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	4225.26 ft^2
Outputs		
Grid Size	Spacing between samples	28.9807 feet
Grid Area	Area represented by one grid	727.359 ft^2
Samples [b]	Optimum number of samples	5.80905
Cost	Total cost of sampling	$6.00

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=7.5	**Size=15**	**Size=22.5**
1-β=90	**Shp=0.8**	29	8	4
	Shp=0.9	25	7	3
	Shp=1	22	6	3
1-β=95	**Shp=0.8**	31	8	4
	Shp=0.9	27	7	3
	Shp=1	24	6	3
1-β=100	**Shp=0.8**	38	10	5
	Shp=0.9	33	9	4
	Shp=1	29	8	4

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $6.00, which averages out to a per sample cost of $1.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**6 Samples**
Field collection costs		$1.00	$6.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$1.00**	**$6.00**
Fixed planning and validation costs			$0.00
Total cost			**$6.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006).

The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

References

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APPENDIX C
NPI PROJECT SITE-SPECIFIC TABLES

Appendix C - Table 1
NPI High Priority Project Site No. 8, Parcel 13408014
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
			Parcel ID	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014
			Location ID	CLB-13408014-SS01	CLB-13408014-SS02	CLB-13408014-SS03	CLB-13408014-SS04	CLB-13408014-SS05	CLB-13408014-SS06	CLB-13408014-SS07	CLB-13408014-SS08	CLB-13408014-SS09	CLB-13408014-SS10	CLB-13408014-SS11	CLB-13408014-SS12	CLB-13408014-SS13	CLB-13408014-SS14	CLB-13408014-SS15	CLB-13408014-SS16	13408014-SS16 (Duplicate)
			Field Sample ID	CLB-13408014-SS01-032510	CLB-13408014-SS02-032510	CLB-13408014-SS03-032510	CLB-13408014-SS04-032510	CLB-13408014-SS05-032510	CLB-13408014-SS06-032510	CLB-13408014-SS07-032510	CLB-13408014-SS08-032510	CLB-13408014-SS09-032510	CLB-13408014-SS10-032510	CLB-13408014-SS11-032510	CLB-13408014-SS12-032510	CLB-13408014-SS13-032510	CLB-13408014-SS14-032510	CLB-13408014-SS15-032510	CLB-13408014-SS16-032510	CLB-13408014-SS17-032510
			Sample Date	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010
Chemical Name	Unit	VAP Generic Residential Direct Contact Criteria	Commercial/Industrial Direct Contact Criteria																	
Aroclor 1016	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	54.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	163	93.9	164	268	552	152	67.4	339	120	62.7	126	433	266	95.2	32.5 U	48.8	44.2
Acenaphthene	µg/kg	**3,500,000**	56,000,000	41.2	65.4	91.3	145	428	97.6	31.1 U	255	31.9 U	29.4 U	61.9	29 U	110	29.3 U	32.5 U	29.6 U	30.8 U
Acenaphthylene	µg/kg	**NA**	NA	66.3	33.1 U	68	125	92	40.5	31.1 U	287	34	29.4 U	120	29 U	70.7	29.3 U	32.5 U	29.6 U	30.8 U
Anthracene	µg/kg	**18,000,000**	280,000,000	221	276	314	555	910	343	109	1,540	101	68	261	102	323	40.9	72.9	130	123
Benzo(a)anthracene	µg/kg	**11,000**	76,000	675	900	893	1,820	2,450	872	351	5,340	374	219	805	359	946	114	185	303	267
Benzo(a)pyrene	µg/kg	**1,100**	7,700	610	920	927	**1,850**	**2,460**	897	372	**5,800**	380	223	753	383	818	132	179	303	268
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	594	929	884	1,790	2640	847	326	6,270	395	224	744	386	831	123	172	282	243
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	378	573	557	1,160	1,550	541	223	3,740	244	161	432	244	456	108	117	201	187
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	594	800	841	1,810	2,220	822	352	5,240	336	205	723	356	803	138	175	290	273
Chrysene	µg/kg	**1,100,000**	7,600,000	779	1,060	1,020	2,090	3,090	978	415	6,290	454	259	932	432	1,040	142	217	342	311
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	159	241	244	511	668	236	96.2	**1,650**	106	70.5	208	101	220	41.5	51.6	87.8	78.2
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,790	2,410	2,330	4,940	7,980	2,260	825	16,100	891	500	2,150	939	2,420	263	445	690	654
Fluorene	µg/kg	**2,400,000**	37,000,000	53	70	95	171	640	115	31.1 U	354	31.9 U	29.4 U	94.6	29 U	88.6	29.3 U	32.5 U	29.6 U	30.8 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	352	544	543	1,110	1,450	514	210	3,680	230	140	422	229	458	92	107	178	163
Naphthalene	µg/kg	**69,000**	150,000	193	102	196	269	899	143	62.4	319	104	63.3	168	344	260	69.3	32.5 U	37.9	39
Phenanthrene	µg/kg	**NA**	NA	885	1,280	1,320	2,820	7,500	1,380	393	7,240	483	260	1,540	595	1,790	129	234	324	353
Pyrene	µg/kg	**1,800,000**	28,000,000	1,380	1,930	1,730	3,730	5,710	1,680	672	10,900	719	406	1,520	731	1,800	205	355	531	497
Aluminum, Total	mg/kg	**NA**	NA	NA	NA	NA	8,730	NA	NA	NA	NA	NA	NA	8,350	NA	NA	NA	NA	8,120	8,730
Antimony, Total	mg/kg	**30**	1,200	NA	NA	NA	1.9	NA	NA	NA	NA	NA	NA	2.1	NA	NA	NA	NA	1.9	2.1
Arsenic, Total	mg/kg	**7**	82	NA	NA	NA	**22**	NA	NA	NA	NA	NA	NA	**22.9**	NA	NA	NA	NA	**18**	**16.8**
Barium, Total	mg/kg	**15,000**	370,000	NA	NA	NA	429	NA	NA	NA	NA	NA	NA	449	NA	NA	NA	NA	255	245
Beryllium, Total	mg/kg	**150**	5,100	NA	NA	NA	0.9	NA	NA	NA	NA	NA	NA	0.5	NA	NA	NA	NA	0.6	0.5
Boron, Total	mg/kg	**NA**	NA	NA	NA	NA	16.9	NA	NA	NA	NA	NA	NA	12	NA	NA	NA	NA	13.2	13.9
Cadmium, Total	mg/kg	**72**	2,300	NA	NA	NA	1.7	NA	NA	NA	NA	NA	NA	1.1	NA	NA	NA	NA	0.2	0.3
Calcium, Total	mg/kg	**NA**	NA	NA	NA	NA	5,740	NA	NA	NA	NA	NA	NA	12,700	NA	NA	NA	NA	19,300	16,200
Chromium, Total	mg/kg	**NA**	NA	NA	NA	NA	11.3	NA	NA	NA	NA	NA	NA	6.3	NA	NA	NA	NA	4.7	4
Cobalt, Total	mg/kg	**1,400**	23,000	NA	NA	NA	9.4	NA	NA	NA	NA	NA	NA	11.8	NA	NA	NA	NA	8.7	9.8
Copper, Total	mg/kg	**NA**	NA	NA	NA	NA	79.5	NA	NA	NA	NA	NA	NA	57.4	NA	NA	NA	NA	33.2	31.7
Iron, Total	mg/kg	**NA**	NA	NA	NA	NA	22,400	NA	NA	NA	NA	NA	NA	24,100	NA	NA	NA	NA	23,100	23,800
Lead, Total	mg/kg	**400**	1,800	NA	NA	NA	**471**	NA	NA	NA	NA	NA	NA	**1,440**	NA	NA	NA	NA	153	79.7
Magnesium, Total	mg/kg	**NA**	NA	NA	NA	NA	1,810	NA	NA	NA	NA	NA	NA	2,910	NA	NA	NA	NA	4,930	5,110
Manganese, Total	mg/kg	**NA**	NA	NA	NA	NA	786	NA	NA	NA	NA	NA	NA	752	NA	NA	NA	NA	556	459
Molybdenum, Total	mg/kg	**NA**	NA	NA	NA	NA	12.2 U	NA	NA	NA	NA	NA	NA	11.9 U	NA	NA	NA	NA	9.1 U	10.9 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	NA	NA	23.2	NA	NA	NA	NA	NA	NA	27	NA	NA	NA	NA	23	25
Phosphorus, Total	mg/kg	**NA**	NA	NA	NA	NA	2,730	NA	NA	NA	NA	NA	NA	674	NA	NA	NA	NA	313	258
Potassium, Total	mg/kg	**NA**	NA	NA	NA	NA	1,140	NA	NA	NA	NA	NA	NA	1,030	NA	NA	NA	NA	1,080	1,050
Selenium, Total	mg/kg	**380**	15,000	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	2.8 U	NA	NA	NA	NA	2.9 U	3.4 U
Silicon, Total	mg/kg	**NA**	NA	NA	NA	NA	1,830	NA	NA	NA	NA	NA	NA	1,230	NA	NA	NA	NA	1,690	1,520
Sodium, Total	mg/kg	**NA**	NA	NA	NA	NA	752	NA	NA	NA	NA	NA	NA	796	NA	NA	NA	NA	886	802
Strontium 1, Total	mg/kg	**NA**	NA	NA	NA	NA	25	NA	NA	NA	NA	NA	NA	10.9	NA	NA	NA	NA	28.1	15.4
Strontium, Total	mg/kg	**NA**	NA	NA	NA	NA	29.1	NA	NA	NA	NA	NA	NA	27.8	NA	NA	NA	NA	50.1	33.4
Sulfur, Total	mg/kg	**NA**	NA	NA	NA	NA	360	NA	NA	NA	NA	NA	NA	292	NA	NA	NA	NA	397	179

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Appendix C - Table 1
NPI High Priority Project Site No. 8, Parcel 13408014
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
			Parcel ID	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014	13408014
			Location ID	CLB-13408014-SS01	CLB-13408014-SS02	CLB-13408014-SS03	CLB-13408014-SS04	CLB-13408014-SS05	CLB-13408014-SS06	CLB-13408014-SS07	CLB-13408014-SS08	CLB-13408014-SS09	CLB-13408014-SS10	CLB-13408014-SS11	CLB-13408014-SS12	CLB-13408014-SS13	CLB-13408014-SS14	CLB-13408014-SS15	CLB-13408014-SS16	13408014-SS16 (Duplicate)
			Field Sample ID	CLB-13408014-SS01-032510	CLB-13408014-SS02-032510	CLB-13408014-SS03-032510	CLB-13408014-SS04-032510	CLB-13408014-SS05-032510	CLB-13408014-SS06-032510	CLB-13408014-SS07-032510	CLB-13408014-SS08-032510	CLB-13408014-SS09-032510	CLB-13408014-SS10-032510	CLB-13408014-SS11-032510	CLB-13408014-SS12-032510	CLB-13408014-SS13-032510	CLB-13408014-SS14-032510	CLB-13408014-SS15-032510	CLB-13408014-SS16-032510	CLB-13408014-SS17-032510
			Sample Date	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**Commercial/Industrial Direct Contact Criteria**																	
Thallium, Total	mg/kg	**6**	230	NA	NA	NA	0 U	NA	NA	NA	NA	NA	NA	0.7	NA	NA	NA	NA	0.4	0.3
Tin, Total	mg/kg	**NA**	NA	NA	NA	NA	1.4	NA	NA	NA	NA	NA	NA	0.7	NA	NA	NA	NA	0.2	0 U
Titanium, Total	mg/kg	**NA**	NA	NA	NA	NA	68.8	NA	NA	NA	NA	NA	NA	28	NA	NA	NA	NA	42.9	29.4
Vanadium, Total	mg/kg	**680**	26,000	NA	NA	NA	7.6	NA	NA	NA	NA	NA	NA	6.1	NA	NA	NA	NA	7.6	6.5
Zinc, Total	mg/kg	**23,000**	880,000	NA	NA	NA	459	NA	NA	NA	NA	NA	NA	631	NA	NA	NA	NA	181	173
Antimony, XRF	mg/kg	**30**	1,200	72 U	81 U	75 U	78 U	**96**	76 U	75 U	76 U	77 U	103 U	91 U	87 U	81 U	91 U	83 U	90 U	82 U
Arsenic, XRF	mg/kg	**6.7**	82	37 U	22 U	36 U	35 U	24 U	20 U	20 U	**34**	**28**	28 U	**77**	**63**	**34**	17 U	30 U	14 U	17 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	51 U	56 U	58	**74**	70	53 U	53 U	54 U	54 U	71 U	63 U	60 U	56 U	62 U	58 U	61 U	56 U
Chromium, XRF	mg/kg	**NA**	NA	151 U	162 U	153 U	156 U	203	143 U	148 U	181	151 U	187 U	185 U	215	154 U	286	317	165 U	155 U
Cobalt, XRF	mg/kg	**1,400**	23,000	221 U	228 U	234 U	232 U	203 U	202 U	203 U	267 U	226 U	250 U	283 U	312 U	214 U	230 U	192 U	260 U	222 U
Copper, XRF	mg/kg	**NA**	NA	137	59	56	96	63	36	52	126	54	33 U	48	37	57	28 U	38	28 U	32
Iron, XRF	mg/kg	**NA**	NA	34,576	33,052	37,604	38,214	29,728	28,289	27,324	47,830	34,247	26,131	43,140	54,844	28,525	28,222	20,548	35,288	32,894
Lead, XRF	mg/kg	**400**	1,800	**830**	207	**734**	**708**	321	194	191	**583**	273	234	**1,538**	240	386	81	**433**	58	117
Manganese, XRF	mg/kg	**NA**	NA	125 U	200	217	366	743	300	333	291	262	385	425	169 U	397	370	120 U	270	438
Mercury, XRF	mg/kg	**7.6**	290	14 U	11 U	12 U	14 U	12 U	12 U	11 U	14 U	13 U	14 U	18 U	12 U	11 U	13 U	12 U	10 U	11 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	9 U	8 U	8 U	8 U	8 U	9 U	8 U	9 U	11 U	10 U	10 U	9 U	10 U	9 U	10 U	9 U
Nickel, XRF	mg/kg	**1,500**	44,000	47 U	48 U	50 U	50 U	45 U	46 U	46 U	79	48 U	60 U	61 U	61 U	49 U	53 U	48 U	56 U	50 U
Rubidium, XRF	mg/kg	**NA**	NA	58	72	67	81	70	70	64	59	76	67	89	65	90	81	61	80	111
Selenium, XRF	mg/kg	**380**	15,000	5 U	4 U	5 U	5 U	4 U	4 U	4 U	5 U	4 U	5 U	7 U	5 U	4 U	4 U	4 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	47 U	52 U	49 U	49 U	48 U	49 U	50 U	50 U	51 U	67 U	59 U	56 U	53 U	59 U	54 U	58 U	112
Strontium, XRF	mg/kg	**NA**	NA	95	96	128	122	110	106	84	278	97	94	127	226	108	93	73	106	135
Tin, XRF	mg/kg	**NA**	NA	74 U	82 U	77 U	80 U	76 U	77 U	77 U	78 U	80 U	105 U	94 U	89 U	83 U	92 U	85 U	92 U	84 U
Titanium, XRF	mg/kg	**NA**	NA	4,184	4,819	4,866	5,686	4,836	5,197	3,881	5,254	5,773	3,212	5,487	6,131	6,574	4,819	2,023	4,864	5,663
Zinc, XRF	mg/kg	**23,000**	880,000	878	270	756	605	458	250	219	1,183	221	179	872	233	240	117	596	127	177
Zirconium, XRF	mg/kg	**NA**	NA	189	193	190	223	223	264	211	159	258	177	212	200	215	223	140	228	216

Notes:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

NA - Not available/Not analyzed for

See electronic deliverable for complete analytical results

U - Non detect

VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria

XRF - X-ray Fluorescence

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Appendix C - Table 2
NPI High Priority Project Site No. 9, Parcel 10427089
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	9	9	9	9	9	9	9	9	9
			Parcel ID	10427089	10427089	10427089	10427089	10427089	10427089	10427089	10427089	10427089
			Location ID	CLB-10427089-SS01	CLB-10427089-SS01 (Duplicate)	CLB-10427089-SS02	CLB-10427089-SS03	CLB-10427089-SS04 [1]	CLB-10427089-SS05	CLB-10427089-SS06	CLB-10427089-SS07	CLB-10427089-SS08
			Field Sample ID	CLB-10427089-SS01-032510	CLB-10427089-SS09-032510	CLB-10427089-SS02-032510	CLB-10427089-SS03-032510	CLB-10427089-SS04-032510	CLB-10427089-SS05-032510	CLB-10427089-SS06-032510	CLB-10427089-SS07-032510	CLB-10427089-SS08-032510
			Sample Date	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
2-Methylnaphthalene	µg/kg	**NA**	NA	332	445	115	132	416	550	237	357	408
Acenaphthene	µg/kg	**3,500,000**	56,000,000	33.6	143 U	32.4 U	30.2 U	160 U	63.7	81	197	181
Acenaphthylene	µg/kg	**NA**	NA	45.3	143 U	177	88.5	160 U	222	55.6	71.2	156 U
Anthracene	µg/kg	**18,000,000**	280,000,000	127	233	192	175	364	272	252	600	503
Benzo(a)anthracene	µg/kg	**11,000**	76,000	475	731	714	499	1,020	839	780	1,420	1,050
Benzo(a)pyrene	µg/kg	**1,100**	7,700	483	762	694	528	1,040	813	748	**1,430**	**1,050**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	485	723	794	509	1,210	875	745	1,340	940
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	322	502	546	434	733	539	465	903	677
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	476	758	663	513	976	803	659	1,280	985
Chrysene	µg/kg	**1,100,000**	7,600,000	548	856	881	587	1,290	1,010	847	1,510	1,190
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	141	212	224	187	299	234	209	394	288
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,020	1,760	1,530	1,020	2,610	1,930	1,730	3,460	2,760
Fluorene	µg/kg	**2,400,000**	37,000,000	30	143 U	32.4 U	30.2 U	160 U	80.3	69.1	178	156 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	297	457	469	356	667	508	433	848	600
Naphthalene	µg/kg	**69,000**	150,000	268	368	120	120	375	468	206	323	346
Phenanthrene	µg/kg	**NA**	NA	541	888	652	504	1,510	1,290	1,020	2,340	1,910
Pyrene	µg/kg	**1,800,000**	28,000,000	877	1,390	1,260	880	2,090	1,590	1,430	2,770	2,150
Aluminum, Total	mg/kg	**NA**	NA	4,180	5,590	NA	NA	5,120	NA	8,330	NA	NA
Antimony, Total	mg/kg	**30**	1,200	3	2.5	NA	NA	3.6	NA	2.1	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	**19.9**	**18.5**	NA	NA	**29.6**	NA	**28.7**	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	307	326	NA	NA	496	NA	452	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	1	0.9	NA	NA	0.6	NA	1.4	NA	NA
Boron, Total	mg/kg	**NA**	NA	13	10.9	NA	NA	12.2	NA	4	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	2	0.9	NA	NA	2	NA	0.9	NA	NA
Calcium, Total	mg/kg	**NA**	NA	14,700	18,000	NA	NA	10,100	NA	24,700	NA	NA
Chromium, Total	mg/kg	**NA**	NA	3.5	1.8	NA	NA	6.8	NA	3	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	6.3	5.2	NA	NA	8.9	NA	8	NA	NA
Copper, Total	mg/kg	**NA**	NA	713	425	NA	NA	1,010	NA	544	NA	NA
Iron, Total	mg/kg	**NA**	NA	14,200	11,600	NA	NA	17,500	NA	20,300	NA	NA
Lead, Total	mg/kg	**400**	1,800	**663**	**503**	NA	NA	**1,680**	NA	**485**	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	2,330	3,260	NA	NA	3,110	NA	5,960	NA	NA
Manganese, Total	mg/kg	**NA**	NA	511	573	NA	NA	1,030	NA	2,320	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	6.2 U	7.8 U	NA	NA	6.4 U	NA	11.2 U	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	24.7	16.2	NA	NA	33	NA	17	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	575	523	NA	NA	955	NA	826	NA	NA
Potassium, Total	mg/kg	**NA**	NA	580	872	NA	NA	686	NA	976	NA	NA
Selenium, Total	mg/kg	**380**	15,000	1.6	1.4	NA	NA	2	NA	1.3 U	NA	NA
Silicon, Total	mg/kg	**NA**	NA	1,080	1,020	NA	NA	1,250	NA	1,390	NA	NA
Sodium, Total	mg/kg	**NA**	NA	594	721	NA	NA	673	NA	673	NA	NA
Strontium 1, Total	mg/kg	**NA**	NA	28.2	34.6	NA	NA	23	NA	46	NA	NA
Strontium, Total	mg/kg	**NA**	NA	32.2	52.9	NA	NA	39.3	NA	61	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	373	396	NA	NA	602	NA	569	NA	NA
Thallium, Total	mg/kg	**6.1**	230	0.1	0.3	NA	NA	0.3 U	NA	2	NA	NA
Tin, Total	mg/kg	**NA**	NA	8.3	5.1	NA	NA	10.4	NA	6	NA	NA
Titanium, Total	mg/kg	**NA**	NA	46.2	53.8	NA	NA	60.8	NA	68	NA	NA
Vanadium, Total	mg/kg	**680**	26,000	3.8	3	NA	NA	3.2	NA	5	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	1,160	582	NA	NA	971	NA	464	NA	NA
Antimony, XRF	mg/kg	**30**	1,200	81 U	81 U	67 U	75 U	82 U	71 U	74 U	78 U	75 U
Arsenic, XRF	mg/kg	**6.7**	82	45 U	44 U	48 U	**85**	64 U	41 U	**40**	38 U	32 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	**87**	56 U	63	52 U	56 U	**94**	65	67	64
Chromium, XRF	mg/kg	**NA**	NA	181 U	174 U	111 U	133 U	175 U	145 U	150 U	166 U	148 U

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Appendix C - Table 2
NPI High Priority Project Site No. 9, Parcel 10427089
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	9	9	9	9	9	9	9	9	9
			Parcel ID	10427089	10427089	10427089	10427089	10427089	10427089	10427089	10427089	10427089
			Location ID	CLB-10427089-SS01	CLB-10427089-SS01 (Duplicate)	CLB-10427089-SS02	CLB-10427089-SS03	CLB-10427089-SS04 [1]	CLB-10427089-SS05	CLB-10427089-SS06	CLB-10427089-SS07	CLB-10427089-SS08
			Field Sample ID	CLB-10427089-SS01-032510	CLB-10427089-SS09-032510	CLB-10427089-SS02-032510	CLB-10427089-SS03-032510	CLB-10427089-SS04-032510	CLB-10427089-SS05-032510	CLB-10427089-SS06-032510	CLB-10427089-SS07-032510	CLB-10427089-SS08-032510
			Sample Date	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010	3/25/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Cobalt, XRF	mg/kg	**1,400**	23,000	277 U	255 U	141 U	178 U	257 U	217 U	217 U	254 U	214 U
Copper, XRF	mg/kg	**NA**	NA	1,064	961	51	170	1,653	397	710	1,881	897
Iron, XRF	mg/kg	**NA**	NA	50,830	43,448	16,480	22,677	42,987	36,139	34,487	43,118	33,872
Lead, XRF	mg/kg	**400**	1,800	**1,104**	**1,003**	**1,669**	**1,862**	**2,189**	**1,032**	**481**	**784**	**599**
Manganese, XRF	mg/kg	**NA**	NA	473	366	692	516	687	579	690	341	539
Mercury, XRF	mg/kg	**7.6**	290	16 U	14 U	12 U	15 U	18 U	15 U	12 U	14 U	14 U
Molybdenum, XRF	mg/kg	**NA**	NA	9	9 U	7 U	8 U	9 U	8 U	8 U	9 U	9
Nickel, XRF	mg/kg	**1,500**	44,000	57 U	55 U	38 U	45 U	68	48 U	49 U	54 U	69
Rubidium, XRF	mg/kg	**NA**	NA	41	49	35	42	43	38	55	55	50
Selenium, XRF	mg/kg	**380**	15,000	6 U	5 U	6 U	6 U	7 U	5 U	4 U	5 U	5 U
Silver, XRF	mg/kg	**380**	15,000	53 U	52 U	43 U	49 U	53 U	47 U	48 U	51 U	49 U
Strontium, XRF	mg/kg	**NA**	NA	139	193	91	136	151	193	130	131	150
Tin, XRF	mg/kg	**NA**	NA	84 U	84 U	68 U	77 U	85 U	74 U	77 U	117	77 U
Titanium, XRF	mg/kg	**NA**	NA	4,234	3,654	1,930	3,896	3,824	2,686	2,893	4,758	4,334
Zinc, XRF	mg/kg	**23,000**	880,000	1,727	1,368	332	651	1,738	1,852	479	809	600
Zirconium, XRF	mg/kg	**NA**	NA	160	174	151	147	169	119	186	184	188

Notes:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

NA - Not available/Not analyzed for

See electronic deliverable for complete analytical results

U - Non detect

VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria

XRF - X-ray Fluorescence

[1] CLB-10427089-SS04-032510 - This sample was also analyzed for full list VOCs (8260); however, none were detected above laboratory detection limits

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Appendix C- Table 3
NPI High Priority Project Site No. 29, Parcel 12320020
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**29**	**29**	**29**	**29**	**29**	**29**	**29**	**29**	**29**
			Parcel ID	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**
			Location ID	**CLB-12320020-SS01**	**CLB-12320020-SS01 [1]**	**CLB-12320020-SS01 [1]**	**CLB-12320020-SS01 [1]**	**CLB-12320020-SS02**	**CLB-12320020-SS03**	**CLB-12320020-SS03 (Duplicate)**	**CLB-12320020-SS04**	**CLB-12320020-SS05**
			Field Sample ID	**CLB-12320020-SS01-032410**	**CLB-12320020-SS01-032410-10**	**CLB-12320020-SS01-032410-11**	**CLB-12320020-SS01-032410-3**	**CLB-12320020-SS02-032410**	**CLB-12320020-SS03-032410**	**CLB-12320020-SS06-032410**	**CLB-12320020-SS04-032410**	**CLB-12320020-SS05-032410**
			Sample Date	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
2-Methylnaphthalene	µg/kg	**NA**	NA	63.6	NA	NA	NA	80.8	84.9	137	184	62.8
Acenaphthene	µg/kg	**3,500,000**	56,000,000	31.8	NA	NA	NA	30.2 U	40.6	91.7	341	30.3 U
Acenaphthylene	µg/kg	**NA**	NA	42.5	NA	NA	NA	30.2 U	29.1 U	35.2	233	30.3 U
Anthracene	µg/kg	**18,000,000**	280,000,000	163	NA	NA	NA	60.6	121	222	1,440	56.3
Benzo(a)anthracene	µg/kg	**11,000**	76,000	498	NA	NA	NA	177	303	611	4,540	189
Benzo(a)pyrene	µg/kg	**1,100**	7,700	552	NA	NA	NA	177	323	660	**5,700**	178
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	568	NA	NA	NA	149	322	646	5,410	184
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	405	NA	NA	NA	114	272	455	4,150	126
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	497	NA	NA	NA	167	319	577	5,190	175
Chrysene	µg/kg	**1,100,000**	7,600,000	586	NA	NA	NA	187	361	708	5,590	212
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	155	NA	NA	NA	47.4	95.3	177	**1,600**	50.3
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,290	NA	NA	NA	411	743	1,590	12,300	427
Fluorene	µg/kg	**2,400,000**	37,000,000	45.8	NA	NA	NA	30.2 U	36.7	84.9	469	30.3 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	347	NA	NA	NA	99.8	209	388	3,780	110
Naphthalene	µg/kg	**69,000**	150,000	59.8	NA	NA	NA	63	64.9	124	205	48.1
Phenanthrene	µg/kg	**NA**	NA	610	NA	NA	NA	243	455	999	5,900	212
Pyrene	µg/kg	**1,800,000**	28,000,000	982	NA	NA	NA	325	578	1,230	9,150	334
Aluminum, Total	mg/kg	**NA**	NA	7,280	NA	NA	NA	NA	4,970	4,740	6,360	NA
Antimony, Total	mg/kg	**30**	1,200	2.1	NA	NA	NA	NA	0.7	1.5	2.7	NA
Arsenic, Total	mg/kg	**6.7**	82	**11.8**	NA	NA	NA	NA	**9.9**	**10.8**	**12**	NA
Barium, Total	mg/kg	**15,000**	370,000	341	NA	NA	NA	NA	268	330	245	NA
Beryllium, Total	mg/kg	**150**	5,100	0.4	NA	NA	NA	NA	0.2	0.3	0.5	NA
Boron, Total	mg/kg	**NA**	NA	15.3	NA	NA	NA	NA	11.8	14.3	19.6	NA
Cadmium, Total	mg/kg	**72**	2,300	0.5	NA	NA	NA	NA	0.6	0.5	0.5	NA
Calcium, Total	mg/kg	**NA**	NA	6,690	NA	NA	NA	NA	3,180	2,960	21,200	NA
Chromium, Total	mg/kg	**NA**	NA	5.2	NA	NA	NA	NA	3.6	2.8	6	NA
Cobalt, Total	mg/kg	**1,400**	23,000	6.2	NA	NA	NA	NA	4.6	5	5.3	NA
Copper, Total	mg/kg	**NA**	NA	45.6	NA	NA	NA	NA	42	37.1	50.5	NA
Iron, Total	mg/kg	**NA**	NA	17,400	NA	NA	NA	NA	14,300	14,900	17,200	NA
Lead, Total	mg/kg	**400**	1,800	**474**	NA	NA	NA	NA	261	251	190	NA
Magnesium, Total	mg/kg	**NA**	NA	2,460	NA	NA	NA	NA	1,200	1,250	6,610	NA
Manganese, Total	mg/kg	**NA**	NA	473	NA	NA	NA	NA	341	343	531	NA
Molybdenum, Total	mg/kg	**NA**	NA	10.5 U	NA	NA	NA	NA	8.2 U	7 U	5 U	NA
Nickel, Total	mg/kg	**1,500**	44,000	15.9	NA	NA	NA	NA	12.8	13.2	16.1	NA
Phosphorus, Total	mg/kg	**NA**	NA	532	NA	NA	NA	NA	569	599	686	NA
Potassium, Total	mg/kg	**NA**	NA	1,040	NA	NA	NA	NA	716	693	1,160	NA
Selenium, Total	mg/kg	**380**	15,000	2.8 U	NA	NA	NA	NA	0.8	0.5	2.3 U	NA
Silicon, Total	mg/kg	**NA**	NA	1,700	NA	NA	NA	NA	1,380	1,030	1,630	NA
Sodium, Total	mg/kg	**NA**	NA	670	NA	NA	NA	NA	797	761	734	NA
Strontium1, Total	mg/kg	**NA**	NA	7.7	NA	NA	NA	NA	11.8	12.4	28	NA
Strontium2, Total	mg/kg	**NA**	NA	22	NA	NA	NA	NA	13.7	15.6	45.6	NA
Sulfur, Total	mg/kg	**NA**	NA	370	NA	NA	NA	NA	179	304	586	NA
Thallium, Total	mg/kg	**6.1**	230	1.1 U	NA	NA	NA	NA	0 U	0.3 U	0.5 U	NA
Tin, Total	mg/kg	**NA**	NA	1	NA	NA	NA	NA	0.8	1.2	0.8	NA

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Appendix C- Table 3
NPI High Priority Project Site No. 29, Parcel 12320020
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**29**	**29**	**29**	**29**	**29**	**29**	**29**	**29**	**29**
			Parcel ID	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**	**12320020**
			Location ID	**CLB-12320020-SS01**	**CLB-12320020-SS01 [1]**	**CLB-12320020-SS01 [1]**	**CLB-12320020-SS01 [1]**	**CLB-12320020-SS02**	**CLB-12320020-SS03**	**CLB-12320020-SS03 (Duplicate)**	**CLB-12320020-SS04**	**CLB-12320020-SS05**
			Field Sample ID	**CLB-12320020-SS01-032410**	**CLB-12320020-SS01-032410-10**	**CLB-12320020-SS01-032410-11**	**CLB-12320020-SS01-032410-3**	**CLB-12320020-SS02-032410**	**CLB-12320020-SS03-032410**	**CLB-12320020-SS06-032410**	**CLB-12320020-SS04-032410**	**CLB-12320020-SS05-032410**
			Sample Date	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Titanium, Total	mg/kg	**NA**	NA	73	NA	NA	NA	NA	59.5	58.2	84.2	NA
Vanadium, Total	mg/kg	**680**	26,000	6.3	NA	NA	NA	NA	4	3	5.2	NA
Zinc, Total	mg/kg	**23,000**	880,000	354	NA	NA	NA	NA	244	245	294	NA
Antimony, XRF	mg/kg	**30**	1,200	NA	75 U	72 U	73 U	85 U	77 U	76 U	85 U	73 U
Arsenic, XRF	mg/kg	**6.7**	82	NA	34 U	**45**	**101**	24 U	27 U	26 U	23 U	21 U
Barium, XRF	mg/kg	**15,000**	370,000	NA	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	NA	52 U	50 U	59	59 U	58	53 U	59 U	51 U
Chromium, XRF	mg/kg	**NA**	NA	NA	137 U	133 U	161	158 U	137 U	131 U	168 U	127 U
Cobalt, XRF	mg/kg	**1,400**	23,000	NA	194 U	174 U	178 U	199 U	191 U	178 U	238 U	176 U
Copper, XRF	mg/kg	**NA**	NA	NA	30	58	59	32	65	38	69	48
Iron, XRF	mg/kg	**NA**	NA	NA	27,049	23,031	23,349	23,065	26,566	23,177	34,176	23,025
Lead, XRF	mg/kg	**400**	1,800	NA	**680**	**879**	**1,112**	236	**417**	398	225	238
Manganese, XRF	mg/kg	**NA**	NA	NA	303	293	297	141	238	293	405	322
Mercury, XRF	mg/kg	**7.6**	290	NA	11 U	13 U	13 U	12 U	12 U	11 U	12 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	NA	8 U	8 U	8 U	9 U	8 U	8 U	9 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	NA	44 U	42 U	43 U	49 U	46 U	44 U	52 U	44
Rubidium, XRF	mg/kg	**NA**	NA	NA	59	62	47	41	52	46	61	46
Selenium, XRF	mg/kg	**380**	15,000	NA	5 U	5 U	5 U	4 U	4 U	4 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	NA	49 U	47 U	47 U	55 U	63	49 U	55 U	48 U
Strontium, XRF	mg/kg	**NA**	NA	NA	92	89	83	105	102	95	124	96
Tin, XRF	mg/kg	**NA**	NA	NA	77 U	73 U	74 U	87 U	78 U	78 U	86 U	75 U
Titanium, XRF	mg/kg	**NA**	NA	NA	3,715	2,748	3,969	3,186	4,142	4,127	5,321	3,829
Zinc, XRF	mg/kg	**23,000**	880,000	NA	373	365	501	216	453	243	359	299
Zirconium, XRF	mg/kg	**NA**	NA	NA	217	201	184	193	223	187	190	188

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results
[1] - Sample CLB-12320020-SS01 was screened with the XRF three times. Results for all three readings are included.

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Appendix C- Table 4a
NPI High Priority Project Site No. 41, Parcel 11827011
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	41	41	41	41	41	41
			Parcel ID	11827011	11827011	11827011	11827011	11827011	11827011
			Location ID	CLB-11827011-SS01	CLB-11827011-SS01 (Duplicate)	CLB-11827011-SS02	CLB-11827011-SS03	CLB-11827011-SS04	CLB-11827011-SS05
			Field Sample ID	CLB-11827011-SS01-032610	CLB-11827011-SS06-032610	CLB-11827011-SS02-032610	CLB-11827011-SS03-032610	CLB-11827011-SS04-032610	CLB-11827011-SS05-032610
			Sample Date	3/26/2010	3/26/2010	3/26/2010	3/26/2010	3/26/2010	3/26/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	40.5 U	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	28.2 U	28.1 U	77.6	98	28.3 U	27.9 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	28.2 U	28.1 U	31.3	29.1 U	28.3 U	27.9 U
Acenaphthylene	µg/kg	**NA**	NA	28.2 U	28.1 U	28.9 U	29.4	28.3 U	27.9 U
Anthracene	µg/kg	**18,000,000**	280,000,000	28.2 U	28.1 U	131	102	93.9	43.8
Benzo(a)anthracene	µg/kg	**11,000**	76,000	28.2 U	28.1 U	310	286	225	90.2
Benzo(a)pyrene	µg/kg	**1,100**	7,700	28.2 U	28.1 U	303	297	233	98.7
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	28.2 U	28.1 U	307	302	216	83.1
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	28.2 U	28.1 U	215	241	158	59.5
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	28.2 U	28.1 U	285	268	221	95.6
Chrysene	µg/kg	**1,100,000**	7,600,000	28.2 U	28.1 U	347	330	255	105
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	28.2 U	28.1 U	85.9	87.6	62.8	27.9 U
Fluoranthene	µg/kg	**2,400,000**	37,000,000	28.2 U	28.1 U	737	665	544	196
Fluorene	µg/kg	**2,400,000**	37,000,000	28.2 U	28.1 U	35.1	29.1 U	28.3 U	27.9 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	28.2 U	28.1 U	184	185	133	53.7
Naphthalene	µg/kg	**69,000**	150,000	28.2 U	28.1 U	58.1	71.5	28.3 U	27.9 U
Phenanthrene	µg/kg	**NA**	NA	28.2 U	28.1 U	415	335	289	90.4
Pyrene	µg/kg	**1,800,000**	28,000,000	28.2 U	28.1 U	564	533	424	171
Aluminum, Total	mg/kg	**NA**	NA	5,080	2,490	NA	13,500	6,800	NA
Antimony, Total	mg/kg	**30**	1,200	0.6	0.7	NA	9.1	1.9	NA
Arsenic, Total	mg/kg	**6.7**	82	**8.5**	4.3	NA	**18**	**14.9**	NA
Barium, Total	mg/kg	**15,000**	370,000	127	113	NA	341	163	NA
Beryllium, Total	mg/kg	**150**	5,100	0 U	0 U	NA	0.5 U	0.2	NA
Boron, Total	mg/kg	**NA**	NA	0.8	4.3	NA	7.6	1.7 U	NA
Cadmium, Total	mg/kg	**72**	2,300	0.4	0.2	NA	0.2	0.1	NA
Calcium, Total	mg/kg	**NA**	NA	2,090	1,050	NA	65,700	9,120	NA
Chromium, Total	mg/kg	**NA**	NA	2.8	2.3	NA	375	3	NA
Cobalt, Total	mg/kg	**1,400**	23,000	3.6	1.8	NA	7.8	5.6	NA
Copper, Total	mg/kg	**NA**	NA	11.6	5.3	NA	36.6	25.2	NA
Iron, Total	mg/kg	**NA**	NA	8,620	4,120	NA	57,900	19,600	NA
Lead, Total	mg/kg	**400**	1,800	17	8.9	NA	77.5	65.2	NA
Magnesium, Total	mg/kg	**NA**	NA	1,580	767	NA	13,900	3,300	NA
Manganese, Total	mg/kg	**NA**	NA	63.7	29	NA	8,550	237	NA
Molybdenum, Total	mg/kg	**NA**	NA	9.5 U	6.3 U	NA	25.4 U	12.1 U	NA
Nickel, Total	mg/kg	**1,500**	44,000	10	4.7	NA	17.6	12.4	NA
Phosphorus, Total	mg/kg	**NA**	NA	641	329	NA	988	346	NA
Potassium, Total	mg/kg	**NA**	NA	1,060	537	NA	1,100	618	NA
Selenium, Total	mg/kg	**380**	15,000	0.5 U	0.9 U	NA	2.8 U	1.3 U	NA
Silicon, Total	mg/kg	**NA**	NA	187	745	NA	1,130	945	NA
Sodium, Total	mg/kg	**NA**	NA	420	300	NA	642	477	NA
Strontium1, Total	mg/kg	**NA**	NA	9.8	3.6	NA	274	20.3	NA

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Appendix C- Table 4a
NPI High Priority Project Site No. 41, Parcel 11827011
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827011**	**11827011**	**11827011**	**11827011**	**11827011**	**11827011**
			Location ID	**CLB-11827011-SS01**	**CLB-11827011-SS01 (Duplicate)**	**CLB-11827011-SS02**	**CLB-11827011-SS03**	**CLB-11827011-SS04**	**CLB-11827011-SS05**
			Field Sample ID	**CLB-11827011-SS01-032610**	**CLB-11827011-SS06-032610**	**CLB-11827011-SS02-032610**	**CLB-11827011-SS03-032610**	**CLB-11827011-SS04-032610**	**CLB-11827011-SS05-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Strontium2, Total	mg/kg	**NA**	NA	10.8	5.5	NA	298	23.8	NA
Sulfur, Total	mg/kg	**NA**	NA	209	126	NA	649	128	NA
Thallium, Total	mg/kg	**6.1**	230	0.2 U	0.6 U	NA	**10.4**	0.2	NA
Tin, Total	mg/kg	**NA**	NA	0.4	0.2	NA	0.9	0.3	NA
Titanium, Total	mg/kg	**NA**	NA	115	61	NA	529	59.3	NA
Vanadium, Total	mg/kg	**680**	26,000	7.1	2.5	NA	236	7.3	NA
Zinc, Total	mg/kg	**23,000**	880,000	114	100	NA	263	153	NA
Antimony, XRF	mg/kg	**30**	1,200	71 U	72 U	97 U	82 U	72 U	71 U
Arsenic, XRF	mg/kg	**7**	82	8 U	8 U	16 U	17 U	**14**	9 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	49 U	**77**	67 U	57 U	50 U	49 U
Chromium, XRF	mg/kg	**NA**	NA	98 U	98 U	171 U	167 U	115 U	104 U
Cobalt, XRF	mg/kg	**1,400**	23,000	103 U	99 U	250 U	224 U	144 U	116 U
Copper, XRF	mg/kg	**NA**	NA	20 U	20 U	81	25 U	20 U	21 U
Iron, XRF	mg/kg	**NA**	NA	7,988	7,716	29,284	31,836	15,812	11,038
Lead, XRF	mg/kg	**400**	1,800	15	12	67	117	45	33
Manganese, XRF	mg/kg	**NA**	NA	73 U	73 U	375	763	90 U	73 U
Mercury, XRF	mg/kg	**7.6**	290	9 U	8 U	12 U	11 U	9 U	8 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	10 U	9 U	8	7 U
Nickel, XRF	mg/kg	**1,500**	44,000	35 U	36 U	59 U	50 U	38 U	37 U
Rubidium, XRF	mg/kg	**NA**	NA	31	32	80	67	44	27
Selenium, XRF	mg/kg	**380**	15,000	3 U	3 U	4 U	4 U	3 U	3 U
Silver, XRF	mg/kg	**380**	15,000	46 U	47	62 U	54 U	47 U	46 U
Strontium, XRF	mg/kg	**NA**	NA	144	139	109	117	98	95
Tin, XRF	mg/kg	**NA**	NA	72 U	73 U	99 U	85 U	74 U	72 U
Titanium, XRF	mg/kg	**NA**	NA	2,460	3,083	4,271	4,813	3,083	3,515
Zinc, XRF	mg/kg	**23,000**	880,000	21	23	109	153	76	56
Zirconium, XRF	mg/kg	**NA**	NA	319	421	199	262	324	186

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 4b
NPI High Priority Project Site No. 41, Parcel 11827012
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**
			Location ID	**CLB-11827012-SS01**	**CLB-11827012-SS02**	**CLB-11827012-SS02 (Duplicate)**	**CLB-11827012-SS03**	**CLB-11827012-SS04**	**CLB-11827012-SS05**	**CLB-11827012-SS06**	**CLB-11827012-SS07**	**CLB-11827012-SS08**
			Field Sample ID	**CLB-11827012-SS01-032610**	**CLB-11827012-SS02-032610**	**CLB-11827012-SS09-032610**	**CLB-11827012-SS03-032610**	**CLB-11827012-SS04-032610**	**CLB-11827012-SS05-032610**	**CLB-11827012-SS06-032610**	**CLB-11827012-SS07-032610**	**CLB-11827012-SS08-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Percent Moisture	%			16	12.1	6.9	13.5	11.9	12.4	13	13.7	13.2
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	61.8	86.7	72.1	36.7	215	28.5	28.7 U	29 U	79.6
Acenaphthene	µg/kg	**3,500,000**	56,000,000	56.3	153	103	42.3	960	28.5 U	28.7 U	62.8	294
Acenaphthylene	µg/kg	**NA**	NA	38.5	32.6	28.2	28.9 U	196	28.5 U	28.7 U	29 U	28.8 U
Anthracene	µg/kg	**18,000,000**	280,000,000	184	413	358	121	2,730	97	37.8	423	625
Benzo(a)anthracene	µg/kg	**11,000**	76,000	525	1,040	907	253	5,330	240	66.9	1,050	1,230
Benzo(a)pyrene	µg/kg	**1,100**	7,700	514	1,020	892	252	**4,380**	239	67.1	923	**1,140**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	459	866	785	206	4,140	207	55	854	946
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	317	581	507	145	2,470	164	41.9	503	590
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	466	907	764	245	4,000	229	70.8	839	912
Chrysene	µg/kg	**1,100,000**	7,600,000	558	1,040	909	279	5,320	268	78.7	1,040	1,200
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	139	276	234	60.7	**1,260**	59.8	28.7 U	252	271
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,320	2,340	2,120	572	13,200	562	168	2,300	3,090
Fluorene	µg/kg	**2,400,000**	37,000,000	51.5	131	82.9	31.2	1,010	28.5 U	28.7 U	67.7	202
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	291	551	481	132	2,400	131	36.6	495	564
Naphthalene	µg/kg	**69,000**	150,000	65.4	78	65.7	35.8	245	28.5 U	28.7 U	29 U	99.4
Phenanthrene	µg/kg	**NA**	NA	719	1,380	1,080	325	11,500	267	103	1,030	2,250
Pyrene	µg/kg	**1,800,000**	28,000,000	1,040	1,880	1,600	481	10,200	451	138	1,760	2,380
Aluminum, Total	mg/kg	**NA**	NA	8,520	6,380	8,190	NA	6,510	NA	NA	NA	NA
Antimony, Total	mg/kg	**30**	1,200	2.2	2.6	2.2	NA	1.4	NA	NA	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	**13.2**	**14.2**	**16.2**	NA	**10.7**	NA	NA	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	198	151	176	NA	184	NA	NA	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	0.4	0.3	0.3	NA	0.3	NA	NA	NA	NA
Boron, Total	mg/kg	**NA**	NA	1.7	0.9	3.6	NA	1.3	NA	NA	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	0.4	0 U	0.4	NA	0.1 U	NA	NA	NA	NA
Calcium, Total	mg/kg	**NA**	NA	12,100	30,900	12,000	NA	11,600	NA	NA	NA	NA
Chromium, Total	mg/kg	**NA**	NA	8.7	2.2	24.6	NA	3.2	NA	NA	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	8.5	7.3	7.8	NA	7.3	NA	NA	NA	NA
Copper, Total	mg/kg	**NA**	NA	26.9	22.1	23.2	NA	23.4	NA	NA	NA	NA
Iron, Total	mg/kg	**NA**	NA	20,200	18,400	23,000	NA	15,900	NA	NA	NA	NA
Lead, Total	mg/kg	**400**	1,800	232	48.4	51	NA	55.8	NA	NA	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	4,120	3,770	4,220	NA	3,680	NA	NA	NA	NA
Manganese, Total	mg/kg	**NA**	NA	525	291	811	NA	320	NA	NA	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	13.8 U	11.9 U	13.6 U	NA	11.3 U	NA	NA	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	20.9	18.3	20	NA	18.7	NA	NA	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	365	292	264	NA	328	NA	NA	NA	NA
Potassium, Total	mg/kg	**NA**	NA	1,070	1,150	1,350	NA	1,080	NA	NA	NA	NA
Selenium, Total	mg/kg	**380**	15,000	5 U	5 U	6.2 U	NA	0.9 U	NA	NA	NA	NA
Silicon, Total	mg/kg	**NA**	NA	866	865	861	NA	806	NA	NA	NA	NA
Sodium, Total	mg/kg	**NA**	NA	399	456	396	NA	557	NA	NA	NA	NA
Strontium1, Total	mg/kg	**NA**	NA	11.3	26.3	23.2	NA	11.9	NA	NA	NA	NA
Strontium2, Total	mg/kg	**NA**	NA	26.7	45.3	25.9	NA	29.5	NA	NA	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	558	1,250	2,750	NA	1,340	NA	NA	NA	NA
Thallium, Total	mg/kg	**6.1**	230	0.7	0.3	0.9	NA	0.1	NA	NA	NA	NA
Tin, Total	mg/kg	**NA**	NA	0.4	0.2	0.4	NA	0 U	NA	NA	NA	NA
Titanium, Total	mg/kg	**NA**	NA	56.3	37.2	46	NA	39.5	NA	NA	NA	NA

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Appendix C - Table 4b
NPI High Priority Project Site No. 41, Parcel 11827012
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**	**11827012**
			Location ID	**CLB-11827012-SS01**	**CLB-11827012-SS02**	**CLB-11827012-SS02 (Duplicate)**	**CLB-11827012-SS03**	**CLB-11827012-SS04**	**CLB-11827012-SS05**	**CLB-11827012-SS06**	**CLB-11827012-SS07**	**CLB-11827012-SS08**
			Field Sample ID	**CLB-11827012-SS01-032610**	**CLB-11827012-SS02-032610**	**CLB-11827012-SS09-032610**	**CLB-11827012-SS03-032610**	**CLB-11827012-SS04-032610**	**CLB-11827012-SS05-032610**	**CLB-11827012-SS06-032610**	**CLB-11827012-SS07-032610**	**CLB-11827012-SS08-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Vanadium, Total	mg/kg	**680**	26,000	10.1	4.3	10.5	NA	5.3	NA	NA	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	219	161	212	NA	168	NA	NA	NA	NA
Antimony, XRF	mg/kg	**30**	1,200	84 U	83 U	79 U	84 U	82 U	87 U	77 U	84 U	73 U
Arsenic, XRF	mg/kg	**7**	82	18 U	**25**	13 U	**20**	15 U	14 U	**15**	**21**	14 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	58 U	58 U	55 U	**76**	**87**	60 U	53 U	58 U	64
Chromium, XRF	mg/kg	**NA**	NA	127 U	142 U	141 U	153 U	133 U	158 U	138 U	170 U	118 U
Cobalt, XRF	mg/kg	**1,400**	23,000	191 U	207 U	183 U	207 U	187 U	223 U	196 U	250 U	148 U
Copper, XRF	mg/kg	**NA**	NA	24 U	26 U	25 U	26 U	26	27 U	23 U	26 U	22 U
Iron, XRF	mg/kg	**NA**	NA	22,062	26,254	23,198	27,425	23,168	27,397	27,410	38,285	17,184
Lead, XRF	mg/kg	**400**	1,800	126	50	59	17	92	53	29	42	103
Manganese, XRF	mg/kg	**NA**	NA	192	115 U	104 U	122 U	169	156	108 U	214	101
Mercury, XRF	mg/kg	**7.6**	290	11 U	10 U	11 U	9 U	11 U	10 U	11 U	11 U	9 U
Molybdenum, XRF	mg/kg	**NA**	NA	9 U	9 U	8 U	9 U	8 U	9 U	8 U	9 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	48 U	48 U	46 U	67	45 U	51 U	59	52 U	40 U
Rubidium, XRF	mg/kg	**NA**	NA	56	70	70	93	57	83	94	93	32
Selenium, XRF	mg/kg	**380**	15,000	4 U	4 U	4 U	4 U	4 U	4 U	3 U	4 U	3 U
Silver, XRF	mg/kg	**380**	15,000	54 U	54 U	51 U	76	52 U	56 U	49 U	54 U	47 U
Strontium, XRF	mg/kg	**NA**	NA	86	107	120	116	80	107	121	156	95
Tin, XRF	mg/kg	**NA**	NA	85 U	84 U	82 U	86 U	83 U	89 U	78 U	86 U	74 U
Titanium, XRF	mg/kg	**NA**	NA	2,948	3,518	3,621	4,055	2,895	3,828	3,775	5,119	3,483
Zinc, XRF	mg/kg	**23,000**	880,000	120	76	85	70	154	83	72	116	105
Zirconium, XRF	mg/kg	**NA**	NA	201	158	161	175	164	227	196	289	125

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 4c
NPI High Priority Project Site No. 41, Parcel 11827013
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**
			Location ID	**CLB-11827013-SS01**	**CLB-11827013-SS02**	**CLB-11827013-SS03**	**CLB-11827013-SS04**	**CLB-11827013-SS05**	**CLB-11827013-SS06**	**CLB-11827013-SS07**	**CLB-11827013-SS08**	**CLB-11827013-SS08 (Duplicate)**	**CLB-11827013-SS09**	**CLB-11827013-SS10**	**CLB-11827013-SS11**	**CLB-11827013-SS12**
			Field Sample ID	**CLB-11827013-SS01-032910**	**CLB-11827013-SS02-032910**	**CLB-11827013-SS03-032910**	**CLB-11827013-SS04-032910**	**CLB-11827013-SS05-032910**	**CLB-11827013-SS06-032910**	**CLB-11827013-SS07-032910**	**CLB-11827013-SS08-032910**	**CLB-11827013-SS13-032910**	**CLB-11827013-SS09-032910**	**CLB-11827013-SS10-032910**	**CLB-11827013-SS11-032910**	**CLB-11827013-SS12-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**													
Percent Moisture	%			15.7	12	13.2	14.2	12.4	12.2	14.7	12.6	10.3	14.7	12.6	14	11.1
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	498	154	69.8	87.1	54.9	101	118	93.9	124	29.3 U	82.9	98.1	47.4
Acenaphthene	µg/kg	**3,500,000**	56,000,000	635	266	60.8	34.9	129	337	423	81.4	59	29.3 U	29.9	29.1 U	55.5
Acenaphthylene	µg/kg	**NA**	NA	198	54.9	149	42.1	28.5 U	28.5 U	29.3 U	122	139	29.3 U	28.6 U	29.1 U	28.1 U
Anthracene	µg/kg	**18,000,000**	280,000,000	1,590	760	365	142	479	947	1,190	362	307	89.5	129	75.4	179
Benzo(a)anthracene	µg/kg	**11,000**	76,000	2,910	1,840	970	398	936	1,690	1,990	853	834	210	304	154	397
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**2,890**	**1,780**	947	419	876	**1,640**	**1,680**	835	814	234	345	164	391
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	2,670	1,530	902	363	691	1,430	1,530	799	734	198	289	151	311
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	1,890	1,000	591	264	493	899	885	598	533	167	401	170	222
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	2,250	1,430	792	389	796	1,280	1,330	718	768	232	299	130	367
Chrysene	µg/kg	**1,100,000**	7,600,000	2,920	1,750	1,000	428	904	1,610	1,850	912	879	228	356	169	422
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	803	452	257	111	220	404	432	231	228	65.3	90.5	43.8	98.3
Fluoranthene	µg/kg	**2,400,000**	37,000,000	6,610	4,070	2,160	881	2,120	3,940	4,680	1,910	1,760	434	677	336	897
Fluorene	µg/kg	**2,400,000**	37,000,000	534	211	80	32.4	120	276	370	71.5	57	29.3 U	28.6 U	29.1 U	32.8
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	1,620	943	536	243	471	855	869	488	482	151	210	97.7	211
Naphthalene	µg/kg	**69,000**	150,000	526	181	81.9	81.2	62.4	134	140	96.1	124	29.3 U	69	62.6	48.4
Phenanthrene	µg/kg	**NA**	NA	5,150	2,330	1,160	454	1,380	2,590	3,740	1,050	846	181	334	194	456
Pyrene	µg/kg	**1,800,000**	28,000,000	5,480	3,340	1,760	725	1,710	3,180	3,650	1,620	1,500	355	604	293	740
Aluminum, Total	mg/kg	**NA**	NA	6,130	NA	NA	NA	NA	5,300	NA	5,260	NA	NA	NA	NA	4,770
Antimony, Total	mg/kg	**30**	1,200	5.1	NA	NA	NA	NA	1	NA	1.9	NA	NA	NA	NA	1.3
Arsenic, Total	mg/kg	**6.7**	82	**14.7**	NA	NA	NA	NA	**8.3**	NA	**7.6**	NA	NA	NA	NA	**9**
Barium, Total	mg/kg	**15,000**	370,000	384	NA	NA	NA	NA	175	NA	255	NA	NA	NA	NA	178
Beryllium, Total	mg/kg	**150**	5,100	0.8	NA	NA	NA	NA	0.2	NA	0.2	NA	NA	NA	NA	0.1
Boron, Total	mg/kg	**NA**	NA	17.6	NA	NA	NA	NA	10.3	NA	10.2	NA	NA	NA	NA	10.8
Cadmium, Total	mg/kg	**72**	2,300	1.4	NA	NA	NA	NA	0 U	NA	0.3	NA	NA	NA	NA	0.2
Calcium, Total	mg/kg	**NA**	NA	16,800	NA	NA	NA	NA	9,100	NA	9,540	NA	NA	NA	NA	3,960
Chromium, Total	mg/kg	**NA**	NA	4.6	NA	NA	NA	NA	0.8	NA	13.3	NA	NA	NA	NA	0.5
Cobalt, Total	mg/kg	**1,400**	23,000	9.7	NA	NA	NA	NA	5.6	NA	3.7	NA	NA	NA	NA	4.9
Copper, Total	mg/kg	**NA**	NA	58.8	NA	NA	NA	NA	15.1	NA	27.2	NA	NA	NA	NA	13.8
Iron, Total	mg/kg	**NA**	NA	15,300	NA	NA	NA	NA	13,200	NA	13,900	NA	NA	NA	NA	13,300
Lead, Total	mg/kg	**400**	1,800	**663**	NA	NA	NA	NA	35.5	NA	397	NA	NA	NA	NA	41.8
Magnesium, Total	mg/kg	**NA**	NA	2,740	NA	NA	NA	NA	2,380	NA	2,240	NA	NA	NA	NA	1,840
Manganese, Total	mg/kg	**NA**	NA	356	NA	NA	NA	NA	210	NA	669	NA	NA	NA	NA	216
Molybdenum, Total	mg/kg	**NA**	NA	6.8 U	NA	NA	NA	NA	9 U	NA	8.2 U	NA	NA	NA	NA	7.9 U
Nickel, Total	mg/kg	**1,500**	44,000	18	NA	NA	NA	NA	14.5	NA	12.1	NA	NA	NA	NA	13.2
Phosphorus, Total	mg/kg	**NA**	NA	362	NA	NA	NA	NA	249	NA	380	NA	NA	NA	NA	308
Potassium, Total	mg/kg	**NA**	NA	904	NA	NA	NA	NA	914	NA	534	NA	NA	NA	NA	822
Selenium, Total	mg/kg	**380**	15,000	0.7 U	NA	NA	NA	NA	0.2	NA	2.8 U	NA	NA	NA	NA	0.5
Silicon, Total	mg/kg	**NA**	NA	1,350	NA	NA	NA	NA	1,430	NA	1,570	NA	NA	NA	NA	1,420
Sodium, Total	mg/kg	**NA**	NA	684	NA	NA	NA	NA	647	NA	572	NA	NA	NA	NA	604
Strontium1, Total	mg/kg	**NA**	NA	29	NA	NA	NA	NA	14.5	NA	14	NA	NA	NA	NA	10.5
Strontium2, Total	mg/kg	**NA**	NA	47.3	NA	NA	NA	NA	17.5	NA	29.4	NA	NA	NA	NA	11.4
Sulfur, Total	mg/kg	**NA**	NA	458	NA	NA	NA	NA	661	NA	235	NA	NA	NA	NA	452
Thallium, Total	mg/kg	**6.1**	230	4	NA	NA	NA	NA	0.1 U	NA	0.5	NA	NA	NA	NA	0.1
Tin, Total	mg/kg	**NA**	NA	2.6	NA	NA	NA	NA	0.2	NA	1.2	NA	NA	NA	NA	0.1 U
Titanium, Total	mg/kg	**NA**	NA	91.3	NA	NA	NA	NA	46.7	NA	82.2	NA	NA	NA	NA	48
Vanadium, Total	mg/kg	**680**	26,000	5.2	NA	NA	NA	NA	1.8	NA	10.7	NA	NA	NA	NA	2.4
Zinc, Total	mg/kg	**23,000**	880,000	351	NA	NA	NA	NA	132	NA	253	NA	NA	NA	NA	134

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Appendix C - Table 4c
NPI High Priority Project Site No. 41, Parcel 11827013
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**	**11827013**
			Location ID	**CLB-11827013-SS01**	**CLB-11827013-SS02**	**CLB-11827013-SS03**	**CLB-11827013-SS04**	**CLB-11827013-SS05**	**CLB-11827013-SS06**	**CLB-11827013-SS07**	**CLB-11827013-SS08**	**CLB-11827013-SS08 (Duplicate)**	**CLB-11827013-SS09**	**CLB-11827013-SS10**	**CLB-11827013-SS11**	**CLB-11827013-SS12**
			Field Sample ID	**CLB-11827013-SS01-032910**	**CLB-11827013-SS02-032910**	**CLB-11827013-SS03-032910**	**CLB-11827013-SS04-032910**	**CLB-11827013-SS05-032910**	**CLB-11827013-SS06-032910**	**CLB-11827013-SS07-032910**	**CLB-11827013-SS08-032910**	**CLB-11827013-SS13-032910**	**CLB-11827013-SS09-032910**	**CLB-11827013-SS10-032910**	**CLB-11827013-SS11-032910**	**CLB-11827013-SS12-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**													
Antimony, XRF	mg/kg	**30**	1,200	70 U	73 U	75 U	73 U	66 U	79 U	73 U	79 U	NA	88 U	88 U	102 U	75 U
Arsenic, XRF	mg/kg	**7**	82	32 U	13 U	34 U	27 U	13 U	**17**	12 U	30 U	NA	**23**	12 U	**15**	**16**
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	NA	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	49 U	50 U	53	51 U	47 U	54 U	50 U	55 U	NA	60 U	59 U	70 U	52 U
Chromium, XRF	mg/kg	**NA**	NA	133 U	120 U	132 U	137 U	104 U	160	114 U	136 U	NA	174 U	151 U	229 U	120 U
Cobalt, XRF	mg/kg	**1,400**	23,000	178 U	148 U	184 U	188 U	155 U	174 U	134 U	188 U	NA	247 U	218 U	364 U	165 U
Copper, XRF	mg/kg	**NA**	NA	42	22	43	29	20 U	23 U	21 U	27	NA	26 U	37	31 U	22 U
Iron, XRF	mg/kg	**NA**	NA	25,310	17,434	25,338	26,311	20,275	21,468	13,998	22,599	NA	35,554	27,557	53,964	20,220
Lead, XRF	mg/kg	**400**	1,800	**673**	86	**650**	**451**	103	39	73	**437**	NA	42	43	30	44
Manganese, XRF	mg/kg	**NA**	NA	139	94 U	233	144	119	120	86 U	130	NA	728	176	178 U	178
Mercury, XRF	mg/kg	**7.6**	290	11 U	10 U	11 U	11 U	8 U	11 U	9 U	11 U	NA	12 U	11 U	13 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	7 U	8 U	8 U	9 U	NA	9 U	9 U	12 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	43 U	40 U	44 U	43 U	38 U	45 U	39 U	44 U	NA	53 U	52 U	68 U	43 U
Rubidium, XRF	mg/kg	**NA**	NA	23	35	41	32	58	57	38	38	NA	87	79	83	56
Selenium, XRF	mg/kg	**380**	15,000	4 U	3 U	4 U	4 U	3 U	4 U	3 U	4 U	NA	4 U	4 U	5 U	3 U
Silver, XRF	mg/kg	**380**	15,000	45 U	47 U	49 U	48 U	43 U	110	47 U	52 U	NA	56 U	72	66 U	48 U
Strontium, XRF	mg/kg	**NA**	NA	130	115	144	110	122	111	110	121	NA	100	125	166	117
Tin, XRF	mg/kg	**NA**	NA	71 U	74 U	77 U	75 U	67 U	81 U	74 U	81 U	NA	89 U	89 U	103 U	77 U
Titanium, XRF	mg/kg	**NA**	NA	3,522	3,183	4,608	5,146	2,327	3,394	2,879	2,322	NA	4,396	5,408	7,032	3,547
Zinc, XRF	mg/kg	**23,000**	880,000	371	87	506	326	62	67	99	258	NA	106	101	88	73
Zirconium, XRF	mg/kg	**NA**	NA	147	147	238	161	153	185	204	160	NA	210	289	229	240

Notes:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 4d
NPI High Priority Project Site No. 41, Parcel 11827014
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	41	41	41	41	41	41
			Parcel ID	11827014	11827014	11827014	11827014	11827014	11827014
			Location ID	CLB-11827014-SS01	CLB-11827014-SS02	CLB-11827014-SS03	CLB-11827014-SS04	CLB-11827014-SS05	CLB-11827014-SS06
			Field Sample ID	CLB-11827014-SS01-032910	CLB-11827014-SS02-032910	CLB-11827014-SS03-032910	CLB-11827014-SS04-032910	CLB-11827014-SS05-032910	CLB-11827014-SS06-032910
			Sample Date	3/29/2010	3/29/2010	3/29/2010	3/29/2010	3/29/2010	3/29/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Percent Moisture	%			9.2	14.2	14.3	11.9	16.9	18.3
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	64.4	68.1	76.7	257	157	396
Acenaphthene	µg/kg	**3,500,000**	56,000,000	165	166	29.2 U	1,080	140	197
Acenaphthylene	µg/kg	**NA**	NA	27.5 U	32.6	29.2 U	69.1	87.3	192
Anthracene	µg/kg	**18,000,000**	280,000,000	477	599	93	2,830	402	785
Benzo(a)anthracene	µg/kg	**11,000**	76,000	896	1,700	268	5,670	746	1,690
Benzo(a)pyrene	µg/kg	**1,100**	7,700	840	**1,530**	286	**5,110**	740	**1,650**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	713	1,230	253	4,640	643	1,460
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	481	849	195	2,830	462	1,040
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	708	1,410	287	3,930	624	1,530
Chrysene	µg/kg	**1,100,000**	7,600,000	887	1,600	300	5,220	761	1,780
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	210	393	78.4	**1,320**	183	446
Fluoranthene	µg/kg	**2,400,000**	37,000,000	2,180	3,560	555	13,100	1,970	3,920
Fluorene	µg/kg	**2,400,000**	37,000,000	122	110	29.2 U	825	128	214
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	453	828	179	2,750	412	948
Naphthalene	µg/kg	**69,000**	150,000	76.5	78.1	54.2	274	165	386
Phenanthrene	µg/kg	**NA**	NA	1,410	1,740	202	8,860	1,450	2,540
Pyrene	µg/kg	**1,800,000**	28,000,000	1,740	2,990	479	10,700	1,510	3,190
Aluminum, Total	mg/kg	**NA**	NA	3,690	NA	4,040	NA	NA	8,560
Antimony, Total	mg/kg	**30**	1,200	1.4	NA	0.4	NA	NA	2.4
Arsenic, Total	mg/kg	**6.7**	82	5.5	NA	6.7	NA	NA	**14.4**
Barium, Total	mg/kg	**15,000**	370,000	158	NA	242	NA	NA	440
Beryllium, Total	mg/kg	**150**	5,100	0 U	NA	0 U	NA	NA	0.8
Boron, Total	mg/kg	**NA**	NA	11.2	NA	8.6	NA	NA	16
Cadmium, Total	mg/kg	**72**	2,300	0.2	NA	0.4	NA	NA	0.7
Calcium, Total	mg/kg	**NA**	NA	5,750	NA	2,770	NA	NA	19,800
Chromium, Total	mg/kg	**NA**	NA	1.8	NA	1.5	NA	NA	4.9
Cobalt, Total	mg/kg	**1,400**	23,000	3.2	NA	3.4	NA	NA	4.7
Copper, Total	mg/kg	**NA**	NA	14.3	NA	14.9	NA	NA	56.8
Iron, Total	mg/kg	**NA**	NA	9,440	NA	9,780	NA	NA	19,200
Lead, Total	mg/kg	**400**	1,800	59.5	NA	241	NA	NA	**721**
Magnesium, Total	mg/kg	**NA**	NA	1,380	NA	1,210	NA	NA	3,560
Manganese, Total	mg/kg	**NA**	NA	151	NA	144	NA	NA	454
Molybdenum, Total	mg/kg	**NA**	NA	7.3 U	NA	6.5 U	NA	NA	12.5 U

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Appendix C - Table 4d
NPI High Priority Project Site No. 41, Parcel 11827014
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827014**	**11827014**	**11827014**	**11827014**	**11827014**	**11827014**
			Location ID	**CLB-11827014-SS01**	**CLB-11827014-SS02**	**CLB-11827014-SS03**	**CLB-11827014-SS04**	**CLB-11827014-SS05**	**CLB-11827014-SS06**
			Field Sample ID	**CLB-11827014-SS01-032910**	**CLB-11827014-SS02-032910**	**CLB-11827014-SS03-032910**	**CLB-11827014-SS04-032910**	**CLB-11827014-SS05-032910**	**CLB-11827014-SS06-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Nickel, Total	mg/kg	**1,500**	44,000	12.6	NA	12.7	NA	NA	17.6
Phosphorus, Total	mg/kg	**NA**	NA	1,080	NA	310	NA	NA	605
Potassium, Total	mg/kg	**NA**	NA	417	NA	447	NA	NA	962
Selenium, Total	mg/kg	**380**	15,000	0.5	NA	0.2	NA	NA	3 U
Silicon, Total	mg/kg	**NA**	NA	984	NA	1,300	NA	NA	1,270
Sodium, Total	mg/kg	**NA**	NA	596	NA	586	NA	NA	817
Strontium1, Total	mg/kg	**NA**	NA	9.8	NA	10.7	NA	NA	55.2
Strontium2, Total	mg/kg	**NA**	NA	11.9	NA	12.3	NA	NA	70.9
Sulfur, Total	mg/kg	**NA**	NA	114	NA	174	NA	NA	651
Thallium, Total	mg/kg	**6.1**	230	0 U	NA	0.1	NA	NA	0.5 U
Tin, Total	mg/kg	**NA**	NA	0 U	NA	3	NA	NA	3.3
Titanium, Total	mg/kg	**NA**	NA	50.2	NA	66.1	NA	NA	131
Vanadium, Total	mg/kg	**680**	26,000	2.8	NA	3.3	NA	NA	4
Zinc, Total	mg/kg	**23,000**	880,000	154	NA	237	NA	NA	497
Antimony, XRF	mg/kg	**30**	1,200	74 U	79 U	77 U	73 U	72 U	83 U
Arsenic, XRF	mg/kg	**7**	82	13 U	24 U	24 U	26 U	**29**	45 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	69	55 U	59	61	51 U	59 U
Chromium, XRF	mg/kg	**NA**	NA	119 U	130 U	135 U	129 U	122 U	165 U
Cobalt, XRF	mg/kg	**1,400**	23,000	156 U	172 U	174 U	165 U	161 U	243 U
Copper, XRF	mg/kg	**NA**	NA	23	35	22 U	49	29	76
Iron, XRF	mg/kg	**NA**	NA	19,290	19,782	21,934	20,844	19,926	34,020
Lead, XRF	mg/kg	**400**	1,800	82	295	332	**408**	316	917
Manganese, XRF	mg/kg	**NA**	NA	170	156	109	102 U	97 U	135 U
Mercury, XRF	mg/kg	**7.6**	290	10 U	11 U	11 U	12 U	11 U	15 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	8 U	9 U
Nickel, XRF	mg/kg	**1,500**	44,000	57	45 U	45 U	42 U	41 U	49 U
Rubidium, XRF	mg/kg	**NA**	NA	39	35	43	37	41	37
Selenium, XRF	mg/kg	**380**	15,000	3 U	4 U	4 U	4 U	4 U	6 U
Silver, XRF	mg/kg	**380**	15,000	47 U	51 U	49 U	47 U	47 U	55 U
Strontium, XRF	mg/kg	**NA**	NA	99	91	160	119	106	156
Tin, XRF	mg/kg	**NA**	NA	76 U	81 U	79 U	75 U	74 U	87 U
Titanium, XRF	mg/kg	**NA**	NA	3,275	3,245	2,846	3,828	3,121	4,171
Zinc, XRF	mg/kg	**23,000**	880,000	141	224	271	250	323	488
Zirconium, XRF	mg/kg	**NA**	NA	202	178	147	128	179	142

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 4e
NPI High Priority Project Site No. 41, Parcel 11827015
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827015**	**11827015**	**11827015**	**11827015**	**11827015**	**11827015**	**11827015**
			Location ID	**CLB-11827015-SS01**	**CLB-11827015-SS02**	**CLB-11827015-SS03**	**CLB-11827015-SS04**	**CLB-11827015-SS05**	**CLB-11827015-SS05 (Duplicate)**	**CLB-11827015-SS06**
			Field Sample ID	**CLB-11827015-SS01-032910**	**CLB-11827015-SS02-032910**	**CLB-11827015-SS03-032910**	**CLB-11827015-SS04-032910**	**CLB-11827015-SS05-032910**	**CLB-11827015-SS07-032910**	**CLB-11827015-SS06-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**							
Percent Moisture	%			17.1	13.7	13.3	20	20.1	19.2	10.3
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	123	604	1,900	32.8	36.9	38.7	28.3
Acenaphthene	µg/kg	**3,500,000**	56,000,000	49.8	185	8,740	55.1	131	30.9 U	28.4
Acenaphthylene	µg/kg	**NA**	NA	438	1,750	632	31.2 U	70.8	87.7	27.9 U
Anthracene	µg/kg	**18,000,000**	280,000,000	581	1,540	23,600	281	903	150	160
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,250	4,190	**32,100**	522	1,760	378	352
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,350**	**4,480**	**25,900**	485	**1,460**	396	363
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,320	4,070	**22,700**	437	1,310	365	308
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	864	2,570	13,800	305	845	236	214
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,120	3,650	21,400	476	1,500	364	308
Chrysene	µg/kg	**1,100,000**	7,600,000	1,340	4,170	28,900	540	1,780	434	372
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	360	**1,210**	**6,580**	133	393	98.9	87.9
Fluoranthene	µg/kg	**2,400,000**	37,000,000	2,920	6,860	90,900	1,140	4,610	907	785
Fluorene	µg/kg	**2,400,000**	37,000,000	67	227	8,640	52.4	97.5	30.9 U	27.9 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	807	2,480	**13,600**	285	814	224	199
Naphthalene	µg/kg	**69,000**	150,000	128	642	2,840	42.8	37.8	40.8	27.9 U
Phenanthrene	µg/kg	**NA**	NA	1,050	2,450	72,500	641	2,090	444	348
Pyrene	µg/kg	**1,800,000**	28,000,000	2,470	6,570	71,700	922	3,500	761	666
Aluminum, Total	mg/kg	**NA**	NA	NA	4,650	NA	NA	8,490	4,710	9,030
Antimony, Total	mg/kg	**30**	1,200	NA	2.9	NA	NA	1.4	1.9	2
Arsenic, Total	mg/kg	**6.7**	82	NA	**22**	NA	NA	**13.2**	**12.2**	**12.6**
Barium, Total	mg/kg	**15,000**	370,000	NA	416	NA	NA	287	163	254
Beryllium, Total	mg/kg	**150**	5,100	NA	0.3	NA	NA	0.3	0.2	0.4
Boron, Total	mg/kg	**NA**	NA	NA	7	NA	NA	7.3	10	15.3
Cadmium, Total	mg/kg	**72**	2,300	NA	2	NA	NA	0.3	0 U	0.4
Calcium, Total	mg/kg	**NA**	NA	NA	5,460	NA	NA	7,620	12,500	10,300
Chromium, Total	mg/kg	**NA**	NA	NA	4.1	NA	NA	4.9	0.6	3.8
Cobalt, Total	mg/kg	**1,400**	23,000	NA	5.1	NA	NA	6.1	5.9	6.2
Copper, Total	mg/kg	**NA**	NA	NA	104	NA	NA	22.1	13.9	18.3
Iron, Total	mg/kg	**NA**	NA	NA	23,300	NA	NA	18,600	13,300	20,100
Lead, Total	mg/kg	**400**	1,800	NA	**771**	NA	NA	**419**	37.6	368
Magnesium, Total	mg/kg	**NA**	NA	NA	1,420	NA	NA	2,980	3,470	3,120
Manganese, Total	mg/kg	**NA**	NA	NA	438	NA	NA	558	166	395
Molybdenum, Total	mg/kg	**NA**	NA	NA	7.5 U	NA	NA	13.8 U	6.9 U	11.8 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	32.8	NA	NA	15.5	15.9	14.6
Phosphorus, Total	mg/kg	**NA**	NA	NA	919	NA	NA	297	208	228
Potassium, Total	mg/kg	**NA**	NA	NA	574	NA	NA	928	839	810
Selenium, Total	mg/kg	**380**	15,000	NA	0.8	NA	NA	2.5 U	0.3	3.1 U
Silicon, Total	mg/kg	**NA**	NA	NA	1,250	NA	NA	1,680	1,330	1,580

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Appendix C - Table 4e
NPI High Priority Project Site No. 41, Parcel 11827015
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827015**	**11827015**	**11827015**	**11827015**	**11827015**	**11827015**	**11827015**
			Location ID	**CLB-11827015-SS01**	**CLB-11827015-SS02**	**CLB-11827015-SS03**	**CLB-11827015-SS04**	**CLB-11827015-SS05**	**CLB-11827015-SS05 (Duplicate)**	**CLB-11827015-SS06**
			Field Sample ID	**CLB-11827015-SS01-032910**	**CLB-11827015-SS02-032910**	**CLB-11827015-SS03-032910**	**CLB-11827015-SS04-032910**	**CLB-11827015-SS05-032910**	**CLB-11827015-SS07-032910**	**CLB-11827015-SS06-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**							
Sodium, Total	mg/kg	**NA**	NA	NA	775	NA	NA	816	742	720
Strontium1, Total	mg/kg	**NA**	NA	NA	17.8	NA	NA	19.6	2.4	14.3
Strontium2, Total	mg/kg	**NA**	NA	NA	35.7	NA	NA	24.9	19	30.4
Sulfur, Total	mg/kg	**NA**	NA	NA	427	NA	NA	427	1,400	274
Thallium, Total	mg/kg	**6.1**	230	NA	0 U	NA	NA	0.3	0.1	0.2
Tin, Total	mg/kg	**NA**	NA	NA	5.5	NA	NA	1.2	0.1 U	0.3
Titanium, Total	mg/kg	**NA**	NA	NA	85.5	NA	NA	69	28.4	55.9
Vanadium, Total	mg/kg	**680**	26,000	NA	3.9	NA	NA	8.1	1.7	6.6
Zinc, Total	mg/kg	**23,000**	880,000	NA	581	NA	NA	147	109	184
Antimony, XRF	mg/kg	**30**	1,200	71 U	76 U	72 U	78 U	87 U	94 U	79 U
Arsenic, XRF	mg/kg	**7**	82	21 U	42 U	23 U	**28**	30 U	33 U	**22**
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	50 U	52 U	51 U	55 U	59 U	64 U	54 U
Chromium, XRF	mg/kg	**NA**	NA	111 U	148 U	114 U	149 U	153 U	166 U	142 U
Cobalt, XRF	mg/kg	**1,400**	23,000	147 U	214 U	153 U	206 U	189 U	217 U	191 U
Copper, XRF	mg/kg	**NA**	NA	44	103	39	23 U	27 U	29 U	22 U
Iron, XRF	mg/kg	**NA**	NA	17,352	34,226	18,342	28,489	20,631	23,784	24,816
Lead, XRF	mg/kg	**400**	1,800	279	**1046**	317	367	405	412	39
Manganese, XRF	mg/kg	**NA**	NA	169	233	243	105 U	116 U	130 U	108 U
Mercury, XRF	mg/kg	**7.6**	290	11 U	14 U	10 U	12 U	11 U	13 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	9 U	10 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	39 U	50	41 U	49 U	70	53 U	47 U
Rubidium, XRF	mg/kg	**NA**	NA	33	40	39	95	54	72	68
Selenium, XRF	mg/kg	**380**	15,000	4 U	5 U	4 U	4 U	5 U	4 U	3 U
Silver, XRF	mg/kg	**380**	15,000	46 U	49 U	47 U	51 U	56 U	60 U	51 U
Strontium, XRF	mg/kg	**NA**	NA	98	131	122	137	90	94	89
Tin, XRF	mg/kg	**NA**	NA	73 U	77 U	74 U	80 U	88 U	95 U	80 U
Titanium, XRF	mg/kg	**NA**	NA	3,338	3,085	2,934	3,069	4,726	5,100	3,587
Zinc, XRF	mg/kg	**23,000**	880,000	267	805	245	203	135	151	77
Zirconium, XRF	mg/kg	**NA**	NA	129	121	122	155	139	185	150

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 4f
NPI High Priority Project Site No. 41, Parcel 11827016
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	41	41	41	41	41
			Parcel ID	11827016	11827016	11827016	11827016	11827016
			Location ID	CLB-11827016-SS01	CLB-11827016-SS02	CLB-11827016-SS03	CLB-11827016-SS04	CLB-11827016-SS05
			Field Sample ID	CLB-11827016-SS01-032910	CLB-11827016-SS02-032910	CLB-11827016-SS03-032910	CLB-11827016-SS04-032910	CLB-11827016-SS05-032910
			Sample Date	3/29/2010	3/29/2010	3/29/2010	3/29/2010	3/29/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Percent Moisture	%			10.4	10.1	12.7	12.3	14.4
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	27.9 U	37.6	38.1	68.8	29.2 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	31	124	28.6 U	161	29.2 U
Acenaphthylene	µg/kg	**NA**	NA	27.9 U	27.8 U	28.6 U	54.8	32.5
Anthracene	µg/kg	**18,000,000**	280,000,000	169	480	50.5	393	126
Benzo(a)anthracene	µg/kg	**11,000**	76,000	339	1,060	104	686	249
Benzo(a)pyrene	µg/kg	**1,100**	7,700	337	996	115	651	259
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	305	966	109	520	245
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	204	578	78.9	351	165
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	303	809	103	592	228
Chrysene	µg/kg	**1,100,000**	7,600,000	359	1,060	123	749	282
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	85.8	259	30.4	155	65.7
Fluoranthene	µg/kg	**2,400,000**	37,000,000	781	2,390	243	1,700	593
Fluorene	µg/kg	**2,400,000**	37,000,000	27.9	94.1	28.6 U	91.1	29.2 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	190	553	71.4	326	152
Naphthalene	µg/kg	**69,000**	150,000	27.9 U	44.4	28.6 U	74.7	29.2 U
Phenanthrene	µg/kg	**NA**	NA	363	1,260	120	1,190	303
Pyrene	µg/kg	**1,800,000**	28,000,000	636	1,990	203	1,430	491
Aluminum, Total	mg/kg	**NA**	NA	4,270	5,340	4,380	NA	NA
Antimony, Total	mg/kg	**30**	1,200	0.4	0.7	4.4	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	5	**8.7**	**11**	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	256	228	179	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	0.1	0.1	0.4	NA	NA
Boron, Total	mg/kg	**NA**	NA	1.4	11.5	15	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	0.2	0.3	1.6	NA	NA
Calcium, Total	mg/kg	**NA**	NA	1,140	2,340	3,170	NA	NA
Chromium, Total	mg/kg	**NA**	NA	0.9 U	1.5	1.8	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	2.6	4.2	17.5	NA	NA
Copper, Total	mg/kg	**NA**	NA	10.8	21.6	20.6	NA	NA
Iron, Total	mg/kg	**NA**	NA	8,830	12,400	10,400	NA	NA
Lead, Total	mg/kg	**400**	1,800	116	209	73.4	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	621	1,180	1,990	NA	NA
Manganese, Total	mg/kg	**NA**	NA	98.8	164	184	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	6.7 U	10.1 U	7.2 U	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	8.5	12.1	13.2	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	294	375	311	NA	NA
Potassium, Total	mg/kg	**NA**	NA	357	586	548	NA	NA
Selenium, Total	mg/kg	**380**	15,000	0.8	0.1	2.3	NA	NA
Silicon, Total	mg/kg	**NA**	NA	1,190	1,220	942	NA	NA
Sodium, Total	mg/kg	**NA**	NA	488	577	607	NA	NA

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Appendix C - Table 4f
NPI High Priority Project Site No. 41, Parcel 11827016
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827016**	**11827016**	**11827016**	**11827016**	**11827016**
			Location ID	**CLB-11827016-SS01**	**CLB-11827016-SS02**	**CLB-11827016-SS03**	**CLB-11827016-SS04**	**CLB-11827016-SS05**
			Field Sample ID	**CLB-11827016-SS01-032910**	**CLB-11827016-SS02-032910**	**CLB-11827016-SS03-032910**	**CLB-11827016-SS04-032910**	**CLB-11827016-SS05-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Strontium1, Total	mg/kg	**NA**	NA	3.7	7.5	8.3	NA	NA
Strontium2, Total	mg/kg	**NA**	NA	5.8	9.2	10.5	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	139	254	147	NA	NA
Thallium, Total	mg/kg	**6.1**	230	0.1 U	0.1 U	4.6	NA	NA
Tin, Total	mg/kg	**NA**	NA	0.4	1.1	1.3	NA	NA
Titanium, Total	mg/kg	**NA**	NA	55.1	54.1	34.5	NA	NA
Vanadium, Total	mg/kg	**680**	26,000	2.4	3.5	4.3	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	142	211	140	NA	NA
Antimony, XRF	mg/kg	**30**	1,200	73 U	79 U	73 U	96 U	71 U
Arsenic, XRF	mg/kg	**7**	82	18 U	16 U	19 U	**31**	16 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	54	54 U	51 U	68 U	50 U
Chromium, XRF	mg/kg	**NA**	NA	122 U	144 U	123 U	267 U	112 U
Cobalt, XRF	mg/kg	**1,400**	23,000	142 U	192 U	160 U	249 U	137 U
Copper, XRF	mg/kg	**NA**	NA	22 U	28	36	94,443	25
Iron, XRF	mg/kg	**NA**	NA	15,952	26,482	20,028	24,285	15,338
Lead, XRF	mg/kg	**400**	1,800	187	123	201	165	152
Manganese, XRF	mg/kg	**NA**	NA	91 U	256	95 U	192 U	102
Mercury, XRF	mg/kg	**7.6**	290	9 U	11 U	10 U	17 U	9 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	9 U	8 U	11 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	40 U	45 U	41 U	101 U	39 U
Rubidium, XRF	mg/kg	**NA**	NA	36	43	41	30	28
Selenium, XRF	mg/kg	**380**	15,000	3 U	4 U	4 U	6 U	3 U
Silver, XRF	mg/kg	**380**	15,000	47 U	50 U	47 U	65 U	46 U
Strontium, XRF	mg/kg	**NA**	NA	112	83	102	137	103
Tin, XRF	mg/kg	**NA**	NA	74 U	80 U	75 U	100 U	72 U
Titanium, XRF	mg/kg	**NA**	NA	3,178	4,560	2,347	6,061	2,780
Zinc, XRF	mg/kg	**23,000**	880,000	138	249	153	3511	158
Zirconium, XRF	mg/kg	**NA**	NA	208	270	167	150	135

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 4g
NPI High Priority Project Site No. 41, Parcel 11827017
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	41	41	41	41	41
			Parcel ID	11827017	11827017	11827017	11827017	11827017
			Location ID	CLB-11827017-SS01	CLB-11827017-SS02	CLB-11827017-SS03	CLB-11827017-SS04	CLB-11827017-SS05
			Field Sample ID	CLB-11827017-SS01-032910	CLB-11827017-SS02-032910	CLB-11827017-SS03-032910	CLB-11827017-SS04-032910	CLB-11827017-SS05-032910
			Sample Date	3/29/2010	3/29/2010	3/29/2010	3/29/2010	3/29/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Percent Moisture	%			17	9.6	11.3	9.2	13
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	156	27.6 U	28.2 U	27.5 U	149
Acenaphthene	µg/kg	**3,500,000**	56,000,000	402	42.4	28.2 U	27.5 U	680
Acenaphthylene	µg/kg	**NA**	NA	65.4	27.6 U	28.2 U	27.5 U	33.5
Anthracene	µg/kg	**18,000,000**	280,000,000	1,120	227	28.2 U	45.8	1,730
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,780	777	65	123	3,180
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,590**	754	69.9	127	**2,920**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,570	634	62.5	101	2,550
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	933	425	42.5	77.8	1,620
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,340	629	64.4	120	2,380
Chrysene	µg/kg	**1,100,000**	7,600,000	1,760	746	72.5	128	2,960
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	430	185	28.2 U	31.7	743
Fluoranthene	µg/kg	**2,400,000**	37,000,000	4,290	1,590	148	271	7,530
Fluorene	µg/kg	**2,400,000**	37,000,000	367	29	28.2 U	27.5 U	520
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	900	410	40.4	71.8	1,560
Naphthalene	µg/kg	**69,000**	150,000	242	31.7	28.2 U	27.5 U	180
Phenanthrene	µg/kg	**NA**	NA	3,260	575	58	108	5,430
Pyrene	µg/kg	**1,800,000**	28,000,000	3,340	1,350	129	229	6,070
Aluminum, Total	mg/kg	**NA**	NA	4,800	NA	4,270	NA	3,810
Antimony, Total	mg/kg	**30**	1,200	1.6	NA	1	NA	0.5
Arsenic, Total	mg/kg	**6.7**	82	**11.6**	NA	**7.6**	NA	**7.9**
Barium, Total	mg/kg	**15,000**	370,000	307	NA	137	NA	176
Beryllium, Total	mg/kg	**150**	5,100	0.2	NA	0.1	NA	0.1
Boron, Total	mg/kg	**NA**	NA	13.7	NA	7.8	NA	11.2
Cadmium, Total	mg/kg	**72**	2,300	0.9	NA	0.2	NA	0.4
Calcium, Total	mg/kg	**NA**	NA	3,290	NA	885	NA	1,560
Chromium, Total	mg/kg	**NA**	NA	2.5	NA	0.3 U	NA	1.2
Cobalt, Total	mg/kg	**1,400**	23,000	3.5	NA	4.3	NA	3.3
Copper, Total	mg/kg	**NA**	NA	40.2	NA	9.1	NA	22.9
Iron, Total	mg/kg	**NA**	NA	13,100	NA	11,700	NA	10,100
Lead, Total	mg/kg	**400**	1,800	328	NA	28.8	NA	118
Magnesium, Total	mg/kg	**NA**	NA	770	NA	845	NA	744
Manganese, Total	mg/kg	**NA**	NA	196	NA	160	NA	165
Molybdenum, Total	mg/kg	**NA**	NA	8.5 U	NA	6.9 U	NA	5.6 U
Nickel, Total	mg/kg	**1,500**	44,000	18.8	NA	10.5	NA	12
Phosphorus, Total	mg/kg	**NA**	NA	1,180	NA	273	NA	355
Potassium, Total	mg/kg	**NA**	NA	490	NA	490	NA	396

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Appendix C - Table 4g
NPI High Priority Project Site No. 41, Parcel 11827017
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	41	41	41	41	41
			Parcel ID	11827017	11827017	11827017	11827017	11827017
			Location ID	CLB-11827017-SS01	CLB-11827017-SS02	CLB-11827017-SS03	CLB-11827017-SS04	CLB-11827017-SS05
			Field Sample ID	CLB-11827017-SS01-032910	CLB-11827017-SS02-032910	CLB-11827017-SS03-032910	CLB-11827017-SS04-032910	CLB-11827017-SS05-032910
			Sample Date	3/29/2010	3/29/2010	3/29/2010	3/29/2010	3/29/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Selenium, Total	mg/kg	**380**	15,000	1.6	NA	0.2 U	NA	0.4
Silicon, Total	mg/kg	**NA**	NA	1,370	NA	1,370	NA	754
Sodium, Total	mg/kg	**NA**	NA	743	NA	461	NA	582
Strontium1, Total	mg/kg	**NA**	NA	16.2	NA	3.1	NA	6.1
Strontium2, Total	mg/kg	**NA**	NA	19.8	NA	4.9	NA	8.4
Sulfur, Total	mg/kg	**NA**	NA	329	NA	51.5	NA	168
Thallium, Total	mg/kg	**6.1**	230	0.3 U	NA	0.2 U	NA	0 U
Tin, Total	mg/kg	**NA**	NA	1.1	NA	0.1	NA	0.9
Titanium, Total	mg/kg	**NA**	NA	74.8	NA	53.8	NA	45.7
Vanadium, Total	mg/kg	**680**	26,000	2.4	NA	3.2	NA	2.8
Zinc, Total	mg/kg	**23,000**	880,000	271	NA	96.4	NA	152
Antimony, XRF	mg/kg	**30**	1,200	74 U	72 U	75 U	77 U	73 U
Arsenic, XRF	mg/kg	**7**	82	27 U	17 U	**11**	11 U	17 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	51 U	66	64	53 U	64
Chromium, XRF	mg/kg	**NA**	NA	132 U	110 U	119 U	129 U	119 U
Cobalt, XRF	mg/kg	**1,400**	23,000	174 U	126 U	146 U	159 U	153 U
Copper, XRF	mg/kg	**NA**	NA	44	21 U	21 U	22 U	43
Iron, XRF	mg/kg	**NA**	NA	24,528	12,049	16,589	18,278	18,586
Lead, XRF	mg/kg	**400**	1,800	**442**	155	32	54	154
Manganese, XRF	mg/kg	**NA**	NA	171	77 U	90 U	100 U	168
Mercury, XRF	mg/kg	**7.6**	290	11 U	9 U	9 U	9 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	48	38 U	40 U	42 U	41 U
Rubidium, XRF	mg/kg	**NA**	NA	32	29	43	34	36
Selenium, XRF	mg/kg	**380**	15,000	4 U	3 U	3 U	3 U	3 U
Silver, XRF	mg/kg	**380**	15,000	47 U	47 U	47 U	49 U	47 U
Strontium, XRF	mg/kg	**NA**	NA	124	97	91	122	103
Tin, XRF	mg/kg	**NA**	NA	114	74 U	75 U	78 U	75 U
Titanium, XRF	mg/kg	**NA**	NA	2,842	2,307	3,145	2,609	3,322
Zinc, XRF	mg/kg	**23,000**	880,000	345	95	52	71	156
Zirconium, XRF	mg/kg	**NA**	NA	138	109	170	119	164

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table4h
NPI High Priority Project Site No. 41, Parcel 11827018
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827018**	**11827018**	**11827018**	**11827018**	**11827018**	**11827018**
			Location ID	**CLB-11827018-SS01**	**CLB-11827018-SS01 (Duplicate)**	**CLB-11827018-SS02**	**CLB-11827018-SS03**	**CLB-11827018-SS04**	**CLB-11827018-SS05**
			Field Sample ID	**CLB-11827018-SS01-032910**	**CLB-11827018-SS06-032910**	**CLB-11827018-SS02-032910**	**CLB-11827018-SS03-032910**	**CLB-11827018-SS04-032910**	**CLB-11827018-SS05-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Percent Moisture	%			12.4	12.4	10	10.7	12.3	11.5
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	55.3	43.6	27.8 U	28 U	28.5 U	28.2 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	139	80.3	27.8 U	28 U	28.5 U	28.2 U
Acenaphthylene	µg/kg	**NA**	NA	28.5 U	28.5 U	27.8 U	28 U	28.5 U	28.2 U
Anthracene	µg/kg	**18,000,000**	280,000,000	392	288	99.2	36.8	49.8	95.1
Benzo(a)anthracene	µg/kg	**11,000**	76,000	843	790	307	87.8	144	287
Benzo(a)pyrene	µg/kg	**1,100**	7,700	810	746	303	89.8	146	301
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	665	632	278	74.7	128	261
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	463	436	189	51.7	95	214
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	689	687	273	82.7	146	271
Chrysene	µg/kg	**1,100,000**	7,600,000	821	785	322	93	154	306
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	203	195	80.7	28 U	39.2	79.8
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,980	1,700	667	198	306	638
Fluorene	µg/kg	**2,400,000**	37,000,000	97.6	56.8	27.8 U	28 U	28.5 U	28.2 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	440	414	176	49.2	86.9	178
Naphthalene	µg/kg	**69,000**	150,000	62.3	45.8	33.3	28 U	28.5 U	28.2 U
Phenanthrene	µg/kg	**NA**	NA	1,170	835	286	77	123	278
Pyrene	µg/kg	**1,800,000**	28,000,000	1,570	1,440	573	170	263	537
Aluminum, Total	mg/kg	**NA**	NA	4,560	4,660	NA	4,490	NA	NA
Antimony, Total	mg/kg	**30**	1,200	0.7	0.2	NA	1.6	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	**7.4**	**8.2**	NA	6.7	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	218	314	NA	188	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	0.1	0.1	NA	0.1	NA	NA
Boron, Total	mg/kg	**NA**	NA	12.1	11.2	NA	14.7	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	0.4	0.4	NA	0.1	NA	NA
Calcium, Total	mg/kg	**NA**	NA	1,130	1,250	NA	508	NA	NA
Chromium, Total	mg/kg	**NA**	NA	0.7	0.1 U	NA	0.1	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	4	3.9	NA	3.7	NA	NA
Copper, Total	mg/kg	**NA**	NA	15.7	17.1	NA	7.9	NA	NA
Iron, Total	mg/kg	**NA**	NA	10,800	11,700	NA	9,570	NA	NA
Lead, Total	mg/kg	**400**	1,800	130	161	NA	38.5	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	809	846	NA	712	NA	NA
Manganese, Total	mg/kg	**NA**	NA	157	151	NA	107	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	7.9 U	8 U	NA	7.2 U	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	11.2	11.8	NA	8.6	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	333	391	NA	223	NA	NA
Potassium, Total	mg/kg	**NA**	NA	421	420	NA	437	NA	NA

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Appendix C - Table4h
NPI High Priority Project Site No. 41, Parcel 11827018
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**41**	**41**	**41**	**41**	**41**	**41**
			Parcel ID	**11827018**	**11827018**	**11827018**	**11827018**	**11827018**	**11827018**
			Location ID	**CLB-11827018-SS01**	**CLB-11827018-SS01 (Duplicate)**	**CLB-11827018-SS02**	**CLB-11827018-SS03**	**CLB-11827018-SS04**	**CLB-11827018-SS05**
			Field Sample ID	**CLB-11827018-SS01-032910**	**CLB-11827018-SS06-032910**	**CLB-11827018-SS02-032910**	**CLB-11827018-SS03-032910**	**CLB-11827018-SS04-032910**	**CLB-11827018-SS05-032910**
			Sample Date	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**	**3/29/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Selenium, Total	mg/kg	**380**	15,000	0.7	0.4	NA	0.3	NA	NA
Silicon, Total	mg/kg	**NA**	NA	836	764	NA	970	NA	NA
Sodium, Total	mg/kg	**NA**	NA	720	833	NA	606	NA	NA
Strontium1, Total	mg/kg	**NA**	NA	5.3	6.4	NA	3.5	NA	NA
Strontium2, Total	mg/kg	**NA**	NA	7.3	8	NA	4.5	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	111	109	NA	28	NA	NA
Thallium, Total	mg/kg	**6.1**	230	0 U	0.1 U	NA	0.5 U	NA	NA
Tin, Total	mg/kg	**NA**	NA	0.3	0.2	NA	0.1	NA	NA
Titanium, Total	mg/kg	**NA**	NA	46.1	41.5	NA	44.8	NA	NA
Vanadium, Total	mg/kg	**680**	26,000	1.6	3	NA	1.3	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	169	164	NA	127	NA	NA
Antimony, XRF	mg/kg	**30**	1,200	73 U	72 U	72 U	**81**	72 U	72 U
Arsenic, XRF	mg/kg	**7**	82	18 U	17 U	18 U	**16**	14 U	19 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	51 U	50 U	50 U	60	50 U	50 U
Chromium, XRF	mg/kg	**NA**	NA	126 U	121 U	115 U	128 U	112 U	110 U
Cobalt, XRF	mg/kg	**1,400**	23,000	149 U	145 U	163 U	175 U	133 U	147 U
Copper, XRF	mg/kg	**NA**	NA	23 U	22 U	22 U	23 U	21 U	21 U
Iron, XRF	mg/kg	**NA**	NA	17,869	16,723	20,532	22,830	14,627	17,650
Lead, XRF	mg/kg	**400**	1,800	189	153	190	100	107	214
Manganese, XRF	mg/kg	**NA**	NA	95 U	91 U	134	105 U	94	93 U
Mercury, XRF	mg/kg	**7.6**	290	10 U	10 U	9 U	10 U	10 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	41	38 U	44	45	38 U	40 U
Rubidium, XRF	mg/kg	**NA**	NA	36	31	33	34	34	33
Selenium, XRF	mg/kg	**380**	15,000	4 U	3 U	3 U	3 U	3 U	4 U
Silver, XRF	mg/kg	**380**	15,000	47 U	47 U	47 U	48 U	53	46 U
Strontium, XRF	mg/kg	**NA**	NA	88	102	98	94	93	102
Tin, XRF	mg/kg	**NA**	NA	74 U	74 U	74 U	77 U	74 U	73 U
Titanium, XRF	mg/kg	**NA**	NA	2,504	3,004	3,447	2,607	2,075	3,263
Zinc, XRF	mg/kg	**23,000**	880,000	133	148	125	98	96	171
Zirconium, XRF	mg/kg	**NA**	NA	167	157	121	163	138	165

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5a
NPI High Priority Project Site No. 42, Parcel 11818053
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42	42	42	42
			Parcel ID	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053
			Location ID	CLB-11818053-SS01	CLB-11818053-SS02	CLB-11818053-SS03	CLB-11818053-SS04	CLB-11818053-SS05	CLB-11818053-SS05 [1]	CLB-11818053-SS05 [1]	CLB-11818053-SS06	CLB-11818053-SS07	CLB-11818053-SS08	CLB-11818053-SS09	CLB-11818053-SS09
			Field Sample ID	CLB-11818053-SS01-033010	CLB-11818053-SS02-033010	CLB-11818053-SS03-033010	CLB-11818053-SS04-033010	CLB-11818053-SS05-033010	CLB-11818053-SS05-033010-7	CLB-11818053-SS05-033010-8	CLB-11818053-SS06-033010	CLB-11818053-SS07-033010	CLB-11818053-SS08-033010	CLB-11818053-SS09-033010	CLB-11818053-SS10-033010
			Sample Date	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**												
2-Methylnaphthalene	µg/kg	**NA**	NA	121	362	29.1 U	29.2 U	34.8	NA	NA	28.6 U	215 U	346	27.4 U	27.4 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	116	1,060	47.8	29.2 U	29.6 U	NA	NA	37.2	215 U	1,820	36.5	27.4 U
Acenaphthylene	µg/kg	**NA**	NA	180	300	31.5	29.2 U	41.4	NA	NA	36.6	280	64.9	27.4 U	27.4 U
Anthracene	µg/kg	**18,000,000**	280,000,000	463	3,180	180	74.6	108	NA	NA	135	553	4,230	136	37.2
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,470	6,430	547	272	395	NA	NA	427	1,780	8,420	239	138
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,610**	**6,180**	495	277	413	NA	NA	413	**1,730**	**7,770**	246	141
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,480	5,500	468	257	415	NA	NA	375	1,660	7,130	189	116
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	1,240	3,830	281	179	284	NA	NA	270	1,330	4,420	141	84.1
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,420	4,900	438	226	369	NA	NA	369	1,430	5,970	211	121
Chrysene	µg/kg	**1,100,000**	7,600,000	1,510	5,980	523	273	426	NA	NA	431	1,940	7,890	245	133
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	469	**1,670**	136	73.5	121	NA	NA	121	507	**2,190**	56.4	38
Fluoranthene	µg/kg	**2,400,000**	37,000,000	2,980	18,200	1130	546	839	NA	NA	858	2,820	21,900	561	292
Fluorene	µg/kg	**2,400,000**	37,000,000	115	923	47.1	29.2 U	29.6 U	NA	NA	36.3	215 U	1,350	27.4 U	27.4 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	1,090	3,670	289	166	269	NA	NA	260	1,100	4,450	130	81
Naphthalene	µg/kg	**69,000**	150,000	120	522	29.1 U	29.2 U	33.9	NA	NA	28.6 U	215 U	457	27.4 U	27.4 U
Phenanthrene	µg/kg	**NA**	NA	1,510	13,400	568	248	383	NA	NA	463	1,290	17,200	316	144
Pyrene	µg/kg	**1,800,000**	28,000,000	2,490	14,500	927	507	717	NA	NA	772	3,040	18,000	494	256
Aluminum, Total	mg/kg	**NA**	NA	5,140	NA	NA	NA	NA	NA	6,480	NA	NA	NA	4,490	4,360
Antimony, Total	mg/kg	**30**	1,200	4.2	NA	NA	NA	NA	NA	2.9	NA	NA	NA	0.5	0.2
Arsenic, Total	mg/kg	**6.7**	82	**14.4**	NA	NA	NA	NA	NA	**11.6**	NA	NA	NA	6.7	5.7
Barium, Total	mg/kg	**15,000**	370,000	362	NA	NA	NA	NA	NA	358	NA	NA	NA	142	139
Beryllium, Total	mg/kg	**150**	5,100	0.2	NA	NA	NA	NA	NA	0.4	NA	NA	NA	0.1	0.2
Boron, Total	mg/kg	**NA**	NA	8.2	NA	NA	NA	NA	NA	4.4	NA	NA	NA	3.3	4.8
Cadmium, Total	mg/kg	**72**	2,300	1.7	NA	NA	NA	NA	NA	0.7	NA	NA	NA	0.6	0.6
Calcium, Total	mg/kg	**NA**	NA	41,600	NA	NA	NA	NA	NA	58,900	NA	NA	NA	931	869
Chromium, Total	mg/kg	**NA**	NA	4.5	NA	NA	NA	NA	NA	2.6	NA	NA	NA	0.2	0.3
Cobalt, Total	mg/kg	**1,400**	23,000	4.9	NA	NA	NA	NA	NA	4.1	NA	NA	NA	3	3
Copper, Total	mg/kg	**NA**	NA	66.7	NA	NA	NA	NA	NA	37.4	NA	NA	NA	12.3	12
Iron, Total	mg/kg	**NA**	NA	26,000	NA	NA	NA	NA	NA	12,000	NA	NA	NA	7,680	7,530
Lead, Total	mg/kg	**400**	1,800	**1,200**	NA	NA	NA	NA	NA	**2,230**	NA	NA	NA	71	60.8
Magnesium, Total	mg/kg	**NA**	NA	5,010	NA	NA	NA	NA	NA	24,800	NA	NA	NA	577	618
Manganese, Total	mg/kg	**NA**	NA	335	NA	NA	NA	NA	NA	433	NA	NA	NA	120	123
Molybdenum, Total	mg/kg	**NA**	NA	5.8 U	NA	NA	NA	NA	NA	1.1	NA	NA	NA	6.4 U	5.5 U
Nickel, Total	mg/kg	**1,500**	44,000	18.1	NA	NA	NA	NA	NA	11	NA	NA	NA	7.8	7.7
Phosphorus, Total	mg/kg	**NA**	NA	820	NA	NA	NA	NA	NA	420	NA	NA	NA	325	318
Potassium, Total	mg/kg	**NA**	NA	798	NA	NA	NA	NA	NA	975	NA	NA	NA	395	378
Selenium, Total	mg/kg	**380**	15,000	2.3 U	NA	NA	NA	NA	NA	0.2 U	NA	NA	NA	1.4	1.3
Silicon, Total	mg/kg	**NA**	NA	450	NA	NA	NA	NA	NA	550	NA	NA	NA	263	399

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Appendix C - Table 5a
NPI High Priority Project Site No. 42, Parcel 11818053
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42	42	42	42
			Parcel ID	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053	11818053
			Location ID	CLB-11818053-SS01	CLB-11818053-SS02	CLB-11818053-SS03	CLB-11818053-SS04	CLB-11818053-SS05	CLB-11818053-SS05 [1]	CLB-11818053-SS05 [1]	CLB-11818053-SS06	CLB-11818053-SS07	CLB-11818053-SS08	CLB-11818053-SS09	CLB-11818053-SS09
			Field Sample ID	CLB-11818053-SS01-033010	CLB-11818053-SS02-033010	CLB-11818053-SS03-033010	CLB-11818053-SS04-033010	CLB-11818053-SS05-033010	CLB-11818053-SS05-033010-7	CLB-11818053-SS05-033010-8	CLB-11818053-SS06-033010	CLB-11818053-SS07-033010	CLB-11818053-SS08-033010	CLB-11818053-SS09-033010	CLB-11818053-SS10-033010
			Sample Date	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**												
Sodium, Total	mg/kg	**NA**	NA	579	NA	NA	NA	NA	NA	676	NA	NA	NA	484	480
Strontium1, Total	mg/kg	**NA**	NA	61.5	NA	NA	NA	NA	NA	45.7	NA	NA	NA	6.1	4.4
Strontium2, Total	mg/kg	**NA**	NA	73.1	NA	NA	NA	NA	NA	64.2	NA	NA	NA	6	5.6
Sulfur, Total	mg/kg	**NA**	NA	559	NA	NA	NA	NA	NA	760	NA	NA	NA	61.5	54.2
Thallium, Total	mg/kg	**6**	230	0.6 U	NA	NA	NA	NA	NA	1.2	NA	NA	NA	0.5	0.7
Tin, Total	mg/kg	**NA**	NA	35.2	NA	NA	NA	NA	NA	0.2	NA	NA	NA	0.2	0.3
Titanium, Total	mg/kg	**NA**	NA	81.3	NA	NA	NA	NA	NA	103	NA	NA	NA	51.6	43.2
Vanadium, Total	mg/kg	**680**	26,000	7.1	NA	NA	NA	NA	NA	3.6	NA	NA	NA	2.9	2.8
Zinc, Total	mg/kg	**23,000**	880,000	502	NA	NA	NA	NA	NA	420	NA	NA	NA	125	122
Antimony, XRF	mg/kg	**30**	1,200	74 U	74 U	71 U	70 U	NA	78 U	76 U	76 U	52 U	74 U	71 U	72 U
Arsenic, XRF	mg/kg	**6.7**	82	32 U	37 U	22 U	25 U	NA	**196**	74 U	60 U	31 U	63 U	13 U	14 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	NA	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	52 U	72	49 U	58	NA	54 U	**75**	53 U	47	52 U	49 U	50 U
Chromium, XRF	mg/kg	**NA**	NA	128 U	141 U	110 U	105 U	NA	147 U	137 U	128 U	84 U	135 U	113 U	105 U
Cobalt, XRF	mg/kg	**1,400**	23,000	193 U	191 U	130 U	133 U	NA	204 U	185 U	173 U	105 U	184 U	125 U	118 U
Copper, XRF	mg/kg	**NA**	NA	46	56	22 U	21 U	NA	51	30	40	18 U	69	21 U	20 U
Iron, XRF	mg/kg	**NA**	NA	26,391	27,910	13,116	14,412	NA	28,137	24,392	21,365	11,389	24,237	12,801	11,165
Lead, XRF	mg/kg	**400**	1,800	**588**	**836**	321	**430**	NA	**3,180**	**3,186**	**2,231**	**869**	**2,362**	99	98
Manganese, XRF	mg/kg	**NA**	NA	221	136	102	182	NA	128 U	147	122	67 U	113 U	119	85
Mercury, XRF	mg/kg	**7.6**	290	11 U	12 U	10 U	10 U	NA	17 U	16 U	15 U	9 U	16 U	10 U	9 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	7 U	NA	8 U	8 U	8 U	6 U	8 U	8	8 U
Nickel, XRF	mg/kg	**1500**	44,000	46 U	45 U	38 U	37 U	NA	48 U	47 U	44 U	28 U	44 U	36 U	37 U
Rubidium, XRF	mg/kg	**NA**	NA	28	43	31	33	NA	46	43	38	11	30	37	31
Selenium, XRF	mg/kg	**380**	15,000	4 U	5 U	3 U	3 U	NA	8 U	8 U	6 U	4 U	7 U	3 U	3 U
Silver, XRF	mg/kg	**380**	15,000	48 U	48 U	46 U	45 U	NA	51 U	49 U	49 U	36 U	49 U	46 U	46 U
Strontium, XRF	mg/kg	**NA**	NA	121	118	122	102	NA	104	115	115	137	113	100	94
Tin, XRF	mg/kg	**NA**	NA	76 U	75 U	72 U	71 U	NA	80 U	78 U	78 U	54 U	76 U	72 U	73 U
Titanium, XRF	mg/kg	**NA**	NA	2,574	3,202	3,615	2,593	NA	2,162	3,432	4,350	706	3,260	2,785	1,441
Zinc, XRF	mg/kg	**23,000**	880,000	467	375	115	172	NA	817	674	322	541	427	114	96
Zirconium, XRF	mg/kg	**NA**	NA	107	176	149	103	NA	132	137	159	23	146	117	151

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results
[1] = Sample CLB-11818053-SS05 was screened by the XRF for metals more than once; therefore, all results are presented.

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Appendix C - Table 5b
NPI High Priority Project Site No. 42, Parcel 11818054
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**
			Location ID	**CLB-11818054-SS01**	**CLB-11818054-SS02**	**CLB-11818054-SS03**	**CLB-11818054-SS04**	**CLB-11818054-SS05**	**CLB-11818054-SS06**	**CLB-11818054-SS07**	**CLB-11818054-SS08**	**CLB-11818054-SS08 (Duplicate)**	**CLB-11818054-SS09**
			Field Sample ID	**CLB-11818054-SS01-033010**	**CLB-11818054-SS02-033010**	**CLB-11818054-SS03-033010**	**CLB-11818054-SS04-033010**	**CLB-11818054-SS05-033010**	**CLB-11818054-SS06-033010**	**CLB-11818054-SS07-033010**	**CLB-11818054-SS08-033010**	**CLB-11818054-SS10-033010**	**CLB-11818054-SS09-033010**
			Sample Date	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Percent Moisture	%			10.6	11.5	13.9	12.9	19.9	10.5	11.2	10.9	11.3	7.1
2-Methylnaphthalene	ug/kg	**NA**	NA	28 U	54.9	199	60.7	47.2	89.9	59.7	69.5	101	38.7
Acenaphthene	ug/kg	**3,500,000**	56,000,000	38.3	71.8	308	174	89.1	288	133	211	326	129
Acenaphthylene	ug/kg	**NA**	NA	28 U	28.3 U	76.7	28.7 U	51.9	27.9 U	43.2	28 U	46.2	26.9 U
Anthracene	ug/kg	**18,000,000**	280,000,000	105	216	980	553	309	694	388	527	865	278
Benzo(a)anthracene	ug/kg	**11,000**	76,000	337	577	1,680	1,260	807	1,660	1,090	1,130	1,480	578
Benzo(a)pyrene	ug/kg	**1,100**	7,700	342	565	**1,470**	**1,180**	828	**1,590**	1,080	1,070	**1,410**	562
Benzo(b)fluoranthene	ug/kg	**11,000**	77,000	296	511	1,280	1,080	786	1,480	1,020	1,020	1,220	532
Benzo(g,h,i)perylene	ug/kg	**NA**	NA	224	371	784	678	596	959	678	647	933	338
Benzo(k)fluoranthene	ug/kg	**110,000**	770,000	299	505	1,220	908	653	1,230	853	828	1,220	428
Chrysene	ug/kg	**1,100,000**	7,600,000	330	557	1,510	1,130	791	1,540	1,040	1,070	1,400	544
Dibenz(a,h)anthracene	ug/kg	**1,100**	7,700	95	169	403	328	246	464	317	305	431	156
Fluoranthene	ug/kg	**2,400,000**	37,000,000	741	1,270	3,540	2,660	1,770	3,660	2,340	2,600	3,560	1,370
Fluorene	ug/kg	**2,400,000**	37,000,000	28 U	58.1	371	147	71.5	207	93	147	278	87
Indeno(1,2,3-cd)pyrene	ug/kg	**11,000**	77,000	209	352	811	669	523	939	661	640	888	338
Naphthalene	ug/kg	**69,000**	150,000	28 U	49	432	64.4	64.4	102	56.9	68.3	116	46.1
Phenanthrene	ug/kg	**NA**	NA	405	737	2,780	1,720	994	2,400	1,380	1,900	3,000	1,000
Pyrene	ug/kg	**1,800,000**	28,000,000	640	1,050	2,860	2,280	1,490	3,070	1,980	2,170	2,840	1,160
Aluminum, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	5,900	NA	4,910	NA	NA	3,990
Antimony, Total	mg/kg	**30**	1,200	NA	NA	NA	NA	2.2	NA	1.3	NA	NA	0.7
Arsenic, Total	mg/kg	**6.7**	82	NA	NA	NA	NA	**11.3**	NA	**10.2**	NA	NA	5.6
Barium, Total	mg/kg	**15,000**	370,000	NA	NA	NA	NA	338	NA	200	NA	NA	125
Beryllium, Total	mg/kg	**150**	5,100	NA	NA	NA	NA	0.3	NA	0.2	NA	NA	0.1
Boron, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	2.3	NA	2.6	NA	NA	2.1
Cadmium, Total	mg/kg	**72**	2,300	NA	NA	NA	NA	0.6	NA	0.8	NA	NA	0.3
Calcium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	11,100	NA	2,340	NA	NA	655
Chromium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	2	NA	2.3	NA	NA	0.3
Cobalt, Total	mg/kg	**1,400**	23,000	NA	NA	NA	NA	4.7	NA	3.8	NA	NA	2.9
Copper, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	34.1	NA	51.6	NA	NA	11
Iron, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	13,300	NA	12,400	NA	NA	7,070
Lead, Total	mg/kg	**400**	1800	NA	NA	NA	NA	**695**	NA	289	NA	NA	35.2
Magnesium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	3,460	NA	905	NA	NA	561
Manganese, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	334	NA	196	NA	NA	51.4
Molybdenum, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	5.8 U	NA	6.9 U	NA	NA	5.2 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	NA	NA	NA	14.7	NA	10.5	NA	NA	7.5
Phosphorus, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	346	NA	524	NA	NA	284
Potassium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	666	NA	378	NA	NA	350
Selenium, Total	mg/kg	**380**	15,000	NA	NA	NA	NA	1.3 U	NA	1.2	NA	NA	1.4
Silicon, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	490	NA	358	NA	NA	462
Sodium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	492	NA	494	NA	NA	396

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Appendix C - Table 5b
NPI High Priority Project Site No. 42, Parcel 11818054
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**	**11818054**
			Location ID	**CLB-11818054-SS01**	**CLB-11818054-SS02**	**CLB-11818054-SS03**	**CLB-11818054-SS04**	**CLB-11818054-SS05**	**CLB-11818054-SS06**	**CLB-11818054-SS07**	**CLB-11818054-SS08**	**CLB-11818054-SS08 (Duplicate)**	**CLB-11818054-SS09**
			Field Sample ID	**CLB-11818054-SS01-033010**	**CLB-11818054-SS02-033010**	**CLB-11818054-SS03-033010**	**CLB-11818054-SS04-033010**	**CLB-11818054-SS05-033010**	**CLB-11818054-SS06-033010**	**CLB-11818054-SS07-033010**	**CLB-11818054-SS08-033010**	**CLB-11818054-SS10-033010**	**CLB-11818054-SS09-033010**
			Sample Date	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Strontium1, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	19.6	NA	13.9	NA	NA	5.4
Strontium2, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	34.8	NA	14.7	NA	NA	4.5
Sulfur, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	398	NA	163	NA	NA	39.4
Thallium, Total	mg/kg	**6.1**	230	NA	NA	NA	NA	1.2	NA	0.7	NA	NA	0.5
Tin, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	0.6	NA	1	NA	NA	0.2
Titanium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	90.4	NA	66.2	NA	NA	34.9
Vanadium, Total	mg/kg	**680**	26,000	NA	NA	NA	NA	6	NA	4.1	NA	NA	2.3
Zinc, Total	mg/kg	**23,000**	880,000	NA	NA	NA	NA	464	NA	297	NA	NA	115
Antimony, XRF	mg/kg	**30**	1,200	72 U	74 U	74 U	74 U	79 U	72 U	72 U	74 U	NA	NA
Arsenic, XRF	mg/kg	**6.7**	82	33 U	24 U	23 U	42 U	**32**	28 U	20 U	**13**	NA	NA
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	NA	NA
Cadmium, XRF	mg/kg	**72**	2,300	50 U	52 U	52 U	52 U	55 U	50 U	50 U	51 U	NA	NA
Chromium, XRF	mg/kg	**NA**	NA	116 U	126 U	120 U	129 U	138 U	123 U	121 U	105 U	NA	NA
Cobalt, XRF	mg/kg	**1,400**	23,000	138 U	151 U	146 U	163 U	176 U	160 U	146 U	117 U	NA	NA
Copper, XRF	mg/kg	**NA**	NA	35	23 U	30	29	24 U	66	36	21 U	NA	NA
Iron, XRF	mg/kg	**NA**	NA	14,739	17,339	15,665	19,236	20,220	19,847	17,110	10,424	NA	NA
Lead, XRF	mg/kg	**400**	1800	**704**	319	295	**1,025**	**486**	**485**	250	45	NA	NA
Manganese, XRF	mg/kg	**NA**	NA	99	95 U	93 U	165	106 U	138	91 U	75 U	NA	NA
Mercury, XRF	mg/kg	**7.6**	290	11 U	10 U	10 U	14 U	11 U	11 U	9 U	9 U	NA	NA
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	10	8 U	9 U	8 U	8 U	8 U	NA	NA
Nickel, XRF	mg/kg	**1,500**	44,000	37 U	40 U	38 U	43 U	43 U	41 U	39 U	38 U	NA	NA
Rubidium, XRF	mg/kg	**NA**	NA	33	34	36	38	35	32	36	29	NA	NA
Selenium, XRF	mg/kg	**380**	15,000	4 U	4 U	4 U	5 U	5 U	4 U	4 U	3 U	NA	NA
Silver, XRF	mg/kg	**380**	15,000	46 U	48 U	48 U	48 U	51 U	47 U	46 U	47 U	NA	NA
Strontium, XRF	mg/kg	**NA**	NA	103	108	105	111	103	106	96	92	NA	NA
Tin, XRF	mg/kg	**NA**	NA	74 U	76 U	76 U	76 U	80 U	74 U	74 U	75 U	NA	NA
Titanium, XRF	mg/kg	**NA**	NA	2,734	3,835	3,251	2,794	3,608	2,185	3,432	1,642	NA	NA
Zinc, XRF	mg/kg	**23,000**	880,000	236	184	143	590	151	226	105	71	NA	NA
Zirconium, XRF	mg/kg	**NA**	NA	130	129	140	130	135	127	141	102	NA	NA

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5c
NPI High Priority Project Site No. 42, Parcel 11818055
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42	42
			Parcel ID	11818055	11818055	11818055	11818055	11818055	11818055	11818055	11818055	11818055	11818055
			Location ID	CLB-11818055-SS01	CLB-11818055-SS02	CLB-11818055-SS03	CLB-11818055-SS04	CLB-11818055-SS05	CLB-11818055-SS06	CLB-11818055-SS07	CLB-11818055-SS08	CLB-11818055-SS09	CLB-11818055-SS09 (Duplicate)
			Field Sample ID	CLB-11818055-SS01-033010	CLB-11818055-SS02-033010	CLB-11818055-SS03-033010	CLB-11818055-SS04-033010	CLB-11818055-SS05-033010	CLB-11818055-SS06-033010	CLB-11818055-SS07-033010	CLB-11818055-SS08-033010	CLB-11818055-SS09-033010	CLB-11818055-SS10-033010
			Sample Date	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria										
Percent Moisture	%			7.7	10.9	10.2	10.4	15.7	20.6	13.6	16.1	13.9	12.8
2-Methylnaphthalene	µg/kg	**NA**	NA	27.1 U	47.6	27.9 U	87.9	43.7	51.9	36	37.6	29 U	28.7 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	27.1 U	85.9	27.9 U	311	64.6	65.1	31.5	35.2	56.2	69.1
Acenaphthylene	µg/kg	**NA**	NA	27.1 U	43.8	27.9 U	27.9 U	29.6 U	38.2	28.9 U	29.8 U	47.9	32.6
Anthracene	µg/kg	**18,000,000**	280,000,000	29.6	299	27.9 U	855	236	249	143	153	257	330
Benzo(a)anthracene	µg/kg	**11,000**	76,000	61.3	921	60.6	1,510	468	532	337	372	647	719
Benzo(a)pyrene	µg/kg	**1,100**	7,700	73.1	836	74	**1,380**	533	584	363	400	643	722
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	66	848	66	1,210	480	545	324	365	576	563
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	53.7	510	52.6	809	462	455	226	257	376	405
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	77.3	741	66.5	1,280	407	510	328	355	575	674
Chrysene	µg/kg	**1,100,000**	7,600,000	81.5	973	72.2	1,560	551	615	369	418	668	736
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	27.1 U	218	27.9 U	363	135	161	91.5	103	164	173
Fluoranthene	µg/kg	**2,400,000**	37,000,000	158	2,390	135	4,190	1,080	1,300	777	865	1,470	1,670
Fluorene	µg/kg	**2,400,000**	37,000,000	27.1 U	65.9	27.9 U	333	46.6	54	28.9 U	29.8 U	37.4	44.8
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	47.2	484	44.2	782	296	351	212	233	361	387
Naphthalene	µg/kg	**69,000**	150,000	27.1 U	54.3	27.9 U	169	41.2	53.7	33.6	38.6	29 U	28.7 U
Phenanthrene	µg/kg	**NA**	NA	61	1450	53.7	3,580	602	693	355	394	627	858
Pyrene	µg/kg	**1,800,000**	28,000,000	133	1,860	121	3,040	928	1,100	676	749	1,230	1,400
Aluminum, Total	mg/kg	**NA**	NA	5,500	NA	NA	NA	NA	NA	NA	5,000	4,640	5,300
Antimony, Total	mg/kg	**30**	1,200	0.7	NA	NA	NA	NA	NA	NA	2.9	0.5	0.6
Arsenic, Total	mg/kg	**6.7**	82	5.2	NA	NA	NA	NA	NA	NA	**9.9**	**6.9**	**6.9**
Barium, Total	mg/kg	**15,000**	370,000	132	NA	NA	NA	NA	NA	NA	229	150	151
Beryllium, Total	mg/kg	**150**	5,100	0.1	NA	NA	NA	NA	NA	NA	0.3	0.1	0.2
Boron, Total	mg/kg	**NA**	NA	0.7	NA	NA	NA	NA	NA	NA	16.4	3.2	2
Cadmium, Total	mg/kg	**72**	2,300	0.2	NA	NA	NA	NA	NA	NA	1.8	0.4	0.4
Calcium, Total	mg/kg	**NA**	NA	465	NA	NA	NA	NA	NA	NA	4,190	1,090	1,230
Chromium, Total	mg/kg	**NA**	NA	3.7	NA	NA	NA	NA	NA	NA	1.9	0.9	1.5
Cobalt, Total	mg/kg	**1,400**	23,000	3.8	NA	NA	NA	NA	NA	NA	9.9	3	3.2
Copper, Total	mg/kg	**NA**	NA	13	NA	NA	NA	NA	NA	NA	24.8	16.6	18.3
Iron, Total	mg/kg	**NA**	NA	8,510	NA	NA	NA	NA	NA	NA	9,030	8,610	9,490
Lead, Total	mg/kg	**400**	1,800	41	NA	NA	NA	NA	NA	NA	171	67.8	64.5
Magnesium, Total	mg/kg	**NA**	NA	714	NA	NA	NA	NA	NA	NA	1,870	544	669
Manganese, Total	mg/kg	**NA**	NA	65	NA	NA	NA	NA	NA	NA	132	124	129
Molybdenum, Total	mg/kg	**NA**	NA	9.2 U	NA	NA	NA	NA	NA	NA	7.3 U	6.2 U	8.2 U
Nickel, Total	mg/kg	**1,500**	44,000	8.4	NA	NA	NA	NA	NA	NA	8.3	7.3	8.5
Phosphorus, Total	mg/kg	**NA**	NA	256	NA	NA	NA	NA	NA	NA	452	377	407
Potassium, Total	mg/kg	**NA**	NA	365	NA	NA	NA	NA	NA	NA	611	388	443
Selenium, Total	mg/kg	**380**	15,000	1.1 U	NA	NA	NA	NA	NA	NA	2.5	1.9	1.9
Silicon, Total	mg/kg	**NA**	NA	785	NA	NA	NA	NA	NA	NA	818	527	389
Sodium, Total	mg/kg	**NA**	NA	476	NA	NA	NA	NA	NA	NA	616	445	512

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Appendix C - Table 5c
NPI High Priority Project Site No. 42, Parcel 11818055
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11818055**	**11818055**	**11818055**	**11818055**	**11818055**	**11818055**	**11818055**	**11818055**	**11818055**	**11818055**
			Location ID	**CLB-11818055-SS01**	**CLB-11818055-SS02**	**CLB-11818055-SS03**	**CLB-11818055-SS04**	**CLB-11818055-SS05**	**CLB-11818055-SS06**	**CLB-11818055-SS07**	**CLB-11818055-SS08**	**CLB-11818055-SS09**	**CLB-11818055-SS09 (Duplicate)**
			Field Sample ID	**CLB-11818055-SS01-033010**	**CLB-11818055-SS02-033010**	**CLB-11818055-SS03-033010**	**CLB-11818055-SS04-033010**	**CLB-11818055-SS05-033010**	**CLB-11818055-SS06-033010**	**CLB-11818055-SS07-033010**	**CLB-11818055-SS08-033010**	**CLB-11818055-SS09-033010**	**CLB-11818055-SS10-033010**
			Sample Date	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**	**3/30/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Strontium1, Total	mg/kg	**NA**	NA	3.7	NA	NA	NA	NA	NA	NA	10	5.8	7
Strontium2, Total	mg/kg	**NA**	NA	4.2	NA	NA	NA	NA	NA	NA	24.2	6.4	7.5
Sulfur, Total	mg/kg	**NA**	NA	19.2	NA	NA	NA	NA	NA	NA	184	105	114
Thallium, Total	mg/kg	**6.1**	230	0.1 U	NA	NA	NA	NA	NA	NA	0.6	0.7	1
Tin, Total	mg/kg	**NA**	NA	0.3	NA	NA	NA	NA	NA	NA	0.9	0.3	0.1
Titanium, Total	mg/kg	**NA**	NA	51.7	NA	NA	NA	NA	NA	NA	67.1	56.1	67.2
Vanadium, Total	mg/kg	**680**	26,000	3.1	NA	NA	NA	NA	NA	NA	4.1	3.6	4.2
Zinc, Total	mg/kg	**23,000**	880,000	134	NA	NA	NA	NA	NA	NA	178	121	119
Antimony, XRF	mg/kg	**30**	1,200	71 U	71 U	72 U	82 U	72 U	71 U	71 U	72 U	73 U	72 U
Arsenic, XRF	mg/kg	**6.7**	82	**13**	11 U	**18**	18 U	16 U	19 U	19 U	20 U	14 U	13 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	50 U	49 U	50 U	56	53	**81**	49 U	50 U	51 U	50 U
Chromium, XRF	mg/kg	**NA**	NA	101 U	107 U	112 U	153 U	121 U	115 U	120 U	115 U	114 U	111 U
Cobalt, XRF	mg/kg	**1,400**	23,000	129 U	124 U	144 U	215 U	143 U	145 U	154 U	149 U	133 U	128 U
Copper, XRF	mg/kg	**NA**	NA	21 U	20 U	21 U	60	21 U	30	31	30	22 U	29
Iron, XRF	mg/kg	**NA**	NA	13,129	12,832	16,304	31,830	16,506	16,496	19,006	17,885	13,948	13,390
Lead, XRF	mg/kg	**400**	1,800	19	61	63	162	128	209	203	232	87	86
Manganese, XRF	mg/kg	**NA**	NA	80 U	78 U	89 U	385	189	88 U	91 U	123	109	82 U
Mercury, XRF	mg/kg	**7.6**	290	9 U	9 U	9 U	12 U	10 U	10 U	9 U	10 U	9 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	7 U	8 U	8 U	8 U	8 U	7 U	8 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1500**	44,000	38 U	38 U	39 U	49 U	40 U	40 U	39 U	39 U	38 U	37 U
Rubidium, XRF	mg/kg	**NA**	NA	34	37	39	42	31	35	30	33	32	30
Selenium, XRF	mg/kg	**380**	15,000	3 U	3 U	3 U	4 U	3 U	3 U	4 U	4 U	3 U	3 U
Silver, XRF	mg/kg	**380**	15,000	46 U	46 U	47 U	61	46 U	46 U	46 U	46 U	47 U	46 U
Strontium, XRF	mg/kg	**NA**	NA	81	110	111	129	100	107	92	97	94	97
Tin, XRF	mg/kg	**NA**	NA	72 U	73 U	74 U	261	74 U	73 U	72 U	74 U	75 U	73 U
Titanium, XRF	mg/kg	**NA**	NA	2,002	1,661	2,634	3,265	2,252	2,083	2,654	2,423	2,668	2,503
Zinc, XRF	mg/kg	**23,000**	880,000	79	103	85	239	173	234	179	157	80	79
Zirconium, XRF	mg/kg	**NA**	NA	129	164	139	187	134	141	122	160	154	169

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5d
NPI High Priority Project Site No. 42, Parcel 11818076
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**
			Location ID	**CLB-11818076-SS01**	**CLB-11818076-SS01 (Duplicate)**	**CLB-11818076-SS02**	**CLB-11818076-SS03**	**CLB-11818076-SS04**	**CLB-11818076-SS05**	**CLB-11818076-SS06**	**CLB-11818076-SS07**	**CLB-11818076-SS08**	**CLB-11818076-SS09**
			Field Sample ID	**CLB-11818076-SS01-040210**	**CLB-11818076-SS10-040210**	**CLB-11818076-SS02-040210**	**CLB-11818076-SS03-040210**	**CLB-11818076-SS04-040210**	**CLB-11818076-SS05-040210**	**CLB-11818076-SS06-040210**	**CLB-11818076-SS07-040210**	**CLB-11818076-SS08-040210**	**CLB-11818076-SS09-040210**
			Sample Date	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Percent Moisture	%			11.8	12	11.9	10.6	8	12.8	10.1	8.3	11.7	7.7
2-Methylnaphthalene	µg/kg	**NA**	NA	79.4	87.5	142 U	140 U	64.8	47.2	89.2	91.8	33.2	41.6
Acenaphthene	µg/kg	**3,500,000**	56,000,000	69.9	69.1	227	209	324	54.4	93	112	111	134
Acenaphthylene	µg/kg	**NA**	NA	64.3	81.2	142 U	148	508	30.2	60.1	35.8	30.5	27.1 U
Anthracene	µg/kg	**18,000,000**	280,000,000	327	344	919	1,170	2,210	193	378	383	309	350
Benzo(a)anthracene	µg/kg	**11,000**	76,000	985	1,130	2,040	2,920	5,090	583	1,060	937	916	795
Benzo(a)pyrene	µg/kg	**1,100**	7,700	894	1,030	**1,830**	**2,570**	**3,830**	540	944	814	807	708
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	821	945	1,630	2,450	3,400	516	850	723	711	624
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	552	622	1,100	1,620	2,030	335	582	485	456	403
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	771	882	1,510	2,170	3,200	467	822	708	704	579
Chrysene	µg/kg	**1,100,000**	7,600,000	895	1,040	1,840	2,640	4,290	545	952	843	833	704
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	250	290	513	727	1,060	150	263	219	222	187
Fluoranthene	µg/kg	**2,400,000**	37,000,000	2,210	2,480	4,850	6,800	11,400	1,360	2,350	2,260	2,050	1,900
Fluorene	µg/kg	**2,400,000**	37,000,000	74.5	72.9	259	234	409	47.7	100	99.5	83.7	104
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	513	587	1,020	1,490	1,990	312	538	457	444	385
Naphthalene	µg/kg	**69,000**	150,000	68.5	72.5	142	140	69.4	40.7	76.8	65.2	33	43.5
Phenanthrene	µg/kg	**NA**	NA	1,110	1,160	3,030	3,960	6,160	712	1,320	1,400	1,130	1,260
Pyrene	µg/kg	**1,800,000**	28,000,000	1,670	1,880	3,630	5,050	7,890	1,020	1,800	1,700	1,590	1,440
Aluminum, Total	mg/kg	**NA**	NA	4,300	4,180	NA	NA	NA	5,800	NA	NA	NA	3,760
Antimony, Total	mg/kg	**30**	1,200	1.3	1.2	NA	NA	NA	1.5	NA	NA	NA	1.4
Arsenic, Total	mg/kg	**6.7**	82	**7.5**	**7.3**	NA	NA	NA	**12.3**	NA	NA	NA	**7.2**
Barium, Total	mg/kg	**15,000**	370,000	195	215	NA	NA	NA	195	NA	NA	NA	180
Beryllium, Total	mg/kg	**150**	5,100	0.1	0.2	NA	NA	NA	0.2	NA	NA	NA	0.1
Boron, Total	mg/kg	**NA**	NA	11.3	15.2	NA	NA	NA	12.9	NA	NA	NA	15.8
Cadmium, Total	mg/kg	**72**	2,300	0.3	0.3	NA	NA	NA	0.4	NA	NA	NA	0.2
Calcium, Total	mg/kg	**NA**	NA	3,860	4,080	NA	NA	NA	5,240	NA	NA	NA	2,870
Chromium, Total	mg/kg	**NA**	NA	0.9	1	NA	NA	NA	0.8	NA	NA	NA	0 U
Cobalt, Total	mg/kg	**1,400**	23,000	3.8	4	NA	NA	NA	5	NA	NA	NA	3.5
Copper, Total	mg/kg	**NA**	NA	30.8	31.6	NA	NA	NA	25.1	NA	NA	NA	13.3
Iron, Total	mg/kg	**NA**	NA	10,700	10,000	NA	NA	NA	15,500	NA	NA	NA	10,000
Lead, Total	mg/kg	**400**	1,800	161	163	NA	NA	NA	100	NA	NA	NA	75.7
Magnesium, Total	mg/kg	**NA**	NA	1,550	1,540	NA	NA	NA	3,560	NA	NA	NA	1,120
Manganese, Total	mg/kg	**NA**	NA	239	263	NA	NA	NA	177	NA	NA	NA	172
Molybdenum, Total	mg/kg	**NA**	NA	7 U	6.5 U	NA	NA	NA	6.4 U	NA	NA	NA	6.3 U
Nickel, Total	mg/kg	**1,500**	44,000	10.2	9.9	NA	NA	NA	16.6	NA	NA	NA	8.7
Phosphorus, Total	mg/kg	**NA**	NA	369	402	NA	NA	NA	307	NA	NA	NA	325
Potassium, Total	mg/kg	**NA**	NA	536	566	NA	NA	NA	825	NA	NA	NA	418
Selenium, Total	mg/kg	**380**	15,000	0.4	2.3 U	NA	NA	NA	0.7	NA	NA	NA	0.8
Silicon, Total	mg/kg	**NA**	NA	1,010	1,280	NA	NA	NA	1,550	NA	NA	NA	534
Sodium, Total	mg/kg	**NA**	NA	588	630	NA	NA	NA	649	NA	NA	NA	550
Strontium1, Total	mg/kg	**NA**	NA	9.6	13.2	NA	NA	NA	8.2	NA	NA	NA	5.1
Strontium2, Total	mg/kg	**NA**	NA	12.3	14.6	NA	NA	NA	10.2	NA	NA	NA	6.5
Sulfur, Total	mg/kg	**NA**	NA	166	189	NA	NA	NA	221	NA	NA	NA	62.8
Thallium, Total	mg/kg	**6.1**	230	0.3	0 U	NA	NA	NA	0.3	NA	NA	NA	0.2 U
Tin, Total	mg/kg	**NA**	NA	1	0.9	NA	NA	NA	0.6	NA	NA	NA	0.1 U
Titanium, Total	mg/kg	**NA**	NA	50.2	47.2	NA	NA	NA	35.8	NA	NA	NA	36.3
Vanadium, Total	mg/kg	**680**	26,000	2.2	3.1	NA	NA	NA	4.7	NA	NA	NA	1.7
Zinc, Total	mg/kg	**23,000**	880,000	186	203	NA	NA	NA	187	NA	NA	NA	178

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Appendix C - Table 5d
NPI High Priority Project Site No. 42, Parcel 11818076
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**	**11818076**
			Location ID	**CLB-11818076-SS01**	**CLB-11818076-SS01 (Duplicate)**	**CLB-11818076-SS02**	**CLB-11818076-SS03**	**CLB-11818076-SS04**	**CLB-11818076-SS05**	**CLB-11818076-SS06**	**CLB-11818076-SS07**	**CLB-11818076-SS08**	**CLB-11818076-SS09**
			Field Sample ID	**CLB-11818076-SS01-040210**	**CLB-11818076-SS10-040210**	**CLB-11818076-SS02-040210**	**CLB-11818076-SS03-040210**	**CLB-11818076-SS04-040210**	**CLB-11818076-SS05-040210**	**CLB-11818076-SS06-040210**	**CLB-11818076-SS07-040210**	**CLB-11818076-SS08-040210**	**CLB-11818076-SS09-040210**
			Sample Date	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Antimony, XRF	mg/kg	**30**	1,200	77 U	73 U	72 U	73 U	69 U	73 U	73 U	77 U	73 U	72 U
Arsenic, XRF	mg/kg	**6.7**	82	**29**	20 U	**24**	15 U	13 U	**21**	18 U	**17**	17 U	13 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	54 U	50 U	50 U	50 U	49 U	70	50 U	53 U	51 U	50 U
Chromium, XRF	mg/kg	**NA**	NA	179 U	121 U	136 U	111 U	107 U	118 U	126 U	120 U	120 U	110 U
Cobalt, XRF	mg/kg	**1,400**	23,000	305 U	165 U	180 U	147 U	141 U	170 U	161 U	149 U	159 U	135 U
Copper, XRF	mg/kg	**NA**	NA	31	37	53	21 U	21 U	62	31	28	29	21 U
Iron, XRF	mg/kg	**NA**	NA	61,648	21,264	24,876	17,141	16,709	22,261	20,757	16,286	18,491	14,689
Lead, XRF	mg/kg	**400**	1,800	207	220	188	120	96	152	179	101	158	90
Manganese, XRF	mg/kg	**NA**	NA	156 U	260	172	173	91	140	188	217	149	170
Mercury, XRF	mg/kg	**7.6**	290	12 U	11 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	10	8 U	8 U	8 U	13	8 U	8 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	56 U	42 U	42 U	40 U	39 U	43 U	41 U	50	42 U	37 U
Rubidium, XRF	mg/kg	**NA**	NA	46	37	32	40	37	56	41	34	49	38
Selenium, XRF	mg/kg	**380**	15,000	4 U	4 U	3 U	3 U	3 U	4 U	4 U	3 U	3 U	3 U
Silver, XRF	mg/kg	**380**	15,000	51 U	47 U	47 U	46 U	46 U	47 U	47 U	49 U	48 U	46 U
Strontium, XRF	mg/kg	**NA**	NA	110	106	106	103	99	87	117	80	84	108
Tin, XRF	mg/kg	**NA**	NA	706	75 U	74 U	74 U	71 U	74 U	74 U	78 U	75 U	73 U
Titanium, XRF	mg/kg	**NA**	NA	2,874	2,638	2,488	2,463	2,851	3,879	3,631	2,837	3,208	2,314
Zinc, XRF	mg/kg	**23,000**	880,000	206	187	197	132	125	164	192	112	156	127
Zirconium, XRF	mg/kg	**NA**	NA	160	142	109	100	186	123	111	116	167	105

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5e
NPI High Priority Project Site No. 42, Parcel 11818077
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42	42	42
			Parcel ID	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077
			Location ID	CLB-11818077-SS01	CLB-11818077-SS01 (Duplicate)	CLB-11818077-SS02	CLB-11818077-SS03	CLB-11818077-SS04	CLB-11818077-SS05	CLB-11818077-SS06	CLB-11818077-SS07	CLB-11818077-SS08	CLB-11818077-SS09	CLB-11818077-SS10
			Field Sample ID	CLB-11818077-SS01-040210	CLB-11818077-SS11-040210	CLB-11818077-SS02-040210	CLB-11818077-SS03-040210	CLB-11818077-SS04-040210	CLB-11818077-SS05-040210	CLB-11818077-SS06-040210	CLB-11818077-SS07-040210	CLB-11818077-SS08-040210	CLB-11818077-SS09-040210	CLB-11818077-SS10-040210
			Sample Date	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria											
Percent Moisture	%			27	26.7	17.6	14.4	19.1	12.7	12.2	14	8.3	11	11
2-Methylnaphthalene	µg/kg	**NA**	NA	184	242	33.5	116	322	28.6 U	118	193	27.3 U	28.1 U	80.3
Acenaphthene	µg/kg	**3,500,000**	56,000,000	80.5	190	57.3	36.3	511	60	153	717	27.3 U	28.1 U	107
Acenaphthylene	µg/kg	**NA**	NA	52.6	64.3	30.3 U	56.2	155 U	36.9	45.9	60.2	27.3 U	28.1 U	279
Anthracene	µg/kg	**18,000,000**	280,000,000	277	394	139	136	1,680	292	836	1,880	32.5	67	634
Benzo(a)anthracene	µg/kg	**11,000**	76,000	751	1,000	331	510	4,060	1,100	2,070	2,800	122	230	1,880
Benzo(a)pyrene	µg/kg	**1,100**	7,700	688	940	301	480	**3,510**	1,060	**1,640**	**2,650**	123	224	**1,610**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	716	870	247	421	2,980	928	1,470	2,320	113	210	1390
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	428	572	174	303	1,950	721	897	1,610	96.1	139	913
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	555	864	261	439	3,080	948	1,470	2,000	106	193	1,530
Chrysene	µg/kg	**1,100,000**	7,600,000	729	964	297	479	3,570	1,000	1,800	2,510	118	220	1,840
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	197	266	79.9	140	970	314	469	649	37.2	61.6	423
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,770	2,380	811	1,050	9,400	2,350	4,680	7,410	276	537	5,080
Fluorene	µg/kg	**2,400,000**	37,000,000	83	187	43.3	36	545	56	160	680	27.3 U	28.1 U	198
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	398	543	164	282	1,900	598	889	1,460	79.4	129	884
Naphthalene	µg/kg	**69,000**	150,000	154	327	36.3	96.8	316	28.6 U	99.5	224	27.3 U	28.1 U	98.3
Phenanthrene	µg/kg	**NA**	NA	1,060	1,510	540	496	5,660	811	2,550	5,820	131	260	3,840
Pyrene	µg/kg	**1,800,000**	28,000,000	1,320	1,750	595	813	6,850	1,840	3,340	5,830	218	409	3,740
Aluminum, Total	mg/kg	**NA**	NA	5,270	3,610	5,590	4,470	4,710	4,550	3,680	4,400	4,000	4,860	4,440
Antimony, Total	mg/kg	**30**	1,200	1.9	1.4	0.5	0.3	0.8	0.4	3.4	0.8	0.4	0.5	0.5
Arsenic, Total	mg/kg	**6.7**	82	**8.7**	**8**	**8.6**	6.3	**8.6**	**7**	**14.4**	**8.7**	**6.9**	**7.1**	**9.2**
Barium, Total	mg/kg	**15,000**	370,000	271	240	201	201	237	259	179	233	126	167	185
Beryllium, Total	mg/kg	**150**	5,100	0.3	0.2	0.3	0.3	0.3	0.2	0.6	0.3	0.3	0.3	0.3
Boron, Total	mg/kg	**NA**	NA	7.9	6.9	6.3	7.9	3.3	4	2.8	5.6	0.2 U	1.1 U	2.4
Cadmium, Total	mg/kg	**72**	2,300	0.8	0.8	0.6	0.7	0.8	0.6	1.5	0.7	0.1	0.2	0.7
Calcium, Total	mg/kg	**NA**	NA	21,600	11,000	4,980	4,190	2,930	1,710	4,430	2,760	956	1,660	1,530
Chromium, Total	mg/kg	**NA**	NA	2.6	2.1	3.9	4.1	0.5	2.1	4.4	1.2	2.6	3.5	2.1
Cobalt, Total	mg/kg	**1,400**	23,000	3.8	3.3	3.5	2.7	3.6	3.9	8.9	3.6	3.5	3.7	3.7
Copper, Total	mg/kg	**NA**	NA	57.7	56.3	53.3	39.2	65.2	23.9	142	32.7	17.6	23.2	33.4
Iron, Total	mg/kg	**NA**	NA	15,100	11,700	10,100	8,560	10,900	9,800	17,100	10,100	9,380	9,600	10,500
Lead, Total	mg/kg	**400**	1,800	265	262	183	168	**462**	**716**	**417**	255	49	146	233
Magnesium, Total	mg/kg	**NA**	NA	2,670	2,650	1,150	1,000	956	1,000	1,780	1,020	912	946	892
Manganese, Total	mg/kg	**NA**	NA	382	208	153	133	164	200	137	192	160	149	162
Molybdenum, Total	mg/kg	**NA**	NA	9.8 U	6.8 U	12.3 U	9.2 U	10.1 U	11.4 U	5.4 U	8.5 U	7.4 U	8.1 U	8.7 U
Nickel, Total	mg/kg	**1,500**	44,000	22.5	45.9	8.8	7.5	8.7	9.1	8.6	9	8.3	9.5	9.6
Phosphorus, Total	mg/kg	**NA**	NA	538	449	733	467	453	331	331	370	274	342	482
Potassium, Total	mg/kg	**NA**	NA	942	727	534	509	458	466	434	523	409	406	360
Selenium, Total	mg/kg	**380**	15,000	2.6	2.3	1.6	2	1.9	1.3	2.8	0.9	1.4	1.2	1.7
Silicon, Total	mg/kg	**NA**	NA	317	311	330	325	163	207	810	268	970	770	193
Sodium, Total	mg/kg	**NA**	NA	543	533	477	466	454	474	384	440	388	406	428
Strontium1, Total	mg/kg	**NA**	NA	39.8	9	6.9	2.4	0.3	3.4 U	6.4	0.2 U	7.1 U	5 U	4.3 U
Strontium2, Total	mg/kg	**NA**	NA	62.5	36.3	20.3	16.3	13.9	10.3	19.8	12.2	4.2	7.4	9.2
Sulfur, Total	mg/kg	**NA**	NA	553	484	201	259	244	192	1,140	181	22.6	88.7	136
Thallium, Total	mg/kg	**6.1**	230	0.5	0.9	0.7	0.4	1.5	0.9	2.3	0.4	0.2	0.6	1
Tin, Total	mg/kg	**NA**	NA	0.9	1	0.8	0.7	0.9	0.6	2.1	0.9	0.6	0.7	0.5
Titanium, Total	mg/kg	**NA**	NA	96.7	55	58.2	46.2	47	47.7	79.1	39.5	41.8	44.4	50.8
Vanadium, Total	mg/kg	**680**	26,000	9.7	9.8	7.1	7.4	9	8.1	9.2	9.1	8.2	7.4	8.9
Zinc, Total	mg/kg	**23,000**	880,000	395	364	272	259	334	210	255	281	116	138	193

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Appendix C - Table 5e
NPI High Priority Project Site No. 42, Parcel 11818077
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42	42	42
			Parcel ID	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077	11818077
			Location ID	CLB-11818077-SS01	CLB-11818077-SS01 (Duplicate)	CLB-11818077-SS02	CLB-11818077-SS03	CLB-11818077-SS04	CLB-11818077-SS05	CLB-11818077-SS06	CLB-11818077-SS07	CLB-11818077-SS08	CLB-11818077-SS09	CLB-11818077-SS10
			Field Sample ID	CLB-11818077-SS01-040210	CLB-11818077-SS11-040210	CLB-11818077-SS02-040210	CLB-11818077-SS03-040210	CLB-11818077-SS04-040210	CLB-11818077-SS05-040210	CLB-11818077-SS06-040210	CLB-11818077-SS07-040210	CLB-11818077-SS08-040210	CLB-11818077-SS09-040210	CLB-11818077-SS10-040210
			Sample Date	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria											
Antimony, XRF	mg/kg	**30**	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic, XRF	mg/kg	**6.7**	82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, XRF	mg/kg	**15,000**	370,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium, XRF	mg/kg	**72**	2,300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt, XRF	mg/kg	**1,400**	23,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead, XRF	mg/kg	**400**	1,800	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury, XRF	mg/kg	**7.6**	290	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, XRF	mg/kg	**1,500**	44,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rubidium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium, XRF	mg/kg	**380**	15,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver, XRF	mg/kg	**380**	15,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Titanium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc, XRF	mg/kg	**23,000**	880,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent

µg/kg - micrograms per kilogram

mg/kg - milligrams per kilogram

NA - Not available/Not analyzed for

U - Non detect

VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria

XRF - X-ray Fluorescence

See electronic deliverable for complete analytical results

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Appendix C - Table 5f
NPI High Priority Project Site No. 42, Parcel 11818078
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42	42
			Parcel ID	11818078	11818078	11818078	11818078	11818078	11818078	11818078	11818078	11818078	11818078
			Location ID	CLB-11818078-SS01	CLB-11818078-SS02	CLB-11818078-SS03	CLB-11818078-SS04	CLB-11818078-SS05	CLB-11818078-SS06	CLB-11818078-SS06 (Duplicate)	CLB-11818078-SS07	CLB-11818078-SS08	CLB-11818078-SS09
			Field Sample ID	CLB-11818078-SS01-040210	CLB-11818078-SS02-040210	CLB-11818078-SS03-040210	CLB-11818078-SS04-040210	CLB-11818078-SS05-040210	CLB-11818078-SS06-040210	CLB-11818078-SS10-040210	CLB-11818078-SS07-040210	CLB-11818078-SS08-040210	CLB-11818078-SS09-040210
			Sample Date	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria										
Percent Moisture	%			26.8	13.7	9.5	12.1	12.1	12	12.5	14.4	9.8	10.6
2-Methylnaphthalene	µg/kg	**NA**	NA	239	144	138 U	91	66	142 U	78.2	146 U	67.9	28 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	185	332	138 U	71.3	38.9	445	471	198	88.3	28 U
Acenaphthylene	µg/kg	**NA**	NA	64.4	41.8	138 U	28.5 U	33	142 U	51.4	146 U	30.6	28 U
Anthracene	µg/kg	**18,000,000**	280,000,000	474	789	138 U	217	130	1,640	1,580	689	208	60.2
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,350	1,920	232	691	399	5,430	3,820	1,620	510	178
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,310**	**1,850**	269	715	451	**6,250**	**3,870**	**1,720**	496	193
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,150	1,670	269	633	411	5,530	3,090	1,330	446	175
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	767	1,070	211	449	333	4,110	2,450	1,120	315	140
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,140	1,480	206	639	384	4,330	2,970	1,400	430	175
Chrysene	µg/kg	**1,100,000**	7,600,000	1,290	1,740	312	692	446	4,940	3,420	1,530	512	190
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	362	498	138 U	199	136	**1,820**	**1,140**	476	140	55.2
Fluoranthene	µg/kg	**2,400,000**	37,000,000	3,030	4,300	479	1,440	880	9,590	7,170	3,470	1,250	407
Fluorene	µg/kg	**2,400,000**	37,000,000	143	243	138 U	53.9	31.7	327	384	146	65.6	28 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	736	1,020	177	435	285	3,830	2,380	1,040	305	129
Naphthalene	µg/kg	**69,000**	150,000	244	146	138 U	80	63.5	211	127	146 U	65.8	28 U
Phenanthrene	µg/kg	**NA**	NA	1,780	2,670	218	790	484	3,890	4,010	1,730	891	217
Pyrene	µg/kg	**1,800,000**	28,000,000	2,370	3,370	388	1,240	721	9,930	6,750	2,910	991	334
Aluminum, Total	mg/kg	**NA**	NA	5620	NA	NA	NA	NA	5870	5770	NA	NA	5,190
Antimony, Total	mg/kg	**30**	1,200	1.5	NA	NA	NA	NA	1.9	1.9	NA	NA	1.4
Arsenic, Total	mg/kg	**6.7**	82	**14.6**	NA	NA	NA	NA	**8.8**	**11.9**	NA	NA	6.2
Barium, Total	mg/kg	**15,000**	370,000	233	NA	NA	NA	NA	177	178	NA	NA	186
Beryllium, Total	mg/kg	**150**	5,100	0.3	NA	NA	NA	NA	0.2	0.3	NA	NA	0.1
Boron, Total	mg/kg	**NA**	NA	14.5	NA	NA	NA	NA	14.4	16.2	NA	NA	9.2
Cadmium, Total	mg/kg	**72**	2,300	0.5	NA	NA	NA	NA	0 U	0.1	NA	NA	0.2
Calcium, Total	mg/kg	**NA**	NA	6830	NA	NA	NA	NA	26,400	20,900	NA	NA	2,860
Chromium, Total	mg/kg	**NA**	NA	3.5	NA	NA	NA	NA	0.7	1.7	NA	NA	1.3
Cobalt, Total	mg/kg	**1,400**	23,000	4	NA	NA	NA	NA	5.6	5.6	NA	NA	3.5
Copper, Total	mg/kg	**NA**	NA	59.9	NA	NA	NA	NA	12.5	12.4	NA	NA	12
Iron, Total	mg/kg	**NA**	NA	14000	NA	NA	NA	NA	15,300	15,600	NA	NA	10,700
Lead, Total	mg/kg	**400**	1800	**484**	NA	NA	NA	NA	21.3	21.7	NA	NA	56.4
Magnesium, Total	mg/kg	**NA**	NA	1,140	NA	NA	NA	NA	8,400	5,670	NA	NA	1,240
Manganese, Total	mg/kg	**NA**	NA	216	NA	NA	NA	NA	278	269	NA	NA	187
Molybdenum, Total	mg/kg	**NA**	NA	8.7 U	NA	NA	NA	NA	4.7 U	5.8 U	NA	NA	8.1 U
Nickel, Total	mg/kg	**1,500**	44,000	12.5	NA	NA	NA	NA	14.9	14.9	NA	NA	9.8
Phosphorus, Total	mg/kg	**NA**	NA	845	NA	NA	NA	NA	215	236	NA	NA	407
Potassium, Total	mg/kg	**NA**	NA	618	NA	NA	NA	NA	1,090	938	NA	NA	545
Selenium, Total	mg/kg	**380**	15,000	0.9	NA	NA	NA	NA	2.6 U	2.5 U	NA	NA	0.6
Silicon, Total	mg/kg	**NA**	NA	1,150	NA	NA	NA	NA	1,180	1,500	NA	NA	1,520
Sodium, Total	mg/kg	**NA**	NA	663	NA	NA	NA	NA	654	618	NA	NA	688
Strontium1, Total	mg/kg	**NA**	NA	7.5	NA	NA	NA	NA	21.6	24.6	NA	NA	6.3
Strontium2, Total	mg/kg	**NA**	NA	22.7	NA	NA	NA	NA	27.6	28.3	NA	NA	8.2
Sulfur, Total	mg/kg	**NA**	NA	263	NA	NA	NA	NA	266	310	NA	NA	122
Thallium, Total	mg/kg	**6.1**	230	0.4 U	NA	NA	NA	NA	0.3 U	0.2 U	NA	NA	0 U
Tin, Total	mg/kg	**NA**	NA	1.5	NA	NA	NA	NA	0.2 U	0 U	NA	NA	0 U
Titanium, Total	mg/kg	**NA**	NA	69.3	NA	NA	NA	NA	29.3	33	NA	NA	61.3
Vanadium, Total	mg/kg	**680**	26,000	4.4	NA	NA	NA	NA	4.4	2.8	NA	NA	2
Zinc, Total	mg/kg	**23,000**	880,000	204	NA	NA	NA	NA	126	139	NA	NA	122

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Appendix C - Table 5f
NPI High Priority Project Site No. 42, Parcel 11818078
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11818078**	**11818078**	**11818078**	**11818078**	**11818078**	**11818078**	**11818078**	**11818078**	**11818078**	**11818078**
			Location ID	**CLB-11818078-SS01**	**CLB-11818078-SS02**	**CLB-11818078-SS03**	**CLB-11818078-SS04**	**CLB-11818078-SS05**	**CLB-11818078-SS06**	**CLB-11818078-SS06 (Duplicate)**	**CLB-11818078-SS07**	**CLB-11818078-SS08**	**CLB-11818078-SS09**
			Field Sample ID	**CLB-11818078-SS01-040210**	**CLB-11818078-SS02-040210**	**CLB-11818078-SS03-040210**	**CLB-11818078-SS04-040210**	**CLB-11818078-SS05-040210**	**CLB-11818078-SS06-040210**	**CLB-11818078-SS10-040210**	**CLB-11818078-SS07-040210**	**CLB-11818078-SS08-040210**	**CLB-11818078-SS09-040210**
			Sample Date	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Antimony, XRF	mg/kg	**30**	1,200	72 U	69 U	73 U	74 U	76 U	80 U	NA	80 U	76 U	NA
Arsenic, XRF	mg/kg	**6.7**	82	33 U	30 U	16 U	26 U	28 U	**17**	NA	**13**	33 U	NA
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	NA	0 U	0 U	NA
Cadmium, XRF	mg/kg	**72**	2,300	50 U	49 U	51 U	52 U	60	55 U	NA	56 U	52 U	NA
Chromium, XRF	mg/kg	**NA**	NA	122 U	128 U	115 U	138 U	136 U	140 U	NA	133 U	127 U	NA
Cobalt, XRF	mg/kg	**1,400**	23,000	160 U	178 U	142 U	190 U	191 U	197 U	NA	189 U	172 U	NA
Copper, XRF	mg/kg	**NA**	NA	68	93	35	64	37	25 U	NA	25 U	60	NA
Iron, XRF	mg/kg	**NA**	NA	20,420	25,492	16,491	27,489	26,973	26,622	NA	23,789	23,795	NA
Lead, XRF	mg/kg	**400**	1800	**686**	**577**	148	**401**	**478**	27	NA	43	**661**	NA
Manganese, XRF	mg/kg	**NA**	NA	130	107 U	91 U	113 U	162	232	NA	214	108 U	NA
Mercury, XRF	mg/kg	**7.6**	290	11 U	10 U	10 U	10 U	12 U	11 U	NA	11 U	11 U	NA
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	8 U	11	NA	9 U	8 U	NA
Nickel, XRF	mg/kg	**1,500**	44,000	41 U	42 U	38 U	43 U	45 U	49	NA	49	42 U	NA
Rubidium, XRF	mg/kg	**NA**	NA	35	28	34	35	46	79	NA	67	37	NA
Selenium, XRF	mg/kg	**380**	15,000	4 U	4 U	3 U	4 U	4 U	4 U	NA	3 U	4 U	NA
Silver, XRF	mg/kg	**380**	15,000	46 U	45 U	47 U	48 U	49 U	51 U	NA	52 U	48 U	NA
Strontium, XRF	mg/kg	**NA**	NA	110	126	107	120	115	102	NA	100	110	NA
Tin, XRF	mg/kg	**NA**	NA	73 U	71 U	74 U	76 U	78 U	81 U	NA	81 U	77 U	NA
Titanium, XRF	mg/kg	**NA**	NA	2,416	2,612	2,487	3,195	3,785	4,501	NA	4,417	3,018	NA
Zinc, XRF	mg/kg	**23,000**	880,000	207	470	120	296	225	109	NA	87	343	NA
Zirconium, XRF	mg/kg	**NA**	NA	155	136	118	158	174	205	NA	202	180	NA

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5g
NPI High Priority Project Site No. 42, Parcel 11819069
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42
			Parcel ID	11819069	11819069	11819069	11819069	11819069	11819069
			Location ID	CLB-11819069-SS01	CLB-11819069-SS02	CLB-11819069-SS03	CLB-11819069-SS04	CLB-11819069-SS05	CLB-11819069-SS06
			Field Sample ID	CLB-11819069-SS01-033010	CLB-11819069-SS02-033010	CLB-11819069-SS03-033010	CLB-11819069-SS04-033010	CLB-11819069-SS05-033010	CLB-11819069-SS06-033010
			Sample Date	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Percent Moisture	%			13.9	14	9	16.1	15	13.7
2-Methylnaphthalene	µg/kg	**NA**	NA	90.7	335	27.5 U	149 U	147 U	32
Acenaphthene	µg/kg	**3,500,000**	56,000,000	248	104	30.5	149 U	147 U	29 U
Acenaphthylene	µg/kg	**NA**	NA	29 U	63	27.5 U	149 U	187	29 U
Anthracene	µg/kg	**18,000,000**	280,000,000	786	396	151	310	175	83.5
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,820	1,110	378	828	1,090	231
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,770**	1,100	376	866	**1,340**	271
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,620	1,090	353	706	1,050	254
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	1,010	678	242	677	1,230	197
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,390	923	317	777	1,040	244
Chrysene	µg/kg	**1,100,000**	7,600,000	1,790	1,190	404	924	1,210	281
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	452	299	95.7	262	315	70
Fluoranthene	µg/kg	**2,400,000**	37,000,000	4,130	2,570	803	1,310	1,440	503
Fluorene	µg/kg	**2,400,000**	37,000,000	170	76.8	27.5 U	149 U	147 U	29 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	963	638	214	528	815	169
Naphthalene	µg/kg	**69,000**	150,000	96.2	280	27.5 U	149 U	147 U	35.6
Phenanthrene	µg/kg	**NA**	NA	2,400	1,410	387	514	151	193
Pyrene	µg/kg	**1,800,000**	28,000,000	3,390	2,050	690	1,420	1,670	450
Aluminum, Total	mg/kg	**NA**	NA	NA	NA	3,750	3,620	NA	3,270
Antimony, Total	mg/kg	**30**	1,200	NA	NA	0.6	2.2	NA	0.6
Arsenic, Total	mg/kg	**6.7**	82	NA	NA	**10.2**	**10.4**	NA	6.5
Barium, Total	mg/kg	**15,000**	370,000	NA	NA	168	451	NA	168
Beryllium, Total	mg/kg	**150**	5,100	NA	NA	0.2	0.2	NA	0.1
Boron, Total	mg/kg	**NA**	NA	NA	NA	2.9	2.6	NA	2.5
Cadmium, Total	mg/kg	**72**	2,300	NA	NA	0.6	0.5	NA	0.6
Calcium, Total	mg/kg	**NA**	NA	NA	NA	929	17,900	NA	1,850
Chromium, Total	mg/kg	**NA**	NA	NA	NA	0.6	8.8	NA	1.3
Cobalt, Total	mg/kg	**1,400**	23,000	NA	NA	4.1	4.4	NA	3.1
Copper, Total	mg/kg	**NA**	NA	NA	NA	31.7	43.5	NA	21.8
Iron, Total	mg/kg	**NA**	NA	NA	NA	10,600	12,800	NA	9,380
Lead, Total	mg/kg	**400**	1,800	NA	NA	242	**1,430**	NA	279
Magnesium, Total	mg/kg	**NA**	NA	NA	NA	700	3,530	NA	927
Manganese, Total	mg/kg	**NA**	NA	NA	NA	177	356	NA	114
Molybdenum, Total	mg/kg	**NA**	NA	NA	NA	5.4 U	2.7 U	NA	4.6 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	NA	9.9	11.4	NA	9.2
Phosphorus, Total	mg/kg	**NA**	NA	NA	NA	354	443	NA	395
Potassium, Total	mg/kg	**NA**	NA	NA	NA	379	592	NA	439
Selenium, Total	mg/kg	**380**	15,000	NA	NA	1.2	2.2	NA	1.8
Silicon, Total	mg/kg	**NA**	NA	NA	NA	252	286	NA	243
Sodium, Total	mg/kg	**NA**	NA	NA	NA	520	552	NA	461

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Appendix C - Table 5g
NPI High Priority Project Site No. 42, Parcel 11819069
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42
			Parcel ID	11819069	11819069	11819069	11819069	11819069	11819069
			Location ID	CLB-11819069-SS01	CLB-11819069-SS02	CLB-11819069-SS03	CLB-11819069-SS04	CLB-11819069-SS05	CLB-11819069-SS06
			Field Sample ID	CLB-11819069-SS01-033010	CLB-11819069-SS02-033010	CLB-11819069-SS03-033010	CLB-11819069-SS04-033010	CLB-11819069-SS05-033010	CLB-11819069-SS06-033010
			Sample Date	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010	3/30/2010
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Strontium1, Total	mg/kg	**NA**	NA	NA	NA	6	12.6	NA	10.3
Strontium2, Total	mg/kg	**NA**	NA	NA	NA	6.9	28.7	NA	10.9
Sulfur, Total	mg/kg	**NA**	NA	NA	NA	106	496	NA	168
Thallium, Total	mg/kg	**6**	230	NA	NA	0.7	0.9	NA	0.5
Tin, Total	mg/kg	**NA**	NA	NA	NA	0.5	0.6	NA	0.2
Titanium, Total	mg/kg	**NA**	NA	NA	NA	49.6	59.2	NA	47.5
Vanadium, Total	mg/kg	**680**	26,000	NA	NA	4	5.9	NA	2.7
Zinc, Total	mg/kg	**23,000**	880,000	NA	NA	127	353	NA	185
Antimony, XRF	mg/kg	**30**	1,200	75 U	74 U	73 U	74 U	71 U	72 U
Arsenic, XRF	mg/kg	**6.7**	82	30 U	23 U	17 U	44 U	33 U	23 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	52 U	67	51 U	58	50 U	54
Chromium, XRF	mg/kg	**NA**	NA	154 U	145 U	123 U	135 U	116 U	112 U
Cobalt, XRF	mg/kg	**1,400**	23,000	236 U	204 U	158 U	169 U	117 U	136 U
Copper, XRF	mg/kg	**NA**	NA	102	78	33	51	33	21 U
Iron, XRF	mg/kg	**NA**	NA	41,135	32,130	19,573	21,291	10,893	14,987
Lead, XRF	mg/kg	**400**	1,800	**519**	318	165	**1,160**	**734**	350
Manganese, XRF	mg/kg	**NA**	NA	126 U	114 U	100	197	135	83 U
Mercury, XRF	mg/kg	**7.6**	290	12 U	12 U	10 U	13 U	10 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	7 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	104	45 U	40 U	42 U	38 U	39 U
Rubidium, XRF	mg/kg	**NA**	NA	29	47	34	35	29	35
Selenium, XRF	mg/kg	**380**	15,000	4 U	4 U	4 U	5 U	4 U	3 U
Silver, XRF	mg/kg	**380**	15,000	48 U	48 U	47 U	48 U	46 U	46 U
Strontium, XRF	mg/kg	**NA**	NA	139	146	93	111	133	123
Tin, XRF	mg/kg	**NA**	NA	78 U	76 U	75 U	76 U	73 U	73 U
Titanium, XRF	mg/kg	**NA**	NA	2,417	3,064	2,537	2,431	2,140	2,002
Zinc, XRF	mg/kg	**23,000**	880,000	398	303	97	393	480	209
Zirconium, XRF	mg/kg	**NA**	NA	123	154	135	120	103	144

NOTES:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent

µg/kg - micrograms per kilogram

mg/kg - milligrams per kilogram

NA - Not available/Not analyzed for

U - Non detect

VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria

XRF - X-ray Fluorescence

See electronic deliverable for complete analytical results

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Appendix C - Table 5h
NPI High Priority Project Site No. 42, Parcel 11819070
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819070	11819070	11819070	11819070	11819070	11819070	11819070	11819070	11819070
			Location ID	CLB-11819070-SS01	CLB-11819070-SS02	CLB-11819070-SS03	CLB-11819070-SS04	CLB-11819070-SS05	CLB-11819070-SS05 (Duplicate)	CLB-11819070-SS06	CLB-11819070-SS07	CLB-11819070-SS08
			Field Sample ID	CLB-11819070-SS01-033110	CLB-11819070-SS02-033110	CLB-11819070-SS03-033110	CLB-11819070-SS04-033110	CLB-11819070-SS05-033110	CLB-11819070-SS09-033110	CLB-11819070-SS06-033110	CLB-11819070-SS07-033110	CLB-11819070-SS08-033110
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Percent Moisture	%											
2-Methylnaphthalene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	µg/kg	**3,500,000**	56,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	µg/kg	**18,000,000**	280,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	µg/kg	**11,000**	76,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	µg/kg	**1,100**	7,700	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	µg/kg	**1,100,000**	7,600,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	µg/kg	**2,400,000**	37,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	µg/kg	**2,400,000**	37,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	µg/kg	**69,000**	150,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	µg/kg	**1,800,000**	28,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum, Total	mg/kg	**NA**	NA	NA	3,780	NA	NA	2,440	2,950	2,810	NA	NA
Antimony, Total	mg/kg	**30**	1,200	NA	3.3	NA	NA	0.4	0.6	1.7	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	NA	**17.9**	NA	NA	**6.8**	**7**	**7.1**	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	NA	333	NA	NA	173	168	319	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	NA	0.3	NA	NA	0.1	0.1	0.1	NA	NA
Boron, Total	mg/kg	**NA**	NA	NA	3.9	NA	NA	2.5	4.3	2.4	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	NA	3.1	NA	NA	0.7	0.5	1	NA	NA
Calcium, Total	mg/kg	**NA**	NA	NA	2,840	NA	NA	1,310	1,320	11,800	NA	NA
Chromium, Total	mg/kg	**NA**	NA	NA	6.6	NA	NA	3.1	2.3	4.6	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	NA	18.1	NA	NA	3.5	3.8	4	NA	NA
Copper, Total	mg/kg	**NA**	NA	NA	73.4	NA	NA	24.1	24.8	36.3	NA	NA
Iron, Total	mg/kg	**NA**	NA	NA	15,000	NA	NA	8,540	9,480	11,800	NA	NA
Lead, Total	mg/kg	**400**	1,800	NA	**948**	NA	NA	163	192	**428**	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	NA	888	NA	NA	784	778	2130	NA	NA
Manganese, Total	mg/kg	**NA**	NA	NA	275	NA	NA	187	187	189	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	NA	6.9 U	NA	NA	6.1 U	7 U	6.7 U	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	NA	13.5	NA	NA	9.3	9.8	11.1	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	NA	364	NA	NA	397	400	491	NA	NA
Potassium, Total	mg/kg	**NA**	NA	NA	412	NA	NA	409	501	422	NA	NA
Selenium, Total	mg/kg	**380**	15,000	NA	0.2	NA	NA	4.1 U	0.8 U	0.7 U	NA	NA
Silicon, Total	mg/kg	**NA**	NA	NA	375	NA	NA	512	577	647	NA	NA
Sodium, Total	mg/kg	**NA**	NA	NA	455	NA	NA	383	340	437	NA	NA
Strontium1, Total	mg/kg	**NA**	NA	NA	18.4	NA	NA	4	6.2	25.4	NA	NA
Strontium2, Total	mg/kg	**NA**	NA	NA	22.1	NA	NA	6	6.8	29.6	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	NA	400	NA	NA	73.2	78.8	298	NA	NA
Thallium, Total	mg/kg	**6.1**	230	NA	2.2	NA	NA	0.1 U	0.3 U	0.1 U	NA	NA
Tin, Total	mg/kg	**NA**	NA	NA	2.5	NA	NA	0.6	0.5	1.1	NA	NA
Titanium, Total	mg/kg	**NA**	NA	NA	59.7	NA	NA	37.7	47.8	46.3	NA	NA
Vanadium, Total	mg/kg	**680**	26,000	NA	6.3	NA	NA	4.1	3	4.6	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	NA	463	NA	NA	193	222	468	NA	NA

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Appendix C - Table 5h
NPI High Priority Project Site No. 42, Parcel 11819070
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819070	11819070	11819070	11819070	11819070	11819070	11819070	11819070	11819070
			Location ID	CLB-11819070-SS01	CLB-11819070-SS02	CLB-11819070-SS03	CLB-11819070-SS04	CLB-11819070-SS05	CLB-11819070-SS05 (Duplicate)	CLB-11819070-SS06	CLB-11819070-SS07	CLB-11819070-SS08
			Field Sample ID	CLB-11819070-SS01-033110	CLB-11819070-SS02-033110	CLB-11819070-SS03-033110	CLB-11819070-SS04-033110	CLB-11819070-SS05-033110	CLB-11819070-SS09-033110	CLB-11819070-SS06-033110	CLB-11819070-SS07-033110	CLB-11819070-SS08-033110
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Antimony, XRF	mg/kg	**30**	1,200	73 U	75 U	73 U	72 U	75 U	72 U	72 U	73 U	73 U
Arsenic, XRF	mg/kg	**6.7**	82	23 U	39 U	**28**	16 U	16 U	18 U	26 U	15 U	31 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	51 U	52 U	51 U	50 U	52 U	51	56	51 U	50 U
Chromium, XRF	mg/kg	**NA**	NA	113 U	128 U	114 U	112 U	111 U	108 U	115 U	110 U	118 U
Cobalt, XRF	mg/kg	**1,400**	23,000	148 U	187 U	151 U	118 U	132 U	131 U	130 U	150 U	148 U
Copper, XRF	mg/kg	**NA**	NA	47	60	30	21 U	22 U	22 U	31	36	59
Iron, XRF	mg/kg	**NA**	NA	17,688	26,309	17,932	11,718	12,975	13,556	14,254	17,367	17,220
Lead, XRF	mg/kg	**400**	1,800	308	**916**	**430**	146	137	170	**429**	124	**630**
Manganese, XRF	mg/kg	**NA**	NA	146	165	239	82 U	87 U	110	223	102	118
Mercury, XRF	mg/kg	**7.6**	290	10 U	12 U	12 U	10 U	9 U	9 U	11 U	9 U	12 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	7 U	8 U	8 U	7 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	39 U	44 U	40 U	36 U	39 U	39 U	48	38 U	41 U
Rubidium, XRF	mg/kg	**NA**	NA	37	35	37	35	32	32	36	28	37
Selenium, XRF	mg/kg	**380**	15,000	4 U	5 U	4 U	3 U	3 U	3 U	4 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	47 U	48 U	47 U	51	48 U	46 U	46 U	47 U	47 U
Strontium, XRF	mg/kg	**NA**	NA	107	116	112	107	109	107	147	102	132
Tin, XRF	mg/kg	**NA**	NA	75 U	76 U	75 U	73 U	76 U	74 U	73 U	74 U	74 U
Titanium, XRF	mg/kg	**NA**	NA	2,598	2,363	2,373	1,785	1,728	1,661	3,354	2,425	3,133
Zinc, XRF	mg/kg	**23,000**	880,000	140	326	196	54	111	130	411	236	322
Zirconium, XRF	mg/kg	**NA**	NA	133	99	182	113	164	128	123	163	159

NOTES:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5i
NPI High Priority Project Site No. 42, Parcel 11819071
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11819071**	**11819071**	**11819071**	**11819071**	**11819071**	**11819071**	**11819071**
			Location ID	**CLB-11819071-SS01**	**CLB-11819071-SS02**	**CLB-11819071-SS03**	**CLB-11819071-SS04**	**CLB-11819071-SS05**	**CLB-11819071-SS06**	**CLB-11819071-SS07**
			Field Sample ID	**CLB-11819071-SS01-033110**	**CLB-11819071-SS02-033110**	**CLB-11819071-SS03-033110**	**CLB-11819071-SS04-033110**	**CLB-11819071-SS05-033110**	**CLB-11819071-SS06-033110**	**CLB-11819071-SS07-033110**
			Sample Date	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**							
Percent Moisture	%									
2-Methylnaphthalene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	µg/kg	**3,500,000**	56,000,000	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	µg/kg	**18,000,000**	280,000,000	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	µg/kg	**11,000**	76,000	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	µg/kg	**1,100**	7,700	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	NA	NA	NA	NA	NA	NA	NA
Chrysene	µg/kg	**1,100,000**	7,600,000	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	µg/kg	**2,400,000**	37,000,000	NA	NA	NA	NA	NA	NA	NA
Fluorene	µg/kg	**2,400,000**	37,000,000	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	NA	NA	NA	NA	NA	NA	NA
Naphthalene	µg/kg	**69,000**	150,000	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	µg/kg	**1,800,000**	28,000,000	NA	NA	NA	NA	NA	NA	NA
Aluminum, Total	mg/kg	**NA**	NA	4,850	NA	3,250	NA	NA	3,110	NA
Antimony, Total	mg/kg	**30**	1,200	2.5	NA	0.7	NA	NA	0.5	NA
Arsenic, Total	mg/kg	**6.7**	82	**16.3**	NA	**9.7**	NA	NA	**9.2**	NA
Barium, Total	mg/kg	**15,000**	370,000	715	NA	191	NA	NA	165	NA
Beryllium, Total	mg/kg	**150**	5,100	0.3	NA	0.1	NA	NA	0.2	NA
Boron, Total	mg/kg	**NA**	NA	1.7	NA	0.8	NA	NA	0.8	NA
Cadmium, Total	mg/kg	**72**	2,300	2.7	NA	1.1	NA	NA	0.7	NA
Calcium, Total	mg/kg	**NA**	NA	6,150	NA	2,440	NA	NA	748	NA
Chromium, Total	mg/kg	**NA**	NA	5.7	NA	1.6	NA	NA	1.2	NA
Cobalt, Total	mg/kg	**1,400**	23,000	7.3	NA	4.4	NA	NA	5	NA
Copper, Total	mg/kg	**NA**	NA	89.9	NA	59.2	NA	NA	19.1	NA
Iron, Total	mg/kg	**NA**	NA	22,000	NA	15,700	NA	NA	10,900	NA
Lead, Total	mg/kg	**400**	1,800	**5,450**	NA	210	NA	NA	68.4	NA
Magnesium, Total	mg/kg	**NA**	NA	1,440	NA	1,410	NA	NA	820	NA
Manganese, Total	mg/kg	**NA**	NA	682	NA	235	NA	NA	366	NA
Molybdenum, Total	mg/kg	**NA**	NA	6.8 U	NA	2.8 U	NA	NA	3.2 U	NA
Nickel, Total	mg/kg	**1,500**	44,000	18.9	NA	13.9	NA	NA	11.6	NA
Phosphorus, Total	mg/kg	**NA**	NA	681	NA	413	NA	NA	249	NA
Potassium, Total	mg/kg	**NA**	NA	620	NA	505	NA	NA	489	NA
Selenium, Total	mg/kg	**380**	15,000	1.4	NA	0.5	NA	NA	1.5	NA
Silicon, Total	mg/kg	**NA**	NA	498	NA	249	NA	NA	261	NA
Sodium, Total	mg/kg	**NA**	NA	507	NA	540	NA	NA	502	NA

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Appendix C - Table 5i
NPI High Priority Project Site No. 42, Parcel 11819071
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11819071**	**11819071**	**11819071**	**11819071**	**11819071**	**11819071**	**11819071**
			Location ID	**CLB-11819071-SS01**	**CLB-11819071-SS02**	**CLB-11819071-SS03**	**CLB-11819071-SS04**	**CLB-11819071-SS05**	**CLB-11819071-SS06**	**CLB-11819071-SS07**
			Field Sample ID	**CLB-11819071-SS01-033110**	**CLB-11819071-SS02-033110**	**CLB-11819071-SS03-033110**	**CLB-11819071-SS04-033110**	**CLB-11819071-SS05-033110**	**CLB-11819071-SS06-033110**	**CLB-11819071-SS07-033110**
			Sample Date	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**							
Strontium1, Total	mg/kg	**NA**	NA	19.6	NA	7.9	NA	NA	5	NA
Strontium2, Total	mg/kg	**NA**	NA	34.7	NA	8.9	NA	NA	4.8	NA
Sulfur, Total	mg/kg	**NA**	NA	532	NA	143	NA	NA	42	NA
Thallium, Total	mg/kg	**6.1**	230	0.6	NA	0.7	NA	NA	1.1	NA
Tin, Total	mg/kg	**NA**	NA	1.6	NA	0.9	NA	NA	0.4	NA
Titanium, Total	mg/kg	**NA**	NA	70.9	NA	47.5	NA	NA	35.6	NA
Vanadium, Total	mg/kg	**680**	26,000	5.3	NA	4.2	NA	NA	2.9	NA
Zinc, Total	mg/kg	**23,000**	880,000	756	NA	238	NA	NA	149	NA
Antimony, XRF	mg/kg	**30**	1,200	79 U	75 U	72 U	75 U	72 U	73 U	75 U
Arsenic, XRF	mg/kg	**6.7**	82	36 U	21 U	**21**	16 U	14 U	14 U	26 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	55 U	52 U	50 U	52 U	50 U	**82**	51 U
Chromium, XRF	mg/kg	**NA**	NA	153 U	119 U	118 U	114 U	104 U	117 U	136 U
Cobalt, XRF	mg/kg	**1,400**	23,000	207 U	174 U	144 U	140 U	123 U	144 U	183 U
Copper, XRF	mg/kg	**NA**	NA	107	39	68	30	29	22 U	71
Iron, XRF	mg/kg	**NA**	NA	28,199	22,828	17,358	14,807	12,856	16,271	25,665
Lead, XRF	mg/kg	**400**	1,800	**693**	244	240	135	104	91	**406**
Manganese, XRF	mg/kg	**NA**	NA	182	105 U	169	341	138	320	130
Mercury, XRF	mg/kg	**7.6**	290	13 U	11 U	10 U	9 U	10 U	10 U	10 U
Molybdenum, XRF	mg/kg	**NA**	NA	12 U	8 U	7 U	8 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	49 U	43 U	53	52	46	40 U	42 U
Rubidium, XRF	mg/kg	**NA**	NA	40	38	36	33	31	34	35
Selenium, XRF	mg/kg	**380**	15,000	5 U	4 U	3 U	3 U	3 U	3 U	4 U
Silver, XRF	mg/kg	**380**	15,000	51 U	48 U	47 U	48 U	56	46 U	48 U
Strontium, XRF	mg/kg	**NA**	NA	150	101	104	89	108	105	96
Tin, XRF	mg/kg	**NA**	NA	81 U	76 U	73 U	76 U	73 U	74 U	76 U
Titanium, XRF	mg/kg	**NA**	NA	3,458	1,469	2,158	2,192	2,814	1,756	3,314
Zinc, XRF	mg/kg	**23000**	880,000	809	277	194	145	117	96	136
Zirconium, XRF	mg/kg	**NA**	NA	1,499	194	134	184	156	349	182

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5j
NPI High Priority Project Site No. 42, Parcel 11819072
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819072	11819072	11819072	11819072	11819072	11819072	11819072	11819072	11819072
			Location ID	CLB-11819072-SS01	CLB-11819072-SS02	CLB-11819072-SS02 [1]	CLB-11819072-SS02 [1]	CLB-11819072-SS02 (Duplicate)	CLB-11819072-SS03	CLB-11819072-SS04	CLB-11819072-SS05	CLB-11819072-SS06
			Field Sample ID	CLB-11819072-SS01-033110	CLB-11819072-SS02-033110	CLB-11819072-SS02-033110-11	CLB-11819072-SS02-033110-8	CLB-11819072-SS07-033110	CLB-11819072-SS03-033110	CLB-11819072-SS04-033110	CLB-11819072-SS05-033110	CLB-11819072-SS06-033110
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Percent Moisture	%			12.2	10.8			9.4	9.1	9.4	11.8	10.3
2-Methylnaphthalene	µg/kg	**NA**	NA	28.5 U	28 U	NA	NA	27.6 U	27.5 U	36	444	499
Acenaphthene	µg/kg	**3,500,000**	56,000,000	28.5 U	28 U	NA	NA	35.8	27.5 U	75	2,430	2,830
Acenaphthylene	µg/kg	**NA**	NA	28.5 U	28 U	NA	NA	27.6 U	27.5 U	27.6 U	59	67.8
Anthracene	µg/kg	**18,000,000**	280,000,000	36.8	77.9	NA	NA	96	43.4	183	5,340	6,290
Benzo(a)anthracene	µg/kg	**11,000**	76,000	104	234	NA	NA	277	141	441	**12,500**	**11,900**
Benzo(a)pyrene	µg/kg	**1,100**	7,700	102	220	NA	NA	259	138	398	**9,150**	**8,650**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	81.2	200	NA	NA	216	128	346	7,440	7,830
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	58.3	137	NA	NA	159	82.3	219	5,050	4,710
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	97.3	181	NA	NA	227	119	358	7,500	6,320
Chrysene	µg/kg	**1,100,000**	7,600,000	110	213	NA	NA	248	134	399	9,350	8,900
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	28.5 U	61.1	NA	NA	72.8	35.7	105	**2,440**	**2,290**
Fluoranthene	µg/kg	**2,400,000**	37,000,000	258	516	NA	NA	601	319	989	31,300	30,700
Fluorene	µg/kg	**2,400,000**	37,000,000	28.5 U	28 U	NA	NA	29.5	27.5 U	72.9	1,720	2,270
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	52.8	122	NA	NA	146	76.1	213	4,830	4,540
Naphthalene	µg/kg	**69,000**	150,000	28.5 U	28 U	NA	NA	27.6 U	27.5 U	46.1	494	557
Phenanthrene	µg/kg	**NA**	NA	156	277	NA	NA	334	177	679	21,000	24,000
Pyrene	µg/kg	**1,800,000**	28,000,000	219	412	NA	NA	487	261	772	23,000	22,800
Aluminum, Total	mg/kg	**NA**	NA	2,850	3,330	NA	NA	NA	NA	NA	3,430	NA
Antimony, Total	mg/kg	**30**	1,200	0.1	0.5	NA	NA	NA	NA	NA	2.2	NA
Arsenic, Total	mg/kg	**6.7**	82	6.2	**8.3**	NA	NA	NA	NA	NA	**14.8**	NA
Barium, Total	mg/kg	**15,000**	370,000	140	177	NA	NA	NA	NA	NA	220	NA
Beryllium, Total	mg/kg	**150**	5,100	0.1	0.1	NA	NA	NA	NA	NA	0.2	NA
Boron, Total	mg/kg	**NA**	NA	2.2	1.9	NA	NA	NA	NA	NA	4.2	NA
Cadmium, Total	mg/kg	**72**	2,300	0.4	0.4	NA	NA	NA	NA	NA	1.7	NA
Calcium, Total	mg/kg	**NA**	NA	656	1,860	NA	NA	NA	NA	NA	2,190	NA
Chromium, Total	mg/kg	**NA**	NA	0.9	1.2	NA	NA	NA	NA	NA	5	NA
Cobalt, Total	mg/kg	**1,400**	23,000	3.1	4.2	NA	NA	NA	NA	NA	9.5	NA
Copper, Total	mg/kg	**NA**	NA	12.1	19.7	NA	NA	NA	NA	NA	85.1	NA
Iron, Total	mg/kg	**NA**	NA	7,670	11,300	NA	NA	NA	NA	NA	12,400	NA
Lead, Total	mg/kg	**400**	1,800	57.4	222	NA	NA	NA	NA	NA	**527**	NA
Magnesium, Total	mg/kg	**NA**	NA	750	955	NA	NA	NA	NA	NA	903	NA
Manganese, Total	mg/kg	**NA**	NA	138	236	NA	NA	NA	NA	NA	183	NA
Molybdenum, Total	mg/kg	**NA**	NA	3.7 U	3.5 U	NA	NA	NA	NA	NA	3.9 U	NA
Nickel, Total	mg/kg	**1,500**	44,000	8.4	11.1	NA	NA	NA	NA	NA	31.5	NA
Phosphorus, Total	mg/kg	**NA**	NA	252	256	NA	NA	NA	NA	NA	451	NA
Potassium, Total	mg/kg	**NA**	NA	432	458	NA	NA	NA	NA	NA	511	NA
Selenium, Total	mg/kg	**380**	15,000	1.3	1.5	NA	NA	NA	NA	NA	2.5	NA
Silicon, Total	mg/kg	**NA**	NA	375	403	NA	NA	NA	NA	NA	370	NA
Sodium, Total	mg/kg	**NA**	NA	523	453	NA	NA	NA	NA	NA	548	NA
Strontium1, Total	mg/kg	**NA**	NA	4.8	7.7	NA	NA	NA	NA	NA	18.1	NA
Strontium2, Total	mg/kg	**NA**	NA	4.4	7.6	NA	NA	NA	NA	NA	20	NA
Sulfur, Total	mg/kg	**NA**	NA	38.3	132	NA	NA	NA	NA	NA	224	NA
Thallium, Total	mg/kg	**6.1**	230	0.2	0.4	NA	NA	NA	NA	NA	2.4	NA
Tin, Total	mg/kg	**NA**	NA	0 U	0.4	NA	NA	NA	NA	NA	1.4	NA
Titanium, Total	mg/kg	**NA**	NA	34.4	46.2	NA	NA	NA	NA	NA	66.9	NA
Vanadium, Total	mg/kg	**680**	26,000	2.2	2.2	NA	NA	NA	NA	NA	3.3	NA
Zinc, Total	mg/kg	**23,000**	880,000	105	174	NA	NA	NA	NA	NA	324	NA

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Appendix C - Table 5j
NPI High Priority Project Site No. 42, Parcel 11819072
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11819072**	**11819072**	**11819072**	**11819072**	**11819072**	**11819072**	**11819072**	**11819072**	**11819072**
			Location ID	**CLB-11819072-SS01**	**CLB-11819072-SS02**	**CLB-11819072-SS02 [1]**	**CLB-11819072-SS02 [1]**	**CLB-11819072-SS02 (Duplicate)**	**CLB-11819072-SS03**	**CLB-11819072-SS04**	**CLB-11819072-SS05**	**CLB-11819072-SS06**
			Field Sample ID	**CLB-11819072-SS01-033110**	**CLB-11819072-SS02-033110**	**CLB-11819072-SS02-033110-11**	**CLB-11819072-SS02-033110-8**	**CLB-11819072-SS07-033110**	**CLB-11819072-SS03-033110**	**CLB-11819072-SS04-033110**	**CLB-11819072-SS05-033110**	**CLB-11819072-SS06-033110**
			Sample Date	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**	**3/31/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Antimony, XRF	mg/kg	**30**	1,200	71 U	73 U	73 U	81 U	74 U	72 U	73 U	77 U	74 U
Arsenic, XRF	mg/kg	**7**	82	12 U	19 U	20 U	**230**	22 U	13 U	15 U	33 U	21 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	49 U	51	50 U	55 U	72	58	50 U	53 U	51 U
Chromium, XRF	mg/kg	**NA**	NA	113 U	114 U	117 U	151 U	121 U	113 U	107 U	138 U	115 U
Cobalt, XRF	mg/kg	**1,400**	23,000	124 U	134 U	144 U	180 U	150 U	138 U	139 U	189 U	139 U
Copper, XRF	mg/kg	**NA**	NA	20 U	29	25	45	22 U	20 U	25	112	45
Iron, XRF	mg/kg	**NA**	NA	12,931	14,422	16,527	21,785	17,957	15,489	15,162	25,787	15,529
Lead, XRF	mg/kg	**400**	1,800	77	234	237	**2,271**	287	88	129	**640**	275
Manganese, XRF	mg/kg	**NA**	NA	155	175	260	491	244	173	177	112 U	84 U
Mercury, XRF	mg/kg	**7.6**	290	8 U	10 U	10 U	16 U	10 U	9 U	10 U	12 U	11 U
Molybdenum, XRF	mg/kg	**NA**	NA	7 U	8 U	8 U	8 U	8 U	7 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	36 U	53	47	47 U	39 U	38 U	40 U	58	42
Rubidium, XRF	mg/kg	**NA**	NA	34	36	36	36	38	40	37	35	36
Selenium, XRF	mg/kg	**380**	15,000	3 U	4 U	3 U	7 U	4 U	3 U	4 U	5 U	4 U
Silver, XRF	mg/kg	**380**	15,000	45 U	75	47 U	51 U	47 U	46 U	46 U	75	47 U
Strontium, XRF	mg/kg	**NA**	NA	101	117	94	115	88	105	121	126	102
Tin, XRF	mg/kg	**NA**	NA	72 U	74 U	74 U	82 U	75 U	73 U	74 U	78 U	75 U
Titanium, XRF	mg/kg	**NA**	NA	1,521	2,929	4,425	7,582	2,572	2,638	2,237	1,512	2,606
Zinc, XRF	mg/kg	**23,000**	880,000	64	126	158	497	138	83	135	392	246
Zirconium, XRF	mg/kg	**NA**	NA	138	187	188	212	147	131	223	121	218

NOTES:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results
[1] - Samples CLB-11818053-SS05, CLB-11819072-002, and CLB-1189074-SS07 were screened with the XRF more than once. Results for all readings are included.

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Appendix C - Table 5k
NPI High Priority Project Site No. 42, Parcel 11819074
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819074	11819074	11819074	11819074	11819074	11819074	11819074	11819074	11819074
			Location ID	CLB-11819074-SS01	CLB-11819074-SS02	CLB-11819074-SS03	CLB-11819074-SS04	CLB-11819074-SS05	CLB-11819074-SS06	CLB-11819074-SS07	CLB-11819074-SS07 [1]	CLB-11819074-SS07 [1]
			Field Sample ID	CLB-11819074-SS01-033110	CLB-11819074-SS02-033110	CLB-11819074-SS03-033110	CLB-11819074-SS04-033110	CLB-11819074-SS05-033110	CLB-11819074-SS06-03311	CLB-11819074-SS07-033110	CLB-11819074-SS07-033110-26	CLB-11819074-SS07-033110-27
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Percent Moisture	%			9.1	14.7	13.4	9.5	10	7.6	13.5		
2-Methylnaphthalene	µg/kg	**NA**	NA	137 U	112	144 U	62.2	27.8 U	27.1 U	877	NA	NA
Acenaphthene	µg/kg	**3,500,000**	56,000,000	137 U	234	144 U	172	27.8 U	27.1 U	3,860	NA	NA
Acenaphthylene	µg/kg	**NA**	NA	137 U	62.6	144 U	31.2	27.8 U	27.1 U	72.7	NA	NA
Anthracene	µg/kg	**18,000,000**	280,000,000	226	657	519	324	37.3	77.5	7590	NA	NA
Benzo(a)anthracene	µg/kg	**11,000**	76,000	820	1,770	1,510	711	175	266	**11,100**	NA	NA
Benzo(a)pyrene	µg/kg	**1,100**	7,700	877	**1,850**	**1,470**	684	223	264	**9,040**	NA	NA
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	848	1,730	1,330	582	195	229	7,140	NA	NA
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	585	1,340	908	463	249	151	4,790	NA	NA
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	777	1,510	1,340	614	164	227	7,440	NA	NA
Chrysene	µg/kg	**1,100,000**	7,600,000	842	1,680	1,480	659	176	260	9,260	NA	NA
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	264	578	419	213	147	64.2	**2360**	NA	NA
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,780	3,790	3,520	1,570	303	613	29,400	NA	NA
Fluorene	µg/kg	**2,400,000**	37,000,000	137 U	238	144 U	126	27.8 U	27.1 U	3,430	NA	NA
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	548	1,160	859	402	163	136	4,660	NA	NA
Naphthalene	µg/kg	**69,000**	150,000	137 U	143	144 U	80	27.8 U	27.1 U	1,090	NA	NA
Phenanthrene	µg/kg	**NA**	NA	831	2,390	1,990	1,160	106	303	25,500	NA	NA
Pyrene	µg/kg	**1,800,000**	28,000,000	1370	2,890	2,660	1,240	253	493	21,200	NA	NA
Aluminum, Total	mg/kg	**NA**	NA	NA	3,810	5,030	NA	NA	2,800	NA	NA	NA
Antimony, Total	mg/kg	**30**	1,200	NA	2.5	2.2	NA	NA	0.7	NA	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	NA	**16.2**	**14**	NA	NA	**7.6**	NA	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	NA	424	324	NA	NA	140	NA	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	NA	0.2	0.4	NA	NA	0.1	NA	NA	NA
Boron, Total	mg/kg	**NA**	NA	NA	3.3	4.8	NA	NA	1.8	NA	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	NA	3	1.9	NA	NA	0.4	NA	NA	NA
Calcium, Total	mg/kg	**NA**	NA	NA	7,240	20,800	NA	NA	786	NA	NA	NA
Chromium, Total	mg/kg	**NA**	NA	NA	14.8	7.3	NA	NA	1.5	NA	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	NA	4.8	4.6	NA	NA	3.9	NA	NA	NA
Copper, Total	mg/kg	**NA**	NA	NA	99.7	85.3	NA	NA	15.3	NA	NA	NA
Iron, Total	mg/kg	**NA**	NA	NA	17,900	16,800	NA	NA	9,340	NA	NA	NA
Lead, Total	mg/kg	**400**	1800	NA	**838**	**475**	NA	NA	66	NA	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	NA	1,060	2,230	NA	NA	763	NA	NA	NA
Manganese, Total	mg/kg	**NA**	NA	NA	281	400	NA	NA	185	NA	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	NA	4 U	6.5 U	NA	NA	5 U	NA	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	NA	62.2	31.4	NA	NA	10	NA	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	NA	1,900	961	NA	NA	210	NA	NA	NA
Potassium, Total	mg/kg	**NA**	NA	NA	629	608	NA	NA	423	NA	NA	NA
Selenium, Total	mg/kg	**380**	15,000	NA	1.7	1.4 U	NA	NA	1.3	NA	NA	NA
Silicon, Total	mg/kg	**NA**	NA	NA	617	278	NA	NA	482	NA	NA	NA
Sodium, Total	mg/kg	**NA**	NA	NA	564	636	NA	NA	485	NA	NA	NA
Strontium1, Total	mg/kg	**NA**	NA	NA	33.9	41.6	NA	NA	3.9	NA	NA	NA
Strontium2, Total	mg/kg	**NA**	NA	NA	49.4	53.4	NA	NA	4.6	NA	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	NA	322	538	NA	NA	37.1	NA	NA	NA
Thallium, Total	mg/kg	**6.1**	230	NA	0.5	0.7	NA	NA	0.3	NA	NA	NA
Tin, Total	mg/kg	**NA**	NA	NA	2.6	1.2	NA	NA	0.2	NA	NA	NA
Titanium, Total	mg/kg	**NA**	NA	NA	70	102	NA	NA	40.5	NA	NA	NA
Vanadium, Total	mg/kg	**680**	26,000	NA	5.2	4.8	NA	NA	2.1	NA	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	NA	621	500	NA	NA	128	NA	NA	NA

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Appendix C - Table 5k
NPI High Priority Project Site No. 42, Parcel 11819074
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819074	11819074	11819074	11819074	11819074	11819074	11819074	11819074	11819074
			Location ID	CLB-11819074-SS01	CLB-11819074-SS02	CLB-11819074-SS03	CLB-11819074-SS04	CLB-11819074-SS05	CLB-11819074-SS06	CLB-11819074-SS07	CLB-11819074-SS07 [1]	CLB-11819074-SS07 [1]
			Field Sample ID	CLB-11819074-SS01-033110	CLB-11819074-SS02-033110	CLB-11819074-SS03-033110	CLB-11819074-SS04-033110	CLB-11819074-SS05-033110	CLB-11819074-SS06-03311	CLB-11819074-SS07-033110	CLB-11819074-SS07-033110-26	CLB-11819074-SS07-033110-27
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Antimony, XRF	mg/kg	**30**	1,200	73 U	76 U	75 U	75 U	73 U	75 U	87 U	77 U	86 U
Arsenic, XRF	mg/kg	**6.7**	82	**26**	43 U	32 U	34 U	19 U	14 U	24 U	**23**	21 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	51 U	52 U	52 U	52 U	50 U	51 U	62	54 U	59 U
Chromium, XRF	mg/kg	**NA**	NA	130 U	146 U	140 U	127 U	118 U	122 U	149 U	150 U	147 U
Cobalt, XRF	mg/kg	**1,400**	23,000	164 U	207 U	193 U	148 U	137 U	144 U	207 U	218 U	214 U
Copper, XRF	mg/kg	**NA**	NA	55	150	136	27	22 U	21 U	56	52	56
Iron, XRF	mg/kg	**NA**	NA	21,082	31,163	28,064	16,859	15,460	15,926	25,598	34,012	27,404
Lead, XRF	mg/kg	**400**	1,800	282	**1,070**	**621**	**708**	204	112	259	232	196
Manganese, XRF	mg/kg	**NA**	NA	159	323	349	234	170	93 U	123 U	178	128 U
Mercury, XRF	mg/kg	**7.6**	290	9 U	14 U	12 U	11 U	10 U	9 U	12 U	11 U	13 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	8 U	8 U	8 U	7 U	8	9 U	9	9 U
Nickel, XRF	mg/kg	**1,500**	44,000	42 U	69	55	40 U	38 U	39 U	47 U	47 U	50 U
Rubidium, XRF	mg/kg	**NA**	NA	29	38	37	32	41	39	56	69	53
Selenium, XRF	mg/kg	**380**	15,000	4 U	5 U	5 U	5 U	4 U	3 U	4 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	47 U	49 U	48 U	53	47 U	87	55 U	50 U	55 U
Strontium, XRF	mg/kg	**NA**	NA	96	159	143	116	89	128	97	122	98
Tin, XRF	mg/kg	**NA**	NA	74 U	77 U	77 U	76 U	74 U	76 U	89 U	79 U	88 U
Titanium, XRF	mg/kg	**NA**	NA	1,661	3,392	2,872	3,060	2,650	2,483	3,764	4,148	4,786
Zinc, XRF	mg/kg	**23,000**	880,000	286	707	452	580	263	96	191	182	166
Zirconium, XRF	mg/kg	**NA**	NA	102	140	169	108	109	189	141	205	134

NOTES:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent

µg/kg - micrograms per kilogram

mg/kg - milligrams per kilogram

NA - Not available/Not analyzed for

U - Non detect

VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria

XRF - X-ray Fluorescence

See electronic deliverable for complete analytical results

[1] - Samples CLB-11818053-SS05, CLB-11819072-002, and CLB-1189074-SS07 were screened with the XRF more than once. Results for all readings are included.

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Appendix C - Table 5l
NPI High Priority Project Site No. 42, Parcel 11819075
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819075	11819075	11819075	11819075	11819075	11819075	11819075	11819075	11819075
			Location ID	CLB-11819075-SS01	CLB-11819075-SS02	CLB-11819075-SS03	CLB-11819075-SS04	CLB-11819075-SS05	CLB-11819075-SS05 (Duplicate)	CLB-11819075-SS06	CLB-11819075-SS07	CLB-11819075-SS08
			Field Sample ID	CLB-11819075-SS01-033110	CLB-11819075-SS02-033110	CLB-11819075-SS03-033110	CLB-11819075-SS04-033110	CLB-11819075-SS05-033110	CLB-11819075-SS09-033110	CLB-11819075-SS06-033110	CLB-11819075-SS07-033110	CLB-11819075-SS08-033110
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Percent Moisture	%			22.5	20.5	10.4	12.3	10.9	11.1	11.9	13.1	8.4
2-Methylnaphthalene	µg/kg	**NA**	NA	32.3 U	31.4 U	342	28.5 U	28 U	28.1 U	276	10,300	27.3 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	39.6	31.4 U	978	28.5 U	28 U	28.1 U	686	21,100	27.3 U
Acenaphthylene	µg/kg	**NA**	NA	32.3 U	31.4 U	28.7	28.5 U	28 U	28.1 U	69.7	171	27.3 U
Anthracene	µg/kg	**18,000,000**	280,000,000	310	31.4 U	1,970	38.8	33.8	28.1 U	2,240	34,900	76.2
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1590	68.4	3,010	155	109	58.2	2,790	**37,700**	219
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1710**	66.5	**2,500**	160	107	67.2	**2,290**	**30,600**	229
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1290	62.8	2,050	158	97.4	56.6	1,960	**25,400**	201
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	956	42.2	1,230	106	78.6	57.5	1,350	15,800	196
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,130	61.2	2,090	151	95.5	59.2	1,740	23,900	192
Chrysene	µg/kg	**1,100,000**	7,600,000	1,470	72.5	2,600	159	113	62.4	2,380	31,700	219
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	490	31.4 U	591	46.7	32.4	28.1 U	585	**7,890**	89.4
Fluoranthene	µg/kg	**2,400,000**	37,000,000	2420	159	7,170	334	256	123	7,050	122,000	495
Fluorene	µg/kg	**2,400,000**	37,000,000	32.3 U	31.4 U	780	28.5 U	28 U	28.1 U	865	19,000	27.3 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	789	37.6	1,220	93.8	62.2	44	1,160	**15,400**	150
Naphthalene	µg/kg	**69,000**	150,000	34.3	31.4 U	503	28.5 U	28 U	28.1 U	289	22,700	27.3 U
Phenanthrene	µg/kg	**NA**	NA	1,170	84	6,280	158	154	54	5,750	142,000	261
Pyrene	µg/kg	**1,800,000**	28,000,000	2,090	137	5,570	277	215	107	5,380	90,400	409
Aluminum, Total	mg/kg	**NA**	NA	NA	3,210	NA	3,550	NA	NA	3,300	NA	NA
Antimony, Total	mg/kg	**30**	1,200	NA	0.7	NA	0.9	NA	NA	1.2	NA	NA
Arsenic, Total	mg/kg	**6.7**	82	NA	**9.4**	NA	**12.6**	NA	NA	**11.2**	NA	NA
Barium, Total	mg/kg	**15,000**	370,000	NA	184	NA	218	NA	NA	658	NA	NA
Beryllium, Total	mg/kg	**150**	5,100	NA	0.1	NA	0.1	NA	NA	0.1	NA	NA
Boron, Total	mg/kg	**NA**	NA	NA	1.5	NA	1.1	NA	NA	4.7	NA	NA
Cadmium, Total	mg/kg	**72**	2,300	NA	0.6	NA	0.8	NA	NA	0.6	NA	NA
Calcium, Total	mg/kg	**NA**	NA	NA	1,350	NA	1,120	NA	NA	1,780	NA	NA
Chromium, Total	mg/kg	**NA**	NA	NA	3.4	NA	3	NA	NA	5.8	NA	NA
Cobalt, Total	mg/kg	**1,400**	23,000	NA	3.7	NA	4.8	NA	NA	4.4	NA	NA
Copper, Total	mg/kg	**NA**	NA	NA	28.5	NA	43.4	NA	NA	46.8	NA	NA
Iron, Total	mg/kg	**NA**	NA	NA	11,500	NA	16,000	NA	NA	11,100	NA	NA
Lead, Total	mg/kg	**400**	1,800	NA	117	NA	277	NA	NA	**1,640**	NA	NA
Magnesium, Total	mg/kg	**NA**	NA	NA	691	NA	996	NA	NA	887	NA	NA
Manganese, Total	mg/kg	**NA**	NA	NA	157	NA	200	NA	NA	215	NA	NA
Molybdenum, Total	mg/kg	**NA**	NA	NA	4 U	NA	4.1 U	NA	NA	3.7 U	NA	NA
Nickel, Total	mg/kg	**1,500**	44,000	NA	10.2	NA	14.8	NA	NA	11.8	NA	NA
Phosphorus, Total	mg/kg	**NA**	NA	NA	636	NA	385	NA	NA	337	NA	NA
Potassium, Total	mg/kg	**NA**	NA	NA	492	NA	424	NA	NA	503	NA	NA
Selenium, Total	mg/kg	**380**	15,000	NA	1.8	NA	1.2	NA	NA	1.7	NA	NA
Silicon, Total	mg/kg	**NA**	NA	NA	357	NA	293	NA	NA	252	NA	NA
Sodium, Total	mg/kg	**NA**	NA	NA	509	NA	492	NA	NA	544	NA	NA
Strontium1, Total	mg/kg	**NA**	NA	NA	14.7	NA	7.8	NA	NA	12.1	NA	NA
Strontium2, Total	mg/kg	**NA**	NA	NA	15.2	NA	8.1	NA	NA	13.7	NA	NA
Sulfur, Total	mg/kg	**NA**	NA	NA	104	NA	113	NA	NA	289	NA	NA
Thallium, Total	mg/kg	**6.1**	230	NA	0.1	NA	0 U	NA	NA	0.7	NA	NA
Tin, Total	mg/kg	**NA**	NA	NA	1.6	NA	1.2	NA	NA	0.7	NA	NA
Titanium, Total	mg/kg	**NA**	NA	NA	59.7	NA	56.2	NA	NA	54.9	NA	NA
Vanadium, Total	mg/kg	**680**	26,000	NA	3.3	NA	2.9	NA	NA	3.3	NA	NA
Zinc, Total	mg/kg	**23,000**	880,000	NA	161	NA	214	NA	NA	359	NA	NA

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Appendix C - Table 5l
NPI High Priority Project Site No. 42, Parcel 11819075
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819075	11819075	11819075	11819075	11819075	11819075	11819075	11819075	11819075
			Location ID	CLB-11819075-SS01	CLB-11819075-SS02	CLB-11819075-SS03	CLB-11819075-SS04	CLB-11819075-SS05	CLB-11819075-SS05 (Duplicate)	CLB-11819075-SS06	CLB-11819075-SS07	CLB-11819075-SS08
			Field Sample ID	CLB-11819075-SS01-033110	CLB-11819075-SS02-033110	CLB-11819075-SS03-033110	CLB-11819075-SS04-033110	CLB-11819075-SS05-033110	CLB-11819075-SS09-033110	CLB-11819075-SS06-033110	CLB-11819075-SS07-033110	CLB-11819075-SS08-033110
			Sample Date	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Antimony, XRF	mg/kg	**30**	1,200	72 U	73 U	73 U	75 U	72 U	73 U	74 U	77 U	74 U
Arsenic, XRF	mg/kg	**6.7**	82	**39**	17 U	30 U	25 U	18 U	17 U	33 U	35 U	23 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	50 U	**87**	50 U	55	50 U	63	52	53 U	**78**
Chromium, XRF	mg/kg	**NA**	NA	121 U	109 U	131	128 U	107 U	101 U	126 U	134 U	121 U
Cobalt, XRF	mg/kg	**1,400**	23,000	146 U	145 U	147 U	154 U	126 U	123 U	151 U	178 U	149 U
Copper, XRF	mg/kg	**NA**	NA	61	37	133	84	27	29	53	54	49
Iron, XRF	mg/kg	**NA**	NA	17,086	16,974	17,068	18,851	13,031	11,914	17,318	23,705	16,497
Lead, XRF	mg/kg	**400**	1,800	**452**	163	**585**	367	201	173	**706**	**701**	306
Manganese, XRF	mg/kg	**NA**	NA	159	91 U	96 U	279	141	167	112	226	204
Mercury, XRF	mg/kg	**7.6**	290	10 U	10 U	11 U	11 U	10 U	9 U	11 U	13 U	11 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	7 U	9	8 U	8 U	8 U	8 U	8 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	39 U	41	40 U	46	39 U	40	41 U	59	42 U
Rubidium, XRF	mg/kg	**NA**	NA	33	33	39	46	38	35	38	44	41
Selenium, XRF	mg/kg	**380**	15,000	4 U	3 U	4 U	4 U	4 U	4 U	5 U	5 U	4 U
Silver, XRF	mg/kg	**380**	15,000	47 U	46 U	47 U	47 U	46 U	61	47 U	49 U	47 U
Strontium, XRF	mg/kg	**NA**	NA	121	118	130	102	114	121	125	121	100
Tin, XRF	mg/kg	**NA**	NA	74 U	74 U	74 U	76 U	73 U	74 U	75 U	78 U	76 U
Titanium, XRF	mg/kg	**NA**	NA	2,439	2,428	2,241	3,084	1,779	2,052	2,374	3,170	2,098
Zinc, XRF	mg/kg	**23,000**	880,000	279	142	302	228	116	118	286	573	196
Zirconium, XRF	mg/kg	**NA**	NA	112	137	135	162	190	168	179	125	173

NOTES:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 5m
NPI High Priority Project Site No. 42, Parcel 11819076
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	42	42	42	42	42	42	42	42	42
			Parcel ID	11819076	11819076	11819076	11819076	11819076	11819076	11819076	11819076	11819076
			Location ID	CLB-11819076-SS01	CLB-11819076-SS02	CLB-11819076-SS03	CLB-11819076-SS04	CLB-11819076-SS05	CLB-11819076-SS06	CLB-11819076-SS06 (Duplicate)	CLB-11819076-SS07	CLB-11819076-SS08
			Field Sample ID	CLB-11819076-SS01-040210	CLB-11819076-SS02-040210	CLB-11819076-SS03-040210	CLB-11819076-SS04-040210	CLB-11819076-SS05-040210	CLB-11819076-SS06-040210	CLB-11819076-SS09-040210	CLB-11819076-SS07-040210	CLB-11819076-SS08-040210
			Sample Date	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010	4/2/2010
Unit	Unit	VAP Generic Residential Direct Contact Criteria	VAP Generic Commercial/Industrial Direct Contact Criteria									
Percent Moisture	%			12.4	7.9	10.7	5.4	8.5	8.2	9.9	13	8.9
2-Methylnaphthalene	µg/kg	**NA**	NA	304	27.2 U	28 U	206	29.2	27.2 U	31.7	141	641
Acenaphthene	µg/kg	**3,500,000**	56,000,000	327	27.2 U	28 U	676	30.8	33	27.7 U	256	898
Acenaphthylene	µg/kg	**NA**	NA	252	27.2 U	28 U	36.8	27.3 U	27.2 U	27.7 U	28.7 U	60.6
Anthracene	µg/kg	**18,000,000**	280,000,000	1,220	45.3	38.5	1,460	86.1	94.8	77.5	600	2,600
Benzo(a)anthracene	µg/kg	**11,000**	76,000	3,920	161	141	2,940	277	302	280	1,040	3,920
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**3,500**	161	142	**2,560**	270	275	277	911	**2,930**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	3,150	147	124	2,100	233	244	253	743	2,200
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	1,960	102	90.7	1,400	157	167	182	528	1,410
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	2,920	131	115	2,250	223	230	226	763	2,310
Chrysene	µg/kg	**1,100,000**	7,600,000	3,410	152	136	2,600	264	280	262	879	3,670
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	1,010	45.9	39.2	690	74.4	76.4	83.3	252	726
Fluoranthene	µg/kg	**2,400,000**	37,000,000	7,670	339	294	6,790	607	620	576	2,400	7,160
Fluorene	µg/kg	**2,400,000**	37,000,000	322	27.2 U	28 U	502	27.3 U	27.2 U	27.7 U	202	848
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	1,960	93.4	80.8	1,370	148	154	165	498	1,270
Naphthalene	µg/kg	**69,000**	150,000	270	27.2 U	28 U	203	27.3 U	27.2 U	27.7 U	117	614
Phenanthrene	µg/kg	**NA**	NA	3,850	168	154	4,870	349	331	286	1,830	7,910
Pyrene	µg/kg	**1,800,000**	28,000,000	5,840	282	246	5,240	500	523	477	1,880	7,360
Aluminum, Total	mg/kg	**NA**	NA	4,230	2,800	2,880	2,900	2,990	3,240	4,860	2,790	3,170
Antimony, Total	mg/kg	**30**	1,200	2.1	0.8	0.7	1.3	0.8	1.4	0.5	0.9	1.1
Arsenic, Total	mg/kg	**6.7**	82	**15.8**	5.6	**8.9**	**15.6**	**8.3**	**10.8**	**7.1**	**8.7**	**9**
Barium, Total	mg/kg	**15,000**	370,000	805	151	210	215	237	294	167	236	208
Beryllium, Total	mg/kg	**150**	5,100	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2
Boron, Total	mg/kg	**NA**	NA	6.4	4.8	6.1	3	5.2	0.5	1.1 U	3.4	4.2
Cadmium, Total	mg/kg	**72**	2,300	2.1	0.7	0.6	0.6	0.7	1.3	0.2	0.9	0.6
Calcium, Total	mg/kg	**NA**	NA	2,780	856	941	956	821	1,430	1,660	2,150	2,460
Chromium, Total	mg/kg	**NA**	NA	3.6	3.1	1.1	4	0.4	3.4	3.5	0.8	1.4
Cobalt, Total	mg/kg	**1,400**	23,000	4.9	3.1	4.2	3.4	4.1	4.2	3.7	3.8	4.3
Copper, Total	mg/kg	**NA**	NA	254	27.6	55.6	60.3	56.9	52.2	23.2	31.4	54.7
Iron, Total	mg/kg	**NA**	NA	17,000	6,790	10,700	14,000	9,560	9,810	9,600	8,840	10,300
Lead, Total	mg/kg	**400**	1,800	**1,800**	149	362	**495**	390	**664**	146	**524**	329
Magnesium, Total	mg/kg	**NA**	NA	938	676	876	764	872	842	946	838	1460
Manganese, Total	mg/kg	**NA**	NA	236	140	205	157	193	212	149	213	215
Molybdenum, Total	mg/kg	**NA**	NA	6.5 U	6.7 U	5.6 U	3.8 U	6.8 U	5.1 U	8.1 U	6.3 U	7 U
Nickel, Total	mg/kg	**1,500**	44,000	16.2	8.2	10.6	9.3	9.7	10.5	9.5	10.5	10.6
Phosphorus, Total	mg/kg	**NA**	NA	713	207	272	629	287	472	342	332	255
Potassium, Total	mg/kg	**NA**	NA	530	348	516	505	436	456	406	441	445
Selenium, Total	mg/kg	**380**	15,000	1	1.2	1.2	1.8	1.3 U	1.7	1.2	1.8	0.6
Silicon, Total	mg/kg	**NA**	NA	235	290	282	289	248	814	770	270	241
Sodium, Total	mg/kg	**NA**	NA	467	402	500	413	466	368	406	418	464
Strontium1, Total	mg/kg	**NA**	NA	8.2	7.4 U	6 U	8.6	7.1 U	2.6 U	5 U	3.7 U	4.2 U
Strontium2, Total	mg/kg	**NA**	NA	35.2	6.3	6.3	8.1	5.5	10	7.4	9.3	8.3
Sulfur, Total	mg/kg	**NA**	NA	382	36	86.9	416	75.9	126	88.7	157	98.7
Thallium, Total	mg/kg	**6.1**	230	0.3	0.1	0.4	0.1	0.1	0.8	0.6	0.6	0.1
Tin, Total	mg/kg	**NA**	NA	4.3	0.6	2.4	1.7	1.6	2	0.7	0.7	2.4
Titanium, Total	mg/kg	**NA**	NA	92.5	34.4	32.5	44.5	39.4	39	44.4	34.8	35.7
Vanadium, Total	mg/kg	**680**	26,000	9.7	7	7	2.1	7.5	7.9	7.4	7.6	8.5
Zinc, Total	mg/kg	**23,000**	880,000	1,300	180	306	167	346	290	138	339	305

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Appendix C - Table 5m
NPI High Priority Project Site No. 42, Parcel 11819076
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
			Parcel ID	**11819076**	**11819076**	**11819076**	**11819076**	**11819076**	**11819076**	**11819076**	**11819076**	**11819076**
			Location ID	**CLB-11819076-SS01**	**CLB-11819076-SS02**	**CLB-11819076-SS03**	**CLB-11819076-SS04**	**CLB-11819076-SS05**	**CLB-11819076-SS06**	**CLB-11819076-SS06 (Duplicate)**	**CLB-11819076-SS07**	**CLB-11819076-SS08**
			Field Sample ID	**CLB-11819076-SS01-040210**	**CLB-11819076-SS02-040210**	**CLB-11819076-SS03-040210**	**CLB-11819076-SS04-040210**	**CLB-11819076-SS05-040210**	**CLB-11819076-SS06-040210**	**CLB-11819076-SS09-040210**	**CLB-11819076-SS07-040210**	**CLB-11819076-SS08-040210**
			Sample Date	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**	**4/2/2010**
Unit	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Antimony, XRF	mg/kg	**30**	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic, XRF	mg/kg	**6.7**	82	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, XRF	mg/kg	**15,000**	370,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium, XRF	mg/kg	**72**	2,300	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt, XRF	mg/kg	**1,400**	23,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead, XRF	mg/kg	**400**	1800	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury, XRF	mg/kg	**7.6**	290	NA	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, XRF	mg/kg	**1,500**	44,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rubidium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium, XRF	mg/kg	**380**	15,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver, XRF	mg/kg	**380**	15,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Titanium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc, XRF	mg/kg	**23,000**	880,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium, XRF	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 6
NPI High Priority Project Site No. 53, Parcel 00814072
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	53	53	53	53
			Parcel ID	00814072	00814072	00814072	00814072
			Location ID	CLB-00814072-SS01	CLB-00814072-SS02	CLB-00814072-SS03	CLB-00814072-SS04
			Field Sample ID	CLB-00814072-SS01-032410	CLB-00814072-SS02-032410	CLB-00814072-SS03-032410	CLB-00814072-SS04-032410
			Sample Date	3/24/2010	3/24/2010	3/24/2010	3/24/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**				
2-Methylnaphthalene	µg/kg	**NA**	NA	602	145	36.7	51.3
Acenaphthene	µg/kg	**3,500,000**	56,000,000	45.9	135	31.1 U	133
Acenaphthylene	µg/kg	**NA**	NA	64.5	49.1	31.1 U	29.8 U
Anthracene	µg/kg	**18,000,000**	280,000,000	61,000	339	62.5	409
Benzo(a)anthracene	µg/kg	**11,000**	76,000	493	800	105	547
Benzo(a)pyrene	µg/kg	**1,100**	7,700	357	726	101	461
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	331	644	90.8	378
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	248	424	58.5	242
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	336	655	86.4	427
Chrysene	µg/kg	**1,100,000**	7,600,000	1,650	826	111	519
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	105	191	31.1 U	115
Fluoranthene	µg/kg	**2,400,000**	37,000,000	731	1,930	274	1,400
Fluorene	µg/kg	**2,400,000**	37,000,000	2,960	93	31.1 U	127
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	197	386	55.3	238
Naphthalene	µg/kg	**69,000**	150,000	812	153	32.9	56
Phenanthrene	µg/kg	**NA**	NA	5,920	1,240	189	1,210
Pyrene	µg/kg	**1,800,000**	28,000,000	547	1,520	218	1,070
Aluminum, Total	mg/kg	**NA**	NA	5,200	6,600	NA	7,460
Antimony, Total	mg/kg	**30**	1,200	2.2	2.4	NA	2
Arsenic, Total	mg/kg	**6.7**	82	**11**	**16.8**	NA	**11.5**
Barium, Total	mg/kg	**15,000**	370,000	172	286	NA	167
Beryllium, Total	mg/kg	**150**	5,100	0.2	0.6	NA	0.4
Boron, Total	mg/kg	**NA**	NA	11.3	15	NA	2.5
Cadmium, Total	mg/kg	**72**	2,300	0.5	0.9	NA	0.2
Calcium, Total	mg/kg	**NA**	NA	2,510	6,140	NA	22,800
Chromium, Total	mg/kg	**NA**	NA	2	5.4	NA	3.2
Cobalt, Total	mg/kg	**1,400**	23,000	5.7	6.4	NA	6.2
Copper, Total	mg/kg	**NA**	NA	32.7	37.4	NA	17.7
Iron, Total	mg/kg	**NA**	NA	15,600	18,700	NA	17,600
Lead, Total	mg/kg	**400**	1,800	171	393	NA	41.1
Magnesium, Total	mg/kg	**NA**	NA	1,560	1,960	NA	4,060
Manganese, Total	mg/kg	**NA**	NA	314	546	NA	860
Molybdenum, Total	mg/kg	**NA**	NA	7.1 U	10.5 U	NA	9.4 U
Nickel, Total	mg/kg	**1,500**	44,000	14.7	19.6	NA	16.4
Phosphorus, Total	mg/kg	**NA**	NA	275	599	NA	228
Potassium, Total	mg/kg	**NA**	NA	744	883	NA	930
Selenium, Total	mg/kg	**380**	15,000	0.6	2.5 U	NA	2.9 U
Silicon, Total	mg/kg	**NA**	NA	1,340	1,250	NA	1,200
Sodium, Total	mg/kg	**NA**	NA	540	547	NA	576
Strontium[1], Total	mg/kg	**NA**	NA	8.9	15	NA	24.5

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Appendix C - Table 6
NPI High Priority Project Site No. 53, Parcel 00814072
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**53**	**53**	**53**	**53**
			Parcel ID	**00814072**	**00814072**	**00814072**	**00814072**
			Location ID	**CLB-00814072-SS01**	**CLB-00814072-SS02**	**CLB-00814072-SS03**	**CLB-00814072-SS04**
			Field Sample ID	**CLB-00814072-SS01-032410**	**CLB-00814072-SS02-032410**	**CLB-00814072-SS03-032410**	**CLB-00814072-SS04-032410**
			Sample Date	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**				
Strontium, Total	mg/kg	**NA**	NA	10.1	29.6	NA	42.4
Sulfur, Total	mg/kg	**NA**	NA	136	302	NA	415
Thallium, Total	mg/kg	**6**	230	0.1 U	0.6	NA	0.7
Tin, Total	mg/kg	**NA**	NA	1.3	0.7	NA	0.1 U
Titanium, Total	mg/kg	**NA**	NA	43.2	55.6	NA	45.8
Vanadium, Total	mg/kg	**680**	26,000	2.6	7	NA	4.1
Zinc, Total	mg/kg	**23,000**	880,000	147	416	NA	150
Antimony, XRF	mg/kg	**30**	1,200	80 U	80 U	88 U	80 U
Arsenic, XRF	mg/kg	**6.7**	82	22 U	**45**	21 U	**15**
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	55 U	56 U	60 U	55 U
Chromium, XRF	mg/kg	**NA**	NA	137 U	169 U	153 U	134 U
Cobalt, XRF	mg/kg	**1,400**	23,000	175 U	268 U	217 U	192 U
Copper, XRF	mg/kg	**NA**	NA	42	57	27 U	23 U
Iron, XRF	mg/kg	**NA**	NA	20,919	44,827	28,301	26,101
Lead, XRF	mg/kg	**400**	1,800	257	**533**	173	42
Manganese, XRF	mg/kg	**NA**	NA	157	363	129 U	293
Mercury, XRF	mg/kg	**7.6**	290	10 U	14 U	12 U	11 U
Molybdenum, XRF	mg/kg	**NA**	NA	9 U	9 U	9 U	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	45 U	53 U	53	52
Rubidium, XRF	mg/kg	**NA**	NA	51	57	82	74
Selenium, XRF	mg/kg	**380**	15,000	4 U	5 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	53	53 U	83	52
Strontium, XRF	mg/kg	**NA**	NA	95	119	120	110
Tin, XRF	mg/kg	**NA**	NA	82 U	83 U	89 U	81 U
Titanium, XRF	mg/kg	**NA**	NA	3,393	5,855	3,987	4,524
Zinc, XRF	mg/kg	**23,000**	880,000	99	488	94	115
Zirconium, XRF	mg/kg	**NA**	NA	213	217	204	214

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
mg/kg - milligrams per kilogram
ug/kg - micrograms per kilogram
NA - Not available/Not analyzed for
See electronic deliverable for complete analytical results
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence

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Appendix C - Table 7a
NPI High Priority Project Site No. 96, Parcel 10533036
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	96	96	96	96	96	96
			Parcel ID	10533036	10533036	10533036	10533036	10533036	10533036
			Location ID	CLB-10533036-SS01	CLB-10533036-SS02	CLB-10533036-SS03	CLB-10533036-SS04	CLB-10533036-SS05	CLB-10533036-SS06
			Field Sample ID	CLB-10533036-SS01-032610	CLB-10533036-SS02-032610	CLB-10533036-SS03-032610	CLB-10533036-SS04-032610	CLB-10533036-SS05-032610	CLB-10533036-SS06-032610
			Sample Date	3/26/2010	3/26/2010	3/26/2010	3/26/2010	3/26/2010	3/26/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	93.2	30.1 U	225	27.6 U	33.7	54.2
Acenaphthene	µg/kg	**3,500,000**	56,000,000	532	37.6	406	153	194	113
Acenaphthylene	µg/kg	**NA**	NA	146	72.1	438	84.6	68.5	60.2
Anthracene	µg/kg	**18,000,000**	280,000,000	1,710	164	1,500	489	604	358
Benzo(a)anthracene	µg/kg	**11,000**	76,000	3,560	535	3,120	1,350	1,510	979
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**3,500**	582	3,110	**1,400**	**1,590**	978
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	3,440	557	2,990	1,280	1,710	864
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	2,340	426	1,900	980	1,120	652
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	2,830	547	2,690	1,220	1,220	948
Chrysene	µg/kg	**1,100,000**	7,600,000	3,680	602	3,470	1,420	1,640	1,060
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	927	162	835	379	421	245
Fluoranthene	µg/kg	**2,400,000**	37,000,000	8,720	1,290	7,840	3,290	4,030	2,460
Fluorene	µg/kg	**2,400,000**	37,000,000	512	46.7	421	120	148	94.4
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	2,100	371	1,770	867	1,000	584
Naphthalene	µg/kg	**69,000**	150,000	160	30.1 U	296	35.9	46.7	68.2
Phenanthrene	µg/kg	**NA**	NA	5,790	608	5,100	1,750	2,240	1,370
Pyrene	µg/kg	**1,800,000**	28,000,000	7,030	1,050	6,260	2,680	3,210	1,920
Aluminum, Total	mg/kg	**NA**	NA	NA	25,100	4,900	NA	NA	7,980
Antimony, Total	mg/kg	**30**	1,200	NA	2.6	1.3	NA	NA	2.6
Arsenic, Total	mg/kg	**6.7**	82	NA	3.8	**15.2**	NA	NA	**8.2**
Barium, Total	mg/kg	**15,000**	370,000	NA	283	276	NA	NA	271
Beryllium, Total	mg/kg	**150**	5,100	NA	8.7	0.2	NA	NA	1.7
Boron, Total	mg/kg	**NA**	NA	NA	25.3	1.9	NA	NA	6.1
Cadmium, Total	mg/kg	**72**	2,300	NA	0.6 U	2.6	NA	NA	0.7
Calcium, Total	mg/kg	**NA**	NA	NA	141,000	4,280	NA	NA	24,100
Chromium, Total	mg/kg	**NA**	NA	NA	3.8	4.7	NA	NA	3.7
Cobalt, Total	mg/kg	**1,400**	23,000	NA	1	4.5	NA	NA	3.4
Copper, Total	mg/kg	**NA**	NA	NA	17.6	74.3	NA	NA	33.2
Iron, Total	mg/kg	**NA**	NA	NA	6,270	13,500	NA	NA	12,300
Lead, Total	mg/kg	**400**	1,800	NA	126	**699**	NA	NA	329
Magnesium, Total	mg/kg	**NA**	NA	NA	36,100	1,040	NA	NA	5,790
Manganese, Total	mg/kg	**NA**	NA	NA	1,830	246	NA	NA	439
Molybdenum, Total	mg/kg	**NA**	NA	NA	22.2 U	9.6 U	NA	NA	11.8 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	4.3	13.6	NA	NA	8.9
Phosphorus, Total	mg/kg	**NA**	NA	NA	382	869	NA	NA	666
Potassium, Total	mg/kg	**NA**	NA	NA	2,960	586	NA	NA	964
Selenium, Total	mg/kg	**380**	15,000	NA	1.7	0.8 U	NA	NA	4.3 U
Silicon, Total	mg/kg	**NA**	NA	NA	1,430	652	NA	NA	1,110

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Appendix C - Table 7a
NPI High Priority Project Site No. 96, Parcel 10533036
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	96	96	96	96	96	96
			Parcel ID	10533036	10533036	10533036	10533036	10533036	10533036
			Location ID	CLB-10533036-SS01	CLB-10533036-SS02	CLB-10533036-SS03	CLB-10533036-SS04	CLB-10533036-SS05	CLB-10533036-SS06
			Field Sample ID	CLB-10533036-SS01-032610	CLB-10533036-SS02-032610	CLB-10533036-SS03-032610	CLB-10533036-SS04-032610	CLB-10533036-SS05-032610	CLB-10533036-SS06-032610
			Sample Date	3/26/2010	3/26/2010	3/26/2010	3/26/2010	3/26/2010	3/26/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Sodium, Total	mg/kg	**NA**	NA	NA	1,610	477	NA	NA	449
Strontium1, Total	mg/kg	**NA**	NA	NA	215	17.6	NA	NA	36.7
Strontium2, Total	mg/kg	**NA**	NA	NA	243	20.7	NA	NA	51.2
Sulfur, Total	mg/kg	**NA**	NA	NA	3,740	330	NA	NA	772
Thallium, Total	mg/kg	**6.1**	230	NA	2.6	0.7	NA	NA	0.1
Tin, Total	mg/kg	**NA**	NA	NA	1.1	1.5	NA	NA	1.1
Titanium, Total	mg/kg	**NA**	NA	NA	384	70.6	NA	NA	97.8
Vanadium, Total	mg/kg	**680**	26,000	NA	3.5	5.2	NA	NA	5.1
Zinc, Total	mg/kg	**23,000**	880,000	NA	156	760	NA	NA	391
Antimony, XRF	mg/kg	**30**	1,200	**75**	84 U	72 U	**75**	78 U	75 U
Arsenic, XRF	mg/kg	**6.7**	82	29 U	20 U	36 U	23 U	23 U	25 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	52 U	59 U	50 U	52 U	54 U	52 U
Chromium, XRF	mg/kg	**NA**	NA	125 U	148 U	136 U	121 U	134 U	128 U
Cobalt, XRF	mg/kg	**1,400**	23,000	158 U	164 U	209 U	156 U	162 U	151 U
Copper, XRF	mg/kg	**NA**	NA	24 U	41	93	23 U	24 U	41
Iron, XRF	mg/kg	**NA**	NA	17,998	16,137	32,284	17,495	18,683	16,886
Lead, XRF	mg/kg	**400**	1,800	**471**	173	**806**	293	299	355
Manganese, XRF	mg/kg	**NA**	NA	646	1288	120 U	275	381	187
Mercury, XRF	mg/kg	**7.6**	290	11 U	13 U	12 U	10 U	11 U	11 U
Molybdenum, XRF	mg/kg	**NA**	NA	9 U	9 U	8 U	9 U	13	8 U
Nickel, XRF	mg/kg	**1,500**	44,000	42 U	47 U	45 U	41 U	61	41 U
Rubidium, XRF	mg/kg	**NA**	NA	32	23	36	37	36	41
Selenium, XRF	mg/kg	**380**	15,000	5 U	4 U	5 U	4 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	49 U	59	47 U	48 U	89	48 U
Strontium, XRF	mg/kg	**NA**	NA	188	259	136	135	175	138
Tin, XRF	mg/kg	**NA**	NA	76 U	87 U	74 U	76 U	79 U	76 U
Titanium, XRF	mg/kg	**NA**	NA	3,377	3,641	3,857	3,233	3,385	3,078
Zinc, XRF	mg/kg	**23,000**	880,000	303	177	774	146	177	258
Zirconium, XRF	mg/kg	**NA**	NA	281	274	209	390	423	258

Notes:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

NA - Not available/Not analyzed for

U - Non detect

VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria

XRF - X-ray Fluorescence

See electronic deliverable for complete analytical results

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Appendix C - Table 7b
NPI High Priority Project Site No. 96, Parcel 15033037
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**96**	**96**	**96**	**96**	**96**
			Parcel ID	**10533037**	**10533037**	**10533037**	**10533037**	**10533037**
			Location ID	**CLB-10533037-SS01**	**CLB-10533037-SS02**	**CLB-10533037-SS03**	**CLB-10533037-SS04**	**CLB-10533037-SS05**
			Field Sample ID	**CLB-10533037-SS01-032610**	**CLB-10533037-SS02-032610**	**CLB-10533037-SS03-032610**	**CLB-10533037-SS04-032610**	**CLB-10533037-SS05-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	171	77.2	45.4	1,510 U	453
Acenaphthene	µg/kg	**3,500,000**	56,000,000	720	29.9 U	153	1,510 U	1,010
Acenaphthylene	µg/kg	**NA**	NA	393	29.9 U	160	2,200	623
Anthracene	µg/kg	**18,000,000**	280,000,000	2,560	49.7	745	11,200	3,540
Benzo(a)anthracene	µg/kg	**11,000**	76,000	5,430	100	1,990	**30,300**	7,650
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**4,670**	118	**2,160**	**32,800**	**7,910**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	4,060	114	2,580	**38,400**	7,850
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	2,640	86.1	1,680	28,900	6,010
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	4,130	102	1,850	29,000	6,390
Chrysene	µg/kg	**1,100,000**	7,600,000	5,190	115	2,260	36,900	8,140
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	**1,220**	34.5	635	**9,200**	**2,170**
Fluoranthene	µg/kg	**2,400,000**	37,000,000	15,200	189	4,880	83,000	20,300
Fluorene	µg/kg	**2,400,000**	37,000,000	789	29.9 U	131	1,510 U	1,050
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	2,520	75.1	1,550	**25,200**	5,180
Naphthalene	µg/kg	**69,000**	150,000	258	54.8	63.8	1,510 U	479
Phenanthrene	µg/kg	**NA**	NA	9,390	104	2,470	36,600	14,600
Pyrene	µg/kg	**1,800,000**	28,000,000	11,800	171	3,910	64,800	16,100
Aluminum, Total	mg/kg	**NA**	NA	NA	6,720	12,900	NA	7,770
Antimony, Total	mg/kg	**30**	1,200	NA	2.4	2.5	NA	2.8
Arsenic, Total	mg/kg	**6.7**	82	NA	**11.1**	4.9	NA	**8.1**
Barium, Total	mg/kg	**15,000**	370,000	NA	206	374	NA	213
Beryllium, Total	mg/kg	**150**	5,100	NA	0.3	3.4	NA	1
Boron, Total	mg/kg	**NA**	NA	NA	6	8.9	NA	7.7
Cadmium, Total	mg/kg	**72**	2,300	NA	0.2	0.1 U	NA	0.2
Calcium, Total	mg/kg	**NA**	NA	NA	32,800	59,500	NA	33,200
Chromium, Total	mg/kg	**NA**	NA	NA	7	4.1	NA	3.2
Cobalt, Total	mg/kg	**1,400**	23,000	NA	7.3	2.8	NA	3.5
Copper, Total	mg/kg	**NA**	NA	NA	25.9	11	NA	24.2
Iron, Total	mg/kg	**NA**	NA	NA	16,400	8,270	NA	11,500
Lead, Total	mg/kg	**400**	1,800	NA	34.6	304	NA	**802**
Magnesium, Total	mg/kg	**NA**	NA	NA	9,240	14,600	NA	6,570
Manganese, Total	mg/kg	**NA**	NA	NA	338	816	NA	391
Molybdenum, Total	mg/kg	**NA**	NA	NA	7.4 U	10.2 U	NA	9.7 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	18.1	6.2	NA	8

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Appendix C - Table 7b
NPI High Priority Project Site No. 96, Parcel 15033037
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**96**	**96**	**96**	**96**	**96**
			Parcel ID	**10533037**	**10533037**	**10533037**	**10533037**	**10533037**
			Location ID	**CLB-10533037-SS01**	**CLB-10533037-SS02**	**CLB-10533037-SS03**	**CLB-10533037-SS04**	**CLB-10533037-SS05**
			Field Sample ID	**CLB-10533037-SS01-032610**	**CLB-10533037-SS02-032610**	**CLB-10533037-SS03-032610**	**CLB-10533037-SS04-032610**	**CLB-10533037-SS05-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Phosphorus, Total	mg/kg	**NA**	NA	NA	301	302	NA	413
Potassium, Total	mg/kg	**NA**	NA	NA	1,230	1,100	NA	732
Selenium, Total	mg/kg	**380**	15,000	NA	4.6 U	3.5 U	NA	3.3 U
Silicon, Total	mg/kg	**NA**	NA	NA	1,180	1,270	NA	905
Sodium, Total	mg/kg	**NA**	NA	NA	475	693	NA	548
Strontium1, Total	mg/kg	**NA**	NA	NA	59.8	98.4	NA	59.3
Strontium2, Total	mg/kg	**NA**	NA	NA	72.5	109	NA	70.6
Sulfur, Total	mg/kg	**NA**	NA	NA	1,350	1,740	NA	652
Thallium, Total	mg/kg	**6**	230	NA	0.7	0.9	NA	0.4
Tin, Total	mg/kg	**NA**	NA	NA	0.2	0.2	NA	2.2
Titanium, Total	mg/kg	**NA**	NA	NA	77.4	189	NA	183
Vanadium, Total	mg/kg	**680**	26,000	NA	6.8	5.6	NA	8.7
Zinc, Total	mg/kg	**23,000**	880,000	NA	173	426	NA	449
Antimony, XRF	mg/kg	**30**	1,200	74 U	83 U	76 U	74 U	75 U
Arsenic, XRF	mg/kg	**6.7**	82	24 U	12 U	**28**	22 U	36 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	58	57 U	**73**	56	58
Chromium, XRF	mg/kg	**NA**	NA	122 U	160 U	124 U	127 U	126 U
Cobalt, XRF	mg/kg	**1400**	23,000	158 U	226 U	151 U	166 U	163 U
Copper, XRF	mg/kg	**NA**	NA	23 U	26 U	29	24 U	23 U
Iron, XRF	mg/kg	**NA**	NA	19,158	31,945	17,119	20,428	18,949
Lead, XRF	mg/kg	**400**	1,800	354	46	306	282	**732**
Manganese, XRF	mg/kg	**NA**	NA	166	122 U	277	125	155
Mercury, XRF	mg/kg	**7.6**	290	11 U	12 U	11 U	12 U	11 U
Molybdenum, XRF	mg/kg	**NA**	NA	8 U	9 U	9 U	9 U	9 U
Nickel, XRF	mg/kg	**1,500**	44,000	42 U	51 U	42 U	43 U	41 U
Rubidium, XRF	mg/kg	**NA**	NA	35	63	35	30	29
Selenium, XRF	mg/kg	**380**	15,000	4 U	3 U	4 U	4 U	5 U
Silver, XRF	mg/kg	**380**	15,000	47 U	53 U	49 U	48 U	49 U
Strontium, XRF	mg/kg	**NA**	NA	122	140	152	146	151
Tin, XRF	mg/kg	**NA**	NA	76 U	84 U	77 U	75 U	77 U
Titanium, XRF	mg/kg	**NA**	NA	4,102	3,052	3,434	7,729	3,845
Zinc, XRF	mg/kg	**23,000**	880,000	277	91	305	452	347
Zirconium, XRF	mg/kg	**NA**	NA	372	177	381	408	350

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 7c
NPI High Priority Project Site No. 96, Parcel 15033038
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**96**	**96**	**96**	**96**	**96**	**96**
			Parcel ID	**10533038**	**10533038**	**10533038**	**10533038**	**10533038**	**10533038**
			Location ID	**CLB-10533038-SS01**	**CLB-10533038-SS02**	**CLB-10533038-SS03**	**CLB-10533038-SS04**	**CLB-10533038-SS05**	**CLB-10533038-SS05 (Duplicate)**
			Field Sample ID	**CLB-10533038-SS01-032610**	**CLB-10533038-SS02-032610**	**CLB-10533038-SS03-032610**	**CLB-10533038-SS04-032610**	**CLB-10533038-SS05-032610**	**CLB-10533038-SS06-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Aroclor 1016	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	42.3 U	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	46.7	66.1	725	90.7	29.1	34.5
Acenaphthene	µg/kg	**3,500,000**	56,000,000	146	351	5,770	284	90.3	167
Acenaphthylene	µg/kg	**NA**	NA	86.1	326	932	34	77.6	141
Anthracene	µg/kg	**18,000,000**	280,000,000	522	1,600	16,300	620	365	709
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,550	4,290	**25,100**	1,300	1,190	1,980
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,580**	**3,930**	**22,000**	**1,320**	**1,140**	**2,110**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,390	3,620	**18,600**	1,040	1,060	1,750
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	986	2,220	11,900	873	688	1,380
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,420	3,210	18,400	1,040	960	1,820
Chrysene	µg/kg	**1,100,000**	7,600,000	1,650	4,110	23,800	1,270	1,180	1,980
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	420	1,030	**5,640**	460	300	576
Fluoranthene	µg/kg	**2,400,000**	37,000,000	3,850	10,800	72,400	3,090	2,860	4,570
Fluorene	µg/kg	**2,400,000**	37,000,000	122	361	5,800	220	83.2	154
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	886	2,090	**11,400**	723	635	1,240
Naphthalene	µg/kg	**69,000**	150,000	63.2	138	1420	120	42	45.6
Phenanthrene	µg/kg	**NA**	NA	2,080	5,210	47,700	2,310	1,310	2,280
Pyrene	µg/kg	**1,800,000**	28,000,000	3,150	8,090	57,500	2,410	2,340	3,780
Aluminum, Total	mg/kg	**NA**	NA	NA	NA	6,100	23,800	6,950	9,150
Antimony, Total	mg/kg	**30**	1,200	NA	NA	2.7	2.5	1.9	1.8
Arsenic, Total	mg/kg	**6.7**	82	NA	NA	6.7	4.2	**7.6**	**10.8**
Barium, Total	mg/kg	**15,000**	370,000	NA	NA	230	309	200	203
Beryllium, Total	mg/kg	**150**	5,100	NA	NA	0.1	8.4	0.6	1.1
Boron, Total	mg/kg	**NA**	NA	NA	NA	6	21.5	2.7	2.6
Cadmium, Total	mg/kg	**72**	2,300	NA	NA	0.1	0.1 U	0.3	0.5
Calcium, Total	mg/kg	**NA**	NA	NA	NA	31,100	133,000	12,900	24,500
Chromium, Total	mg/kg	**NA**	NA	NA	NA	4.3	2.7	3.7	5.2
Cobalt, Total	mg/kg	**1,400**	23,000	NA	NA	3.9	1.4	5.6	5.5
Copper, Total	mg/kg	**NA**	NA	NA	NA	19.1	14.9	23.9	26.3
Iron, Total	mg/kg	**NA**	NA	NA	NA	8,890	11,600	12,900	21,900
Lead, Total	mg/kg	**400**	1,800	NA	NA	**441**	163	265	240
Magnesium, Total	mg/kg	**NA**	NA	NA	NA	11,200	31,700	3,490	6,180
Manganese, Total	mg/kg	**NA**	NA	NA	NA	342	1,540	572	685
Molybdenum, Total	mg/kg	**NA**	NA	NA	NA	5.4 U	16.8 U	10.8 U	11.9 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	NA	9.7	4.2	12.3	13.9
Phosphorus, Total	mg/kg	**NA**	NA	NA	NA	324	289	379	446
Potassium, Total	mg/kg	**NA**	NA	NA	NA	760	2,370	660	947
Selenium, Total	mg/kg	**380**	15,000	NA	NA	0 U	0.3 U	1.1 U	5.4 U

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Appendix C - Table 7c
NPI High Priority Project Site No. 96, Parcel 15033038
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**96**	**96**	**96**	**96**	**96**	**96**
			Parcel ID	**10533038**	**10533038**	**10533038**	**10533038**	**10533038**	**10533038**
			Location ID	**CLB-10533038-SS01**	**CLB-10533038-SS02**	**CLB-10533038-SS03**	**CLB-10533038-SS04**	**CLB-10533038-SS05**	**CLB-10533038-SS05 (Duplicate)**
			Field Sample ID	**CLB-10533038-SS01-032610**	**CLB-10533038-SS02-032610**	**CLB-10533038-SS03-032610**	**CLB-10533038-SS04-032610**	**CLB-10533038-SS05-032610**	**CLB-10533038-SS06-032610**
			Sample Date	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**	**3/26/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Silicon, Total	mg/kg	**NA**	NA	NA	NA	658	1,310	1,010	932
Sodium, Total	mg/kg	**NA**	NA	NA	NA	602	1,480	393	499
Strontium1, Total	mg/kg	**NA**	NA	NA	NA	31.9	205	30.4	54.5
Strontium2, Total	mg/kg	**NA**	NA	NA	NA	51.2	232	45.2	66.1
Sulfur, Total	mg/kg	**NA**	NA	NA	NA	616	4,190	310	508
Thallium, Total	mg/kg	**6.1**	230	NA	NA	0.4	2	0.9	0.1 U
Tin, Total	mg/kg	**NA**	NA	NA	NA	0.1	0.2	0.4	0.4
Titanium, Total	mg/kg	**NA**	NA	NA	NA	222	349	64.5	106
Vanadium, Total	mg/kg	**680**	26,000	NA	NA	7	5.8	5.2	7.3
Zinc, Total	mg/kg	**23,000**	880,000	NA	NA	362	184	251	252
Antimony, XRF	mg/kg	**30**	1,200	79 U	79 U	81 U	88 U	85 U	83 U
Arsenic, XRF	mg/kg	**6.7**	82	35 U	35 U	38 U	26 U	**32**	**42**
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	55 U	54 U	56 U	63	58 U	56 U
Chromium, XRF	mg/kg	**NA**	NA	140 U	131 U	137 U	145 U	143 U	141 U
Cobalt, XRF	mg/kg	**1,400**	23,000	183 U	157 U	172 U	192 U	180 U	192 U
Copper, XRF	mg/kg	**NA**	NA	31	24 U	26 U	38	30	25 U
Iron, XRF	mg/kg	**NA**	NA	22,209	16,835	18,038	21,924	20,744	22,916
Lead, XRF	mg/kg	**400**	1,800	**635**	**682**	**710**	294	278	322
Manganese, XRF	mg/kg	**NA**	NA	700	282	168	1301	279	426
Mercury, XRF	mg/kg	**7.6**	290	13 U	12 U	12 U	13 U	13 U	12 U
Molybdenum, XRF	mg/kg	**NA**	NA	9 U	9 U	9 U	10 U	9 U	9 U
Nickel, XRF	mg/kg	**1,500**	44,000	46 U	43 U	44 U	49 U	44 U	48 U
Rubidium, XRF	mg/kg	**NA**	NA	37	45	41	42	42	51
Selenium, XRF	mg/kg	**380**	15,000	5 U	4 U	5 U	5 U	4 U	4 U
Silver, XRF	mg/kg	**380**	15,000	52 U	51 U	53 U	57 U	54 U	52 U
Strontium, XRF	mg/kg	**NA**	NA	180	218	157	276	111	123
Tin, XRF	mg/kg	**NA**	NA	82 U	80 U	82 U	88 U	86 U	84 U
Titanium, XRF	mg/kg	**NA**	NA	3,155	2,426	3,040	2,942	3,462	3,882
Zinc, XRF	mg/kg	**23,000**	880,000	428	271	400	181	253	180
Zirconium, XRF	mg/kg	**NA**	NA	321	223	236	259	187	210

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 8
NPI High Priority Project Site No. 100, Parcel 02204039
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	100	100	100	100	100	100	100	100	100	100	100
			Parcel ID	02204039	02204039	02204039	02204039	02204039	02204039	02204039	02204039	02204039	02204039	02204039
			Location ID	CLB-02204039-SS01	CLB-02204039-SS02	CLB-02204039-SS03	CLB-02204039-SS03 [1]	CLB-02204039-SS03 [1]	CLB-02204039-SS04	CLB-02204039-SS05	CLB-02204039-SS06	CLB-02204039-SS07	CLB-02204039-SS08	CLB-02204039-SS08 (Duplicate)
			Field Sample ID	CLB-02204039-SS01-032410	CLB-02204039-SS02-032410	CLB-02204039-SS03-032410	CLB-02204039-SS03-032410-6	CLB-02204039-SS03-032410-7	CLB-02204039-SS04-032410	CLB-02204039-SS05-032410	CLB-02204039-SS06-032410	CLB-02204039-SS07-032410	CLB-02204039-SS08-032410	CLB-02204039-SS08-032410D
			Sample Date	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010	3/24/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**											
2-Methylnaphthalene	µg/kg	**NA**	NA	57.4	56.7	157	NA	NA	85.9	63.4	76.4	74	28.7 U	28.7 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	29.5 U	33.9 U	29.4 U	NA	NA	29.4 U	29.6 U	30.6 U	29.7 U	28.7 U	28.7 U
Acenaphthylene	µg/kg	**NA**	NA	29.5 U	108	29.4 U	NA	NA	29.4 U	38.3	30.6 U	29.7 U	28.7 U	28.7 U
Anthracene	µg/kg	**18,000,000**	280,000,000	38.7	137	29.4 U	NA	NA	43.4	66.6	30.6 U	29.7 U	28.7 U	28.7 U
Benzo(a)anthracene	µg/kg	**11,000**	76,000	160	450	62.2	NA	NA	166	192	109	94.6	28.7 U	28.7 U
Benzo(a)pyrene	µg/kg	**1,100**	7,700	186	478	68.6	NA	NA	175	219	127	110	28.7 U	28.7 U
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	196	550	70.3	NA	NA	172	215	180	106	28.7 U	28.7 U
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	131	331	48.6	NA	NA	115	150	122	73.4	28.7 U	28.7 U
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	205	551	74.6	NA	NA	178	222	126	117	28.7 U	28.7 U
Chrysene	µg/kg	**1,100,000**	7,600,000	214	613	84.3	NA	NA	198	235	185	124	28.7 U	28.7 U
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	50.4	137	29.4 U	NA	NA	47.3	58	53.3	29.7 U	28.7 U	28.7 U
Fluoranthene	µg/kg	**2,400,000**	37,000,000	409	1,260	146	NA	NA	440	476	238	250	43.1	36.8
Fluorene	µg/kg	**2,400,000**	37,000,000	29.5 U	42.2	29.4 U	NA	NA	29.4 U	29.6 U	30.6 U	29.7 U	28.7 U	28.7 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	122	319	44.1	NA	NA	106	137	96.6	68.2	28.7 U	28.7 U
Naphthalene	µg/kg	**69,000**	150,000	47.2	51.1	109	NA	NA	58.6	51.6	62.6	61.1	28.7 U	28.7 U
Phenanthrene	µg/kg	**NA**	NA	162	628	102	NA	NA	214	188	127	111	28.7 U	28.7 U
Pyrene	µg/kg	**1,800,000**	28,000,000	315	869	116	NA	NA	324	366	194	191	35.5	30.6
Aluminum, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	6,130	NA	5,830	NA	7,420	8,730
Antimony, Total	mg/kg	**30**	1,200	NA	NA	NA	NA	NA	1.4	NA	1.7	NA	1.3	1
Arsenic, Total	mg/kg	**6.7**	82	NA	NA	NA	NA	NA	**13.6**	NA	**13.7**	NA	**17.6**	**14.2**
Barium, Total	mg/kg	**15,000**	370,000	NA	NA	NA	NA	NA	168	NA	206	NA	187	181
Beryllium, Total	mg/kg	**150**	5,100	NA	NA	NA	NA	NA	0.4	NA	0.4	NA	0.3	0.3
Boron, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	2.5	NA	1.9	NA	12.4	6.9
Cadmium, Total	mg/kg	**72**	2,300	NA	NA	NA	NA	NA	0.5	NA	0.7	NA	0.7	0.4
Calcium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	2,790	NA	1,860	NA	1,250	1,150
Chromium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	2.2	NA	6.2	NA	1.7	2.7
Cobalt, Total	mg/kg	**1,400**	23,000	NA	NA	NA	NA	NA	6.3	NA	7.1	NA	8	7.9
Copper, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	26.5	NA	22.8	NA	21.7	20.1
Iron, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	18,000	NA	17,800	NA	24,900	20,700
Lead, Total	mg/kg	**400**	1,800	NA	NA	NA	NA	NA	**426**	NA	81.6	NA	43	63.6
Magnesium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	1,890	NA	1,280	NA	2,300	2,490
Manganese, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	391	NA	388	NA	439	434
Molybdenum, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	8.3 U	NA	8.1 U	NA	8.6 U	11.6 U
Nickel, Total	mg/kg	**1,500**	44,000	NA	NA	NA	NA	NA	16.6	NA	12.3	NA	20.9	21.7
Phosphorus, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	311	NA	271	NA	226	191
Potassium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	714	NA	516	NA	774	849
Selenium, Total	mg/kg	**380**	15,000	NA	NA	NA	NA	NA	0.4	NA	1	NA	3.6 U	3.4 U
Silicon, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	766	NA	967	NA	1,090	1,540
Sodium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	435	NA	433	NA	539	613
Strontium1, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	16.4	NA	23.5	NA	6.2	5.9
Strontium2, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	31	NA	38.9	NA	8.2	7.9
Sulfur, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	142	NA	122	NA	173	33.6
Thallium, Total	mg/kg	**6.1**	230	NA	NA	NA	NA	NA	0.6	NA	0.1	NA	0.5	0.4
Tin, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	0.1	NA	0.2	NA	0.1	0.3
Titanium, Total	mg/kg	**NA**	NA	NA	NA	NA	NA	NA	30.3	NA	34.3	NA	39.6	55.3
Vanadium, Total	mg/kg	**680**	26,000	NA	NA	NA	NA	NA	3.7	NA	7.4	NA	7.9	5.3
Zinc, Total	mg/kg	**23,000**	880,000	NA	NA	NA	NA	NA	156	NA	145	NA	162	140

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Appendix C - Table 8
NPI High Priority Project Site No. 100, Parcel 02204039
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
			Parcel ID	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**	**02204039**
			Location ID	**CLB-02204039-SS01**	**CLB-02204039-SS02**	**CLB-02204039-SS03**	**CLB-02204039-SS03 [1]**	**CLB-02204039-SS03 [1]**	**CLB-02204039-SS04**	**CLB-02204039-SS05**	**CLB-02204039-SS06**	**CLB-02204039-SS07**	**CLB-02204039-SS08**	**CLB-02204039-SS08 (Duplicate)**
			Field Sample ID	**CLB-02204039-SS01-032410**	**CLB-02204039-SS02-032410**	**CLB-02204039-SS03-032410**	**CLB-02204039-SS03-032410-6**	**CLB-02204039-SS03-032410-7**	**CLB-02204039-SS04-032410**	**CLB-02204039-SS05-032410**	**CLB-02204039-SS06-032410**	**CLB-02204039-SS07-032410**	**CLB-02204039-SS08-032410**	**CLB-02204039-SS08-032410D**
			Sample Date	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**	**3/24/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**											
Antimony, XRF	mg/kg	**30**	1,200	97 U	84 U	87 U	81 U	81 U	90 U	82 U	94 U	84 U	87 U	106 U
Arsenic, XRF	mg/kg	**6.7**	82	16 U	**14**	16 U	15 U	15 U	**20**	**17**	**32**	**24**	14 U	15 U
Barium, XRF	mg/kg	**15,000**	370,000	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
Cadmium, XRF	mg/kg	**72**	2,300	67 U	60 U	61 U	56 U	56 U	61 U	57 U	65 U	58 U	60 U	72 U
Chromium, XRF	mg/kg	**NA**	NA	171 U	161 U	164 U	147 U	147 U	173 U	157 U	186 U	149 U	156 U	182 U
Cobalt, XRF	mg/kg	**1,400**	23,000	222 U	212 U	236 U	219 U	207 U	230 U	214 U	271 U	221 U	223 U	246 U
Copper, XRF	mg/kg	**NA**	NA	29 U	27 U	28 U	25 U	39	28 U	25 U	39	27 U	26 U	31 U
Iron, XRF	mg/kg	**NA**	NA	22,273	23,092	30,412	30,341	28,034	29,673	27,741	35,130	28,760	26,131	24,926
Lead, XRF	mg/kg	**400**	1,800	61	41	84	88	85	131	77	92	90	51	38
Manganese, XRF	mg/kg	**NA**	NA	324	124 U	308	398	237	333	1,082	335	225	207	287
Mercury, XRF	mg/kg	**7.6**	290	13 U	12 U	12 U	12 U	11 U	13 U	11 U	13 U	12 U	12 U	16 U
Molybdenum, XRF	mg/kg	**NA**	NA	11 U	10 U	10 U	9 U	9 U	10 U	9 U	11 U	9 U	10 U	11 U
Nickel, XRF	mg/kg	**1,500**	44,000	57 U	49 U	51 U	50 U	47 U	52 U	50 U	58 U	51 U	51 U	62 U
Rubidium, XRF	mg/kg	**NA**	NA	67	49	75	69	80	75	69	58	75	78	62
Selenium, XRF	mg/kg	**380**	15,000	4 U	4 U	4 U	4 U	3 U	4 U	4 U	5 U	4 U	4 U	5 U
Silver, XRF	mg/kg	**380**	15,000	64 U	57 U	57 U	52 U	51 U	57 U	53 U	61 U	54 U	57 U	67 U
Strontium, XRF	mg/kg	**NA**	NA	77	143	143	151	122	294	94	206	98	94	72
Tin, XRF	mg/kg	**NA**	NA	99 U	85 U	89 U	82 U	82 U	91 U	84 U	95 U	85 U	88 U	107 U
Titanium, XRF	mg/kg	**NA**	NA	3,935	2,685	5,355	4,597	4,079	6,120	5,222	4,860	5,163	4,900	3,196
Zinc, XRF	mg/kg	**23,000**	880,000	87	103	115	113	117	127	129	146	265	93	94
Zirconium, XRF	mg/kg	**NA**	NA	192	98	219	220	196	216	271	179	222	183	166

Notes:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria

mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

[1] - Sample CLB-12320020-SS01 was screened with the XRF three times. Results for all three readings are included.

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Appendix C - Table 9a
NPI Medium Priority Project Site No. 11, Parcel 14225131
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**11**	**11**	**11**	**11**	**11**
			Parcel ID	**14225131**	**14225131**	**14225131**	**14225131**	**14225131**
			Location ID	**CLB-14225131-SS01**	**CLB-14225131-SS02**	**CLB-14225131-SS03**	**CLB-14225131-SS03 (Duplicate)**	**CLB-14225131-SS04**
			Field Sample ID	**CLB-14225131-SS01-040510**	**CLB-14225131-SS02-040510**	**CLB-14225131-SS03-040510**	**CLB-14225131-SS05-040510**	**CLB-14225131-SS04-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
2-Methylnaphthalene	µg/kg	**NA**	NA	70	288	49.5	100	79.4
Acenaphthene	µg/kg	**3,500,000**	56,000,000	34.4 U	30.2 U	28.9 U	29.2 U	61
Acenaphthylene	µg/kg	**NA**	NA	34.4 U	91.3	28.9 U	36.2	46.3
Anthracene	µg/kg	**18,000,000**	280,000,000	58.7	145	38.2	48.6	154
Benzo(a)anthracene	µg/kg	**11,000**	76,000	181	407	106	137	343
Benzo(a)pyrene	µg/kg	**1,100**	7,700	187	389	102	138	358
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	194	358	100	135	340
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	136	247	64.7	97.4	248
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	161	353	94.3	123	315
Chrysene	µg/kg	**1,100,000**	7,600,000	200	397	107	141	336
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	59	100	28.9 U	38.8	108
Fluoranthene	µg/kg	**2,400,000**	37,000,000	396	922	222	311	803
Fluorene	µg/kg	**2,400,000**	37,000,000	34.4 U	41.5	28.9 U	29.2 U	64.4
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	119	230	61.3	84.8	229
Naphthalene	µg/kg	**69,000**	150,000	54.3	230	38.5	62.7	71.4
Phenanthrene	µg/kg	**NA**	NA	158	488	101	166	470
Pyrene	µg/kg	**1,800,000**	28,000,000	286	688	163	232	570
Aluminum, Total	mg/kg	**NA**	NA	9,450	8,510	9,830	10,400	8,880
Antimony, Total	mg/kg	**30**	1,200	1.9	2	3.6	1.5	2.3
Arsenic, Total	mg/kg	**6.7**	82	**11.4**	**7.9**	**16.3**	**14.7**	**12.5**
Barium, Total	mg/kg	**15,000**	370,000	170	190	172	166	199
Beryllium, Total	mg/kg	**150**	5,100	0.4	0.7	0.8	0.6	0.5
Boron, Total	mg/kg	**NA**	NA	3.9	4.8	1.2	2.3 U	1.3
Cadmium, Total	mg/kg	**72**	2,300	0.9	0.5	2.5	0.2	1
Calcium, Total	mg/kg	**NA**	NA	11,100	23,000	15,400	15,100	7,240
Chromium, Total	mg/kg	**NA**	NA	5.2	3.1	6.9	4.6	6.5
Cobalt, Total	mg/kg	**1,400**	23,000	6.9	4.4	17.8	6.7	9.6
Copper, Total	mg/kg	**NA**	NA	22.1	19.9	30.8	28.1	40.6
Iron, Total	mg/kg	**NA**	NA	16,900	13,500	20,700	21,200	23,700

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Appendix C - Table 9a
NPI Medium Priority Project Site No. 11, Parcel 14225131
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**11**	**11**	**11**	**11**	**11**
			Parcel ID	**14225131**	**14225131**	**14225131**	**14225131**	**14225131**
			Location ID	**CLB-14225131-SS01**	**CLB-14225131-SS02**	**CLB-14225131-SS03**	**CLB-14225131-SS03 (Duplicate)**	**CLB-14225131-SS04**
			Field Sample ID	**CLB-14225131-SS01-040510**	**CLB-14225131-SS02-040510**	**CLB-14225131-SS03-040510**	**CLB-14225131-SS05-040510**	**CLB-14225131-SS04-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**					
Lead, Total	mg/kg	**400**	1,800	49.4	68.5	45.5	48.9	301
Magnesium, Total	mg/kg	**NA**	NA	3,340	2,910	4,410	3,600	3,240
Manganese, Total	mg/kg	**NA**	NA	457	336	298	249	369
Molybdenum, Total	mg/kg	**NA**	NA	13 U	11 U	10.3 U	12.1 U	12.8 U
Nickel, Total	mg/kg	**1,500**	44,000	16.6	12.6	20.8	19.4	29.5
Phosphorus, Total	mg/kg	**NA**	NA	322	361	308	273	397
Potassium, Total	mg/kg	**NA**	NA	1,140	913	943	959	1,160
Selenium, Total	mg/kg	**380**	15,000	4.4 U	1.7 U	1.4 U	1.8 U	5.3 U
Silicon, Total	mg/kg	**NA**	NA	998	566	583	395	557
Sodium, Total	mg/kg	**NA**	NA	431	486	625	646	389
Strontium1, Total	mg/kg	**NA**	NA	23.2	43.3	5.3	0.1	6.2
Strontium2, Total	mg/kg	**NA**	NA	26	65.7	33.6	27.3	21.3
Sulfur, Total	mg/kg	**NA**	NA	589	427	147	165	290
Thallium, Total	mg/kg	**6.1**	230	0.2	0.4	3.2	0.9	0.7 U
Tin, Total	mg/kg	**NA**	NA	0.5	0.3	1.5	0.2	0.3
Titanium, Total	mg/kg	**NA**	NA	37.6	34.8	31	28.9	30.1
Vanadium, Total	mg/kg	**680**	26,000	9.1	12.6	16.5	12.6	9.1
Zinc, Total	mg/kg	**23,000**	880,000	163	286	120	141	284

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)]
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 9b
NPI Medium Priority Project Site No. 11, Parcel 14227156
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**11**	**11**	**11**	**11**	**11**	**11**
			Parcel ID	**14227156**	**14227156**	**14227156**	**14227156**	**14227156**	**14227156**
			Location ID	**CLB-14227156-SS01**	**CLB-14227156-SS01 (Duplicate)**	**CLB-14227156-SS02**	**CLB-14227156-SS03**	**CLB-14227156-SS04**	**CLB-14227156-SS05**
			Field Sample ID	**CLB-14227156-SS01-040510**	**CLB-14227156-SS06-040510**	**CLB-14227156-SS02-040510**	**CLB-14227156-SS03-040510**	**CLB-14227156-SS04-040510**	**CLB-14227156-SS05-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Percent Moisture	%			22.9	24.2	25.5	22.3	27.3	30.7
2-Methylnaphthalene	µg/kg	**NA**	NA	73.2	71.3	53	36.2	321	134
Acenaphthene	µg/kg	**3,500,000**	56,000,000	32.4 U	33 U	33.5 U	32.2 U	34.4 U	36.1 U
Acenaphthylene	µg/kg	**NA**	NA	38.2	35.3	71.1	32.2 U	91.4	58.3
Anthracene	µg/kg	**18,000,000**	280,000,000	238	64.2	167	34.3	185	165
Benzo(a)anthracene	µg/kg	**11,000**	76,000	702	263	611	100	524	382
Benzo(a)pyrene	µg/kg	**1,100**	7,700	603	277	538	102	511	322
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	568	267	499	93.9	577	339
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	341	177	283	72.5	358	197
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	519	256	474	92.7	418	295
Chrysene	µg/kg	**1,100,000**	7,600,000	639	285	560	108	583	404
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	160	74.9	148	32.2 U	166	99.3
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,600	666	1,320	216	1,250	930
Fluorene	µg/kg	**2,400,000**	37,000,000	43.2	33 U	40.1	32.2 U	50.6	63.9
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	334	165	283	59.7	319	188
Naphthalene	µg/kg	**69,000**	150,000	62.6	62.4	52.2	32.2 U	249	118
Phenanthrene	µg/kg	**NA**	NA	841	304	504	109	646	635
Pyrene	µg/kg	**1,800,000**	28,000,000	1,130	476	918	166	927	636
Aluminum, Total	mg/kg	**NA**	NA	8,750	9,110	9,410	9,460	6,790	7,820
Antimony, Total	mg/kg	**30**	1,200	1.5	1.6	1.3	1.4	1.6	1.8
Arsenic, Total	mg/kg	**6.7**	82	**11.6**	**11.4**	**12.9**	**13.8**	**13.2**	**14.8**
Barium, Total	mg/kg	**15,000**	370,000	187	178	241	210	450	291
Beryllium, Total	mg/kg	**150**	5,100	0.6	0.6	0.6	0.6	0.8	0.6
Boron, Total	mg/kg	**NA**	NA	3.7	2.6	1.1	0.7	4.3	4.7
Cadmium, Total	mg/kg	**72**	2,300	0.9	0.9	0.6	0.5	1.4	1.1
Calcium, Total	mg/kg	**NA**	NA	3,700	3,820	5,380	6,710	7,290	4,480
Chromium, Total	mg/kg	**NA**	NA	4.3	5.2	5.9	7.4	8	5.8
Cobalt, Total	mg/kg	**1,400**	23,000	5.9	6.5	8.2	7.7	5.8	7.2
Copper, Total	mg/kg	**NA**	NA	26.4	28.8	28.8	33.9	84.7	55
Iron, Total	mg/kg	**NA**	NA	18,500	18,200	19,800	20,800	14,600	19,400

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Appendix C - Table 9b
NPI Medium Priority Project Site No. 11, Parcel 14227156
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**11**	**11**	**11**	**11**	**11**	**11**
			Parcel ID	**14227156**	**14227156**	**14227156**	**14227156**	**14227156**	**14227156**
			Location ID	**CLB-14227156-SS01**	**CLB-14227156-SS01 (Duplicate)**	**CLB-14227156-SS02**	**CLB-14227156-SS03**	**CLB-14227156-SS04**	**CLB-14227156-SS05**
			Field Sample ID	**CLB-14227156-SS01-040510**	**CLB-14227156-SS06-040510**	**CLB-14227156-SS02-040510**	**CLB-14227156-SS03-040510**	**CLB-14227156-SS04-040510**	**CLB-14227156-SS05-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Lead, Total	mg/kg	**400**	1800	102	119	167	186	**758**	227
Magnesium, Total	mg/kg	**NA**	NA	2,330	2,370	3,310	3,190	1,980	1,420
Manganese, Total	mg/kg	**NA**	NA	268	285	274	335	337	349
Molybdenum, Total	mg/kg	**NA**	NA	10.9 U	11.9 U	12 U	11 U	10.1 U	9.8 U
Nickel, Total	mg/kg	**1,500**	44,000	15.2	15.8	22.1	20.1	19.6	14.8
Phosphorus, Total	mg/kg	**NA**	NA	296	302	555	378	658	881
Potassium, Total	mg/kg	**NA**	NA	737	725	1,250	1,210	685	796
Selenium, Total	mg/kg	**380**	15,000	2.5 U	2.9 U	3.5 U	3.4 U	1.9	1.7 U
Silicon, Total	mg/kg	**NA**	NA	288	345	237	644	498	560
Sodium, Total	mg/kg	**NA**	NA	557	455	492	500	644	604
Strontium1, Total	mg/kg	**NA**	NA	3	8.3 U	4.5 U	9.7	46.9	20.5
Strontium2, Total	mg/kg	**NA**	NA	15.2	15.4	20.6	24.3	70.3	45.7
Sulfur, Total	mg/kg	**NA**	NA	193	218	726	315	396	341
Thallium, Total	mg/kg	**6.1**	230	0.6	0.4	0.1	0.6	0.4	0.5
Tin, Total	mg/kg	**NA**	NA	0.5	0.4	0.3	0.7	1.4	1.3
Titanium, Total	mg/kg	**NA**	NA	26.1	21.8	27.4	39.1	62.2	42.9
Vanadium, Total	mg/kg	**680**	26,000	12.2	12.8	17.7	14.4	11.5	12.1
Zinc, Total	mg/kg	**23,000**	880,000	511	577	218	231	448	424

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 10
NPI Medium Priority Project Site No. 19, Parcel 11501027
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**
			Parcel ID	**11501027**	**11501027**	**11501027**	**11501027**	**11501027**	**11501027**	**11501027**	**11501028**	**11501028**	**11501028**	**11501028**	**11501028**	**11501028**
			Location ID	**CLB-11501027-SS01**	**CLB-11501027-SS02**	**CLB-11501027-SS03**	**CLB-11501027-SS03 (Duplicate)**	**CLB-11501027-SS04**	**CLB-11501027-SS05**	**CLB-11501027-SS06**	**CLB-11501028-SS01**	**CLB-11501028-SS02**	**CLB-11501028-SS03**	**CLB-11501028-SS04**	**CLB-11501028-SS05**	**CLB-11501028-SS06**
			Field Sample ID	**CLB-11501027-SS01-040610**	**CLB-11501027-SS02-040610**	**CLB-11501027-SS03-040610**	**CLB-11501027-SS07-040610**	**CLB-11501027-SS04-040610**	**CLB-11501027-SS05-040610**	**CLB-11501027-SS06-040610**	**CLB-11501028-SS01-040610**	**CLB-11501028-SS02-040610**	**CLB-11501028-SS03-040610**	**CLB-11501028-SS04-040610**	**CLB-11501028-SS05-040610**	**CLB-11501028-SS06-040610**
			Sample Date	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**													
Aroclor 1016	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	ug/kg	**NA**	NA	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	ug/kg	**NA**	NA	27.1 U	28.5 U	27.3 U	27.3 U	29.7 U	27.7 U	42.9	89	28.3 U	42.3	29.9	222	29.1 U
Acenaphthene	ug/kg	**3,500,000**	56,000,000	27.1 U	28.5 U	27.3 U	33.7	29.7 U	27.7 U	74.3	53.6	37.5	54.9	33.8	1,040	29.1 U
Acenaphthylene	ug/kg	**NA**	NA	27.1 U	28.5 U	79.9	50.9	43.1	83.9	214	64.3	209	198	233	2,150	46.7
Anthracene	ug/kg	**18,000,000**	280,000,000	43.5	41.8	130	114	109	140	451	205	317	338	331	5,870	88.7
Benzo(a)anthracene	ug/kg	**11,000**	76,000	97.5	147	340	338	305	449	1,320	519	1,020	983	967	**13,900**	215
Benzo(a)pyrene	ug/kg	**1,100**	7,700	89.8	148	289	318	270	424	**1,230**	482	902	1,020	856	**11,800**	207
Benzo(b)fluoranthene	ug/kg	**11,000**	77,000	67.5	134	243	259	241	392	963	419	754	957	807	8,520	177
Benzo(g,h,i)perylene	ug/kg	**NA**	NA	53.3	95.8	172	192	153	261	683	282	517	686	499	5,740	132
Benzo(k)fluoranthene	ug/kg	**110,000**	770,000	69.1	137	265	277	254	394	1,120	438	827	865	739	8,780	187
Chrysene	ug/kg	**1,100,000**	7,600,000	90.7	143	291	287	289	417	1,170	476	884	935	855	11,700	205
Dibenz(a,h)anthracene	ug/kg	**1,100**	7,700	27.1 U	41.8	79.2	88.8	72.1	121	330	136	250	298	239	**2,870**	55.7
Fluoranthene	ug/kg	**2,400,000**	37,000,000	181	317	745	664	726	935	2,750	1,130	2,050	2,020	1,930	28,700	529
Fluorene	ug/kg	**2,400,000**	37,000,000	27.1 U	28.5 U	30.1	27.3 U	29.7 U	29.8	99.7	73.6	60.3	73.1	54.2	1,440	29.1 U
Indeno(1,2,3-cd)pyrene	ug/kg	**11,000**	77,000	45.3	89.4	159	181	149	251	664	272	502	631	485	5,630	116
Naphthalene	ug/kg	**69,000**	150,000	27.1 U	28.5 U	27.3 U	27.3 U	29.7 U	27.7 U	45.6	83.8	28.3 U	43.4	29.1 U	306	29.1 U
Phenanthrene	ug/kg	**NA**	NA	148	129	352	273	377	404	1,310	692	840	863	815	15,200	250
Pyrene	ug/kg	**1,800,000**	28,000,000	202	246	540	529	535	710	2,160	856	1,500	1,520	1,550	23,100	393
Aluminum, Total	mg/kg	**NA**	NA	3,910	4,260	4,870	4,890	7,650	4,470	4,010	3,850	4,060	8,470	3,870	3,870	4,730
Antimony, Total	mg/kg	**30**	1,200	0.3	0.3	1.7	1.6	2.2	3.1	2	1.8	1.3	2	0.8	1.9	1.8
Arsenic, Total	mg/kg	**6.7**	82	**6.9**	**6.8**	**6.8**	**7**	**12.8**	**8.8**	**11**	**12.4**	**9.5**	**12.8**	**9**	**8.6**	**8.2**
Barium, Total	mg/kg	**15,000**	370,000	123	122	131	135	195	252	152	180	150	188	141	199	121
Beryllium, Total	mg/kg	**150**	5,100	0.2	0.2	0.2	0.2	0.7	0.3	0.3	0.4	0.4	0.7	0.3	0.3	0.4
Boron, Total	mg/kg	**NA**	NA	0.7 U	0.3	2.1	1.9	2.8	1.3	0.8	0.8	0.6 U	0.7	0 U	2.3	0.7
Cadmium, Total	mg/kg	**72**	2,300	0.1	0.3	0.1	0 U	0.3	0.2	0.1	1.8	0.2	0 U	0.3	0.3	0.2
Calcium, Total	mg/kg	**NA**	NA	855	1,280	13,000	14,800	19,800	20,700	17,600	3,580	13,100	20,900	10,000	20,700	16,500
Chromium, Total	mg/kg	**NA**	NA	1.6	2.3	1.4	3	3.5	3	1.8	3.4	2.3	3.7	2.7	2.8	3.1
Cobalt, Total	mg/kg	**1,400**	23,000	4.2	3.5	2.9	2.8	7.1	5.1	5.7	17.2	5	7.5	5	4	6.4
Copper, Total	mg/kg	**NA**	NA	9.1	11.2	9.8	9.8	22.7	22.9	18.2	28.4	19	19.3	22.6	17.5	17.6
Iron, Total	mg/kg	**NA**	NA	9,420	9,410	9,040	9,510	17,900	12,300	13,500	10,600	12,000	19,400	11,600	9,860	14,700

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Appendix C - Table 10
NPI Medium Priority Project Site No. 19, Parcel 11501027
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**
			Parcel ID	**11501027**	**11501027**	**11501027**	**11501027**	**11501027**	**11501027**	**11501027**	**11501028**	**11501028**	**11501028**	**11501028**	**11501028**	**11501028**
			Location ID	**CLB-11501027-SS01**	**CLB-11501027-SS02**	**CLB-11501027-SS03**	**CLB-11501027-SS03 (Duplicate)**	**CLB-11501027-SS04**	**CLB-11501027-SS05**	**CLB-11501027-SS06**	**CLB-11501028-SS01**	**CLB-11501028-SS02**	**CLB-11501028-SS03**	**CLB-11501028-SS04**	**CLB-11501028-SS05**	**CLB-11501028-SS06**
			Field Sample ID	**CLB-11501027-SS01-040610**	**CLB-11501027-SS02-040610**	**CLB-11501027-SS03-040610**	**CLB-11501027-SS07-040610**	**CLB-11501027-SS04-040610**	**CLB-11501027-SS05-040610**	**CLB-11501027-SS06-040610**	**CLB-11501028-SS01-040610**	**CLB-11501028-SS02-040610**	**CLB-11501028-SS03-040610**	**CLB-11501028-SS04-040610**	**CLB-11501028-SS05-040610**	**CLB-11501028-SS06-040610**
			Sample Date	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**													
Lead, Total	mg/kg	**400**	1,800	20.1	51.4	31.6	34.5	72.3	143	122	182	51.8	47.9	86	252	28.3
Magnesium, Total	mg/kg	**NA**	NA	793	812	2,380	4,950	5,130	5,290	7,330	1,870	3,960	4,950	3,890	5,280	6,470
Manganese, Total	mg/kg	**NA**	NA	143	94.1	110	130	414	233	279	186	231	479	210	220	238
Molybdenum, Total	mg/kg	**NA**	NA	4.5 U	5.2 U	6.4 U	6.5 U	5.5 U	6.8 U	1.7 U	5.5 U	5.6 U	10.2 U	3.3 U	2.8 U	4.3 U
Nickel, Total	mg/kg	**1,500**	44,000	9.8	8.5	7.2	7	18.6	13.6	15.1	13	13.1	19.5	13.6	10.7	17.5
Phosphorus, Total	mg/kg	**NA**	NA	200	208	245	251	297	362	358	463	332	267	341	286	294
Potassium, Total	mg/kg	**NA**	NA	345	349	388	380	1,090	718	762	580	645	1060	725	645	898
Selenium, Total	mg/kg	**380**	15,000	1.7	1.2	1.2	1.6	2.3 U	1.5	2.2 U	3.2	1.6	2.5 U	1.4	1.4	2.1 U
Silicon, Total	mg/kg	**NA**	NA	492	242	1170	326	738	507	606	457	653	1490	487	451	308
Sodium, Total	mg/kg	**NA**	NA	514	426	454	496	556	653	474	644	535	510	580	506	400
Strontium1, Total	mg/kg	**NA**	NA	6.1 U	3.1 U	64	38.4	25.4	37.8	1.9	7.3	8.4	21.3	7	22.1	9.3
Strontium2, Total	mg/kg	**NA**	NA	6.6	8.1	86.2	60.7	52.8	65.2	28.9	20.9	23.7	50.8	22.4	48.6	23.7
Sulfur, Total	mg/kg	**NA**	NA	1	68.3	88	81.2	568	500	576	355	415	480	526	486	729
Thallium, Total	mg/kg	**6.1**	230	0.2	0.6	0.9	1.2	0.6	0.6	0.9	2.7	0.8	1	0.4	0.2	0.8
Tin, Total	mg/kg	**NA**	NA	0.5	0.5	0.2	0.2	0.4	0.8	0.3	1.1	0.5	0.4	0.2	0.4	0.2
Titanium, Total	mg/kg	**NA**	NA	88.5	87.9	77.6	76.2	45.7	38.5	37.9	55.2	44.1	64.7	35.8	46.6	33.6
Vanadium, Total	mg/kg	**680**	26,000	9.8	9.4	9.1	9.7	11.2	10.9	9.9	10.8	9.5	9.9	9.5	10.3	9.3
Zinc, Total	mg/kg	**23,000**	880,000	67.9	106	102	102	182	224	157	169	126	118	124	214	127

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 11
NPI Medium Priority Project Site No. 32, Parcel 02006013
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	32	32	32	32	32	32	32	32	32	32
			Parcel ID	02006013	02006013	02006013	02006013	02006013	02006013	02006013	02006013	02006013	02006013
			Location ID	CLB-02006013-SS01	CLB-02006013-SS02	CLB-02006013-SS03	CLB-02006013-SS04	CLB-02006013-SS05	CLB-02006013-SS06	CLB-02006013-SS07	-02006013-SS07 (Dupli	CLB-02006013-SS08	CLB-02006013-SS09
			Field Sample ID	CLB-02006013-SS01-040510	CLB-02006013-SS02-040510	CLB-02006013-SS03-040510	CLB-02006013-SS04-040510	CLB-02006013-SS05-040510	CLB-02006013-SS06-040510	CLB-02006013-SS07-040510	CLB-02006013-SS10-040510	CLB-02006013-SS08-040510	CLB-02006013-SS09-040510
			Sample Date	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Aroclor 1016	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	44.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	49.5	48.4	47.5	37.5 U	29.1 U	28.4 U	30 U	29.9 U	81.7	33.2
Acenaphthene	µg/kg	**3,500,000**	56,000,000	31.7 U	47.4	32.4 U	37.5 U	29.1 U	28.4 U	30 U	29.9 U	28 U	29 U
Acenaphthylene	µg/kg	**NA**	NA	31.7 U	60	32.4 U	37.5 U	29.1 U	28.4 U	30 U	29.9 U	28 U	29 U
Anthracene	µg/kg	**18,000,000**	280,000,000	50.5	216	104	53.5	29.1 U	28.4 U	30 U	29.9 U	28 U	29 U
Benzo(a)anthracene	µg/kg	**11,000**	76,000	246	809	406	194	88.3	91.9	37.7	31.1	54.1	90
Benzo(a)pyrene	µg/kg	**1,100**	7,700	272	805	404	205	94.6	118	38.5	33.2	63.6	94.6
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	284	755	396	196	102	122	39.8	36.3	71.7	102
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	188	498	253	133	68.5	102	30 U	29.9 U	65.3	63.3
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	244	710	341	174	82.1	104	36.8	31.7	56.6	89.4
Chrysene	µg/kg	**1,100,000**	7,600,000	274	809	407	197	96.3	107	42.8	36.7	65.4	100
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	76.1	220	112	59.9	29.1 U	38.7	30 U	29.9 U	28 U	29 U
Fluoranthene	µg/kg	**2,400,000**	37,000,000	589	1860	922	450	209	197	89.5	74.2	120	226
Fluorene	µg/kg	**2,400,000**	37,000,000	31.7 U	48.1	32.4 U	37.5 U	29.1 U	28.4 U	30 U	29.9 U	28 U	29 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	173	472	239	127	61.6	86.8	30 U	29.9 U	47	58.5
Naphthalene	µg/kg	**69,000**	150,000	42.8	46.6	41.4	37.5 U	29.1 U	28.4 U	30 U	29.9 U	64.5	29 U
Phenanthrene	µg/kg	**NA**	NA	217	780	378	210	93.8	79.6	37.2	29.9 U	62.7	97.9
Pyrene	µg/kg	**1,800,000**	28,000,000	430	1,390	688	336	157	148	65.5	55.7	93	168
Aluminum, Total	mg/kg	**NA**	NA	11,300	9,070	9,240	8,280	8,320	8,890	7,810	9,000	7,860	10,200
Antimony, Total	mg/kg	**30**	1,200	1.5	1.7	1	1.8	1.5	2.2	1.9	2.2	3.3	1.2
Arsenic, Total	mg/kg	**7**	82	**10.5**	**11.1**	**13**	**9.9**	**12.3**	**13.9**	**11.1**	**14.8**	**17.4**	**14.6**
Barium, Total	mg/kg	**15,000**	370,000	193	199	209	201	185	184	165	176	200	213
Beryllium, Total	mg/kg	**150**	5,100	0.4	0.4	0.5	0.4	0.6	0.7	0.5	0.6	0.8	0.6
Boron, Total	mg/kg	**NA**	NA	3.3	0.2	2	0.6 U	2.1	3.7	1.6	1.8	5.7	0.9 U
Cadmium, Total	mg/kg	**72**	2,300	0.7	0.4	0.4	0.4	0.4	0.1	0.1 U	0 U	0.7	0.2
Calcium, Total	mg/kg	**NA**	NA	3,720	2,890	5,300	5,200	18,500	41,000	17,800	24,900	35,800	8,860
Chromium, Total	mg/kg	**NA**	NA	6.7	4.7	5.3	5.2	5.3	4.8	5.2	5.7	3.8	6
Cobalt, Total	mg/kg	**1,400**	23,000	6.6	6.9	8.5	7.1	9.3	7.7	6.8	7.3	6.7	8
Copper, Total	mg/kg	**NA**	NA	36.4	30.6	36.4	34.5	21.3	20.5	17.6	18.1	27	27.5
Iron, Total	mg/kg	**NA**	NA	19,600	19,100	20,100	18,500	20,200	19,700	16,300	19,800	17,700	20,400

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Appendix C - Table 11
NPI Medium Priority Project Site No. 32, Parcel 02006013
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
			Parcel ID	**02006013**	**02006013**	**02006013**	**02006013**	**02006013**	**02006013**	**02006013**	**02006013**	**02006013**	**02006013**
			Location ID	**CLB-02006013-SS01**	**CLB-02006013-SS02**	**CLB-02006013-SS03**	**CLB-02006013-SS04**	**CLB-02006013-SS05**	**CLB-02006013-SS06**	**CLB-02006013-SS07**	**-02006013-SS07 (Dupli**	**CLB-02006013-SS08**	**CLB-02006013-SS09**
			Field Sample ID	**CLB-02006013-SS01-040510**	**CLB-02006013-SS02-040510**	**CLB-02006013-SS03-040510**	**CLB-02006013-SS04-040510**	**CLB-02006013-SS05-040510**	**CLB-02006013-SS06-040510**	**CLB-02006013-SS07-040510**	**CLB-02006013-SS10-040510**	**CLB-02006013-SS08-040510**	**CLB-02006013-SS09-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**										
Lead, Total	mg/kg	**400**	1,800	127	183	102	221	36.5	81	25.2	23.8	168	47
Magnesium, Total	mg/kg	**NA**	NA	2,310	1,850	3,040	2,490	7,630	14,900	5,610	10,900	12,600	3,660
Manganese, Total	mg/kg	**NA**	NA	295	291	322	368	471	438	300	256	376	248
Molybdenum, Total	mg/kg	**NA**	NA	16.8 U	15.4 U	14.4 U	12.4 U	5.8 U	1.8 U	5.3 U	5 U	6.8 U	12.3 U
Nickel, Total	mg/kg	**1,500**	44,000	14.8	12.5	19.9	16	19.5	20.1	17.4	18.5	12.3	19.8
Phosphorus, Total	mg/kg	**NA**	NA	401	319	376	400	301	271	249	221	521	238
Potassium, Total	mg/kg	**NA**	NA	1,300	829	1,230	957	1,290	1,220	1,570	1,500	885	1,320
Selenium, Total	mg/kg	**380**	15,000	5.8 U	4.4 U	4.7 U	4.5 U	2.2 U	3.2 U	2.1 U	2.6 U	4 U	2.8 U
Silicon, Total	mg/kg	**NA**	NA	854	663	600	668	278	518	379	714	377	395
Sodium, Total	mg/kg	**NA**	NA	377	464	457	431	508	584	500	523	489	614
Strontium1, Total	mg/kg	**NA**	NA	13.9	9.2	2.6	17.7	5.9	17.1	2.2 U	0.9 U	23.4	5.9
Strontium2, Total	mg/kg	**NA**	NA	15.6	12.3	18.9	20.6	32	47.4	23.8	26	42.6	21.3
Sulfur, Total	mg/kg	**NA**	NA	396	295	282	263	243	295	459	315	509	235
Thallium, Total	mg/kg	**6.1**	230	0.6 U	0.5	0.6	0.1	0.2 U	0.3 U	1 U	0.5	0.2	1.1
Tin, Total	mg/kg	**NA**	NA	0.6	0.6	0.4	0.5	0.2	0.4	0.2	0.4	0.5	0.2
Titanium, Total	mg/kg	**NA**	NA	48.8	31	34.6	30.8	27	33.7	24.9	29.2	39.3	37
Vanadium, Total	mg/kg	**680**	26,000	10.2	7.9	7.4	8.6	14.2	14.4	13.3	14.9	10.9	14.6
Zinc, Total	mg/kg	**23000**	880,000	245	160	189	201	136	160	133	130	281	130

Notes:

Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria

% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 12a
NPI Medium Priority Project Site No. 48, Parcel 10614014
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
			Parcel ID	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**
			Location ID	**CLB-10614014-SS01**	**CLB-10614014-SS02**	**CLB-10614014-SS03**	**CLB-10614014-SS04**	**CLB-10614014-SS05**	**CLB-10614014-SS06**	**CLB-10614014-SS06 (Duplicate)**	**CLB-10614014-SS07**	**CLB-10614014-SS08**	**CLB-10614014-SS09**	**CLB-10614014-SS10**	**CLB-10614014-SS11**	**CLB-10614014-SS12**
			Field Sample ID	**CLB-10614014-SS01-040610**	**CLB-10614014-SS02-040610**	**CLB-10614014-SS03-040610**	**CLB-10614014-SS04-040610**	**CLB-10614014-SS05-040610**	**CLB-10614014-SS06-040610**	**CLB-10614014-SS13-040610**	**CLB-10614014-SS07-040610**	**CLB-10614014-SS08-040610**	**CLB-10614014-SS09-040610**	**CLB-10614014-SS10-040610**	**CLB-10614014-SS11-040610**	**CLB-10614014-SS12-040610**
			Sample Date	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/ Industrial Direct Contact Criteria**													
Aroclor 1016	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	39.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	195	103	79.4	65.3	148 U	76.1	27.8 U	101	432	137 U	289	80.7	140 U
Acenaphthene	µg/kg	**3,500,000**	56,000,000	74.5	304	126	109	185	479	39.5	113	330	137 U	1,170	47.7	140 U
Acenaphthylene	µg/kg	**NA**	NA	143	80	227	111	297	156	65.1	106	71.3	137 U	730	43.4	354
Anthracene	µg/kg	**18,000,000**	280,000,000	355	816	713	429	814	1,430	171	661	926	198	4,990	179	404
Benzo(a)anthracene	µg/kg	**11,000**	76,000	1,430	1,790	2,670	1,450	2,680	3,710	731	1,790	1,770	693	7,160	793	1,210
Benzo(a)pyrene	µg/kg	**1,100**	7,700	**1,420**	**1,600**	**2,600**	**1,440**	**2,540**	**3,310**	748	**1,510**	**1,500**	896	**6,040**	788	**1,490**
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	1,370	1,500	2,240	1,310	2,310	2,940	675	1,290	1,420	874	4,680	713	1,390
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	871	774	1,590	903	1,640	1,900	471	843	826	577	3,060	495	1,060
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	1,160	1,460	2,260	1,220	2,190	2,820	662	1,360	1,240	713	5,000	718	1,170
Chrysene	µg/kg	**1,100,000**	7,600,000	1,330	1,600	2,410	1,360	2,400	3,300	686	1,570	1,560	721	5,970	767	1,230
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	382	383	687	393	689	869	204	386	417	256	**1,560**	230	428
Fluoranthene	µg/kg	**2,400,000**	37,000,000	3,210	4,310	5,970	3,230	6,360	9,860	1,660	4,430	4,180	958	17,200	1,670	2,340
Fluorene	µg/kg	**2,400,000**	37,000,000	76.8	322	156	121	200	489	44.4	143	345	137 U	1,740	42.1	140 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	811	774	1,480	840	1,470	1,810	441	809	809	555	3,090	471	980
Naphthalene	µg/kg	**69,000**	150,000	144	112	81.9	69	148 U	89.7	27.8 U	86.3	369	137 U	289	77	140 U
Phenanthrene	µg/kg	**NA**	NA	1,140	2,580	2,110	1,460	2,460	4,790	530	2,090	2,860	390	13,600	667	904
Pyrene	µg/kg	**1,800,000**	28,000,000	2,460	3,110	4,670	2,560	4,910	6,680	1,270	3,220	2,950	770	12,500	1,310	1,790
Aluminum, Total	mg/kg	**NA**	NA	4,220	3,750	4,660	4,970	2,930	6,490	5,290	3,930	3,160	8,480	7,880	5,290	6,640
Antimony, Total	mg/kg	**30**	1,200	**65.9**	2.5	1.9	2.2	3.1	2.2	1.9	2.4	1.9	2	2.1	1.4	2.1
Arsenic, Total	mg/kg	**6.7**	82	**15.2**	5.1	**9.6**	**10**	**6.8**	**8**	**7.7**	**8.7**	**7.2**	**10.6**	**51.6**	6.6	**11.5**
Barium, Total	mg/kg	**15,000**	370,000	160	206	167	165	1,150	180	155	191	261	194	168	170	155
Beryllium, Total	mg/kg	**150**	5,100	0.4	0.6	0.4	0.5	0.3	1.1	0.6	0.4	0.4	1.1	0.7	0.5	0.6
Boron, Total	mg/kg	**NA**	NA	1.8	6.4	1.1	3.5	6.1	4	1.7	5.5	12.3	6.3	4.7	4.3	4.2
Cadmium, Total	mg/kg	**72**	2,300	1.7	0 U	0.2	0.8	0.5	0.1	0.2	0 U	0.7	0.1	0.7	0.3	0.1 U
Calcium, Total	mg/kg	**NA**	NA	10,800	18,500	22,500	33,600	37,300	29,200	18,700	28,800	9,740	43,100	16,200	10,100	34,200
Chromium, Total	mg/kg	**NA**	NA	4150	4.2	6.7	3.6	7.6	3	3.6	3.3	11.7	3	3.8	3.4	3.6
Cobalt, Total	mg/kg	**1,400**	23,000	1.8	2.5	4.6	5.5	5.1	4.2	5	4.6	3.6	5.4	8.6	3.1	6.9
Copper, Total	mg/kg	**NA**	NA	48	18.3	28.2	24.1	28.6	15.2	13	21.3	29.9	17.6	27.1	28.4	20.7
Iron, Total	mg/kg	**NA**	NA	10,700	7,420	14,300	13,100	8,640	11,400	11,900	13,300	16,500	14,800	31,000	8,390	16,700

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Appendix C - Table 12a
NPI Medium Priority Project Site No. 48, Parcel 10614014
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
			Parcel ID	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**	**10614014**
			Location ID	**CLB-10614014-SS01**	**CLB-10614014-SS02**	**CLB-10614014-SS03**	**CLB-10614014-SS04**	**CLB-10614014-SS05**	**CLB-10614014-SS06**	**CLB-10614014-SS06 (Duplicate)**	**CLB-10614014-SS07**	**CLB-10614014-SS08**	**CLB-10614014-SS09**	**CLB-10614014-SS10**	**CLB-10614014-SS11**	**CLB-10614014-SS12**
			Field Sample ID	**CLB-10614014-SS01-040610**	**CLB-10614014-SS02-040610**	**CLB-10614014-SS03-040610**	**CLB-10614014-SS04-040610**	**CLB-10614014-SS05-040610**	**CLB-10614014-SS06-040610**	**CLB-10614014-SS13-040610**	**CLB-10614014-SS07-040610**	**CLB-10614014-SS08-040610**	**CLB-10614014-SS09-040610**	**CLB-10614014-SS10-040610**	**CLB-10614014-SS11-040610**	**CLB-10614014-SS12-040610**
			Sample Date	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/ Industrial Direct Contact Criteria**													
Lead, Total	mg/kg	**400**	1,800	148	102	125	93.8	**518**	44.2	52.5	115	135	53.9	311	140	41
Magnesium, Total	mg/kg	**NA**	NA	2,540	3,670	6,930	9,980	4,010	7,850	5,370	8,990	2,640	8,550	4,200	2,230	12,500
Manganese, Total	mg/kg	**NA**	NA	200	265	288	395	179	438	400	289	489	480	407	278	295
Molybdenum, Total	mg/kg	**NA**	NA	5.2 U	4.5 U	4.5 U	3.5 U	2.7 U	5.2 U	6 U	1.9 U	3.2 U	6 U	7.9 U	7.7 U	2 U
Nickel, Total	mg/kg	**1,500**	44,000	9.7	7.2	13.3	13.4	10.9	10.7	11.2	14.8	15.2	15.1	18.9	9.2	18.1
Phosphorus, Total	mg/kg	**NA**	NA	310	435	369	322	710	220	218	397	774	221	356	418	312
Potassium, Total	mg/kg	**NA**	NA	593	713	853	987	592	822	791	743	596	1,220	1,240	544	1,440
Selenium, Total	mg/kg	**380**	15,000	1.3	2.8	1.8 U	1.9 U	2.8	1.9	1.6	1.8	1.5	1.8 U	4.1 U	2.1	1.6 U
Silicon, Total	mg/kg	**NA**	NA	580	480	390	677	579	589	385	486	344	636	826	418	601
Sodium, Total	mg/kg	**NA**	NA	586	585	724	416	461	571	419	638	610	676	425	499	551
Strontium1, Total	mg/kg	**NA**	NA	3.8	19.2	11.1	23.5	40.1	21.5	17.5	14.7	10.4	51.1	9.8	3.3 U	14.1
Strontium2, Total	mg/kg	**NA**	NA	31.8	47	40.9	50.7	62.7	49.7	31	45.4	37.8	75.1	36.5	22	42.5
Sulfur, Total	mg/kg	**NA**	NA	406	436	470	560	794	519	307	410	271	1,320	709	212	1,070
Thallium, Total	mg/kg	**6.1**	230	1.7	0.3	1.1	0.3 U	0.1 U	0.9	0.5	0.8	0.9	0.2	0.3	0.6	0.4 U
Tin, Total	mg/kg	**NA**	NA	0.6	0.4	0.6	0.7	1.2	0.5	0.4	0.5	0.8	0.2	0.5	0.6	0.3
Titanium, Total	mg/kg	**NA**	NA	68.3	45.1	50.2	38.3	44.5	65.3	47.8	29.4	45.8	54.4	47.1	64.5	26.3
Vanadium, Total	mg/kg	**680**	26,000	8.6 U	7.8	9.9	9.3	8.6	9.3	8.8	10.1	6.8	9.9	12.1	8.3	10.2
Zinc, Total	mg/kg	**23,000**	880,000	136	161	137	183	1,270	128	138	155	198	133	170	179	133

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 12b
NPI Medium Priority Project Site No. 48, Parcel No. 10614015
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	48	48	48	48	48	48	48	48	48
			Parcel ID	10614015	10614015	10614015	10614015	10614015	10614015	10614015	10614015	10614015
			Location ID	CLB-10614015-SS01	CLB-10614015-SS02	CLB-10614015-SS03	CLB-10614015-SS04	CLB-10614015-SS05	CLB-10614015-SS06	CLB-10614015-SS07	CLB-10614015-SS08	CLB-10614015-SS09
			Field Sample ID	CLB-10614015-SS01-040610	CLB-10614015-SS02-040610	CLB-10614015-SS03-040610	CLB-10614015-SS04-040610	CLB-10614015-SS05-040610	CLB-10614015-SS06-040610	CLB-10614015-SS07-040610	CLB-10614015-SS08-040610	CLB-10614015-SS09-040610
			Sample Date	4/6/2010	4/6/2010	4/6/2010	4/6/2010	4/6/2010	4/6/2010	4/6/2010	4/6/2010	4/6/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/ Industrial Direct Contact Criteria**									
Percent Moisture	%			7.3	7.4	8.9	12.3	5.2	7.1	7.2	6	7.4
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	64.1	85.2	49.3	116	132 U	176	1,100	26.9	320
Acenaphthene	µg/kg	**3,500,000**	56,000,000	30.4	79.9	27.9	62.2	132 U	118	36	38.9	27 U
Acenaphthylene	µg/kg	**NA**	NA	27 U	35.7	76.5	65.9	302	169	121	54.6	33
Anthracene	µg/kg	**18,000,000**	280,000,000	99.4	297	142	233	677	550	120	162	92.7
Benzo(a)anthracene	µg/kg	**11,000**	76,000	435	1,210	530	732	2,690	1,620	295	724	278
Benzo(a)pyrene	µg/kg	**1,100**	7,700	451	**1,170**	554	697	**2,530**	**1,540**	214	735	253
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	416	1,090	583	684	2,360	1,410	321	669	220
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	321	718	376	463	1,650	930	141	457	164
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	409	977	480	603	2,230	1,320	237	646	230
Chrysene	µg/kg	**1,100,000**	7,600,000	428	1,090	511	695	2,500	1,520	369	666	259
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	138	329	168	207	707	414	72.3	205	74
Fluoranthene	µg/kg	**2,400,000**	37,000,000	901	2,530	1,090	1,610	5,660	3,930	852	1,540	617
Fluorene	µg/kg	**2,400,000**	37,000,000	27 U	64.9	34.4	58.1	132 U	126	26.9 U	36	27 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	297	676	354	431	1530	888	138	430	148
Naphthalene	µg/kg	**69,000**	150,000	53.6	67.1	41.9	97.7	132 U	144	1,660	26.6 U	259
Phenanthrene	µg/kg	**NA**	NA	378	987	394	795	2,040	1,890	844	479	396
Pyrene	µg/kg	**1,800,000**	28,000,000	718	2,020	832	1,210	4,800	2,880	578	1,220	459
Aluminum, Total	mg/kg	**NA**	NA	4,750	3,940	7,330	5,600	5,620	5,840	4,060	NA	4,100
Antimony, Total	mg/kg	**30**	1,200	0.5	0.7	5.3	2.8	2.4	2.4	3.2	NA	0.5
Arsenic, Total	mg/kg	**6.7**	82	**6.9**	**7.8**	**16.3**	**12.3**	**12.2**	**13**	**15.2**	NA	4.7
Barium, Total	mg/kg	**15,000**	370,000	177	173	197	277	216	199	264	NA	160
Beryllium, Total	mg/kg	**150**	5,100	0.3	0.3	0.9	0.5	0.4	0.5	0.4	NA	0.2
Boron, Total	mg/kg	**NA**	NA	4.6	3.5	5.8	4.3	3.3	2.6	17.9	NA	5.4
Cadmium, Total	mg/kg	**72**	2,300	0.5	0.6	1.1	0.1	0.2	0.4	2.6	NA	0.3
Calcium, Total	mg/kg	**NA**	NA	5,260	10,400	44,400	34,200	30,500	20,700	12,900	NA	2,790
Chromium, Total	mg/kg	**NA**	NA	0.9	0.6	1.7	2.1	4	3.3	5.1	NA	2
Cobalt, Total	mg/kg	**1,400**	23,000	3.2	3.1	13	6.6	5.1	6.4	16.2	NA	3.4
Copper, Total	mg/kg	**NA**	NA	24.4	30.9	27.3	27.3	21.2	30.7	54.2	NA	13
Iron, Total	mg/kg	**NA**	NA	9,210	9,760	19,900	16,600	17,700	15,200	13,500	NA	8,470

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Appendix C - Table 12b
NPI Medium Priority Project Site No. 48, Parcel No. 10614015
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
			Parcel ID	**10614015**	**10614015**	**10614015**	**10614015**	**10614015**	**10614015**	**10614015**	**10614015**	**10614015**
			Location ID	**CLB-10614015-SS01**	**CLB-10614015-SS02**	**CLB-10614015-SS03**	**CLB-10614015-SS04**	**CLB-10614015-SS05**	**CLB-10614015-SS06**	**CLB-10614015-SS07**	**CLB-10614015-SS08**	**CLB-10614015-SS09**
			Field Sample ID	**CLB-10614015-SS01-040610**	**CLB-10614015-SS02-040610**	**CLB-10614015-SS03-040610**	**CLB-10614015-SS04-040610**	**CLB-10614015-SS05-040610**	**CLB-10614015-SS06-040610**	**CLB-10614015-SS07-040610**	**CLB-10614015-SS08-040610**	**CLB-10614015-SS09-040610**
			Sample Date	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**	**4/6/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/ Industrial Direct Contact Criteria**									
Lead, Total	mg/kg	**400**	1,800	74.5	95	63.8	119	129	155	186	NA	43.9
Magnesium, Total	mg/kg	**NA**	NA	1,280	4,880	15,500	7,050	9,090	7,220	5,040	NA	1,030
Manganese, Total	mg/kg	**NA**	NA	122	157	436	705	368	299	223	NA	68.7
Molybdenum, Total	mg/kg	**NA**	NA	9 U	6.3 U	4.5 U	7.5 U	3 U	5.8 U	2.9 U	NA	8.8 U
Nickel, Total	mg/kg	**1,500**	44,000	9.1	9	19.1	16.4	14.6	16.4	20.9	NA	8.9
Phosphorus, Total	mg/kg	**NA**	NA	344	310	244	324	283	282	278	NA	220
Potassium, Total	mg/kg	**NA**	NA	532	494	1,160	895	871	943	576	NA	620
Selenium, Total	mg/kg	**380**	15,000	1.5	2	1.3	1.1 U	1.6 U	2.3	2.5	NA	0.9
Silicon, Total	mg/kg	**NA**	NA	381	273	234	311	389	401	351	NA	336
Sodium, Total	mg/kg	**NA**	NA	476	469	586	592	497	507	547	NA	449
Strontium1, Total	mg/kg	**NA**	NA	11.8 U	2.7 U	33.1	18.5	435	35.4	60.6	NA	4.3 U
Strontium2, Total	mg/kg	**NA**	NA	15.1	26.4	60.7	50.4	447	51.9	70.9	NA	9.2
Sulfur, Total	mg/kg	**NA**	NA	157	252	830	607	780	615	677	NA	105
Thallium, Total	mg/kg	**6.1**	230	0.6	1.1	5.8	1.1	0.3	0.4	1	NA	0.3
Tin, Total	mg/kg	**NA**	NA	0.2	0.6	1.3	0.6	0.3	0.5	1.8	NA	0 U
Titanium, Total	mg/kg	**NA**	NA	48.6	37.1	49.1	34.8	45.2	48.1	147	NA	50
Vanadium, Total	mg/kg	**680**	26,000	8.6	9.1	10.9	10.7	3.7	4.3	5.3	NA	9.8
Zinc, Total	mg/kg	**23,000**	880,000	188	261	170	209	197	201	270	NA	133

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 13
NPI Medium Priority Project Site No. 61, Parcel 0614017
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	61	61	61	61	61	61	61	61	61
			Parcel ID	01614017	01614017	01614017	01614017	01614017	01614017	01614017	01614017	01614017
			Location ID	CLB-01614017-SS01	CLB-01614017-SS02	CLB-01614017-SS03	CLB-01614017-SS03 (Duplicate)	CLB-01614017-SS04	CLB-01614017-SS05	CLB-01614017-SS06	CLB-01614017-SS07	CLB-01614017-SS08
			Field Sample ID	CLB-01614017-SS01-040510	CLB-01614017-SS02-040510	CLB-01614017-SS03-040510	CLB-01614017-SS09-040510	LB-01614017-SS04-04051	CLB-01614017-SS05-040510	CLB-01614017-SS06-040510	CLB-01614017-SS07-040510	CLB-01614017-SS08-040510
			Sample Date	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**									
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	42.8 U	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	29 U	145 U	29.8 U	29.5 U	61.8	52.4	51.7	619	197
Acenaphthene	µg/kg	**3,500,000**	56,000,000	29 U	145 U	29.8 U	29.5 U	35.4	30 U	30.5 U	328	40.1
Acenaphthylene	µg/kg	**NA**	NA	29 U	145 U	29.8 U	29.5 U	30.7 U	30 U	30.5 U	52.4	113
Anthracene	µg/kg	**18,000,000**	280,000,000	29 U	145 U	29.8 U	29.5 U	127	55.9	88.9	819	280
Benzo(a)anthracene	µg/kg	**11,000**	76,000	65.1	314	29.8 U	29.5 U	384	232	344	1,590	817
Benzo(a)pyrene	µg/kg	**1,100**	7,700	69.2	360	29.8 U	29.5 U	388	230	334	**1,330**	695
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	73.6	418	29.8 U	29.5 U	379	210	316	1,200	611
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	48.7	302	29.8 U	29.5 U	272	160	203	689	397
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	65	314	29.8 U	29.5 U	369	201	290	1,010	631
Chrysene	µg/kg	**1,100,000**	7,600,000	75.5	381	29.8 U	29.5 U	418	220	339	1,350	715
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	29 U	145 U	29.8 U	29.5 U	118	64.6	93.7	347	188
Fluoranthene	µg/kg	**2,400,000**	37,000,000	151	739	29.8 U	29.5 U	905	516	787	3,620	1,860
Fluorene	µg/kg	**2,400,000**	37,000,000	29 U	145 U	29.8 U	29.5 U	30.8	30 U	30.5 U	299	50.2
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	44.2	279	29.8 U	29.5 U	263	139	191	677	382
Naphthalene	µg/kg	**69,000**	150,000	29 U	145 U	29.8 U	29.5 U	54.6	40.7	40.6	516	151
Phenanthrene	µg/kg	**NA**	NA	69.7	267	29.8 U	29.5 U	465	225	345	2,670	990
Pyrene	µg/kg	**1,800,000**	28,000,000	132	553	29.8 U	29.5 U	718	405	605	2,710	1,350
Aluminum, Total	mg/kg	**NA**	NA	6,960	5,760	5,150	5,220	5,890	5,850	5,500	5,890	5,870
Antimony, Total	mg/kg	**30**	1,200	2.7	1.4	0.4	0.4	1.7	0.9	0.6	0.9	1.7
Arsenic, Total	mg/kg	**6.7**	82	**12.5**	**7.9**	4.8	4.4	**16.4**	**14.5**	**20.7**	**11.5**	**11.7**
Barium, Total	mg/kg	**15,000**	370,000	157	156	167	176	216	203	196	206	208
Beryllium, Total	mg/kg	**150**	5,100	0.4	0.2	0.2	0.2	0.3	1.2	0.4	0.4	0.5
Boron, Total	mg/kg	**NA**	NA	1.5	2.3	5.4	6.1	3.9	24.2	2.6	3	6.4
Cadmium, Total	mg/kg	**72**	2,300	1.2	0.4	0 U	0.1	1.3	0.4	0.9	0.6	0.6
Calcium, Total	mg/kg	**NA**	NA	1,350	5,770	1,130	1,180	4,490	3,290	739	1,710	2,500
Chromium, Total	mg/kg	**NA**	NA	4.4	3.7	2.7	2.1	6.6	3.7	6	4.6	4.3
Cobalt, Total	mg/kg	**1,400**	23,000	17.5	5.4	3.2	2.5	5.3	5.6	4.7	4.4	4.4
Copper, Total	mg/kg	**NA**	NA	30.3	15.1	7.8	6.7	36.7	40.4	30.5	31.5	51.8
Iron, Total	mg/kg	**NA**	NA	16,100	13,000	7,210	7,230	13,600	9,210	12,800	11,200	12,600
Lead, Total	mg/kg	**400**	1,800	80.3	105	24.7	48.8	316	**662**	229	152	**473**
Magnesium, Total	mg/kg	**NA**	NA	1310	2150	590	685	1620	811	671	768	759
Manganese, Total	mg/kg	**NA**	NA	214	341	211	179	518	249	292	327	298
Molybdenum, Total	mg/kg	**NA**	NA	11.8 U	9.4 U	9.1 U	8 U	11.7 U	9.3 U	10.7 U	10.7 U	7.5 U
Nickel, Total	mg/kg	**1,500**	44,000	15.1	10.7	6.7	6	12.7	14.6	8.8	11.5	11
Phosphorus, Total	mg/kg	**NA**	NA	339	381	523	581	966	694	1060	838	733
Potassium, Total	mg/kg	**NA**	NA	538	445	327	301	516	520	422	473	766
Selenium, Total	mg/kg	**380**	15,000	0.5 U	1.9 U	0.4 U	0.6 U	1.1 U	1 U	0.8 U	4.2 U	1 U
Silicon, Total	mg/kg	**NA**	NA	693	337	537	686	468	500	493	309	480
Sodium, Total	mg/kg	**NA**	NA	434	353	414	347	347	442	346	367	376
Strontium1, Total	mg/kg	**NA**	NA	7.1	11.7	5.6	6.7	13	20	3.8	15	5
Strontium2, Total	mg/kg	**NA**	NA	9.2	13.5	8.2	8.4	14	33.8	5	16.7	17.8
Sulfur, Total	mg/kg	**NA**	NA	43.7	154	108	113	241	117	207	711	277
Thallium, Total	mg/kg	**6.1**	230	2.3	0.2	0.5	0.2	0.5	0.1	0.3	0.6	0.3 U
Tin, Total	mg/kg	**NA**	NA	0.8	0.2	0.1	0.3	0.7	2.1	0.8	0.5	1.1
Titanium, Total	mg/kg	**NA**	NA	48.4	45.3	43.5	52.1	65.3	67.2	52.9	70.8	62.1
Vanadium, Total	mg/kg	**680**	26,000	8.9	6.4	4.7	3.9	5.7	6.2	6.1	7.2	5.8
Zinc, Total	mg/kg	**23,000**	880,000	143	184	97.7	114	283	245	182	258	318

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 14a
NPI Medium Priority Project Site No. 102, Parcel 00630009
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	102	102	102	102	102	102
			Parcel ID	00630009	00630009	00630009	00630009	00630009	00630009
			Location ID	CLB-00630009-SS01	CLB-000630009-SS02	CLB-00630009-SS03	CLB-00630009-SS03 (Duplicate)	CLB-00630009-SS04	CLB-00630009-SS05
			Field Sample ID	CLB-00630009-SS01-040510	CLB-00630009-SS02-040510	CLB-00630009-SS03-040510	CLB-00630009-SS06-040510	CLB-00630009-SS04-040510	CLB-00630009-SS05-040510
			Sample Date	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010	4/5/2010
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	47.2 U	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	211	165	53.1	70	40.5	57.6
Acenaphthene	µg/kg	**3,500,000**	56,000,000	32.9 U	243	33.7 U	55.9	38.5	35.1
Acenaphthylene	µg/kg	**NA**	NA	32.9 U	33	33.7 U	34.8 U	30.2 U	32.6 U
Anthracene	µg/kg	**18,000,000**	280,000,000	100	772	91.3	184	123	121
Benzo(a)anthracene	µg/kg	**11,000**	76,000	431	1,670	289	438	413	487
Benzo(a)pyrene	µg/kg	**1,100**	7,700	342	**1,370**	263	372	408	462
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	385	1,410	256	336	413	418
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	221	809	166	213	248	285
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	335	1,250	220	328	318	415
Chrysene	µg/kg	**1,100,000**	7,600,000	452	1,680	279	413	399	476
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	115	400	75.6	104	109	125
Fluoranthene	µg/kg	**2,400,000**	37,000,000	836	4,280	654	973	895	1090
Fluorene	µg/kg	**2,400,000**	37,000,000	32.9 U	259	33.7 U	57.4	33.1	32.6 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	202	801	150	199	229	264
Naphthalene	µg/kg	**69,000**	150,000	154	145	49.7	64.7	36	51.5
Phenanthrene	µg/kg	**NA**	NA	461	3,030	332	618	412	458
Pyrene	µg/kg	**1,800,000**	28,000,000	606	2,840	493	738	710	854
Aluminum, Total	mg/kg	**NA**	NA	5,060	4,300	5,240	5,400	6,230	12,400
Antimony, Total	mg/kg	**30**	1,200	3	3	1.3	0.8	2	2.5
Arsenic, Total	mg/kg	**6.7**	82	**8.6**	**10.8**	**9.5**	**10.4**	**11.5**	**10.3**
Barium, Total	mg/kg	**15,000**	370,000	185	294	209	273	199	248
Beryllium, Total	mg/kg	**150**	5,100	0.2	0.2	0.3	0.4	0.4	0.7
Boron, Total	mg/kg	**NA**	NA	6	0.1	0.4	0.1	2.7	6.6
Cadmium, Total	mg/kg	**72**	2,300	0.4	0.8	0.7	0.8	0.7	2
Calcium, Total	mg/kg	**NA**	NA	54,100	2,770	2,350	2,600	5,010	29,000
Chromium, Total	mg/kg	**NA**	NA	3.5	7.7	4.2	2.9	4.7	4.9
Cobalt, Total	mg/kg	**1,400**	23,000	4.4	5.5	4.3	5.7	6.5	4.8

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Appendix C - Table 14a
NPI Medium Priority Project Site No. 102, Parcel 00630009
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**102**	**102**	**102**	**102**	**102**	**102**
			Parcel ID	**00630009**	**00630009**	**00630009**	**00630009**	**00630009**	**00630009**
			Location ID	**CLB-00630009-SS01**	**CLB-000630009-SS02**	**CLB-00630009-SS03**	**CLB-00630009-SS03 (Duplicate)**	**CLB-00630009-SS04**	**CLB-00630009-SS05**
			Field Sample ID	**CLB-00630009-SS01-040510**	**CLB-00630009-SS02-040510**	**CLB-00630009-SS03-040510**	**CLB-00630009-SS06-040510**	**CLB-00630009-SS04-040510**	**CLB-00630009-SS05-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Copper, Total	mg/kg	**NA**	NA	25.8	51.6	27.5	32.7	27	24.7
Iron, Total	mg/kg	**NA**	NA	13,500	26,700	15,400	13,800	16,700	12,800
Lead, Total	mg/kg	**400**	1,800	174	318	260	256	232	**580**
Magnesium, Total	mg/kg	**NA**	NA	21,600	818	1,040	1,120	2,090	6,700
Manganese, Total	mg/kg	**NA**	NA	348	388	213	333	303	1630
Molybdenum, Total	mg/kg	**NA**	NA	3	8.8 U	10.3 U	8.8 U	11.8 U	16.6 U
Nickel, Total	mg/kg	**1,500**	44,000	10.5	16.9	10.1	12	14.6	11.8
Phosphorus, Total	mg/kg	**NA**	NA	425	838	464	408	394	231
Potassium, Total	mg/kg	**NA**	NA	783	705	1,130	1,180	919	749
Selenium, Total	mg/kg	**380**	15,000	3.9 U	2 U	0.9 U	1	1.1 U	3 U
Silicon, Total	mg/kg	**NA**	NA	735	333	705	278	687	778
Sodium, Total	mg/kg	**NA**	NA	406	448	424	542	366	527
Strontium1, Total	mg/kg	**NA**	NA	15.7	13.4	10.8	0.7	15.2	40.1
Strontium2, Total	mg/kg	**NA**	NA	32.7	15.3	12.7	14.9	16.2	50
Sulfur, Total	mg/kg	**NA**	NA	435	346	196	274	346	332
Thallium, Total	mg/kg	**6.1**	230	1.3 U	0.4 U	0.1 U	0.4	0.2	0.9
Tin, Total	mg/kg	**NA**	NA	0.8	1.2	0.7	0.8	0.3	0.3
Titanium, Total	mg/kg	**NA**	NA	78.6	55.8	46.9	44.1	44.4	235
Vanadium, Total	mg/kg	**680**	26,000	6.2	7.2	5.8	9.8	6.6	7
Zinc, Total	mg/kg	**23,000**	880,000	287	295	219	176	281	441

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and Commercial/Industrial [3745-300-08 (3) (c)] Direct Contact Clean-up Criteria
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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Appendix C - Table 14b
NPI Medium Priority Project Site No. 102, Parcel 00630010
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**102**	**102**	**102**	**102**	**102**	**102**
			Parcel ID	**00630010**	**00630010**	**00630010**	**00630010**	**00630010**	**00630010**
			Location ID	**CLB-00630010-SS01**	**CLB-00630010-SS02**	**CLB-00630010-SS03**	**CLB-00630010-SS04**	**CLB-00630010-SS05**	**CLB-00630010-SS06**
			Field Sample ID	**CLB-00630010-SS01-040510**	**CLB-00630010-SS02-040510**	**CLB-00630010-SS03-040510**	**CLB-00630010-SS04-040510**	**CLB-00630010-SS05-040510**	**CLB-00630010-SS06-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Percent Moisture	%			21.7	16.5	27.1	18.3	22.4	29.5
Aroclor 1016	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	µg/kg	**NA**	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	**NA**	NA	54.7	29.9 U	172 U	78.3	396	65.3
Acenaphthene	µg/kg	**3,500,000**	56,000,000	58.9	29.9 U	172 U	98.9	229	35.5 U
Acenaphthylene	µg/kg	**NA**	NA	31.9 U	29.9 U	172 U	63.6	121	35.5 U
Anthracene	µg/kg	**18,000,000**	280,000,000	249	82.9	172 U	400	654	35.5 U
Benzo(a)anthracene	µg/kg	**11,000**	76,000	773	289	508	920	1,610	73.1
Benzo(a)pyrene	µg/kg	**1,100**	7,700	688	278	482	828	**1,430**	72.6
Benzo(b)fluoranthene	µg/kg	**11,000**	77,000	619	264	503	762	1,300	72.4
Benzo(g,h,i)perylene	µg/kg	**NA**	NA	408	175	343	475	833	46.9
Benzo(k)fluoranthene	µg/kg	**110,000**	770,000	607	241	397	737	1,260	64.1
Chrysene	µg/kg	**1,100,000**	7,600,000	705	285	540	905	1,570	72.1
Dibenz(a,h)anthracene	µg/kg	**1,100**	7,700	188	76.7	172 U	223	397	35.5 U
Fluoranthene	µg/kg	**2,400,000**	37,000,000	1,710	652	1,240	2,340	3,970	140
Fluorene	µg/kg	**2,400,000**	37,000,000	48.8	29.9 U	172 U	186	259	35.5 U
Indeno(1,2,3-cd)pyrene	µg/kg	**11,000**	77,000	383	162	294	461	793	45.1
Naphthalene	µg/kg	**69,000**	150,000	47.5	29.9 U	172 U	132	391	62.6
Phenanthrene	µg/kg	**NA**	NA	894	307	757	1,810	2,980	71.3
Pyrene	µg/kg	**1,800,000**	28,000,000	1,320	501	931	1,650	2,890	108
Aluminum, Total	mg/kg	**NA**	NA	5,440	7,030	5,470	6,100	6,370	6,760
Antimony, Total	mg/kg	**30**	1,200	1.3	3.3	1.6	1.4	2.6	1.5
Arsenic, Total	mg/kg	**6.7**	82	**10.6**	**12.7**	6.6	**10**	**15.1**	**20.5**
Barium, Total	mg/kg	**15,000**	370,000	198	183	228	214	447	405
Beryllium, Total	mg/kg	**150**	5,100	0.5	0.4	0.2	0.3	0.8	1
Boron, Total	mg/kg	**NA**	NA	1.5	5.7	3.9	1.9	8.9	0.3
Cadmium, Total	mg/kg	**72**	2,300	0.5	1.6	0.9	0.6	1.3	0.7
Calcium, Total	mg/kg	**NA**	NA	2,540	2,840	2,140	1,840	7,690	4,620
Chromium, Total	mg/kg	**NA**	NA	4.1	5.4	3.3	3.9	7.1	5.2
Cobalt, Total	mg/kg	**1,400**	23,000	5.1	15.5	4.8	5	6.9	9.8
Copper, Total	mg/kg	**NA**	NA	38.2	26	29	29.2	72.6	44
Iron, Total	mg/kg	**NA**	NA	13,600	16,000	12,600	14,200	16,500	19,500

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Appendix C - Table 14b
NPI Medium Priority Project Site No. 102, Parcel 00630010
Summary of Surface Soil Results
Cleveland Land Bank Properties Site
Cleveland, Cuyahoga County, Ohio

			NPI Project Site Number	**102**	**102**	**102**	**102**	**102**	**102**
			Parcel ID	**00630010**	**00630010**	**00630010**	**00630010**	**00630010**	**00630010**
			Location ID	**CLB-00630010-SS01**	**CLB-00630010-SS02**	**CLB-00630010-SS03**	**CLB-00630010-SS04**	**CLB-00630010-SS05**	**CLB-00630010-SS06**
			Field Sample ID	**CLB-00630010-SS01-040510**	**CLB-00630010-SS02-040510**	**CLB-00630010-SS03-040510**	**CLB-00630010-SS04-040510**	**CLB-00630010-SS05-040510**	**CLB-00630010-SS06-040510**
			Sample Date	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**	**4/5/2010**
Chemical Name	**Unit**	**VAP Generic Residential Direct Contact Criteria**	**VAP Generic Commercial/Industrial Direct Contact Criteria**						
Lead, Total	mg/kg	**400**	1,800	227	137	**528**	254	**960**	279
Magnesium, Total	mg/kg	**NA**	NA	1,130	1,740	1,060	1,140	1,730	1,160
Manganese, Total	mg/kg	**NA**	NA	273	315	223	242	329	1,740
Molybdenum, Total	mg/kg	**NA**	NA	7.4 U	10.8 U	7.2 U	11.7 U	9.7 U	11.5 U
Nickel, Total	mg/kg	**1,500**	44,000	12.8	15.5	11.2	12.2	16	22.6
Phosphorus, Total	mg/kg	**NA**	NA	402	324	374	412	594	1,130
Potassium, Total	mg/kg	**NA**	NA	690	725	664	618	924	577
Selenium, Total	mg/kg	**380**	15,000	1.2	3.1 U	0.8 U	1 U	4.3 U	1.5 U
Silicon, Total	mg/kg	**NA**	NA	588	648	718	702	320	576
Sodium, Total	mg/kg	**NA**	NA	563	356	359	431	478	536
Strontium1, Total	mg/kg	**NA**	NA	1.3	12.2	2.9 U	8.9	41.9	2.7 U
Strontium2, Total	mg/kg	**NA**	NA	14.1	13.3	10.8	12.1	53	23.3
Sulfur, Total	mg/kg	**NA**	NA	246	197	214	168	400	260
Thallium, Total	mg/kg	**6.1**	230	0.6	2.2	0.1	0.9	0 U	2.6
Tin, Total	mg/kg	**NA**	NA	0.7	1.1	0.6	0.6	1.8	1.2
Titanium, Total	mg/kg	**NA**	NA	54.6	52.1	49.5	50.2	80	61.8
Vanadium, Total	mg/kg	**680**	26,000	9.8	9.4	5.5	6.4	8	14
Zinc, Total	mg/kg	**23,000**	880,000	172	238	466	235	674	246

Notes:
Shaded bold - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential Direct Contact Criteria
Shaded bold and Boxed - Constituent Concentration exceeds the Ohio EPA Voluntary Action Program Generic Residential and Commercial/Industrial Direct Contact Criteria
% - Percent
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not available/Not analyzed for
U - Non detect
VAP - Ohio EPA Voluntary Action Program Generic Residential [3745-300-08 (3) (b)] and
XRF - X-ray Fluorescence
See electronic deliverable for complete analytical results

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APPENDIX D
NPI PROJECT SITE-SPECIFIC FIGURES

Non-Responsive

DRAFT

Miles Park Ave

Miles Park Ave

Pratt Ave

E 93rd St

E 93rd St

Cleveland

13408014

CLB-13408014-SS15 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Lead, XRF	433	MG/KG	[400]

CLB-13408014-SS16 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, Total	18	MG/KG	[6.7]
Arsenic, Total	16.8	MG/KG	[6.7]

CLB-13408014-SS11 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, Total	22.9	MG/KG	[6.7]
Arsenic, XRF	77	MG/KG	[6.7]
Lead, Total	1440	MG/KG	[400]
Lead, XRF	1538	MG/KG	[400]

CLB-13408014-SS12 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, XRF	63	MG/KG	[6.7]

CLB-13408014-SS13 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, XRF	34	MG/KG	[6.7]

CLB-13408014-SS09 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, XRF	28	MG/KG	[6.7]

CLB-13408014-SS08 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, XRF	34	MG/KG	[6.7]
Benzo(a)pyrene	5800	UG/KG	[1100]
Dibenz(a,h)anthracene	1650	UG/KG	[1100]
Lead, XRF	583	MG/KG	[400]

CLB-13408014-SS05 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Antimony, XRF	96	MG/KG	[30]
Benzo(a)pyrene	2460	UG/KG	[1100]

CLB-13408014-SS04 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Arsenic, Total	22.1	MG/KG	[6.7]
Benzo(a)pyrene	1850	UG/KG	[1100]
Cadmium, XRF	74	MG/KG	[72]
Lead, Total	471	MG/KG	[400]
Lead, XRF	708	MG/KG	[400]

CLB-13408014-SS01 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Lead, XRF	830	MG/KG	[400]

CLB-13408014-SS03 03/25/10

Parameter	Result	Units	[VAP Std. Res]
Lead, XRF	734	MG/KG	[400]

Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-13408014-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

13408014 Parcel I.D. Number

[redacted]

[redacted]

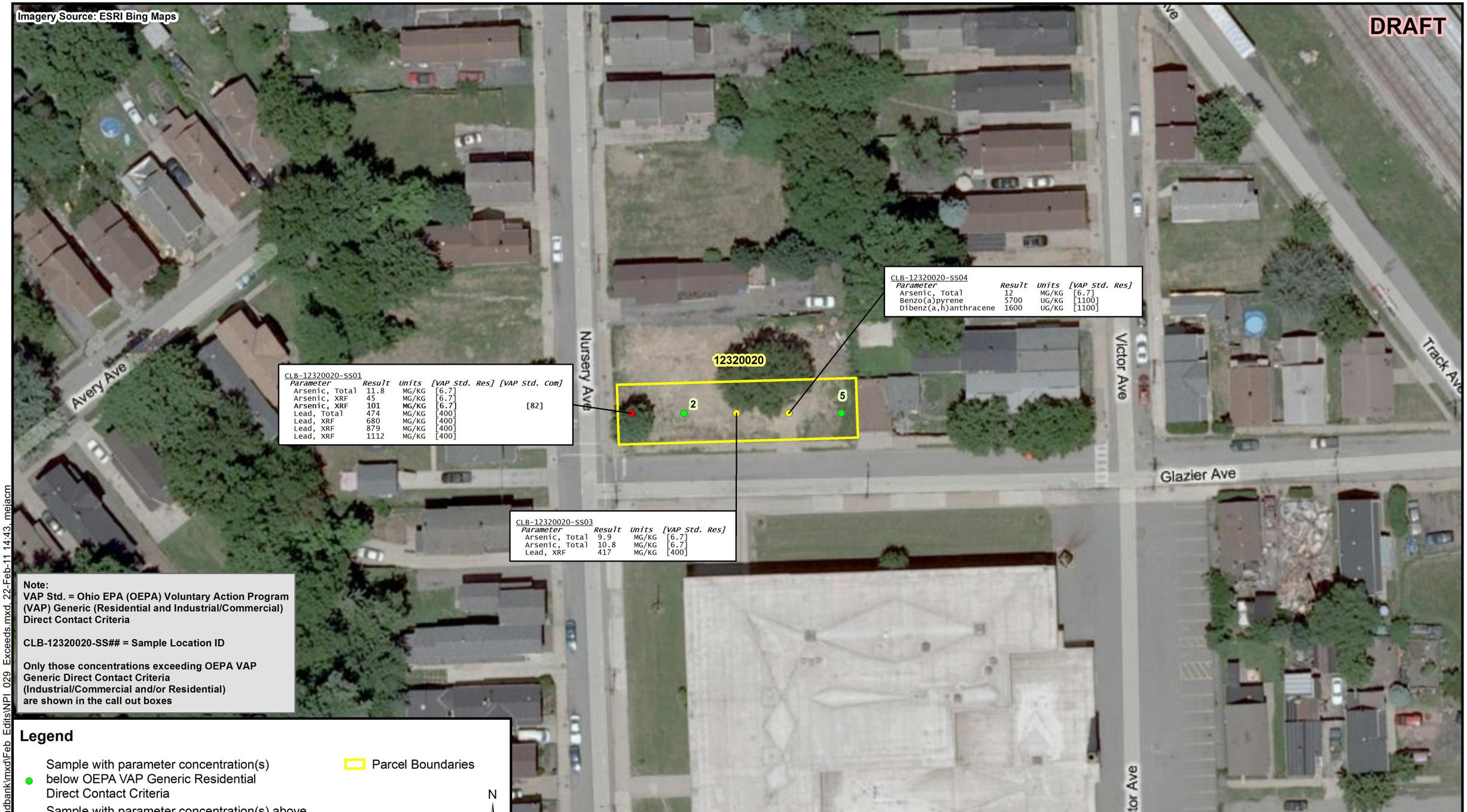
[redacted]

File: D:\Cleveland Landbank\mxd\Feb Edits\NPI 009 Exceeds.mxd, 21-Feb-11 21:26, mejacm

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 2
Soil Sample Location and Results
NPI Project #9 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



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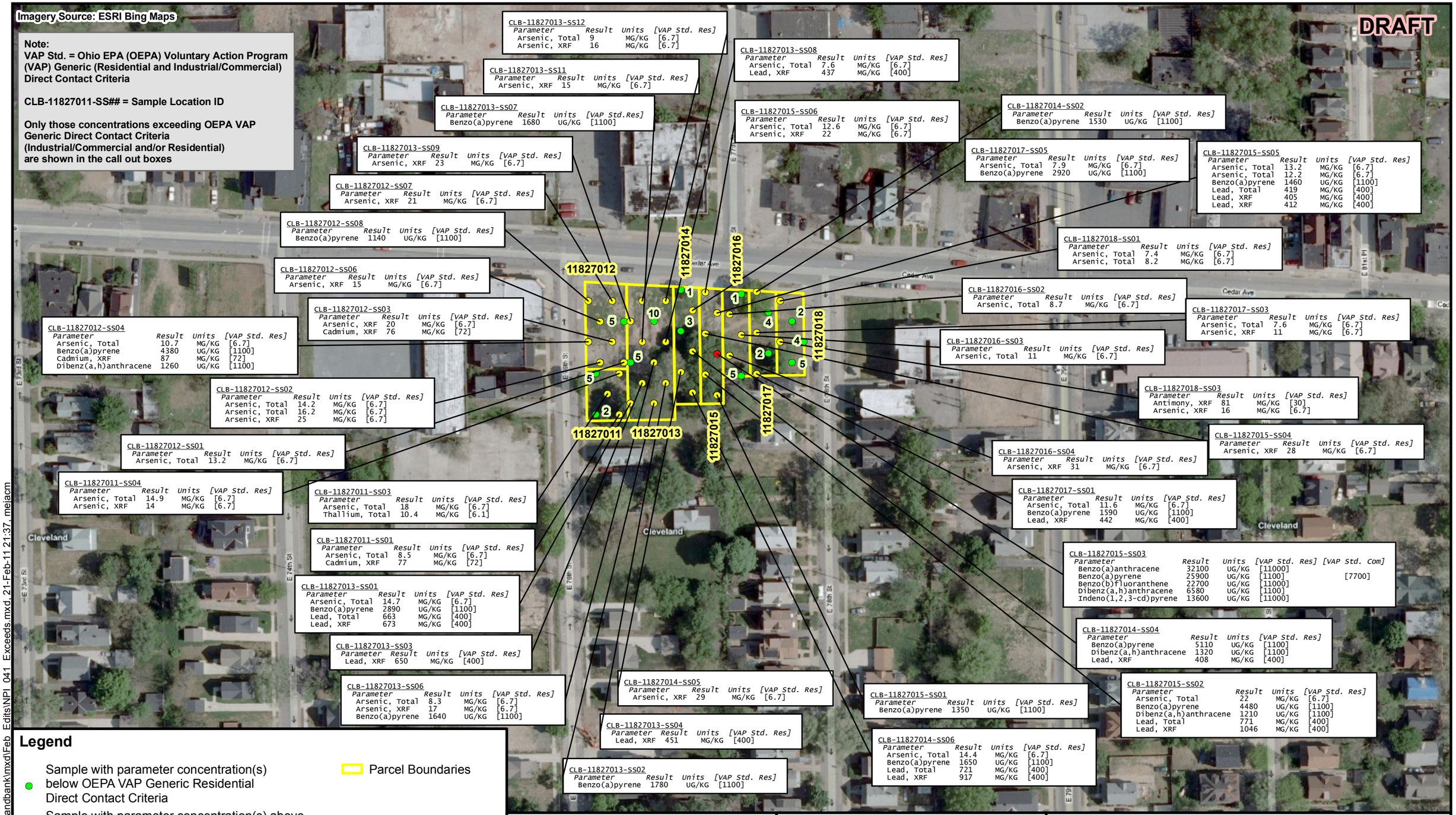
Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 3
Soil Sample Location and Results
NPI Project #29 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



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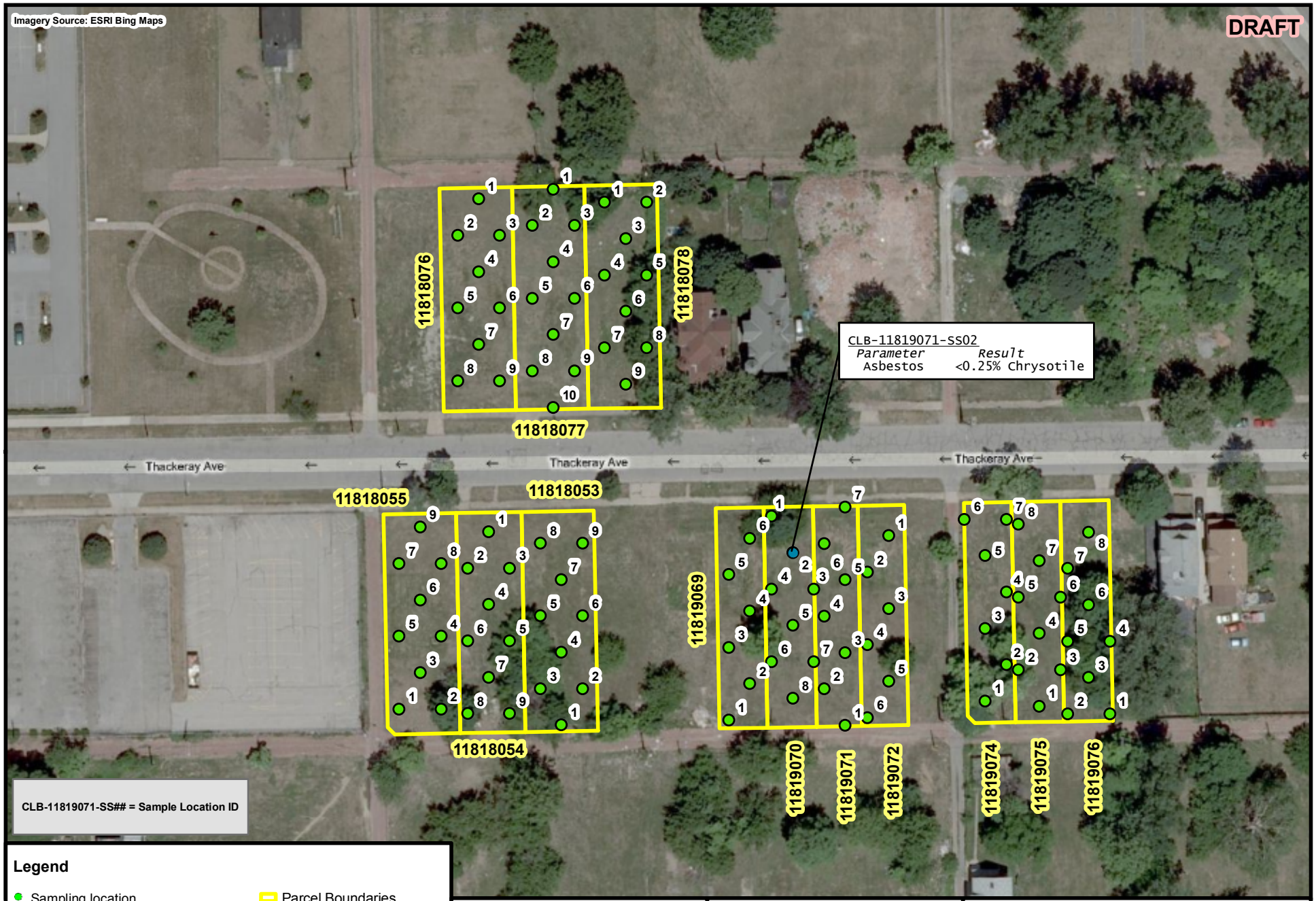
Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 4
Soil Sample Location and Results
NPI Project #41 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_042_Asbestos.mxd, 22-Feb-11 10:13, mejacm

Legend

- Sampling location
- Asbestos Containing Material Detected
- Parcel Boundaries

0 90 Feet

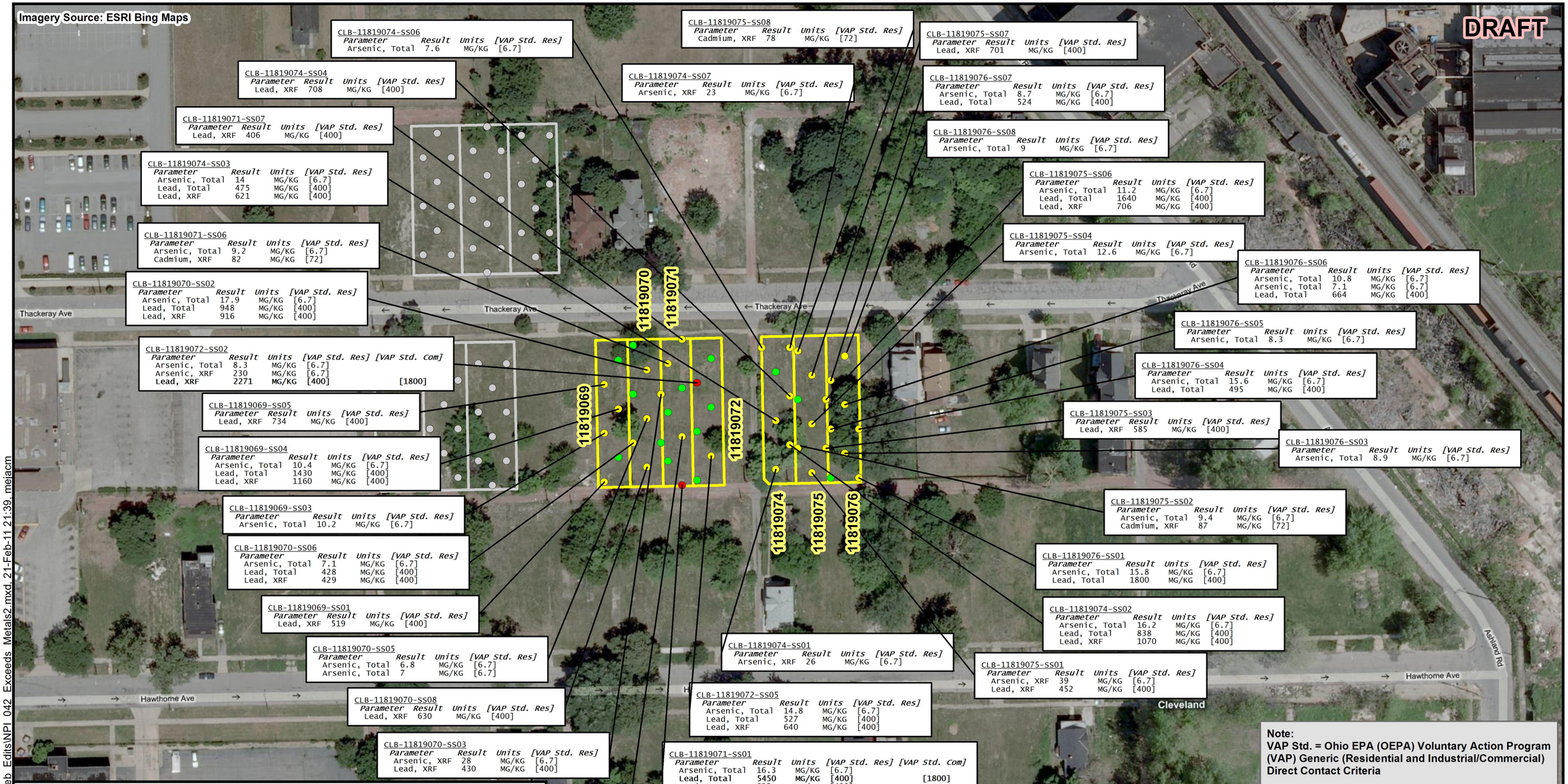
00630009: Parcel I.D. Number

N

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 5a
Soil Sample Location and Results - Asbestos
NPI Project #42 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-11819074-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria
- Sample with parameter concentration(s) above both OEPA VAP Generic Residential and Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

0 100 Feet

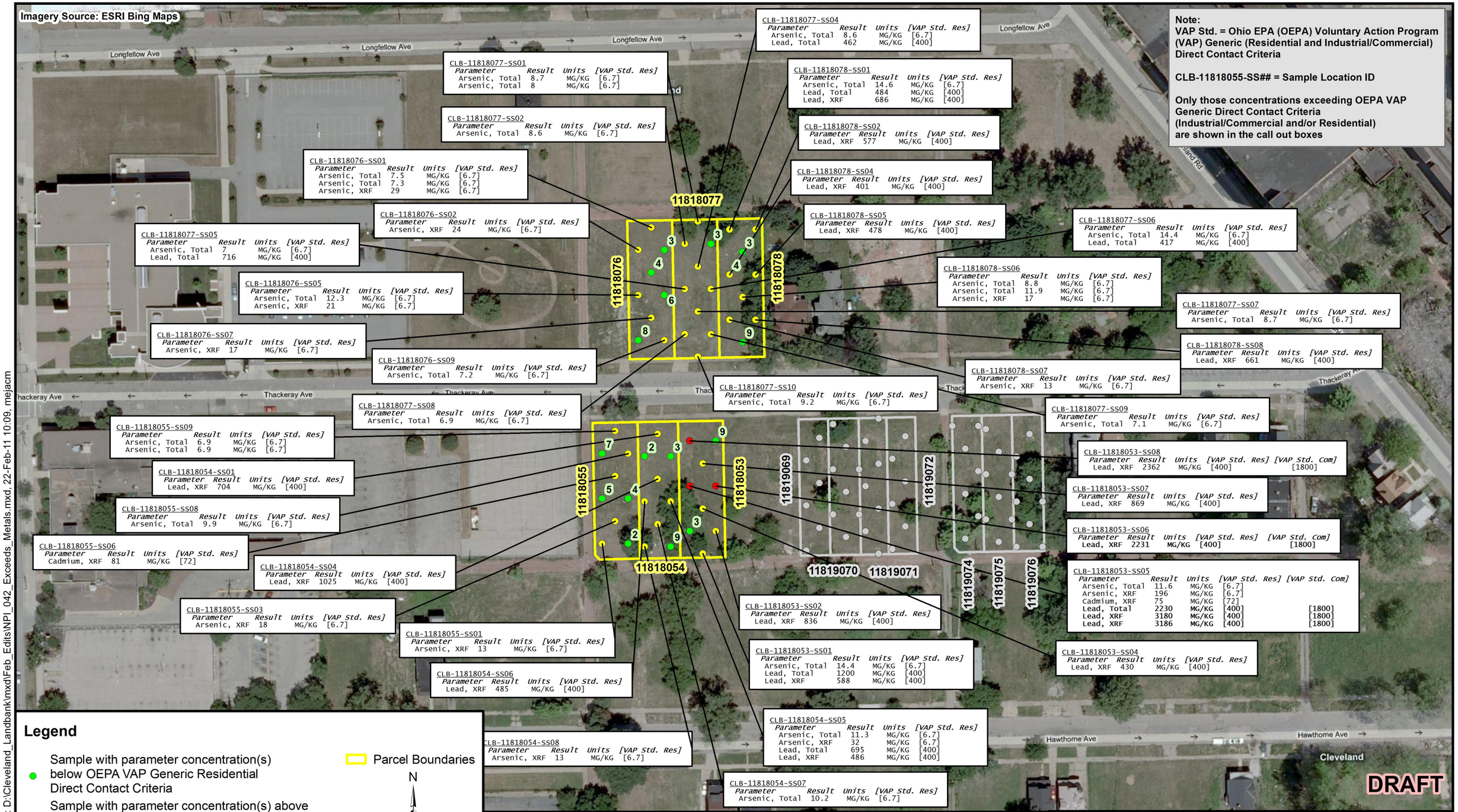
11819074 Parcel I.D. Number

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 5b
Soil Sample Location and Results - Metals
NPI Project #42 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_042_Exceeds_Metals2.mxd 21-Feb-11 21:39 mejacm



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-11818055-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria
- Sample with parameter concentration(s) above both OEPA VAP Generic Residential and Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

00630009: Parcel I.D. Number

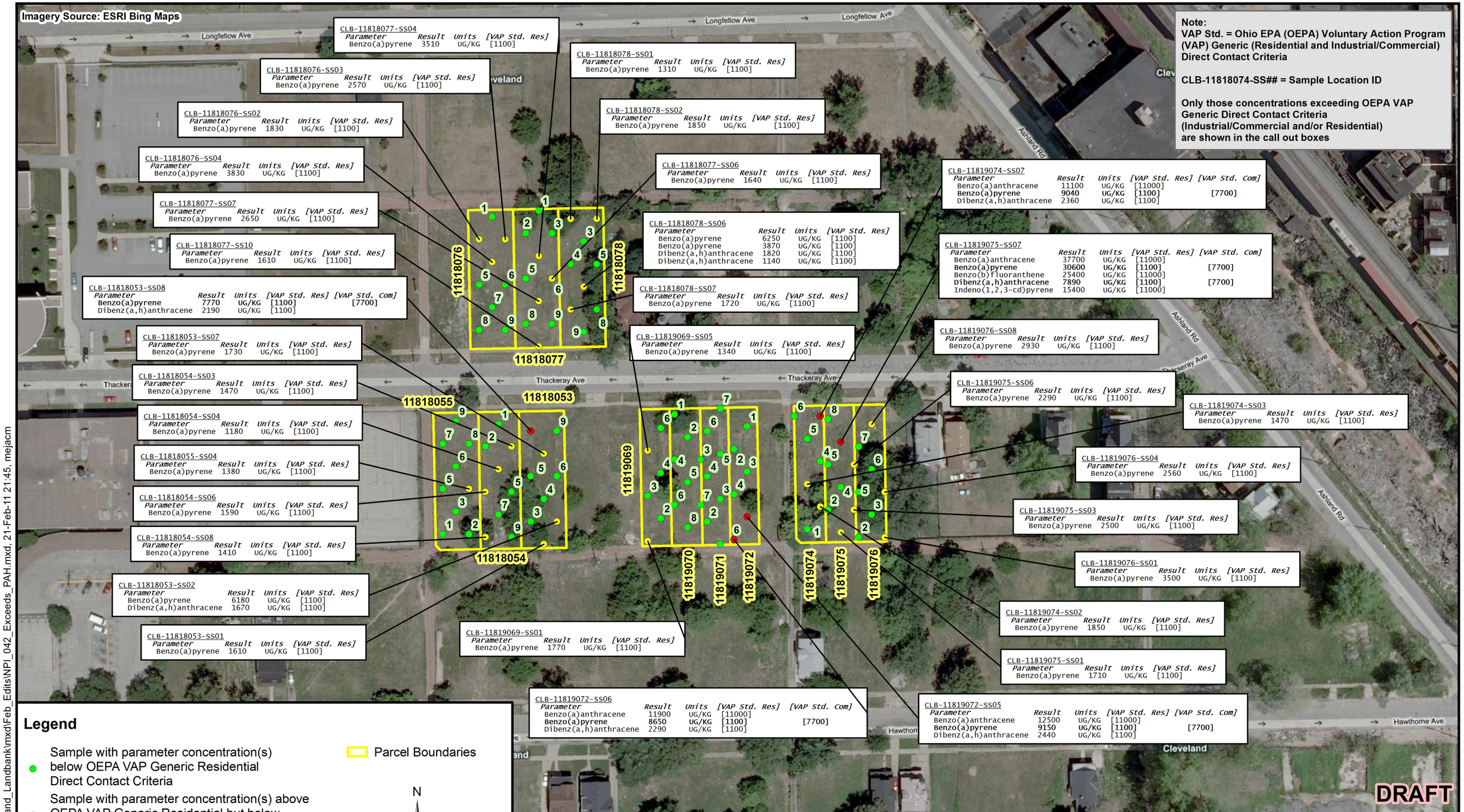
0 100 Feet

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 5c
Soil Sample Location and Results - Metals
NPI Project #42 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_042_Exceeds_Metals.mxd, 22-Feb-11 10:09, mejacm



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-11818074-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

CLB-11818077-SS04

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	3510	UG/KG	[1100]

CLB-11818078-SS01

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1310	UG/KG	[1100]

CLB-11818076-SS03

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	2570	UG/KG	[1100]

CLB-11818078-SS02

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1850	UG/KG	[1100]

CLB-11818076-SS02

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1830	UG/KG	[1100]

CLB-11818077-SS06

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1640	UG/KG	[1100]

CLB-11818076-SS04

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	3830	UG/KG	[1100]

CLB-11818077-SS07

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	2650	UG/KG	[1100]

CLB-11818078-SS06

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	6250	UG/KG	[1100]
Benzo(a)pyrene	3870	UG/KG	[1100]
Dibenz(a,h)anthracene	1820	UG/KG	[1100]
Dibenz(a,h)anthracene	1140	UG/KG	[1100]

CLB-11818077-SS10

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1610	UG/KG	[1100]

CLB-11818078-SS07

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1720	UG/KG	[1100]

CLB-11818053-SS08

Parameter	Result	Units	[VAP Std. Res]	[VAP Std. Com]
Benzo(a)pyrene	7770	UG/KG	[1100]	[7700]
Dibenz(a,h)anthracene	2190	UG/KG	[1100]	

CLB-11819069-SS05

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1340	UG/KG	[1100]

CLB-11818053-SS07

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1730	UG/KG	[1100]

CLB-11818054-SS03

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1470	UG/KG	[1100]

CLB-11818054-SS04

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1180	UG/KG	[1100]

CLB-11818055-SS04

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1380	UG/KG	[1100]

CLB-11818054-SS06

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1590	UG/KG	[1100]

CLB-11818054-SS08

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1410	UG/KG	[1100]

CLB-11818053-SS02

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	6180	UG/KG	[1100]
Dibenz(a,h)anthracene	1670	UG/KG	[1100]

CLB-11818053-SS01

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1610	UG/KG	[1100]

CLB-11819069-SS01

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1770	UG/KG	[1100]

CLB-11819074-SS07

Parameter	Result	Units	[VAP Std. Res]	[VAP Std. Com]
Benzo(a)anthracene	11100	UG/KG	[11000]	
Benzo(a)pyrene	9040	UG/KG	[1100]	[7700]
Dibenz(a,h)anthracene	2360	UG/KG	[1100]	

CLB-11819075-SS07

Parameter	Result	Units	[VAP Std. Res]	[VAP Std. Com]
Benzo(a)anthracene	37700	UG/KG	[11000]	
Benzo(a)pyrene	30600	UG/KG	[1100]	[7700]
Benzo(b)fluoranthene	25400	UG/KG	[11000]	
Dibenz(a,h)anthracene	7890	UG/KG	[1100]	[7700]
Indeno(1,2,3-cd)pyrene	15400	UG/KG	[11000]	

CLB-11819076-SS08

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	2930	UG/KG	[1100]

CLB-11819075-SS06

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	2290	UG/KG	[1100]

CLB-11819074-SS03

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1470	UG/KG	[1100]

CLB-11819076-SS04

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	2560	UG/KG	[1100]

CLB-11819075-SS03

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	2500	UG/KG	[1100]

CLB-11819076-SS01

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	3500	UG/KG	[1100]

CLB-11819074-SS02

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1850	UG/KG	[1100]

CLB-11819075-SS01

Parameter	Result	Units	[VAP Std. Res]
Benzo(a)pyrene	1710	UG/KG	[1100]

CLB-11819072-SS06

Parameter	Result	Units	[VAP Std. Res]	[VAP Std. Com]
Benzo(a)anthracene	11900	UG/KG	[11000]	
Benzo(a)pyrene	8650	UG/KG	[1100]	[7700]
Dibenz(a,h)anthracene	2290	UG/KG	[1100]	

CLB-11819072-SS05

Parameter	Result	Units	[VAP Std. Res]	[VAP Std. Com]
Benzo(a)anthracene	12500	UG/KG	[11000]	
Benzo(a)pyrene	9150	UG/KG	[1100]	[7700]
Dibenz(a,h)anthracene	2440	UG/KG	[1100]	

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria
- Sample with parameter concentration(s) above both OEPA VAP Generic Residential and Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

0 100 Feet

00630009: Parcel I.D. Number

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 5d
Soil Sample Location and Results - PAHs
NPI Project #42 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_042_Exceeds_PAH.mxd, 21-Feb-11 21:45, mejacm

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_053_Exceeds.mxd, 21-Feb-11 21:48, mejacm

Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-11827011-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

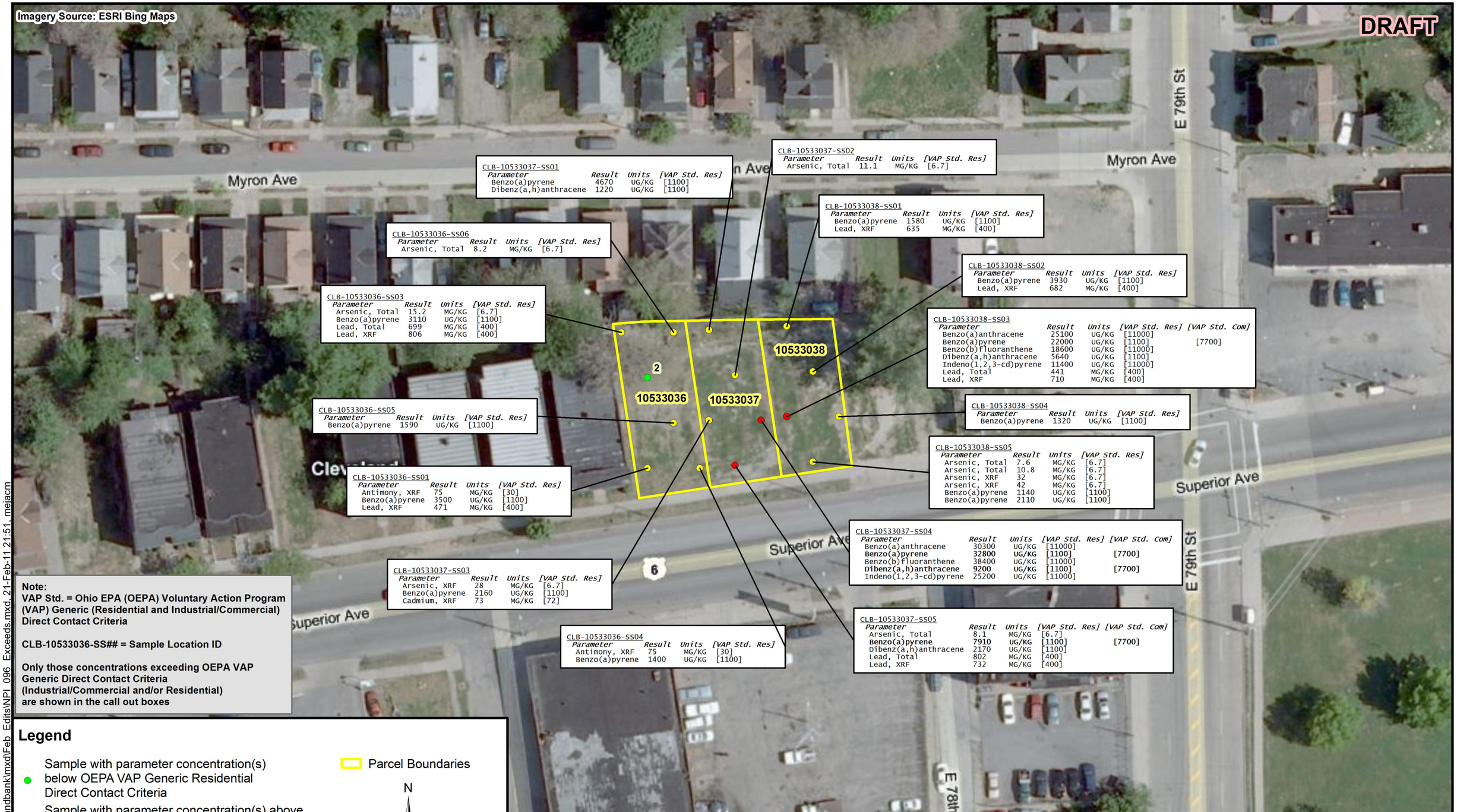
0 50 Feet

00814072: Parcel I.D. Number

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 6
Soil Sample Location and Results
NPI Project #53 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-10533036-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria
- Sample with parameter concentration(s) above both OEPA VAP Generic Residential and Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

0 50 Feet

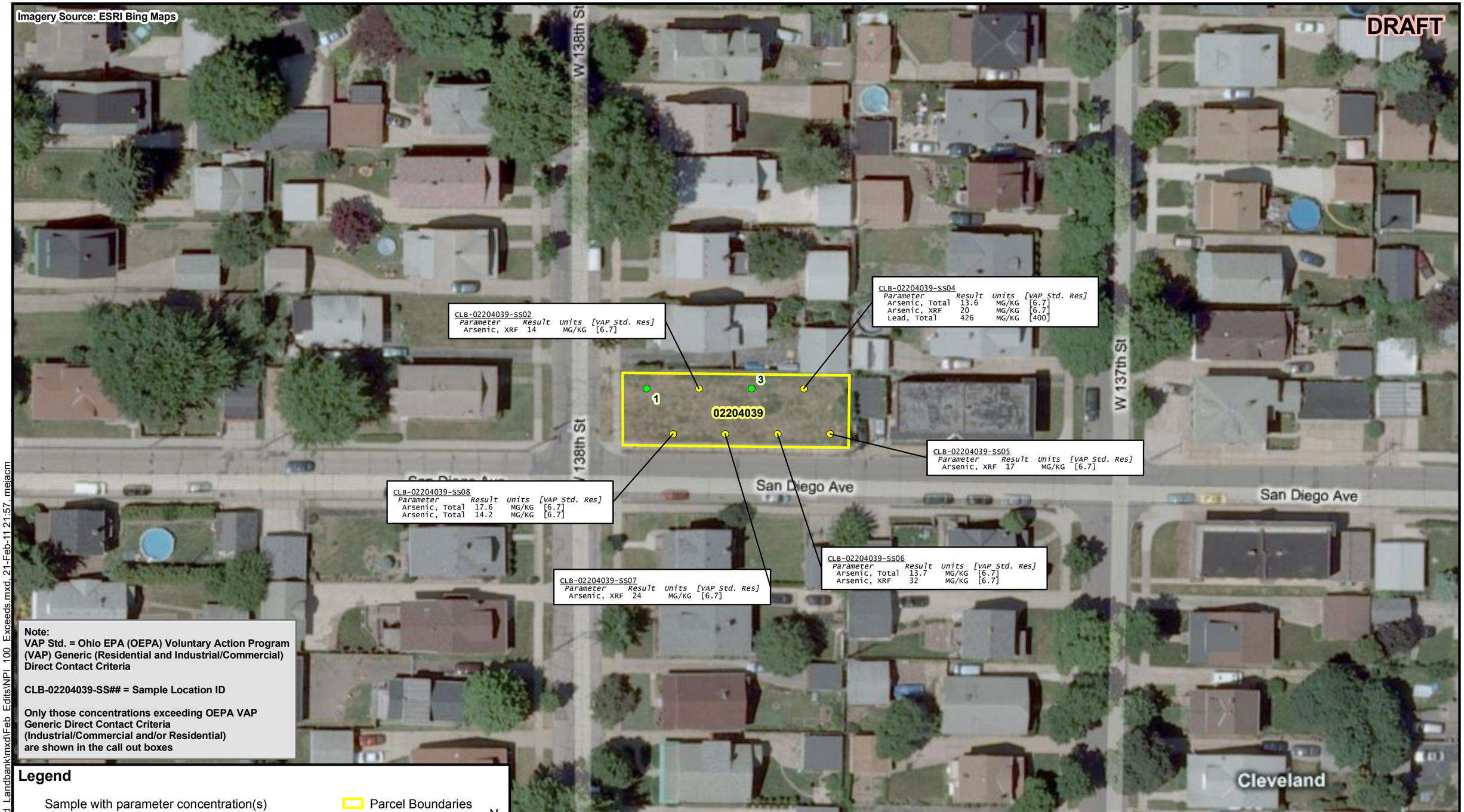
10533036: Parcel I.D. Number

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 7
Soil Sample Location and Results
NPI Project #96 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland Landbank\mxd\Feb Edits\NPI_096_Exceeds.mxd, 21-Feb-11 21:51, mejacm



File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_100_Exceeds.mxd, 21-Feb-11 21:57, mejacm

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 8
Soil Sample Location and Results
NPI Project #100 - High Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_011_Exceeds.mxd, 21-Feb-11 21:29, mejacm

Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-14225131-SS## = Sample Location ID
CLB-14227156-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria
- Parcel Boundaries

N

0 100 Feet

14225131: Parcel I.D. Number

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

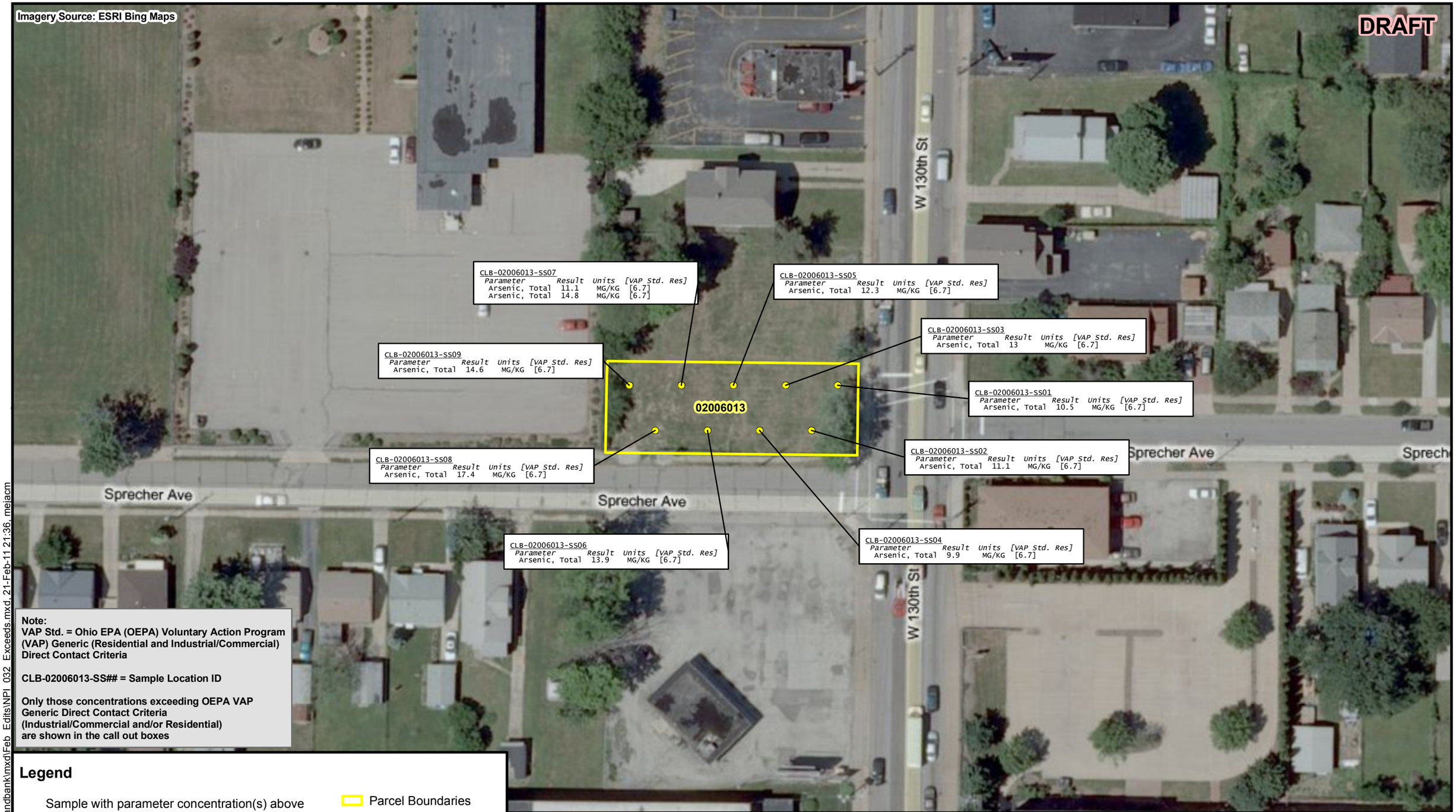
Appendix D - Figure 9
Soil Sample Location and Results
NPI Project #11 - Medium Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_019_Exceeds.mxd, 21-Feb-11 21:30, mejacm

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 10
Soil Sample Location and Results
NPI Project #19 - Medium Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-02006013-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

02006013: Parcel I.D. Number

0 50 Feet

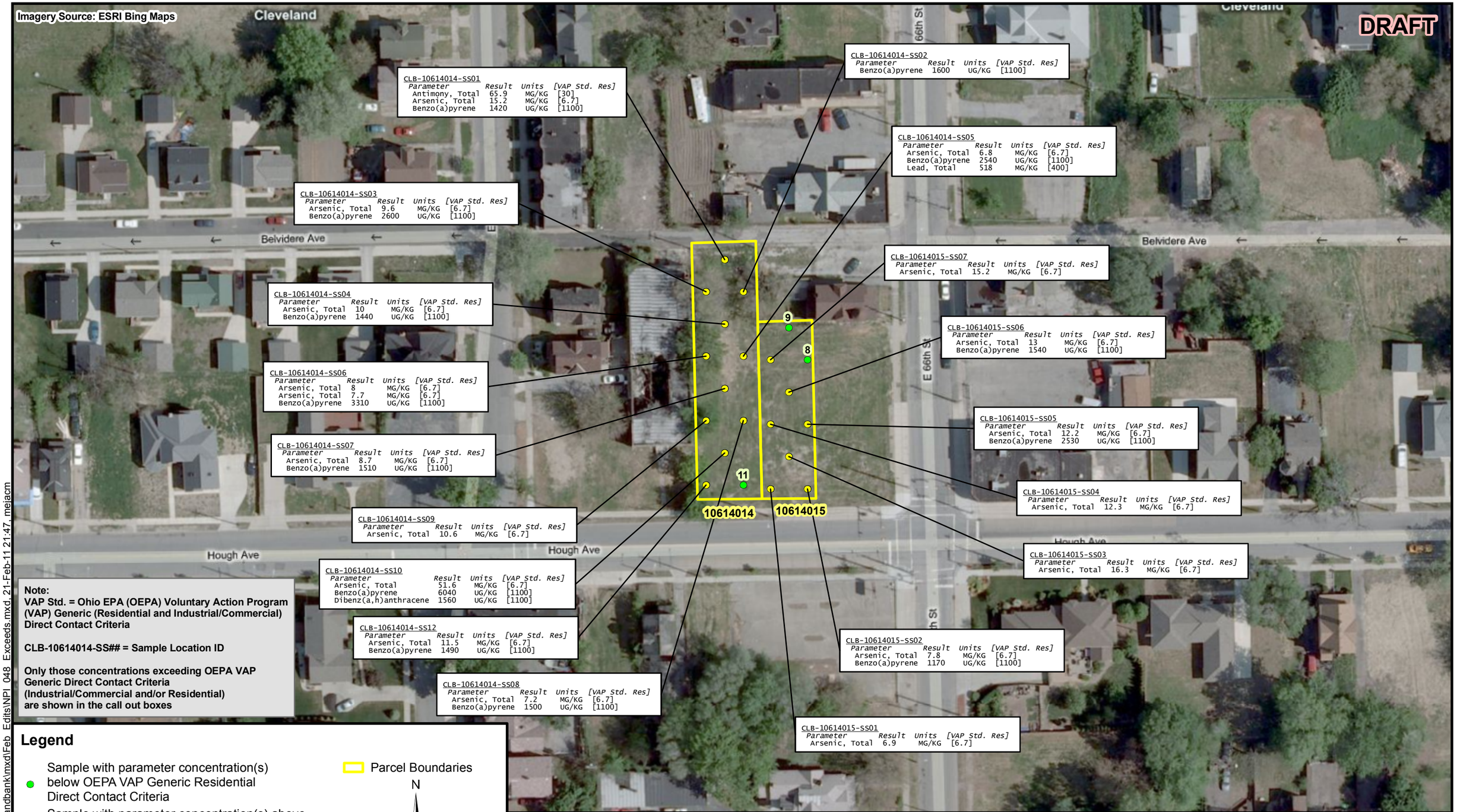
N

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 11
Soil Sample Location and Results
NPI Project #32 - Medium Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_032_Exceeds.mxd, 21-Feb-11 21:36, mejacm



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-10614014-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

- Sample with parameter concentration(s) below OEPA VAP Generic Residential Direct Contact Criteria
- Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

N

0 70 Feet

10614014: Parcel I.D. Number

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 12
Soil Sample Location and Results
NPI Project #48 - Medium Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

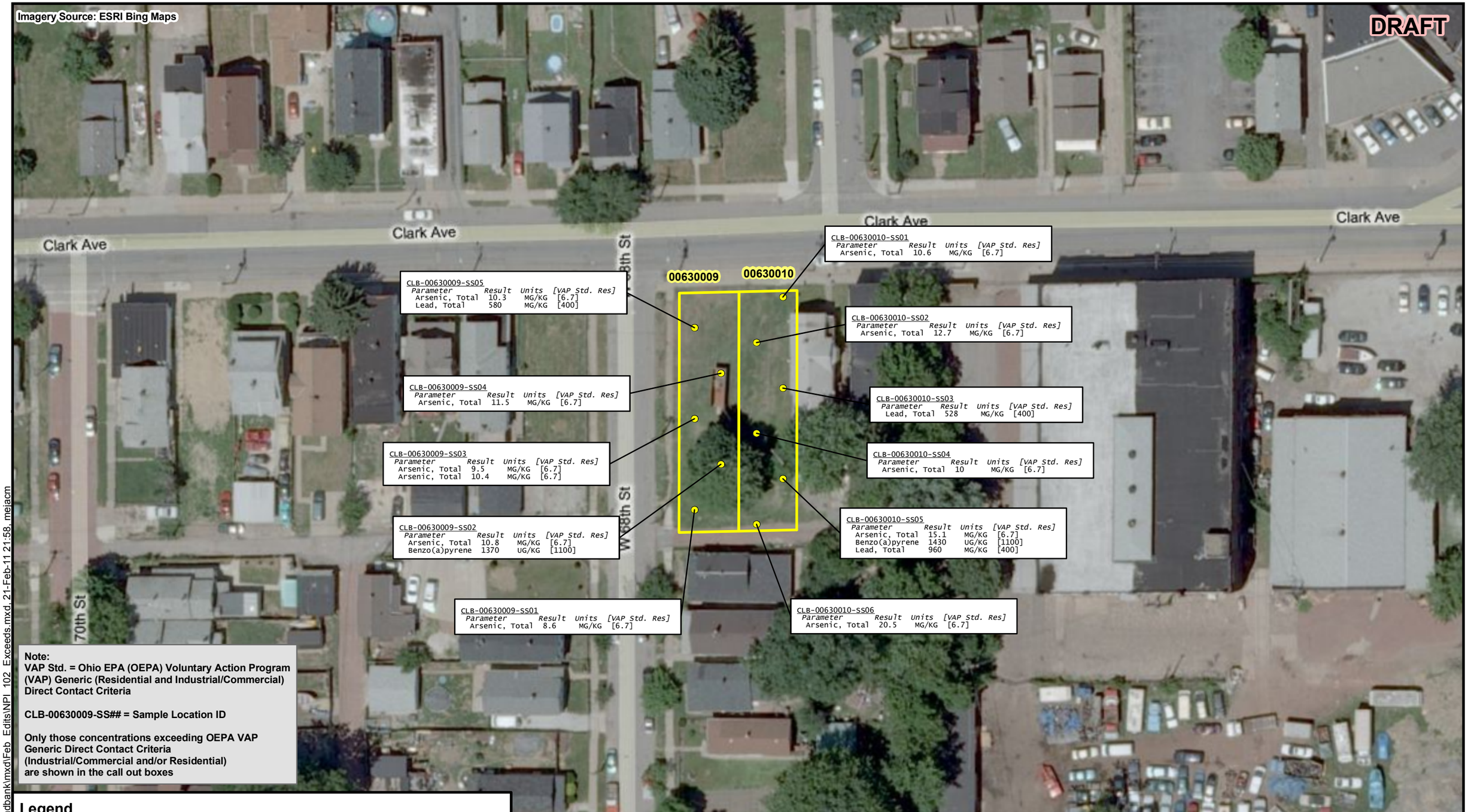
File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_048_Exceeds.mxd, 21-Feb-11 21:47, mejacm

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_061_Exceeds.mxd, 21-Feb-11 21:50, mejacm

Prepared For:
US EPA Region V
Contract No.: EP-S5-06-04
TDD: S05-0016-1001-003
DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 13
Soil Sample Location and Results
NPI Project #61 - Medium Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio



Note:
VAP Std. = Ohio EPA (OEPA) Voluntary Action Program (VAP) Generic (Residential and Industrial/Commercial) Direct Contact Criteria

CLB-00630009-SS## = Sample Location ID

Only those concentrations exceeding OEPA VAP Generic Direct Contact Criteria (Industrial/Commercial and/or Residential) are shown in the call out boxes

Legend

Sample with parameter concentration(s) above OEPA VAP Generic Residential but below Generic Industrial/Commercial Direct Contact Criteria

Parcel Boundaries

0 50 Feet

N

00630009 Parcel I.D. Number

Prepared For:
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Contract No.: EP-S5-06-04
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DCN: 904-2A-AGNZ

Prepared By:
WESTON SOLUTIONS, INC.
750 E Bunker Ct. Suite 500
Vernon Hills, Illinois 60061

Appendix D - Figure 14
Soil Sample Location and Results
NPI Project #102 - Medium Priority Site
Cleveland Land Bank Properties
Cleveland, Cuyahoga County, Ohio

File: D:\Cleveland_Landbank\mxd\Feb_Edits\NPI_102_Exceeds.mxd, 21-Feb-11 21:58, mejacm

APPENDIX E
DATA VALIDATION REPORTS

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036079
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 25 soil samples, three field duplicate samples, two equipment blank samples, and one trip blank sample collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM
- Volatile Organic Compounds (VOCs) by Method SW-846 8260

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	**Lab ID** 5036079-	**Analysis**	**Date Collected**
02204039-SS01-032410	001	PAHs	3/24/2010
02204039-SS02-032410	002	PAHs	3/24/2010
02204039-SS03-032410	003	PAHs	3/24/2010
02204039-SS04-032410	004	PAHs	3/24/2010
02204039-SS05-032410	005	PAHs	3/24/2010
02204039-SS06-032410	006	PAHs	3/24/2010
02204039-SS07-032410	007	PAHs	3/24/2010
02204039-SS08-032410	008	PAHs	3/24/2010
02204039-SS09-032410	009	PAHs	3/24/2010
00814072-SS01-032410	010	PAHs	3/24/2010
00814072-SS02-032410	011	PAHs	3/24/2010
00814072-SS03-032410	012	PAHs	3/24/2010
00814072-SS04-032410	013	PAHs	3/24/2010
12320020-SS01-032410	014	PAHs	3/24/2010

Samples CLB-	Lab ID 5036079-	Analysis	Date Collected
12320020-SS02-032410	015	PAHs	3/24/2010
12320020-SS03-032410	016	PAHs	3/24/2010
12320020-SS04-032410	017	PAHs	3/24/2010
12320020-SS05-032410	018	PAHs	3/24/2010
12320020-SS06-032410	019	PAHs	3/24/2010
10427089-WS01-032510	020	PAHs	3/25/2010
Trip Blank	021	VOCs	3/24/2010
10427089-SS01-032510	022	PAHs	3/25/2010
10427089-SS02-032510	023	PAHs	3/25/2010
10427089-SS03-032510	024	PAHs	3/25/2010
10427089-SS04-032510	025	PAHs, VOCs	3/25/2010
10427089-SS05-032510	026	PAHs	3/25/2010
10427089-SS06-032510	027	PAHs	3/25/2010
10427089-SS07-032510	028	PAHs	3/25/2010
10427089-SS08-032510	029	PAHs	3/25/2010
10427089-SS09-032510	030	PAHs	3/25/2010
12320020-WS01-032410	031	PAHs	3/24/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-10427089-WS01-032510 and CLB-12320020-WS01-032410, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-02204039-SS01-032410 as the spiked sample. The percent recoveries were within the laboratory-established control limits. RPDs for eight compounds were above the laboratory-established control limit. Since the recoveries were acceptable, no qualifications were applied to any data based on the MS/MSD RPD alone.

5. Field Duplicate Results

Sample CLB-02204039-SS09-032410 is a duplicate of sample CLB-02204039-SS08-032410. Sample CLB-12320020-SS06-032410 is a duplicate of sample CLB-12320020-SS03-032410. Sample CLB-10427089-SS09-032510 is a duplicate of sample CLB-10427089-SS01-032510.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 0 to 16 percent for field duplicate samples CLB-02204039-SS08-032410/CLB-02204039-SS09-032410 indicating good correlation with each other.

The RPDs ranged from NC (one result ND and one result detected) to 79 percent for field duplicate samples CLB-12320020-SS03-032410/CLB-12320020-SS06-032410. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Acenaphthene	40.6	91.7	77*
Anthracene	121	222	59
Benzo(a)anthracene	303	611	67
Benzo(a)pyrene	323	660	69
Benzo(b)fluoranthene	322	646	67
Benzo(g,h,i)perylene	272	455	50.3
Benzo(k)fluoranthene	319	577	58
Chrysene	361	708	65
Dibenz(a,h)anthracene	95.3	177	60
Fluoranthene	743	1590	73
Fluorene	36.7	84.9	79*
Indeno(1,2,3-cd)pyrene	209	388	60
Naphthalene	64.9	124	63*
Phenanthrene	455	999	75
Pyrene	578	1230	72

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene,

indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene in samples CLB-12320020-SS03-032410 and CLB-12320020-SS06-032410 were flagged "J" as estimated.

The RPDs ranged from NC to 53 percent for field duplicate samples CLB-10427089-SS01-032510/CLB-10427089-SS09-032510. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Anthracene	127	233	53
Fluoranthene	1020	1760	53

Detected results for anthracene and fluoranthene in samples CLB-10427089-SS01-032510 and CLB-10427089-SS09-032510 were flagged "J" as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

VOCs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The trip blank sample, Trip Blank, was free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits with the following exceptions. Acetone was recovered above the control limits in both the aqueous and solid LCS. Acetone was not detected in the samples and no qualification was required.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-10427089-SS04-032510 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits with the following exceptions. Thirteen compounds [2-chlorotoluene; 2-hexanone; 4-chlorotoluene; acrylonitrile; bromobenzene; ethylbenzene; isopropylbenzene (cumene); n-propylbenzene; p-isopropyltoluene; sec-butylbenzene; styrene; trans-1,3-dichloropropene; and xylenes (total)] were recovered below the

laboratory-established control limits but above 20% in the MS and/or MSD. Nine compounds (1,2,3-trichlorobenzene; 1,2,4-trichlorobenzene; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 1,4-dichlorobenzene; hexachloro-1,3-butadiene; n-butylbenzene; trans-1,4-dichloro-2-butene; and vinyl acetate were recovered below the laboratory-established control limits and below 20% in the MS and/or MSD. One compound (ethyl methacrylate) was not recovered in the MS or MSD. The non-detected 2-chlorotoluene; 2-hexanone; 4-chlorotoluene; acrylonitrile; bromobenzene; ethylbenzene; isopropylbenzene (cumene); n-propylbenzene; p-isopropyltoluene; sec-butylbenzene; styrene; trans-1,3-dichloropropene; xylenes (total); 1,2,3-trichlorobenzene; 1,2,4-trichlorobenzene; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 1,4-dichlorobenzene; hexachloro-1,3-butadiene; n-butylbenzene; trans-1,4-dichloro-2-butene; and vinyl acetate results in sample CLB-10427089-SS04-032510 were flagged “UJ” as estimated. The non-detected ethyl methacrylate result in sample CLB-10427089-SS04-032510 was flagged “R” as rejected.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the VOC results are acceptable for use with the exception of the ethyl methacrylate result in sample CLB-10427089-SS04-032510.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036088
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 23 soil samples and three field duplicate samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM
- Polychlorinated Biphenyl Compounds (PCBs) by Method SW-846 8082

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036088-	Analysis	Date Collected
10533036-SS01-032610	001	PAHs	3/26/2010
10533036-SS02-032610	002	PAHs	3/26/2010
10533036-SS03-032610	003	PAHs	3/26/2010
10533036-SS04-032610	004	PAHs	3/26/2010
10533036-SS05-032610	005	PAHs	3/26/2010
10533038-SS01-032610	006	PAHs, PCBs	3/26/2010
10533038-SS02-032610	007	PAHs	3/26/2010
10533038-SS03-032610	008	PAHs	3/26/2010
10533038-SS04-032610	009	PAHs	3/26/2010
10533038-SS05-032610	010	PAHs	3/26/2010
10533038-SS06-032610	011	PAHs	3/26/2010
11827011-SS01-032610	012	PAHs	3/26/2010
11827011-SS02-032610	013	PAHs, PCBs	3/26/2010
11827011-SS03-032610	014	PAHs	3/26/2010
11827011-SS04-032610	015	PAHs	3/26/2010

Samples CLB-	Lab ID 5036088-	Analysis	Date Collected
11827011-SS05-032610	016	PAHs	3/26/2010
11827011-SS06-032610	017	PAHs	3/26/2010
11827012-SS01-032610	018	PAHs	3/26/2010
11827012-SS02-032610	019	PAHs	3/26/2010
11827012-SS03-032610	020	PAHs	3/26/2010
11827012-SS04-032610	021	PAHs	3/26/2010
11827012-SS05-032610	022	PAHs	3/26/2010
11827012-SS06-032610	023	PAHs	3/26/2010
11827012-SS07-032610	024	PAHs	3/26/2010
11827012-SS08-032610	025	PAHs	3/26/2010
11827012-SS09-032610	026	PAHs	3/26/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-10533038-SS05-032610 and CLB-11827011-SS01-032610 as the spiked sample. For sample CLB-10533038-SS05-032610 the percent recoveries were within the laboratory-established control limits with the following exceptions. The MS recoveries of anthracene, benzo(a)anthrancene, fluoranthene, phenanthrene, and pyrene were recovered above control limits. RPDs for 14 compounds were above the laboratory-established control limit. The detected anthracene, benzo(a)anthrancene, fluoranthene, phenanthrene, and pyrene results in sample CLB-10533038-SS05-032610 were flagged “J” as estimated. No qualifications were applied to any data based on the MS/MSD RPD alone.

The percent recoveries for the MS/MSD of sample CLB-11827011-SS01-032610 were within the laboratory-established control limits. RPDs for all compounds were above the laboratory-established control limit. Since the recoveries were acceptable, no qualifications were applied to any data based on the MS/MSD RPD alone.

5. Field Duplicate Results

Sample CLB-10533038-SS06-032610 is a duplicate of sample CLB-10533038-SS05-032610. Sample CLB-11827011-SS06-032610 is a duplicate of sample CLB-11827011-SS01-032610. Sample CLB-11827012-SS09-032610 is a duplicate of sample CLB-11827012-SS02-032610.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 8.2 to 91 percent for field duplicate samples CLB-10533038-SS05-032610/CLB-10533038-SS06-032610. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Acenaphthene	90.3	167	60
Acenaphthylene	77.6	141	71*
Anthracene	365	709	64
Benzo(a)pyrene	1140	2110	60
Benzo(g,h,i)perylene	688	1380	68
Benzo(k)fluoranthene	960	1820	62
Chrysene	1180	1980	51
Dibenz(a,h)anthracene	300	576	63
Fluorene	83.2	154	60
Indeno(1,2,3-cd)pyrene	635	1240	65
Phenanthrene	1310	2280	91

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for acenaphthene, anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, and phenanthrene in samples CLB-10533038-SS05-032610 and CLB-10533038-SS06-032610 were flagged "J" as estimated.

Samples CLB-11827011-SS01-032610 and CLB-11827011-SS06-032610 were non-detect for all compounds indicating good correlation with each other.

The RPDs ranged from 10 to 45 percent for field duplicate samples CLB-11827012-SS02-032610/CLB-11827012-SS09-0325610 indicating good correlation with each other.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

PCBs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-10533038-SS01-032610 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits.

Overall Assessment

Based on the quality control data presented and this validation review, all of the PCB results are acceptable for use without qualification.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036091
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 22 soil samples, one field duplicate sample, and three equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM
- Polychlorinated Biphenyl Compounds (PCBs) by Method SW-846 8082

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	**Lab ID** 5036091-	**Analysis**	**Date Collected**
13408014-SS01-032510	001	PAHs PCBs	3/25/2010
13408014-SS02-032510	002	PAHs	3/25/2010
13408014-SS03-032510	003	PAHs	3/25/2010
13408014-SS04-032510	004	PAHs	3/25/2010
13408014-SS05-032510	005	PAHs	3/25/2010
13408014-SS06-032510	006	PAHs,	3/25/2010
13408014-SS07-032510	007	PAHs	3/25/2010
13408014-SS08-032510	008	PAHs	3/25/2010
13408014-SS09-032510	009	PAHs	3/25/2010
13408014-SS10-032510	010	PAHs	3/25/2010
13408014-SS11-032510	011	PAHs	3/25/2010
13408014-SS12-032510	012	PAHs	3/25/2010
13408014-SS13-032510	013	PAHs	3/25/2010
13408014-SS14-032510	014	PAHs	3/25/2010

Samples CLB-	Lab ID 5036091-	Analysis	Date Collected
13408014-SS15-032510	015	PAHs	3/25/2010
13408014-SS16-032510	016	PAHs	3/25/2010
13408014-SS17-032510	017	PAHs	3/25/2010
10533037-SS01-032610	018	PAHs	3/26/2010
10533037-SS02-032610	019	PAHs	3/26/2010
10533037-SS03-032610	020	PAHs	3/26/2010
10533037-SS04-032610	021	PAHs	3/26/2010
10533037-SS05-032610	022	PAHs	3/26/2010
10533036-SS06-032610	023	PAHs	3/26/2010
10533038-WS01-032610	024	PAHs	3/26/2010
11827011-WS01-032610	025	PAHs	3/26/2010
11827012-WS01-032610	026	PAHs	3/26/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-10533038-WS01-032610, CLB-11827011-WS01-032610, and CLB-11827012-WS01-032610, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-13408014-SS16-032510 and CLB-10533037-SS01-032610 as the spiked sample. The percent recoveries and RPDs in the MS/MSD of sample CLB-13408014-SS16-032510 were within the laboratory-established control limits with one exception. The RPD for fluoranthene in the MS/MSD of sample CLB-13408014-SS16-032510 was above control limits. No qualifications were applied to any data based on the MS/MSD RPD alone.

The recoveries of anthracene, benzo(a)anthrancene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g.h.i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene in the MS of sample CLB-10533037-SS01-032610 were recovered below control limits. RPDs for 15 compounds were above the laboratory-established control limit. The detected anthracene, benzo(a)anthrancene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g.h.i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene results in sample CLB-10533037-SS01-032610 were flagged "J" as estimated. No qualifications were applied to any data based on the MS/MSD RPD alone.

5. Field Duplicate Results

Sample CLB-13408014-SS17-032510 is a duplicate of sample CLB-13408014-SS16-032510.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 0 to 15 percent indicating good correlation with each other.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

PCBs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using a sample from another work order from this site. The percent recoveries and RPDs were within the laboratory-established control limits.

Overall Assessment

Based on the quality control data presented and this validation review, all of the PCB results are acceptable for use without qualification.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036127
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 29 soil samples, two field duplicate samples, and three equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036127-	Analysis	Date Collected
11827013-SS01-032910	001	PAHs	3/29/2010
11827013-SS02-032910	002	PAHs	3/29/2010
11827013-SS03-032910	003	PAHs	3/29/2010
11827013-SS04-032910	004	PAHs	3/29/2010
11827013-SS05-032910	005	PAHs	3/29/2010
11827013-SS06-032910	006	PAHs,	3/29/2010
11827013-SS07-032910	007	PAHs	3/29/2010
11827013-SS08-032910	008	PAHs	3/29/2010
11827013-SS09-032910	009	PAHs	3/29/2010
11827013-SS10-032910	010	PAHs	3/29/2010
11827013-SS11-032910	011	PAHs	3/29/2010
11827013-SS12-032910	012	PAHs	3/29/2010
11827013-SS13-032910	013	PAHs	3/29/2010
11827014-SS01-032910	014	PAHs	3/29/2010
11827014-SS02-032910	015	PAHs	3/29/2010

Samples CLB-	Lab ID 5036127-	Analysis	Date Collected
11827014-SS03-032910	016	PAHs	3/29/2010
11827014-SS04-032910	017	PAHs	3/29/2010
11827014-SS05-032910	018	PAHs	3/29/2010
11827014-SS06-032910	019	PAHs	3/29/2010
11827015-SS01-032910	020	PAHs	3/29/2010
11827015-SS02-032910	021	PAHs	3/29/2010
11827015-SS03-032910	022	PAHs	3/29/2010
11827015-SS04-032910	023	PAHs	3/29/2010
11827015-SS05-032910	024	PAHs	3/29/2010
11827015-SS06-032910	025	PAHs	3/29/2010
11827015-SS07-032910	026	PAHs	3/29/2010
11827016-SS01-032910	027	PAHs	3/29/2010
11827016-SS02-032910	028	PAHs	3/29/2010
11827016-SS03-032910	029	PAHs	3/29/2010
11827016-SS04-032910	030	PAHs	3/29/2010
11827016-SS05-032910	031	PAHs	3/29/2010
11827013-WS01-032910	032	PAHs	3/29/2010
11827015-WS01-032910	033	PAHs	3/29/2010
11827018-WS01-032910	034	PAHs	3/29/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-11827013-WS01-032910, CLB-11827015-WS01-032910, and CLB-11827018-WS01-032910, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-11827013-SS08-032910 and CLB-11827016-SS05-032910 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits.

5. Field Duplicate Results

CLB-11827013-SS13-032910 is a duplicate of sample CLB-11827013-SS08-032910. Sample CLB-11827015-SS07-032910 is a duplicate of sample CLB-11827015-SS05-032910.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 1.3 to 32 percent for field duplicate samples CLB-11827013-SS08-032910/CLB-11827013-SS13-032910 indicating good correlation with each other.

The RPDs ranged from NC (one result ND and one result detected) to 143 percent for field duplicate samples CLB-11827015-SS05-032910/CLB-11827015-SS07-032910. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Anthracene	903	150	143
Benzo(a)anthracene	1760	378	129
Benzo(a)pyrene	1460	396	115
Benzo(b)fluoranthene	1310	365	113
Benzo(g,h,i)perylene	845	236	136
Benzo(k)fluoranthene	1500	364	122
Chrysene	1780	434	122
Dibenz(a,h)anthracene	393	98.9	120
Fluoranthene	4610	907	134
Indeno(1,2,3-cd)pyrene	814	224	114
Phenanthrene	2090	444	130
Pyrene	3500	761	129

Detected results for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene in samples CLB-11827015-SS05-032910 and CLB-11827015-SS07-03291 were flagged “J” as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036136
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 10 soil samples and one field duplicate sample collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	**Lab ID** 5036136-	**Analysis**	**Date Collected**
11827017-SS01-032910	001	PAHs	3/29/2010
11827017-SS02-032910	002	PAHs	3/29/2010
11827017-SS03-032910	003	PAHs	3/29/2010
11827017-SS04-032910	004	PAHs	3/29/2010
11827017-SS05-032910	005	PAHs	3/29/2010
11827018-SS01-032910	006	PAHs,	3/29/2010
11827018-SS02-032910	007	PAHs	3/29/2010
11827018-SS03-032910	008	PAHs	3/29/2010
11827018-SS04-032910	009	PAHs	3/29/2010
11827018-SS05-032910	010	PAHs	3/29/2010
11827018-SS06-032910	011	PAHs	3/29/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using a sample from another work order from this site. Several percent recoveries and RPDs were outside the laboratory-established control limits. No qualifications are applied to samples from this work order.

5. Field Duplicate Results

CLB-11827018-SS06-032910 is a duplicate of sample CLB-11827018-SS01-032910.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from <1 to 54 percent. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Acenaphthene	139	80.3	54*
Fluorene	97.6	56.8	53*

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Overall Assessment

Based on the quality control data presented and this validation review, all of the PAH results are acceptable for use without qualification.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036197
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 33 soil samples, three field duplicate samples, and two equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036197-	Analysis	Date Collected
11818053-SS01-033010	001	PAHs	3/30/2010
11818053-SS02-033010	002	PAHs	3/30/2010
11818053-SS03-033010	003	PAHs	3/30/2010
11818053-SS04-033010	004	PAHs	3/30/2010
11818053-SS05-033010	005	PAHs	3/30/2010
11818053-SS06-033010	006	PAHs,	3/30/2010
11818053-SS07-033010	007	PAHs	3/30/2010
11818053-SS08-033010	008	PAHs	3/30/2010
11818053-SS10-033010	009	PAHs	3/30/2010
11818054-WS01-033010	010	PAHs	3/30/2010
11818055-WS01-033010	011	PAHs	3/30/2010
11818054-SS01-033010	012	PAHs	3/30/2010
11818054-SS02-033010	013	PAHs	3/30/2010
11818054-SS03-033010	014	PAHs	3/30/2010
11818054-SS04-033010	015	PAHs	3/30/2010

Samples CLB-	Lab ID 5036197-	Analysis	Date Collected
11818054-SS05-033010	016	PAHs	3/30/2010
11818054-SS06-033010	017	PAHs	3/30/2010
11818054-SS07-033010	018	PAHs	3/30/2010
11818054-SS08-033010	019	PAHs	3/30/2010
11818054-SS09-033010	020	PAHs	3/30/2010
11818054-SS10-033010	021	PAHs	3/30/2010
11818055-SS01-033010	022	PAHs	3/30/2010
11818055-SS02-033010	023	PAHs	3/30/2010
11818055-SS03-033010	024	PAHs	3/30/2010
11818055-SS04-033010	025	PAHs	3/30/2010
11818055-SS05-033010	026	PAHs	3/30/2010
11818055-SS06-033010	027	PAHs	3/30/2010
11818055-SS07-033010	028	PAHs	3/30/2010
11818055-SS08-033010	029	PAHs	3/30/2010
11818055-SS09-033010	030	PAHs	3/30/2010
11818055-SS10-033010	031	PAHs	3/30/2010
11819069-SS01-033010	032	PAHs	3/30/2010
11819069-SS02-033010	033	PAHs	3/30/2010
11819069-SS03-033010	034	PAHs	3/30/2010
11819069-SS04-033010	035	PAHs	3/30/2010
11819069-SS06-033010	036	PAHs	3/30/2010
11818053-SS09-033010	037	PAHs	3/30/2010
11819069-SS05-033010	038	PAHs	3/30/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody with one exception. Equipment blank sample, CLB-11818053-WS01-033010 was received broken and therefore, not analyzed. All samples were received by the laboratory in good condition with the exception that all samples were received at 11.9 °C. Detected and non-detected results in all samples were flagged “J” and “UJ” as estimated. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-11818054-WS01-033010 and CLB-11818055-WS01-033010, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-11818053-SS09-033010 and CLB-11819069-SS05-033010 as the spiked sample.

For sample CLB-11818053-SS09-033010 the percent recoveries were within the laboratory-established control limits with the following exceptions. The MS recoveries of anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were recovered above control limits. RPDs for 14 compounds were above the laboratory-established control limit. The detected anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene results in sample CLB-11818053-SS09-033010 were flagged “J” as estimated. No qualifications were applied to any data based on the MS/MSD RPD alone.

The percent recoveries and RPDs were within the laboratory-established control limits for the MS/MSD of sample CLB-11819069-SS05-033010.

5. Field Duplicate Results

CLB-11818053-SS10-033010 is a duplicate of sample CLB-11818053-SS09-033010. Sample CLB-11818054-SS10-033010 is a duplicate of sample CLB-11818054-SS08-033010. Sample CLB-11818055-SS10-033010 is a duplicate of sample CLB-11818055-SS09-033010.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 0 to 114 percent for field duplicate samples CLB-11818053-SS09-033010/CLB-11818053-SS10-033010. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Anthracene	37.2	136	114
Benzo(a)anthracene	138	239	54
Benzo(a)pyrene	141	246	54
Benzo(g,h,i)perylene	84.1	141	51*
Benzo(k)fluoranthene	121	211	54

Compound	Sample Concentration	Duplicate Concentration	RPD
Chrysene	133	245	59
Fluoranthene	292	561	63
Phenanthrene	144	316	75
Pyrene	256	494	63

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene in samples CLB-11818053-SS09-033010 and CLB-11818053-SS10-033010 were flagged "J" as estimated.

The RPDs ranged from NC (one result ND and one result detected) to 62 percent for field duplicate samples CLB-11818054-SS008-033010/CLB-11818054-SS10-033010. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Fluorene	147	278	62
Naphthalene	68.3	116	52*

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for fluorene in samples CLB-11818054-SS08-033010 and CLB-11818054-SS10-033010 were flagged "J" as estimated.

The RPDs ranged from 0 to 38 percent for field duplicate samples CLB-11818055-SS09-033010/CLB-11818055-SS10-033010 indicating good correlation with each other.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036274
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 15 soil samples, one field duplicate sample, and three equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036274-	Analysis	Date Collected
11819070-WS01-033110	001	PAHs	3/31/2010
11819072-WS01-033110	002	PAHs	3/31/2010
11819075-WS01-033110	003	PAHs	3/31/2010
11819070-SS01-033110	004	PAHs	3/31/2010
11819070-SS02-033110	005	PAHs	3/31/2010
11819070-SS03-033110	006	PAHs,	3/31/2010
11819070-SS04-033110	007	PAHs	3/31/2010
11819070-SS05-033110	008	PAHs	3/31/2010
11819070-SS06-033110	009	PAHs	3/31/2010
11819070-SS07-033110	010	PAHs	3/31/2010
11819070-SS08-033110	011	PAHs	3/31/2010
11819070-SS09-033110	012	PAHs	3/31/2010
11819071-SS01-033110	013	PAHs	3/31/2010
11819071-SS02-033110	014	PAHs	3/31/2010
11819071-SS03-033110	015	PAHs	3/31/2010

Samples CLB-	Lab ID 5036274-	Analysis	Date Collected
11819071-SS04-033110	016	PAHs	3/31/2010
11819071-SS05-033110	017	PAHs	3/31/2010
11819071-SS06-033110	018	PAHs	3/31/2010
11819071-SS07-033110	019	PAHs	3/31/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-11819070-WS01-033110, CLB-11819072-WS01-033110, and CLB-11819075-WS01-033110, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-11819071-SS02-033110 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits.

5. Field Duplicate Results

CLB-11819070-SS09-033110 is a duplicate of sample CLB-11819070-SS05-033110.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from NC (one result ND and one result detected) to 47 percent for field duplicate samples CLB-11819070-SS05-033110/CLB-11819070-SS09-033110 indicating good correlation with each other.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036277
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 21 soil samples and two field duplicate samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	**Lab ID** 5036277-	**Analysis**	**Date Collected**
11819072-SS01-033110	001	PAHs	3/31/2010
11819072-SS02-033110	002	PAHs	3/31/2010
11819072-SS03-033110	003	PAHs	3/31/2010
11819072-SS04-033110	004	PAHs	3/31/2010
11819072-SS05-033110	005	PAHs	3/31/2010
11819072-SS06-033110	006	PAHs,	3/31/2010
11819072-SS07-033110	007	PAHs	3/31/2010
11819074-SS01-033110	008	PAHs	3/31/2010
11819074-SS02-033110	009	PAHs	3/31/2010
11819074-SS03-033110	010	PAHs	3/31/2010
11819074-SS04-033110	011	PAHs	3/31/2010
11819074-SS05-033110	012	PAHs	3/31/2010
11819074-SS06-033110	013	PAHs	3/31/2010
11819074-SS07-033110	014	PAHs	3/31/2010
11819075-SS01-033110	015	PAHs	3/31/2010
11819075-SS02-033110	016	PAHs	3/31/2010

Samples CLB-	Lab ID 5036277-	Analysis	Date Collected
11819075-SS03-033110	017	PAHs	3/31/2010
11819075-SS04-033110	018	PAHs	3/31/2010
11819075-SS05-033110	019	PAHs	3/31/2010
11819075-SS06-033110	020	PAHs	3/31/2010
11819075-SS07-033110	021	PAHs	3/31/2010
11819075-SS08-033110	022	PAHs	3/31/2010
11819075-SS09-033110	023	PAHs	3/31/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-11819075-SS05-033110 and a sample from another work order from this site as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits.

5. Field Duplicate Results

CLB-11819072-SS07-033110 is a duplicate of sample CLB-11819072-SS02-033110. CLB-11819075-SS09-033110 is a duplicate of sample CLB-11819075-SS05-033110.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 0 to 23 percent for field duplicate samples CLB-11819072-SS02-033110/CLB-11819072-SS07-033110 indicating good correlation with each other.

The RPDs ranged from 0 to 96 percent for field duplicate samples CLB-11819075-SS05-033110/CLB-11819075-SS09-033110. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Benzo(a)anthracene	109	58.2	61*
Benzo(b)fluoranthene	97.4	56.6	53*
Chrysene	113	62.4	58*
Fluoranthene	256	123	70
Phenanthrene	154	53.9	96
Pyrene	215	107	67

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for fluoranthene, phenanthrene, and pyrene in samples CLB-11819075-SS05-033110 and CLB-11819075-SS09-033110 were flagged “J” as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036320
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 18 soil samples, two field duplicate samples, and two equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036320-	Analysis	Date Collected
11818076-WS01-040210	001	PAHs	4/2/2010
11819076-WS01-040210	002	PAHs	4/2/2010
11819076-SS01-040210	003	PAHs	4/2/2010
11819076-SS02-040210	004	PAHs	4/2/2010
11819076-SS03-040210	005	PAHs	4/2/2010
11819076-SS04-040210	006	PAHs,	4/2/2010
11819076-SS05-040210	007	PAHs	4/2/2010
11819076-SS06-040210	008	PAHs	4/2/2010
11819076-SS07-040210	009	PAHs	4/2/2010
11819076-SS08-040210	010	PAHs	4/2/2010
11819076-SS09-040210	011	PAHs	4/2/2010
11818077-SS01-040210	012	PAHs	4/2/2010
11818077-SS02-040210	013	PAHs	4/2/2010
11818077-SS03-040210	014	PAHs	4/2/2010
11818077-SS04-040210	015	PAHs	4/2/2010

Samples CLB-	Lab ID 5036320-	Analysis	Date Collected
11818077-SS05-040210	016	PAHs	4/2/2010
11818077-SS06-040210	017	PAHs	4/2/2010
11818077-SS07-040210	018	PAHs	4/2/2010
11818077-SS08-040210	019	PAHs	4/2/2010
11818077-SS09-040210	020	PAHs	4/2/2010
11818077-SS10-040210	021	PAHs	4/2/2010
11818077-SS11-040210	022	PAHs	4/2/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody with one exception. Equipment blank sample, CLB-11818077-WS01-040210 was received broken and therefore, not analyzed. All other samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-11818076-WS01-040210 and CLB-11819076-WS01-040210, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-11818077-SS02-040210 and CLB-11818077-SS08-040210 as the spiked sample.

The percent recoveries and RPDs were within the laboratory-established control limits for the MS/MSD of samples CLB-11818077-SS02-040210 and CLB-11818077-SS08-040210.

5. Field Duplicate Results

CLB-11819076-SS09-040210 is a duplicate of sample CLB-11819076-SS06-040210. Sample CLB-11818077-SS11-040210 is a duplicate of sample CLB-11818077-SS01-040210.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 0 to 20 percent for field duplicate samples CLB-11819076-SS06-040210/CLB-11819076-SS09-040210 indicating good correlation with each other.

The RPDs ranged from 19 to 81 percent for field duplicate samples CLB-11818077-SS01-040210/CLB-11818077-SS11-040210. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Acenaphthene	80.5	190	81
Fluorene	82.8	187	77
Naphthalene	154	327	72

Detected results for acenaphthene, fluorene, and naphthalene in samples CLB-11818077-SS01-040210 and CLB-11818077-SS11-040210 were flagged “J” as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036321
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 18 soil samples and two field duplicate samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	**Lab ID** 5036321-	**Analysis**	**Date Collected**
11818076-SS01-040210	001	PAHs	4/2/2010
11818076-SS02-040210	002	PAHs	4/2/2010
11818076-SS03-040210	003	PAHs	4/2/2010
11818076-SS04-040210	004	PAHs	4/2/2010
11818076-SS05-040210	005	PAHs	4/2/2010
11818076-SS06-040210	006	PAHs,	4/2/2010
11818076-SS07-040210	007	PAHs	4/2/2010
11818076-SS08-040210	008	PAHs	4/2/2010
11818076-SS09-040210	009	PAHs	4/2/2010
11818076-SS10-040210	010	PAHs	4/2/2010
11818078-SS01-040210	011	PAHs	4/2/2010
11818078-SS02-040210	012	PAHs	4/2/2010
11818078-SS03-040210	013	PAHs	4/2/2010
11818078-SS04-040210	014	PAHs	4/2/2010
11818078-SS05-040210	015	PAHs	4/2/2010
11818078-SS06-040210	016	PAHs	4/2/2010

Samples CLB-	Lab ID 5036321-	Analysis	Date Collected
11818078-SS07-040210	017	PAHs	4/2/2010
11818078-SS08-040210	018	PAHs	4/2/2010
11818078-SS09-040210	019	PAHs	4/2/2010
11818078-SS10-040210	020	PAHs	4/2/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples from another work order from this site. The percent recoveries and RPDs were within the laboratory-established control limits.

5. Field Duplicate Results

CLB-11818076-SS10-040210 is a duplicate of sample CLB-11818076-SS01-040210. Sample CLB-11818078-SS10-040210 is a duplicate of sample CLB-11818078-SS06-040210.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 1.2 to 23 percent for field duplicate samples CLB-11818076-SS01-040210/CLB-11818076-SS10-040210 indicating good correlation with each other.

The RPDs ranged from NC (one result ND and one result detected) to 57 percent for field duplicate samples CLB-11818078-SS06-040210/CLB-11818078-SS10-040210. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Benzo(b)fluoranthene	5530	3090	57
Benzo(g,h,i)perylene	4110	2450	51

Detected results for benzo(b)fluoranthene and benzo(g,h,i)perylene in samples CLB-11818078-SS06-040210 and CLB-11818078-SS10-0402100 were flagged "J" as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036366
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 15 soil samples, two field duplicate samples, and five equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM
- Polychlorinated Biphenyl Compounds (PCBs) by Method SW-846 8082

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036366-	Analysis	Date Collected
14225131-WS01-040510	001	PAHs	4/5/2010
14227156-WS01-040510	002	PAHs	4/5/2010
00630009-WS01-040510	003	PAHs	4/5/2010
01614017-WS01-040510	004	PAHs	4/5/2010
02006013-WS01-040510	005	PAHs	4/5/2010
00630009-SS01-040510	006	PAHs,	4/5/2010
00630009-SS02-040510	007	PAHs	4/5/2010
00630009-SS03-040510	008	PAHs, PCBs	4/5/2010
00630009-SS04-040510	009	PAHs	4/5/2010
00630009-SS05-040510	010	PAHs	4/5/2010
00630009-SS06-040510	011	PAHs	4/5/2010
00630010-SS01-040510	012	PAHs	4/5/2010
00630010-SS02-040510	013	PAHs	4/5/2010
00630010-SS03-040510	014	PAHs	4/5/2010

Samples CLB-	Lab ID 5036366-	Analysis	Date Collected
00630010-SS04-040510	015	PAHs	4/5/2010
00630010-SS05-040510	016	PAHs	4/5/2010
00630010-SS06-040510	017	PAHs	4/5/2010
14225131-SS01-040510	018	PAHs	4/5/2010
14225131-SS02-040510	019	PAHs	4/5/2010
14225131-SS03-040510	020	PAHs	4/5/2010
14225131-SS04-040510	021	PAHs	4/5/2010
14225131-SS05-040510	022	PAHs	4/5/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-14225131-WS01-040510, CLB-14227156-WS01-040510, CLB-00630009-WS01-040510, CLB-01614017-WS01-040510, and CLB-02006013-WS01-040510, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-14225131-SS03-040510 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits with one exception. The RPD for fluoranthene was above control limits. No qualifications were applied to any data based on the MS/MSD RPD alone.

5. Field Duplicate Results

Sample CLB-00630009-SS06-040510 is a duplicate of sample CLB-00630009-SS03-040510. Sample CLB-14225131-SS05-040510 is a duplicate of sample CLB-14225131-SS03-040510.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from NC (one result ND and one result detected) to 67 percent for field duplicate samples CLB-00630009-SS03-040510/CLB-00630009-SS06-040510. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Anthracene	91.3	184	67
Phenanthrene	332	618	60

Detected results for anthracene and phenanthrene in samples CLB-00630009-SS03-040510 and CLB-00630009-SS06-040510 were flagged "J" as estimated.

The RPDs ranged from 0 to 68 percent for samples CLB-14225131-SS03-040510/CLB-14225131-SS05-040510. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
2-Methylnaphthalene	49.5	100	68*

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

PCBs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using a sample from another work order from this site. The percent recoveries and RPDs were within the laboratory-established control limits.

Overall Assessment

Based on the quality control data presented and this validation review, all of the PCB results are acceptable for use without qualification.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036368
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 22 soil samples, three field duplicate samples, and one equipment blank sample collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM
- Polychlorinated Biphenyl Compounds (PCBs) by Method SW-846 8082

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036368-	Analysis	Date Collected
01614017-SS01-040510	001	PAHs	4/5/2010
01614017-SS02-040510	002	PAHs	4/5/2010
01614017-SS03-040510	003	PAHs	4/5/2010
01614017-SS04-040510	004	PAHs	4/5/2010
01614017-SS05-040510	005	PAHs	4/5/2010
01614017-SS06-040510	006	PAHs,	4/5/2010
01614017-SS07-040510	007	PAHs, PCBs	4/5/2010
01614017-SS08-040510	008	PAHs	4/5/2010
01614017-SS09-040510	009	PAHs	4/5/2010
14227156-SS01-040510	010	PAHs	4/5/2010
14227156-SS02-040510	011	PAHs	4/5/2010
14227156-SS03-040510	012	PAHs	4/5/2010
14227156-SS04-040510	013	PAHs	4/5/2010
14227156-SS05-040510	014	PAHs	4/5/2010

Samples CLB-	Lab ID 5036368-	Analysis	Date Collected
14227156-SS06-040510	015	PAHs	4/5/2010
02006013-SS01-040510	016	PAHs, PCBs	4/5/2010
02006013-SS02-040510	017	PAHs	4/5/2010
02006013-SS03-040510	018	PAHs	4/5/2010
02006013-SS04-040510	019	PAHs	4/5/2010
02006013-SS05-040510	020	PAHs	4/5/2010
02006013-SS06-040510	021	PAHs	4/5/2010
02006013-SS07-040510	022	PAHs	4/5/2010
02006013-SS08-040510	023	PAHs	4/5/2010
02006013-SS09-040510	024	PAHs	4/5/2010
02006013-SS10-040510	025	PAHs	4/5/2010
11818078-WS01-040210	026	PAHs	4/2/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank sample, CLB-11818078-WS01-040210, was free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-01614017-SS04-040510, CLB-01614017-SS05-040510, and a sample another work order from this site as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits.

5. Field Duplicate Results

Sample CLB-01614017-SS09-040510 is a duplicate of sample CLB-01614017-SS03-040510. Sample CLB-14227156-SS06-040510 is a duplicate of sample CLB-14227156-SS01-040510. Sample CLB-02006013-SS10-040510 is a duplicate of sample CLB-02006013-SS07-040510.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

Field duplicate samples CLB-01614017-SS03-040510/CLB-01614017-SS09-040510 were non-detect for all compounds indicating a good correlation with each other.

The RPDs ranged from 0 to 115 percent for field duplicate samples CLB-14227156-SS01-040510/CLB-14227156-SS06-040510. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Anthracene	238	64.2	115
Benzo(a)anthracene	702	263	91
Benzo(a)pyrene	603	277	74
Benzo(b)fluoranthene	568	277	72
Benzo(g,h,i)perylene	341	177	63
Benzo(k)fluoranthene	519	256	68
Chrysene	639	285	77
Dibenz(a,h)anthracene	160	74.9	72*
Fluoranthene	1600	666	82
Indeno(1,2,3-cd)pyrene	334	165	68
Phenanthrene	841	304	94
Pyrene	1130	476	81

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene in samples CLB-14227156-SS01-040510 and CLB-14227156-SS06-040510 were flagged “J” as estimated.

The RPDs ranged from 0 to 19 percent for samples CLB-02006013-SS07-040510/CLB-02006013-SS10-040510 showing good correlation with each other.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

PCBs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using a sample from another work order from this site. The percent recoveries and RPDs were within the laboratory-established control limits.

Overall Assessment

Based on the quality control data presented and this validation review, all of the PCB results are acceptable for use without qualification.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036392
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 20 soil samples and one field duplicate sample collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	Lab ID 5036392-	Analysis	Date Collected
10614014-SS02-040610	001	PAHs	4/6/2010
10614014-SS03-040610	002	PAHs	4/6/2010
10614014-SS04-040610	003	PAHs	4/6/2010
10614014-SS05-040610	004	PAHs	4/6/2010
10614014-SS06-040610	005	PAHs	4/6/2010
10614014-SS07-040610	006	PAHs,	4/6/2010
10614014-SS08-040610	007	PAHs	4/6/2010
10614014-SS09-040610	008	PAHs	4/6/2010
10614014-SS10-040610	009	PAHs	4/6/2010
10614014-SS11-040610	010	PAHs	4/6/2010
10614014-SS12-040610	011	PAHs	4/6/2010
10614014-SS13-040610	012	PAHs	4/6/2010
10614015-SS01-040610	013	PAHs	4/6/2010
10614015-SS02-040610	014	PAHs	4/6/2010
10614015-SS03-040610	015	PAHs	4/6/2010
10614015-SS04-040610	016	PAHs	4/6/2010

Samples CLB-	Lab ID 5036392-	Analysis	Date Collected
10614015-SS05-040610	017	PAHs	4/6/2010
10614015-SS06-040610	018	PAHs	4/6/2010
10614015-SS07-040610	019	PAHs	4/6/2010
10614015-SS08-040610	020	PAHs	4/6/2010
10614015-SS09-040610	021	PAHs	4/6/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using samples CLB-10614015-SS03-040610 and a sample another work order from this site as the spiked sample.

The percent recoveries and RPDs were within the laboratory-established control limits for the MS/MSD of sample CLB-10614015-SS03-040610.

One recovery and 8 RPDs were high in the sample from another work order from this site. No qualifications were applied to the data in this work order.

5. Field Duplicate Results

CLB-10614014-SS13-040610 is a duplicate of sample CLB-10614014-SS06-040610.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from NC (one result ND and one result detected) to 170 percent. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Acenaphthene	479	39.5	170
Acenaphthylene	156	65.1	82
Anthracene	1430	171	157
Benzo(a)anthracene	3710	731	134
Benzo(a)pyrene	3310	748	126
Benzo(b)fluoranthene	2940	675	125
Benzo(g,h,i)perylene	1900	471	121
Benzo(k)fluoranthene	2820	662	124
Chrysene	3300	686	131
Dibenz(a,h)anthracene	869	204	124
Fluoranthene	9860	1660	142
Fluorene	489	44.4	167
Indeno(1,2,3-cd)pyrene	1810	441	122
Phenanthrene	4790	530	160
Pyrene	6680	1270	136

Detected results for acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene in samples CLB-10614014-SS06-040610 and CLB-10614014-SS13-040610 were flagged “J” as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

START 3
Cleveland Land Bank
DATA VALIDATION REPORT

Date: February 15, 2011
Laboratory: Pace
Laboratory Project #: 5036395
Data Validation Performed By: Gloria J. Switalski (Weston) Superfund Technical Assessment and Response Team (START)
Weston Work Order #: 20405.012.016.0904.00

This data validation report has been prepared by WESTON START under the START III Region V contract. This report documents the data validation for 13 soil samples, one field duplicate sample, and three equipment blank samples collected for the Cleveland Land Bank project. Samples were analyzed for the parameters below following the stated methods:

- Polynuclear Aromatic Hydrocarbons (PAHs) by Method SW-846 8270SIM
- Polychlorinated Biphenyl Compounds (PCBs) by Method SW-846 8082

A level II data package was requested from Pace. The data validation was conducted in general accordance with the U.S. EPA "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", dated June 2008 and the applicable methods listed above.

General

1. Samples

The following table summarizes the samples for which this data validation is being conducted.

Samples CLB-	**Lab ID** 5036395-	**Analysis**	**Date Collected**
11501027-WS01-040610	001	PAHs	4/6/2010
11501028-WS01-040610	002	PAHs	4/6/2010
10614014-WS01-040610	003	PAHs	4/6/2010
11501027-SS01-040610	004	PAHs	4/6/2010
11501027-SS02-040610	005	PAHs, PCBs	4/6/2010
11501027-SS03-040610	006	PAHs,	4/6/2010
11501027-SS04-040610	007	PAHs	4/6/2010
11501027-SS05-040610	008	PAHs	4/6/2010
11501027-SS06-040610	009	PAHs	4/6/2010
11501027-SS07-040610	010	PAHs	4/6/2010
11501028-SS01-040610	011	PAHs	4/6/2010
11501028-SS02-040610	012	PAHs	4/6/2010
11501028-SS03-040610	013	PAHs	4/6/2010
11501028-SS04-040610	014	PAHs	4/6/2010

Samples CLB-	Lab ID 5036395-	Analysis	Date Collected
11501028-SS05-040610	015	PAHs	4/6/2010
11501028-SS06-040610	016	PAHs	4/6/2010
10614014-SS01-040610	017	PAHs, PCBs	4/6/2010

2. Holding Times / Sample Receipt

Samples were received intact and under custody. All samples were received by the laboratory in good condition. All samples were extracted and/or analyzed within method required holding times.

PAHs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

The equipment blank samples, CLB-11501027-WS01-040610, CLB-11501028-WS01-040610, and CLB-10614014-WS01-040610, were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Pace analyzed an MS and MSD using sample CLB-1151501027-SS04-040610 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits with the following exceptions. The MS recovery of fluoranthene was recovered above the control limit. RPDs for 8 compounds were above the laboratory-established control limit. The detected fluoranthene result in sample CLB-1151501027-SS04-040610 was flagged “J” as estimated. No qualifications were applied to any data based on the MS/MSD RPD alone.

5. Field Duplicate Results

Sample CLB-11501027-SS07-040610 is a duplicate of sample CLB-11501027-SS02-040610.

The field duplicate results were evaluated by calculating RPDs between the investigative and field duplicate sample results. Note that there is no established quality control limit for RPD for field duplicates; however, 50 RPD is generally used for evaluation.

The RPDs ranged from 0 to 133 percent. RPDs >50 are listed below:

Compound	Sample Concentration	Duplicate Concentration	RPD
Anthracene	41.8	114	93*
Benzo(a)anthracene	147	338	79
Benzo(a)pyrene	148	318	73
Benzo(b)fluoranthene	134	259	64
Benzo(g,h,i)perylene	95.8	192	67
Benzo(k)fluoranthene	137	277	68
Chrysene	143	287	67
Dibenz(a,h)anthracene	41.8	88.8	72*
Fluoranthene	317	664	133
Indeno(1,2,3-cd)pyrene	89.4	181	68
Phenanthrene	129	273	72
Pyrene	246	529	73

*Sample concentrations <5x reporting limit (RL) and absolute difference between the samples <3.5 times RL; no qualification applied.

Detected results for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene in samples CLB-11501027-SS02-040610 and CLB-11501027-SS07-040610 were flagged "J" as estimated.

Overall Assessment

Based on the quality control data presented and this validation review and the required qualifications, all of the PAH results are acceptable for use.

PCBs

1. Blanks

Method blanks were analyzed with the samples and were free of target compound contamination above the reporting limits.

2. Surrogate Results

The surrogate spike recoveries were within the laboratory-established control limits.

3. LCS Results

The LCS recoveries were within the laboratory-established control limits.

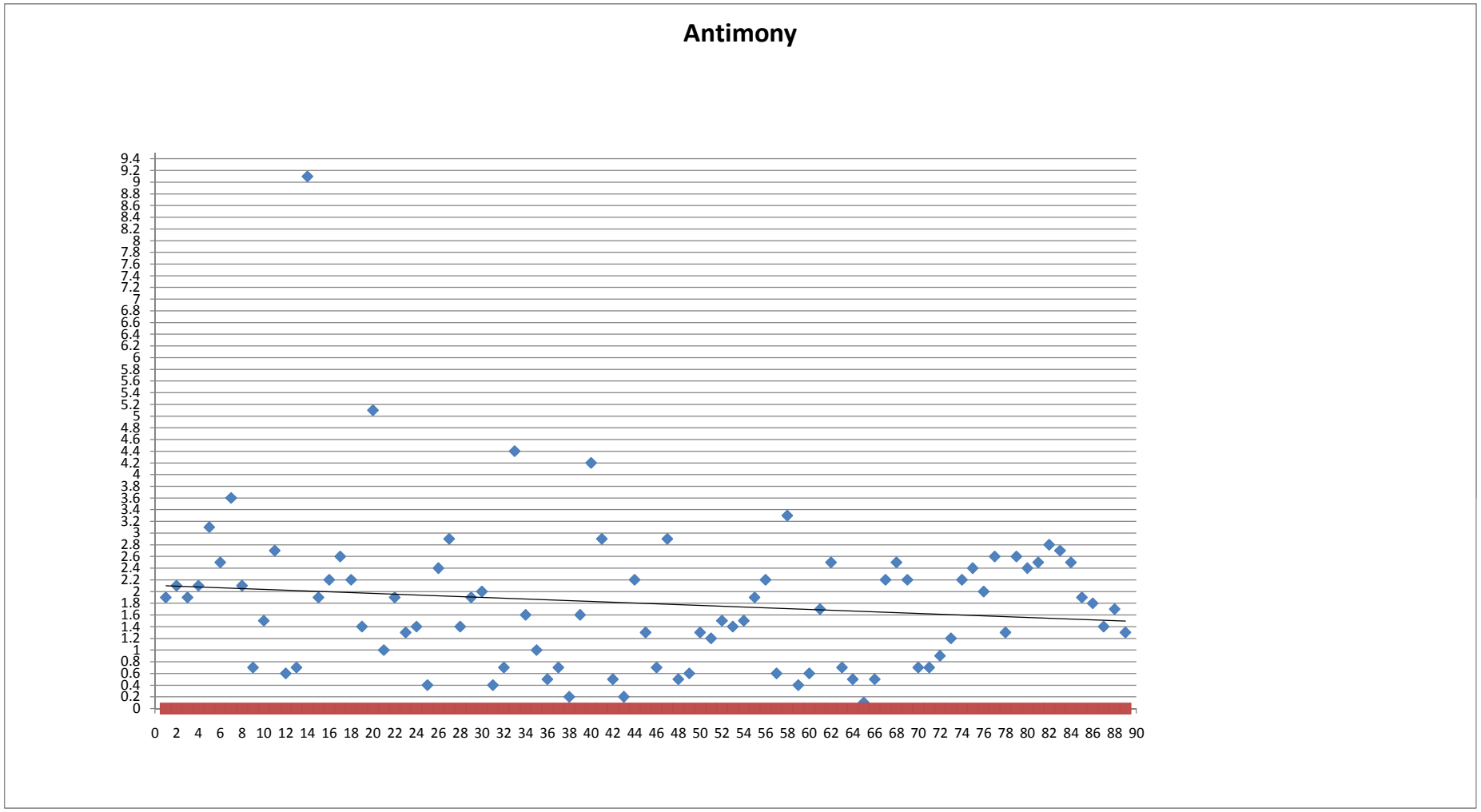
4. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

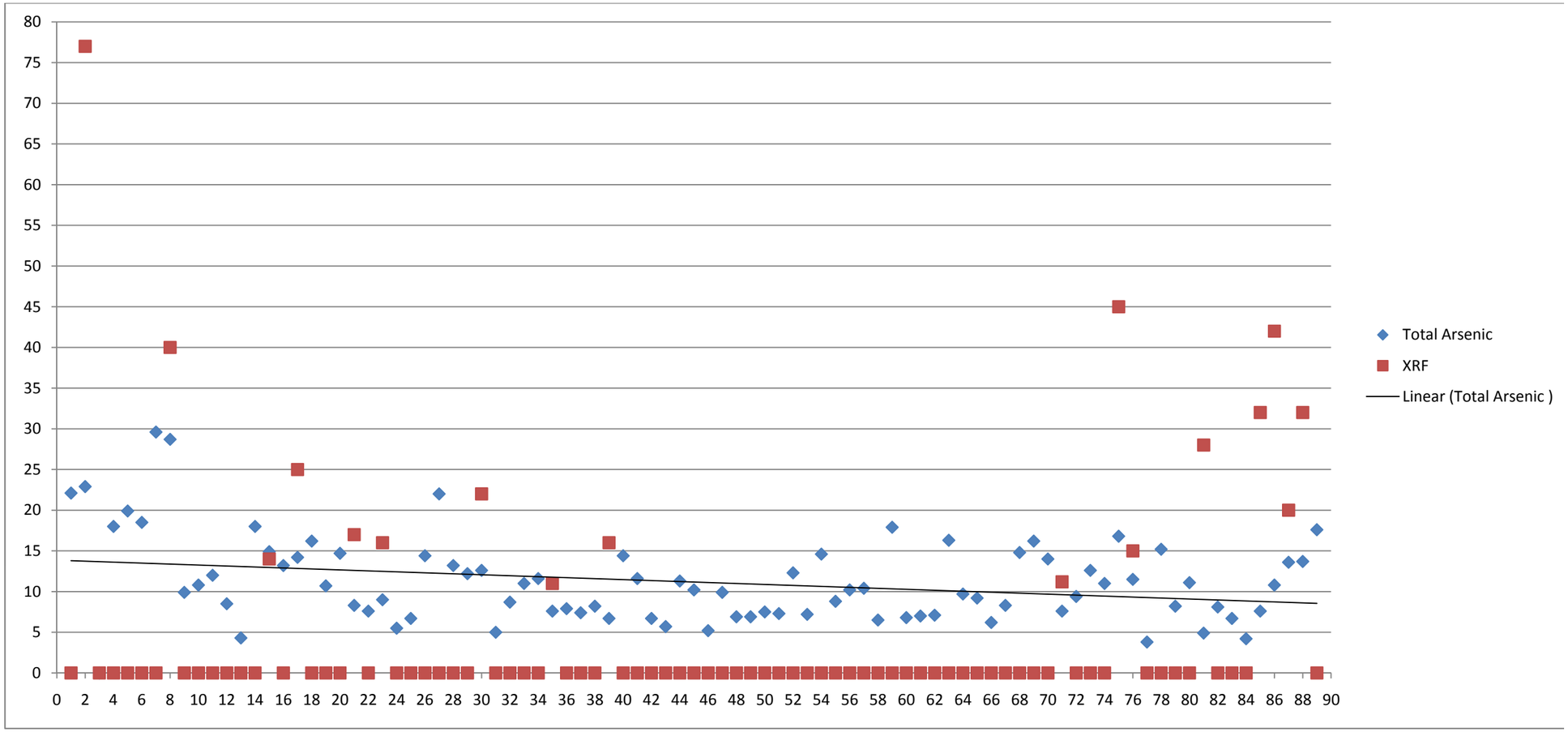
Pace analyzed an MS and MSD using a sample CLB-11501027-SS02-040610 as the spiked sample. The percent recoveries and RPDs were within the laboratory-established control limits.

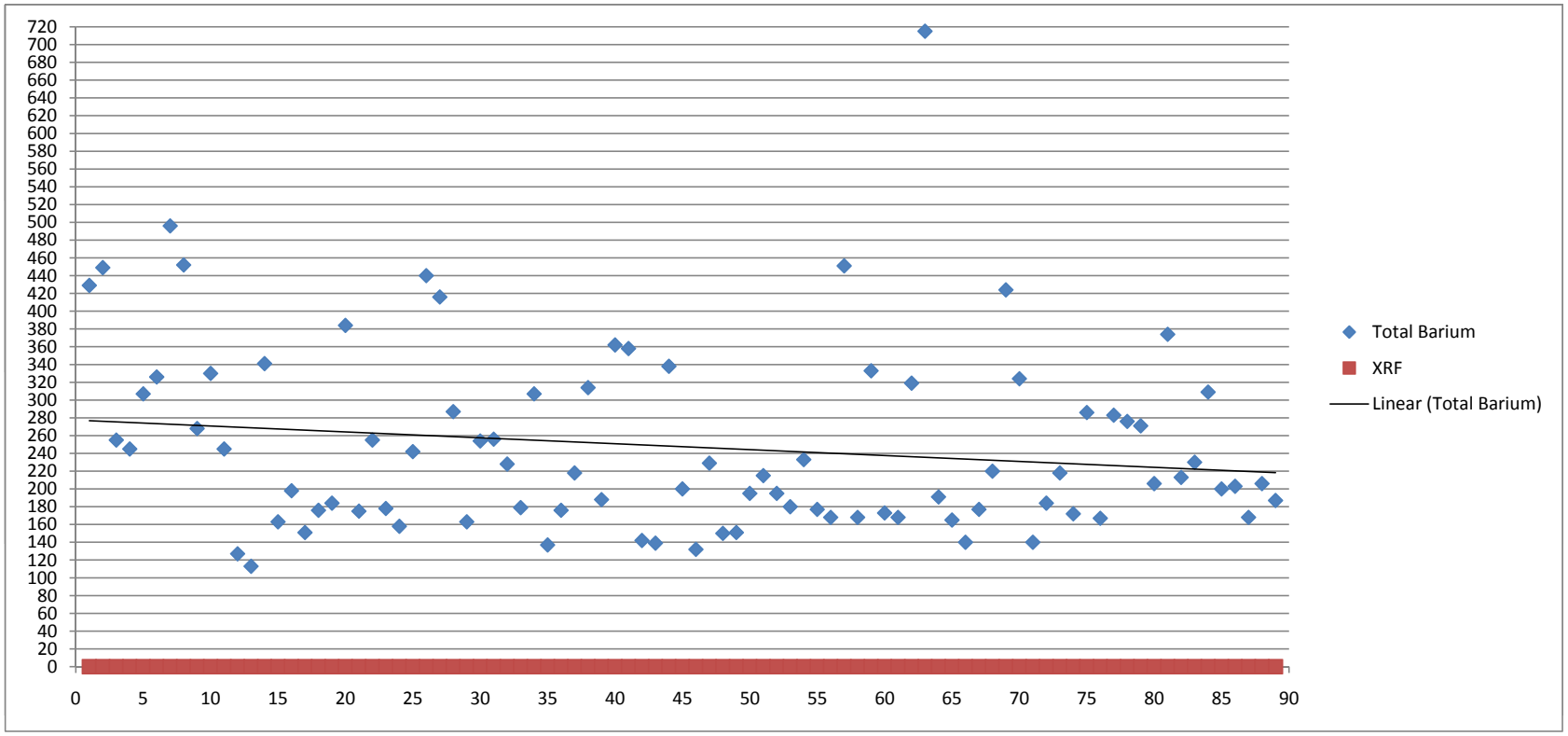
Overall Assessment

Based on the quality control data presented and this validation review, all of the PCB results are acceptable for use without qualification.

APPENDIX F
SCATTER PLOTS: LABORATORY METALS RESULTS VS. XRF RESULTS


Antimony
9.4
9.2
9
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90


80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
Total Arsenic
XRF
Linear (Total Arsenic)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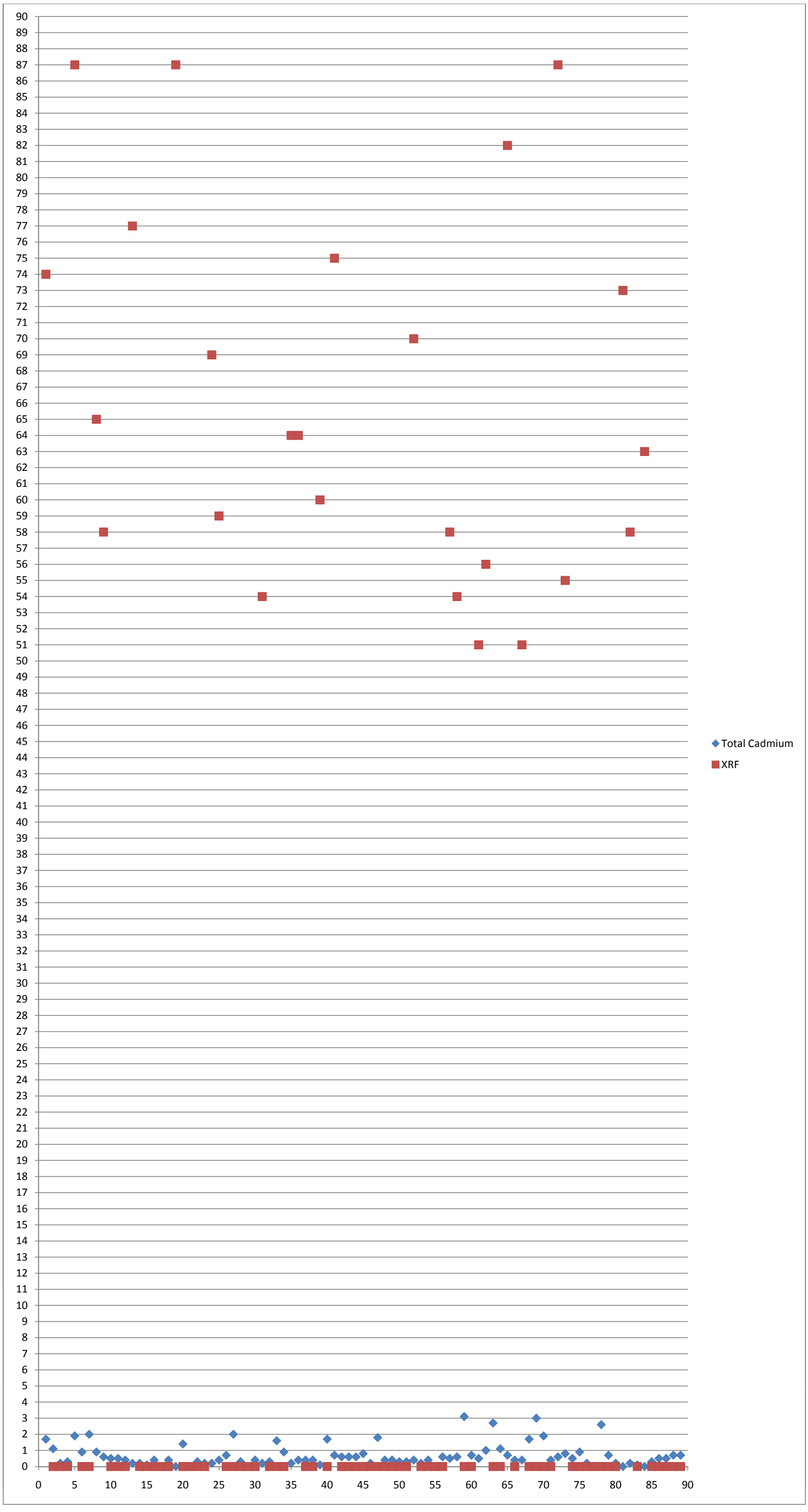
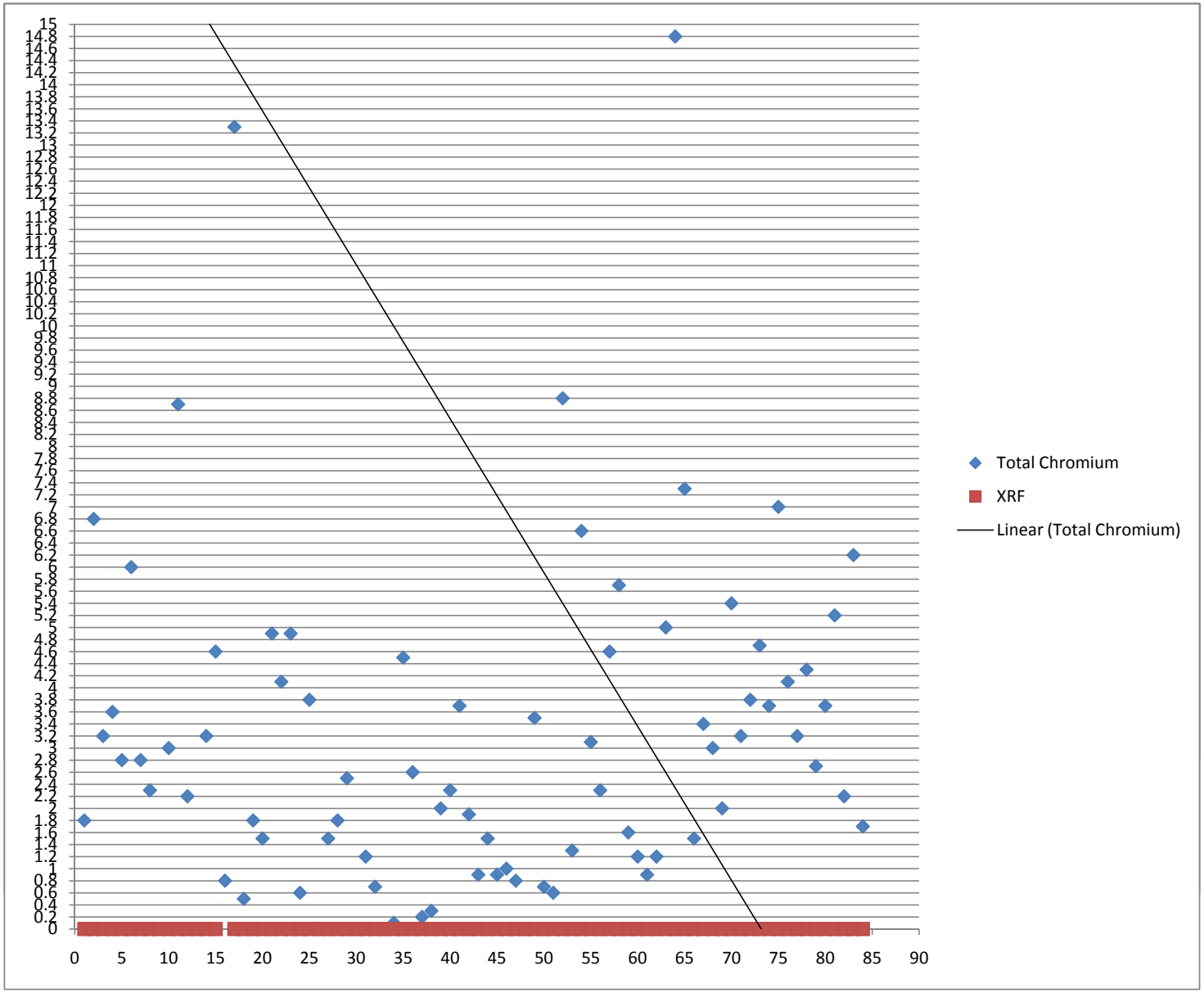
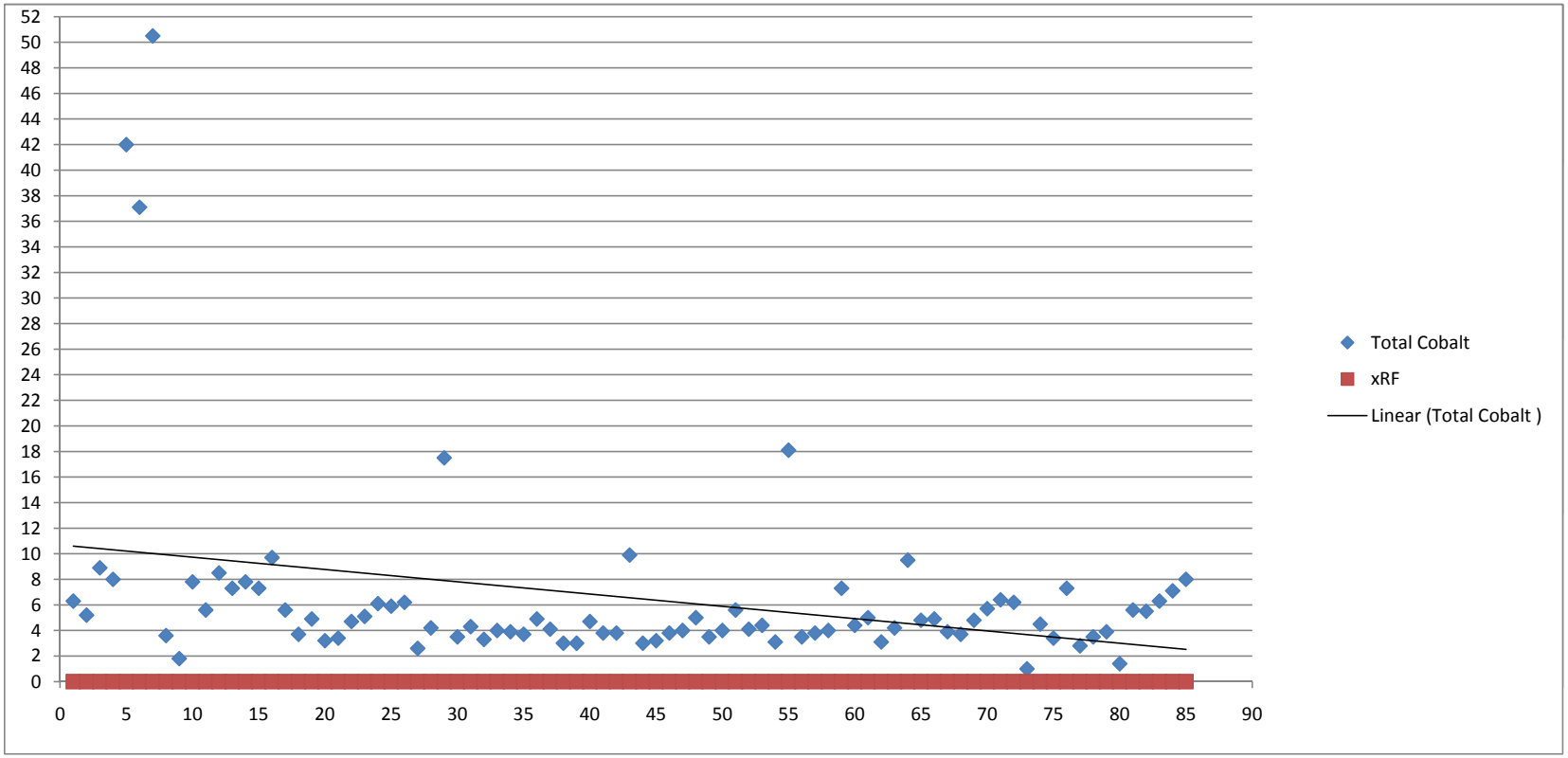
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Total Barium
XRF
Linear (Total Barium)


Total Cadmium
XRF


Total Chromium
XRF
Linear (Total Chromium)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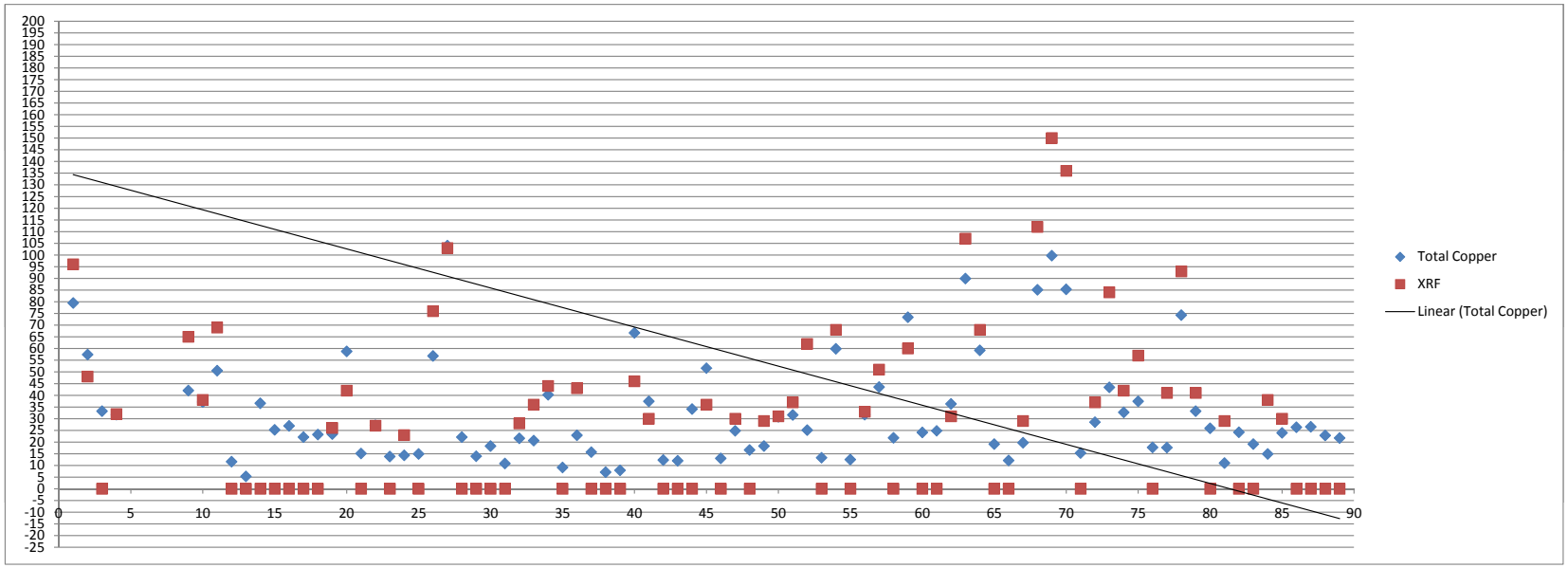
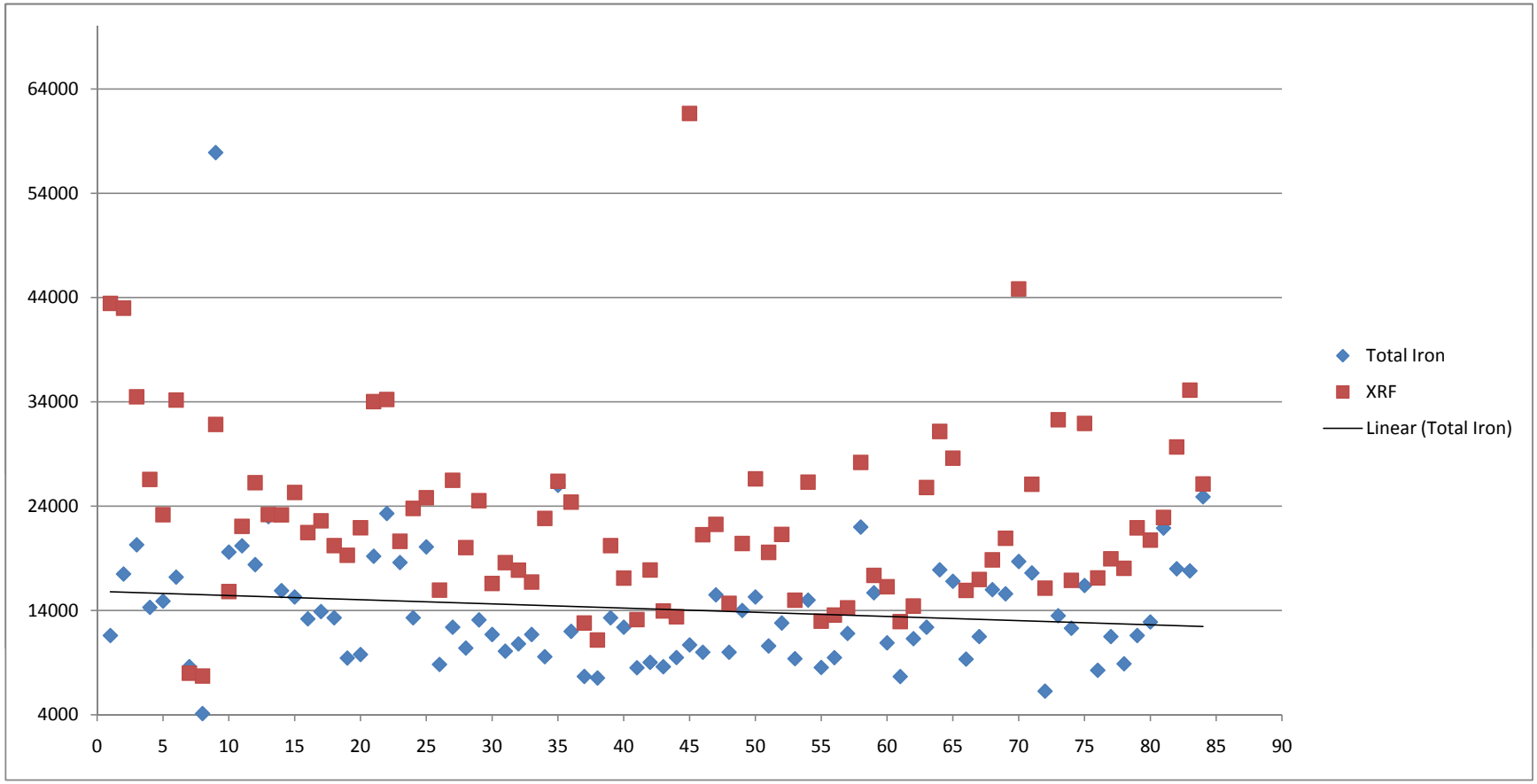
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Total Cobalt
xRF
Linear (Total Cobalt)


Total Copper
XRF
Linear (Total Copper)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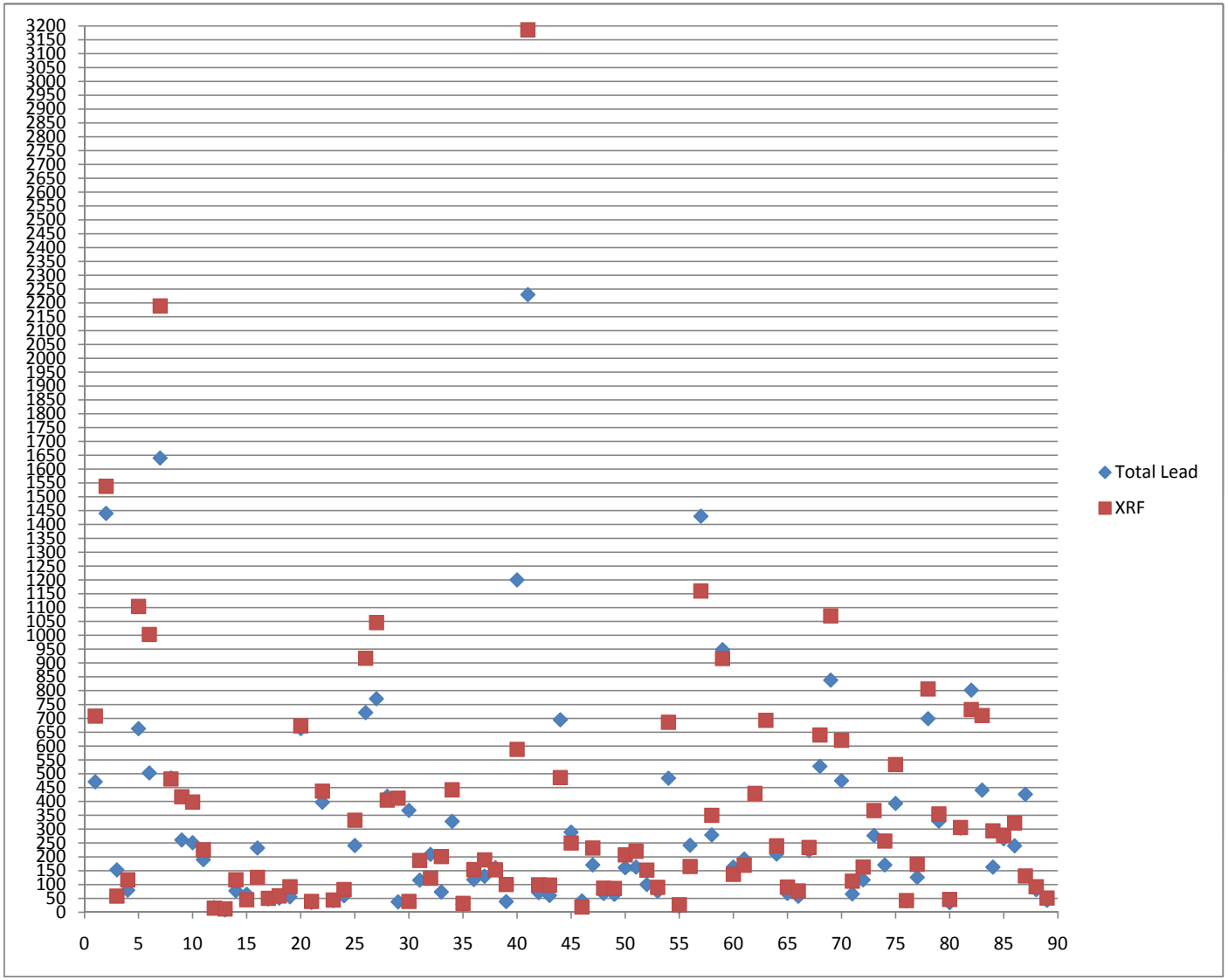
44000
34000
24000
14000
4000
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Total Iron
XRF
Linear (Total Iron)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3100
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2800
2750
2700
2650
2600
2550
2500
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2300
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2200
2150
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2050
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1750
1700
1650
1600
1550
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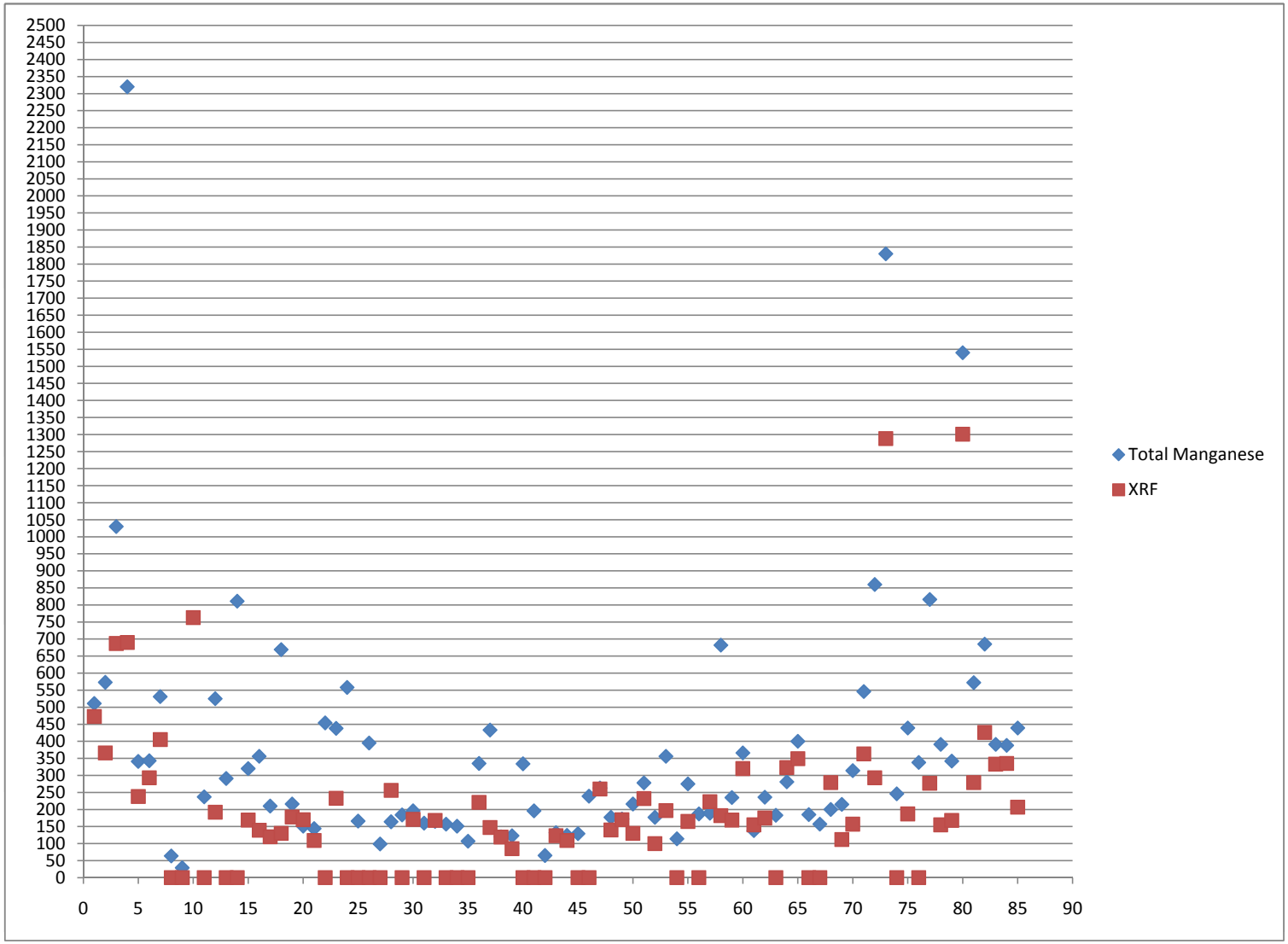
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Total Lead
XRF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2400
2350
2300
2250
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2150
2100
2050
2000
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1900
1850
1800
1750
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1000
950
900
850
800
750
700
650
600
550
500
450
400
350
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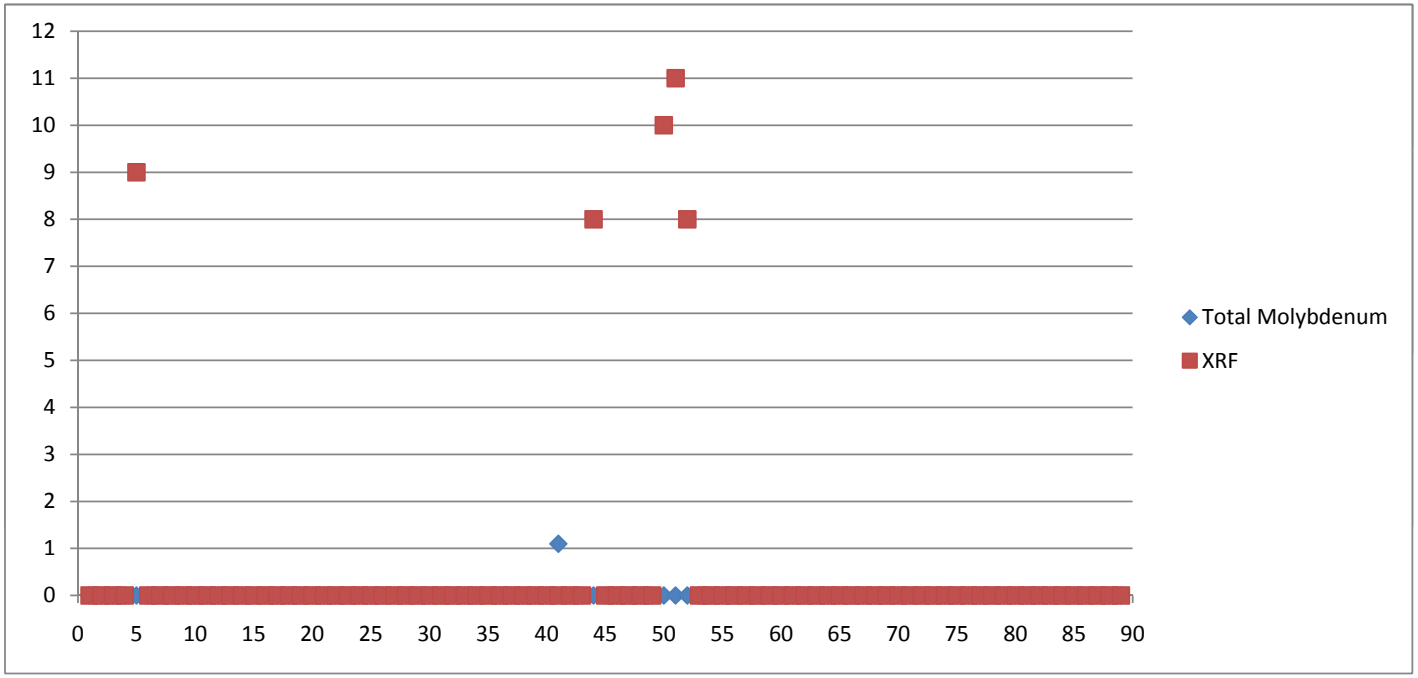
250
200
150
100
50
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
Total Manganese
XRF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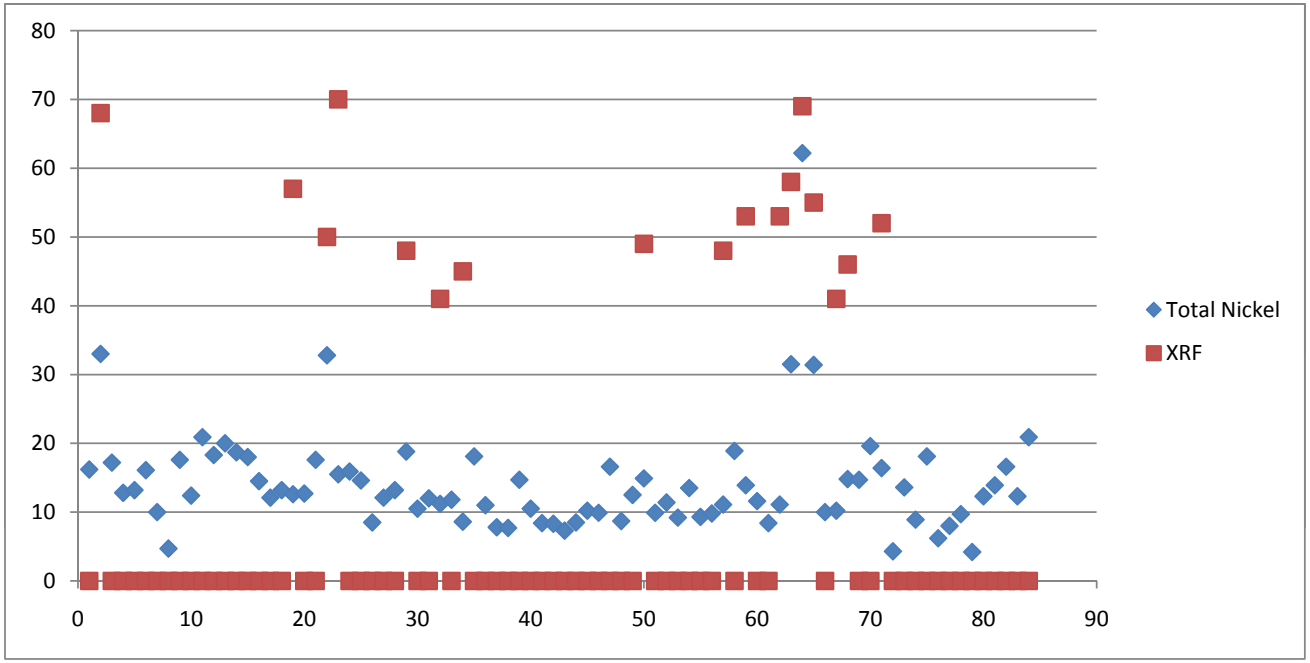
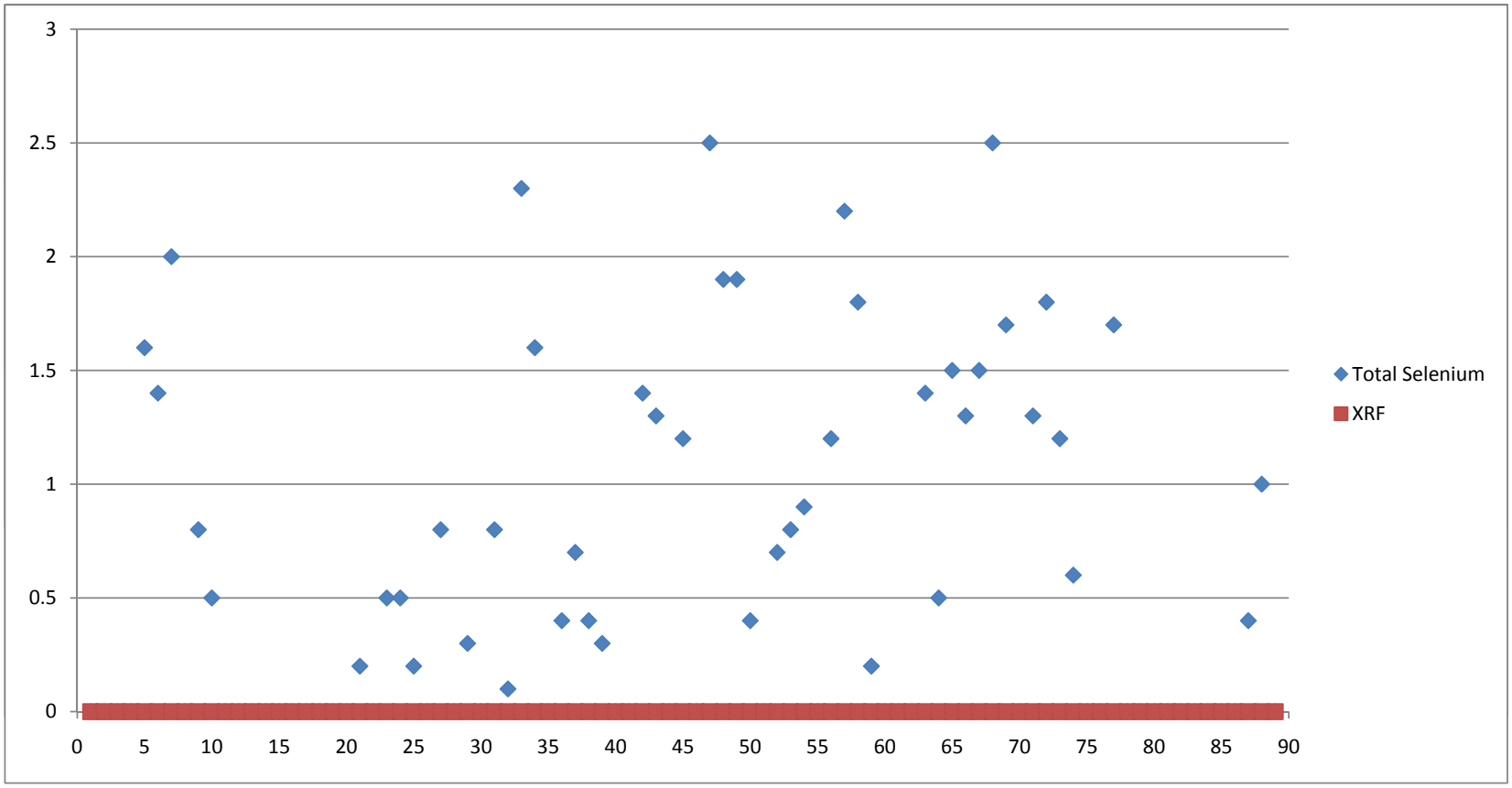
10
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Total Molybdenum
XRF


80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
Total Nickel
XRF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0
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10
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40
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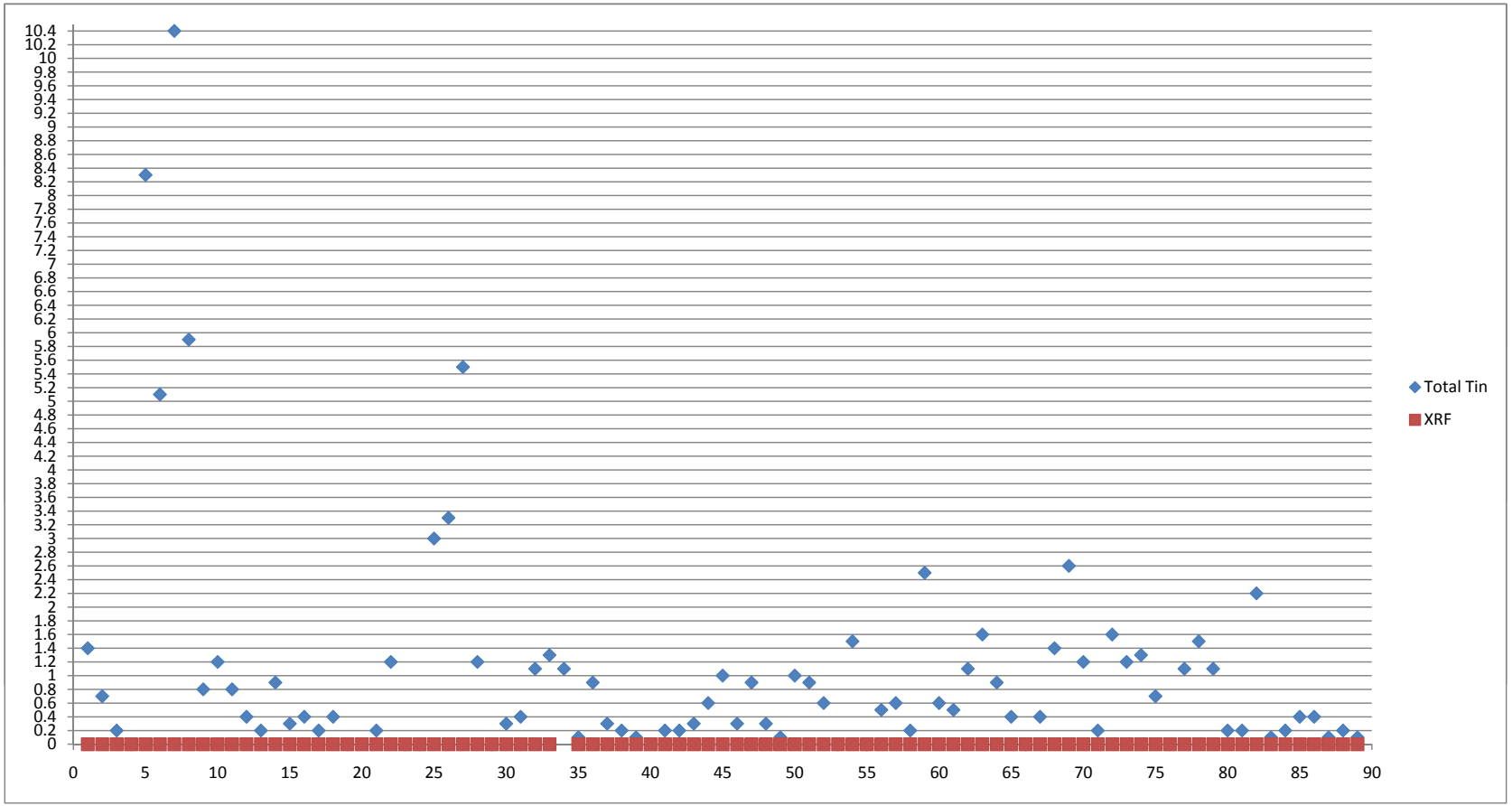
55
60
65
70
75
80
85
90
Total Selenium
XRF


10.4
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5.8
5.6
5.4
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5
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4.2
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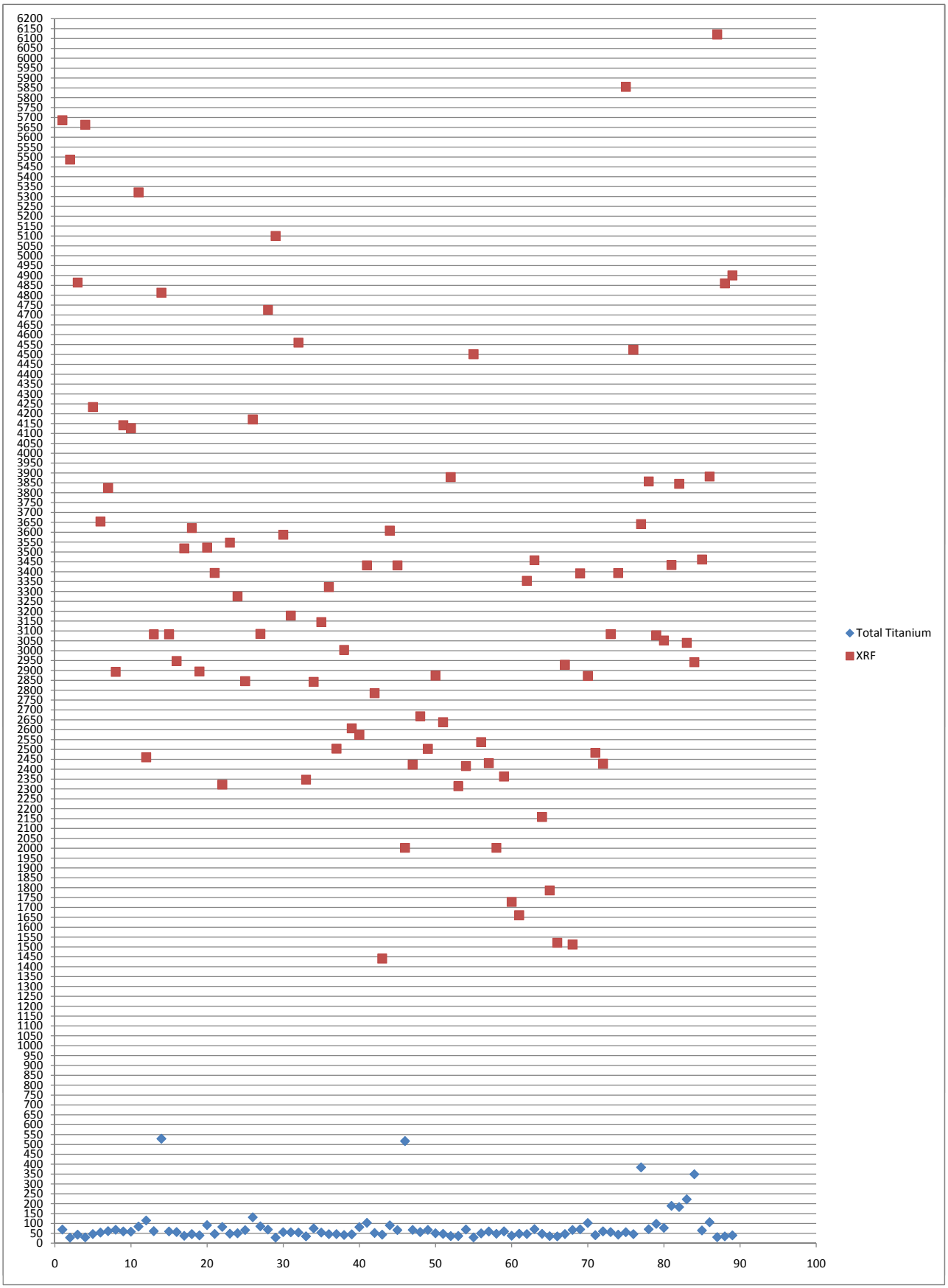
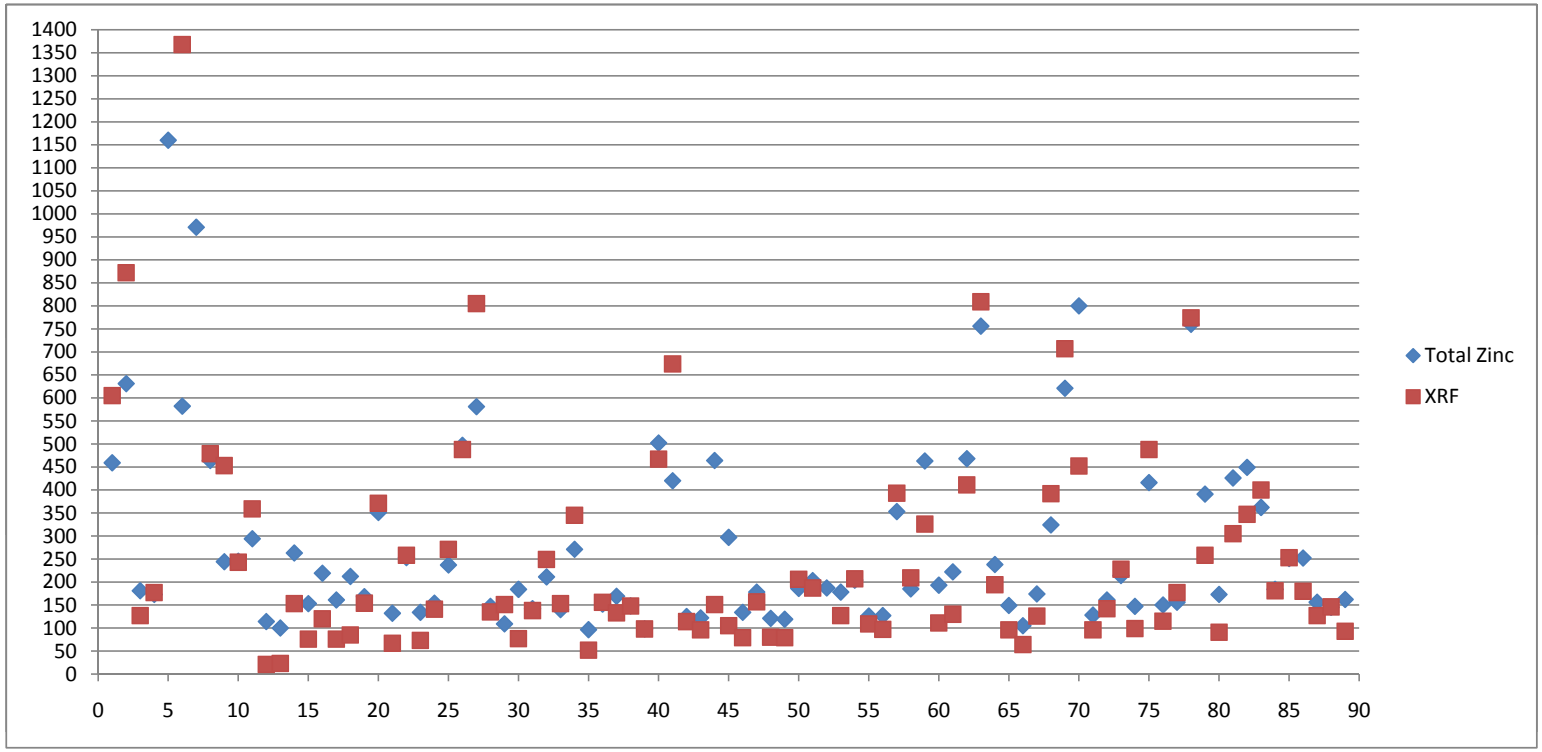
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Total Tin
XRF


Total Titanium
XRF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700
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550
500
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Total Zinc
XRF