ADVANCED GeoServices
a Montrose Environmental Group company

April 26, 2022 2001-847-19

Mr. Andrew Haneiko
USEPA-Region III - (3SD21)
1650 Arch Street
Philadelphia, PA 19103-2029

RE: Crater Resources Superfund Site
2021 Annual Monitored Natural Attenuation (MNA) Report

Dear Mr. Haneiko:

Enclosed please find three copies of the 2021 Annual Monitored Natural Attenuation (MNA) Report prepared by Key Environmental, Inc. on behalf of the Crater Resources Cooperating Respondent Group (the Group). This Report discusses the results of the March and September 2021 groundwater sampling events which were conducted in accordance with the Monitored Natural Attenuation Work Plan (MNAWP). The monitoring frequency was reduced to a semi-annual monitoring program in 2013 with continued annual reporting as approved by USEPA in a letter from Joseph McDowell dated April 30, 2013.

The 2021 Annual MNA Report incorporates USEPA reviewer comments for the 2020 Annual MNA Report that were provided via email on March 9, 2022. These comments (in **bold**) are also responded to herein:

USEPA Comment: On page 3-4, the report states that chloroform has not been detected historically in the center of plume wells. Chloroform is a COC in the center of the plume and has a cleanup goal, based on the RI findings. Section 4.1, 3rd paragraph, raises good points concerning chloroform, but again, chloroform does have some association with the site history.

Response: The referenced statement regarding chloroform not being detected historically in the center of plume (COP) monitoring wells has been removed from the 2021 report. However, it should be noted that chloroform is not typically detected in the COP monitoring wells. The RI stated that chloroform was detected in the onsite groundwater samples at concentrations ranging from 0.12 to 3.0 ug/L. The onsite chloroform groundwater sample data is similar to the background wells (BG-1S and BG-1D) sample data, which indicate background chloroform concentrations up to 2.4 ug/L. The chloroform cleanup standards specified for the COP wells (1 ug/L) and extent of plume (EOP) wells (0.015 ug/L) are less than the concentrations that have been detected in background wells.

USEPA Comment: Section 3.3.2: The national and regional data for arsenic will not be nearly as relevant as the local background conditions. National data was provided partly to explain why the background well is acceptable even if it exceeds the cleanup goals. EPA agrees that the cleanup goals may be lower than local background for some metals; this is why the ROD specified that cleanup below background would not be required.

Response: A review of regional data provides a frame of reference and an approximate naturally occurring range of concentrations for a given constituent. A review of regional data may not be as relevant as local background conditions, but it does promote a better understanding of what types of concentrations could be attributed to natural conditions. An evaluation of regional data can also contribute to a weight of evidence conclusion that supplements site-specific data evaluations.

USEPA Comment: Section 3.3.2, last two paragraphs: The soil metal analysis will not be as helpful as local background well data and the correlation (or lack of correlation) between the inorganic and organic chemicals. Cyanide may be especially useful as an indicator of site-related contamination.

Response: We agree that soil metal analysis will not be as helpful as local background well data and the correlation, or lack of correlation, between constituents. Soil data was included per a previous USEPA comment letter. Inclusion of soil data may not be as meaningful as groundwater sample data, however, it does contribute to overall site understanding. Cyanide and organic constituents, such as benzene, naphthalene, and phenols, are indicators of site-related impacts.

If you have any questions please do not hesitate to call me at "non responsive based on revised scope" [redacted]

Sincerely,

Advanced GeoServices Corp. dba Montrose Environmental Services

"non responsive based on revised scope" [redacted]

Project Manager

"non responsive based on revised scope" [redacted]

cc: Distribution List (attached)

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2021 ANNUAL MONITORED NATURAL ATTENUATION REPORT

CRATER RESOURCES SUPERFUND SITE
UPPER MERION TOWNSHIP, PENNSYLVANIA

Prepared for:

Crater Resources Cooperating Respondents Group

Prepared by:

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200 Third Avenue
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APRIL 2022

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LIST OF ABBREVIATIONS/ACRONYMS

AGC	Advanced GeoServices Corp.
COI	Constituent of Interest
COP	Center of Plume
CV	Coefficient of Variation
EOP	Extent of Plume
FS	Feasibility Study
FTS	Field and Technical Services, LLC
Group	Crater Resources Cooperating Respondents Group
GWCS	Groundwater Cleanup Standard
IDW	Investigation Derived Waste
KEY	Key Environmental, Inc.
Liberty	Liberty Property Trust and Liberty Property Limited Partnership
M-K	Mann-Kendall
µg/L	Micrograms per Liter
mg/L	Milligrams per Liter
MNA	Monitored Natural Attenuation
MNAWP	Monitored Natural Attenuation Work Plan
mS/cm	MilliSiemens per centimeter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mV	MilliVolts
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
ROD	Record of Decision
Site	Crater Resources Superfund Site, Upper Merion Township, Pennsylvania
S.U.	Standard Units
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TEAP	Terminal Electron Accepting Processes
USEPA	United States Environmental Protection Agency
USGS	United States Geological Society
VOCs	Volatile Organic Compounds
WAL	Waste Ammonia Liquor
WMW	Wilcoxon-Mann-Whitney

1.0 INTRODUCTION

On behalf of the Crater Resources Cooperating Respondents Group (Group), Key Environmental, Inc. (KEY) has prepared this 2021 Annual Monitored Natural Attenuation (MNA) Groundwater Monitoring Report for the Crater Resources Superfund Site (Site) located in Upper Merion Township, Pennsylvania (Figure 1). This 2021 Annual MNA Report discusses the results of the 2021 semi-annual groundwater sampling events. These events were conducted in accordance with the Monitored Natural Attenuation Work Plan (MNAWP) (KEY, June 2010). The MNAWP was approved by the United States Environmental Protection Agency (USEPA) Region III on August 17, 2010.

As groundwater monitoring commenced in November 2010, the sampling events covered by this report comprise the eleventh year of groundwater monitoring following the remediation of Quarry 3 and USEPA approval of the MNAWP. Monitoring was conducted at a quarterly frequency from November 2010 through November 2012, after which the Group requested USEPA approval to modify the monitoring frequency to semi-annually. This request was approved by a letter dated April 30, 2013, from Joseph McDowell of USEPA to [redacted] P.E. of Advanced GeoServices Corporation (AGC), authorizing the modification of the sampling frequency from quarterly to semi-annual sampling.

USEPA issued comments regarding the 2020 Annual Monitored Natural Attenuation Report on March 9, 2022. The USEPA comments on the 2020 report, as well as comments on previous reports, have been taken into consideration in the preparation of this report. Text, tables, figures, and additional data analyses reflect requests made in USEPA comments. USEPA's MNA Guidance directs that assessment of natural attenuation begin only after source control has been implemented. Source control remedial actions for certain operable units were completed only recently; Quarry 1 in 2020 and Quarry 2 in 2019. While the success of MNA at Quarry 3 can be seen in downward trends of constituent concentrations in groundwater downgradient of that operable unit, it is too early to assess the success of MNA at Quarry 1 and Quarry 2.

By letter dated January 19, 2017, USEPA informed the Group that the established schedule for MNA would not begin until after all source control (remediation) actions had been completed. The completion of the cap on Quarry 1 represented the last source control remedial action for the Site. The impermeable cap was installed prior to the September 2020 groundwater sampling event and the remaining topsoil and grading took place in September 2020. Therefore, the September 2020 sampling event represented the first sampling event after completion of functional source control. This report, therefore, reflects the first 18 months of MNA following implementation of Site-wide source control. EPA has indicated its willingness to consider modification of the Groundwater Cleanup Standards selected in the ROD following the completion of two full years of MNA after the implementation of Site-wide source control.

1.1 SITE LOCATION

The Site is located approximately one mile north of Gulph Mills, Pennsylvania, one mile south of King of Prussia, and 10 miles northwest of Philadelphia, in Upper Merion Township, Montgomery

County, Pennsylvania. The Site covers approximately 95 acres on several individual parcels that have been partially developed for commercial use. Additional commercial development is continuing at the Site. Four former quarries (Quarries 1, 2, 3, and 4) are located at the Site and encompass approximately 14 acres. The Site is bounded by, and includes, parts of the Renaissance at Gulph Mills office complex to the north and east; by the Gulph Mills Golf Club to the south; and by Crooked Lane to the west.

1.2 SITE HISTORY

Quarries 1, 2, and 3 are former iron ore and marble quarries that were used for the disposal of waste from the former Alan Wood Steel Company coke and coke byproducts manufacturing operations and later for construction and demolition debris. Discharges to Quarries 1 and 2 ceased at some point before 1977 and, by that date, these quarries had been filled to grade with construction and demolition debris. Discharges to Quarry 3 ceased in 1980, and the quarry then was left as an open quarry. Aerial photographs indicate that Quarry 4, a former sand and gravel quarry, was being actively filled with earthen material between 1965 and 1975, and by 1980 it was filled to grade.

1.2.1 Regulatory History

Over the past 40 years the Site has been thoroughly assessed and investigated by federal, state, and local environmental regulatory agencies, the Crater Resources Participating Parties Group, and the Crater Resources Cooperating Respondent Group (the Group). A Remedial Investigation (RI) was performed by the Crater Resources Participating Parties Group and that investigation is summarized in a document titled "Remedial Investigation Report, Crater Resources Superfund Site", dated June 4, 1999. Following approval of the RI Report, the Crater Resources Participating Parties Group prepared a Feasibility Study (FS) for the Site entitled "Feasibility Study for the Crater Resources Superfund Site, Upper Merion Township, Pennsylvania," dated February 29, 2000. The USEPA modified and then approved the FS by letter dated June 16, 2000. The USEPA issued a Record of Decision (ROD) for the Site on September 27, 2000, which set forth the remedial requirements for the Site. Subsequent to issuance of the ROD, AGC completed additional groundwater pre-design investigations on behalf of the Group. AGC, on behalf of the Group, completed the remediation of Quarry 3, which included removal of impacted soil and pond sediments. The Quarry 3 remedial activities were conducted between March 2009 and March 2010. Subsequently, the MNAWP was prepared and submitted to USEPA.

Based on the ROD issued for this Site by the USEPA, the selected remedial actions for the Site included the following:

- Removal of all impacted soils and sediment in Quarry 3;
- Construction of a cap to prevent infiltration of surface water into the impacted soils in Quarries 1, 2, and 4 and other contaminated areas;
- MNA of the groundwater following source mitigation;

- Further investigation of the former waste ammonia liquor (WAL) pipeline; and,
- Institutional controls.

1.2.2 Current Status of Remedial Actions

The USEPA completed a Fourth Five-Year Review Report (USEPA, July 2021) for the Site, which listed the status of the remedial action objectives at the following operable units (OUs):

- Quarry 1 (OU 1) – Remedial action is complete. Permanent multimedia cap construction completed in 2021.
- Quarry 2 (OU 2) – Remedial action is complete. Permanent multimedia cap construction completed in 2019.
- Quarry 3 (OU 3) – Remedial action is complete. Removal of contaminated soil was completed in 2012.
- Quarry 4 (OU 4) – Remedial action is complete. A demonstration project was completed in 2012 to show that leaching from the quarry to groundwater is not occurring.
- WAL Pipeline (OU 5) – Remedial action is complete. Removal of contaminated soil was completed in 2012.
- Groundwater MNA (OU 6) – Groundwater MNA remedy is ongoing.
- Cinder/Slag Fill Area (OU 7) – Remedial action is complete. Removal of contaminated soil was completed in 2003.
- Area 6/Lot 44 (OU 8) – Remedial action is complete. Removal of contaminated soil was completed in 2010.
- Southeast Property Area (OU 9) – Remedial action is complete. Removal of contaminated soil was completed in 2010.
- Lot 7 (OU 10) – Remedial action is complete. Removal of contaminated soil was completed in 2011.

Additionally, institutional controls, which prohibit the use of groundwater at the Site, are in effect.

1.3 REPORT ORGANIZATION

The remainder of this annual report will discuss the groundwater MNA activities that occurred at the Site during the 2021 semi-annual monitoring events. This report includes an evaluation of constituent concentrations and natural attenuation indicator parameter trends.

The annual MNA report is divided into the following seven sections:

- **Section 1.0 – Introduction:** presents a brief description of the Site and discussion of Site history, current status of remedial actions, and report organization.
- **Section 2.0 – MNA Data Collection:** presents a discussion of the procedures for implementing the MNA events.

- **Section 3.0 – Results:** presents a discussion of the potentiometric measurements and analytical results.
- **Section 4.0 – Data Evaluation:** presents an evaluation of the monitoring results for Site constituents of interest and natural attenuation indicator parameters.
- **Section 5.0 – Summary:** provides a summary of the observations from the first 11 years of groundwater monitoring.
- **Section 6.0 – Recommendations:** presents recommended modifications to the MNA sampling and analysis program based upon the first 11 years of monitoring.
- **Section 7.0 – References:** provides the references that were utilized in the development of this report.

2.0 MNA DATA COLLECTION

The scope of work and procedures for implementing the MNA sampling events are provided in this Section.

The monitoring procedures conducted during the sampling events are consistent with the protocols specified in the following documents:

- Quality Assurance Project Plan (QAPP), Appendix I of the Crater Resources Superfund Site Remedial Design Work Plan (AGC, December 2003);
- Addendum to QAPP (AGC, March 2008);
- MNAWP (KEY, June 2010);
- USEPA letter dated April 30, 2013; and,
- Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (USEPA, April 1999).

Field activities were performed by AGC and KEY's affiliated operations, maintenance, and monitoring company, Field & Technical Services, LLC (FTS).

2.1 WATER LEVEL MEASUREMENTS

Prior to groundwater sample collection, depth to groundwater was measured in all monitoring wells shown on Figure 2. Water levels were measured in accordance with the approved MNAWP and were taken, in general, from least to greatest constituent of interest (COI) concentrations based on concentrations detected during the previous sampling event. Depth to water, total well depths, and time/date of measurement were recorded by the field technicians. Measurements were made and recorded to the nearest 0.01 foot.

Field data were recorded on Groundwater Gauging Sheets and are provided in Appendix A. Additionally, during each event, the well risers, locks, caps, casings, and concrete pads were inspected and the conditions of them were recorded on Groundwater Monitoring Well Inspection Forms (Appendix A). Monitoring wells at the Site were observed to be in good condition with no significant damage reported.

The water level data were used to construct potentiometric surface elevation contour maps for evaluation of groundwater flow directions and hydraulic gradients. The potentiometric surface elevation contour maps for each gauging event are presented as Figures 3A and 3B and are discussed in Section 3.1.

2.2 GROUNDWATER SAMPLING LOCATIONS

The MNA sampling and analysis program includes the sampling of groundwater at the 12 monitoring well locations shown on Figure 2[1]. The monitoring locations consist of monitoring wells that are located: 1) hydraulically upgradient of the Site; 2) within the plume at the fringe of the source; 3) within the plume downgradient of the source; and, 4) at the extent of and beyond the downgradient limit of the plume.

2.3 GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling was conducted using a low-flow purging and sampling technique in accordance with the approved MNAWP. Parameters measured and recorded during monitoring well purging and sampling consist of field indicator parameters (i.e., pH, specific conductance, temperature, dissolved oxygen, oxidation-reduction potential [ORP], and turbidity). A YSI 556 multi-parameter water quality meter installed within a flow-through cell was used to monitor pH, specific conductance, temperature, dissolved oxygen, and ORP, and either a LaMotte 2020 meter or a Hanna meter was used to monitor turbidity. All water quality meters used during low flow purging and sampling were calibrated before use and at a minimum frequency of once per day. Information regarding water quality meter calibration was recorded on Equipment Calibration Forms.

Monitoring well purging was conducted using either a non-dedicated stainless steel submersible pump or a non-dedicated stainless steel bladder pump with dedicated Teflon®-lined tubing. Sampling was initiated after stabilization of field parameters was achieved. Samples were collected directly from the Teflon®-lined tubing after the YSI-556 and its flow-through cell were removed. Generally, monitoring wells were sampled in order of least to greatest constituent concentrations based on analytical results for the previous event. This procedure was followed to minimize any potential for cross contamination between wells. Field parameter measurements, corresponding purge volumes, and field notes were recorded on Groundwater Sample Collection Forms, which are included in Appendix A.

Quality assurance/quality control (QA/QC) samples were also collected during each event and consisted of duplicate samples, equipment blanks, trip blanks (for volatile organic compounds only), and matrix spike/matrix spike duplicates (MS/MSD). Sample handling, preservation, packaging, and shipment were conducted in accordance with protocols set forth in the approved MNAWP.

2.4 ANALYTICAL PARAMETERS

The list of groundwater quality parameters that were analyzed and associated analytical methods used during the sampling events are provided in Table 1. The parameters consist of the following

[1] The 12 monitoring locations are a reduction from the original 16 monitoring locations. By letter dated April 30, 2013, the USEPA approved the discontinuation of sampling of groundwater from monitoring wells MW-15S, MW-15D, MW-16S, and MW-16D.

COIs: volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); target analyte list (TAL) metals, and total and available cyanide. Laboratory reports and data validation summary reports for each event are presented on the CD provided as Appendix B.

In addition to the groundwater quality parameters listed above, analyses of natural attenuation indicator parameters (dissolved iron, dissolved manganese, methane, nitrate, sulfide, and sulfate) were completed to support the evaluation of the occurrence of biodegradation and overall natural attenuation trends.

2.5 MONITORING FREQUENCY

Groundwater monitoring events currently occur on a semi-annual basis.[2]

2.6 EQUIPMENT DECONTAMINATION

Non-dedicated groundwater sampling and monitoring equipment was decontaminated between monitoring well locations in accordance with the approved MNAWP. Decontamination liquids were managed in accordance with the procedures described in Section 2.7.

2.7 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Purge water and decontamination fluids generated during the monitoring activities were containerized for subsequent off-Site disposal in Department of Transportation approved 55-gallon steel drums with proper labeling.

Other investigation derived waste (IDW) such as personal protective equipment (PPE), consisting mainly of gloves, were managed as general trash. The dedicated tubing used during groundwater sampling was saved, placed in bags, labeled with the corresponding well designation, and retained for use in future sampling events. Dedicated equipment is used to minimize cross contamination between sampling locations. Purging prior to sample collection eliminates any risk of cross contamination as a result of the reuse of sample tubing in the same well from round to round.

[2] The initial monitoring program frequency was quarterly, but was reduced to semi-annually after completion of the second year of quarterly monitoring and pursuant to the April 30, 2013 USEPA approval letter.

3.0 RESULTS

The results of the 2021 groundwater monitoring events are presented in this Section as follows: Section 3.1 presents the potentiometric surface elevation measurements, which identify the groundwater flow direction and hydraulic gradients for each event; Section 3.2 discusses the field parameter measurement results from the groundwater sampling events; and Section 3.3 discusses the analytical results from the groundwater sampling events.

3.1 POTENTIOMETRIC SURFACE MEASUREMENTS

In March and September 2021, potentiometric surface elevations were measured in accordance with the approved MNAWP and the resultant data are presented in Tables 2A and 2B, respectively. Figures 3A and 3B present potentiometric surface elevation contour maps for the data collected during the gauging efforts.

The observed flow direction and hydraulic gradients during the first and second 2021 MNA events were generally consistent with historical measurements; groundwater flow direction was observed as toward the northeast, and horizontal hydraulic gradients downgradient of Quarries 2 and 3 were observed to be 0.013 ft/ft and 0.011 ft/ft, respectively.

3.2 FIELD PARAMETER MEASUREMENTS

Field parameters were measured during each sampling event in accordance with the approved MNAWP. Field parameters were measured during well purging to establish stable groundwater conditions before sample collection. These measurements were recorded on a Groundwater Sample Collection Form for each monitoring well during each sampling event. The field parameter measurements for each well during the sampling events are presented in Table 3. Table 3 also contains historical field and MNA parameter data. The minimum and maximum values for each of the 2021 events are summarized below:

- pH results
  - March 2021: 5.40 standard units (s.u.) (BG-1D) to 10.08 s.u. (MW-21S).
  - September 2021: 5.03 s.u. (BG-1D) to 8.47 s.u. (MW-11D).

- Specific conductivity results
  - March 2021: 0.511 milliSiemens per centimeter (mS/cm) (MW-8) to 8.724 mS/cm (MW-13S).
  - September 2021: 0.292 mS/cm (MW-21S) to 9.067 mS/cm (MW-13S).

- Temperature results
  - March 2021: 10.10ºC (MW-21S) to 19.21ºC (MW-20S).
  - September 2021: 15.1ºC (BG-1S and MW-11S) to 24.5ºC (MW-20S).

- ORP results
  - March 2021: -142.4 milliVolts (mV) (MW-13S) to 195.4 mV (MW-17D).
  - September 2021: -277.0 mV (MW-13S) to 188.8 mV (BG-1S).

- Dissolved oxygen results:
  - March 2021: 0.62 milligrams per liter (mg/L) (MW-20S) to 6.92 mg/L (MW-21S).
  - September 2021: 0.23 mg/L (MW-6) to 5.90 mg/L (BG-1S).

- Turbidity results:
  - March 2021: 3.30 Nephelometric Turbidity Units (NTU) (MW-6) to 668 NTU (MW-20S).
  - September 2021: 2.33 NTU (MW-19S) to 1179 NTU (MW-17D).

The field parameter data do not indicate conditions that would inhibit natural attenuation of organic constituents. Natural attenuation of organic constituents occurs throughout a wide range of field conditions. However, the natural attenuation mechanisms, pathways, and rates may vary due to specific conditions. The pH varies among wells but is in a generally acceptable range for biodegradation which is reported to be 5-9 pH standard units (NJDEP, 2012). Measurements of pH greater than 9 standard units are occasionally detected, however, these higher measurements are not sustained and are not considered representative of typical pH measured at the Site throughout the historical monitoring period. Specific conductance and turbidity are measures related to inorganic constituents and do not typically adversely affect the occurrence of biodegradation. Shallow background values of dissolved oxygen and ORP are generally indicative of oxic conditions that are favorable for aerobic degradation. The depleted dissolved oxygen and reduced ORP values observed at locations in proximity to the potential source areas are indications of natural attenuation via biodegradation. The deep zone background values of dissolved oxygen and ORP are indications of anaerobic conditions, which are likely a result of the well depth and hydrogeologic setting. High turbidity samples are typically correlated with higher concentrations of inorganic constituents. Turbidity is discussed further in Section 3.3.2 of this report. Natural attenuation via biodegradation occurs in aerobic and anaerobic zones. Section 4.2 of this report presents a detailed description of natural attenuation processes in relation to geochemistry.

3.3 ANALYTICAL RESULTS

Twenty seven sampling events (November 2010, February 2011, May 2011, August 2011, December 2011, March 2012, May 2012, September 2012, November 2012, February 2013, August 2013, March 2014, August 2014, March 2015, August 2015, March 2016, August 2016, March 2017, August 2017, March 2018, September 2018, March 2019, September 2019, March 2020, September 2020, March 2021, and September 2021) have been conducted since the completion of Quarry 3 remediation activities and installation of the background wells. Three events have occurred following material completion of all source control remedial activities (including completion of remedial action at Quarries 1 and 2). Current and historical groundwater analytical data for COIs that have Groundwater Cleanup Standards (GWCS) specified in the ROD are summarized in Tables 4A and 4B relative to the center of plume (COP) and extent of plume (EOP) standards, respectively. Figures 4A and 4B also present a summary of the COI

concentration data and exceedances of the GWCS at each monitoring location for the COP and EOP respectively. COP wells consist of the wells adjacent to the former Quarries 1, 2, and 3 (MW-6, MW-11S, MW-11D, and MW-13S). The EOP wells consist of MW-8, MW-17S, MW-17D, MW-19S, MW-20S, and MW-21S[3].

3.3.1 Organic Constituents

The analysis of groundwater samples shows organic constituent GWCS exceedances are primarily limited to the immediate vicinity of Quarries 1, 2, and 3. Constituents appear to be attenuating along the flow paths from the quarries as evidenced by the observed reductions in concentrations (See Plume Maps presented as Figures 5A through 8A and 5B through 8B).

Center of Plume Wells

MW-6

Monitoring well MW-6 is located at the perimeter of Quarry 1. COP GWCS exceedances for 2,4-dimethylphenol and benzene were observed at MW-6 during the March 2021 sampling event. A COP GWCS exceedance for benzene was observed at MW-6 during the September 2021 sampling event. All other organic constituent concentrations analyzed were below the COP GWCS or not detected during the 2021 sampling events. Naphthalene concentrations in MW-6 groundwater samples have not been detected above the COP GWCS since April 2015.

MW-11S

Monitoring well MW-11S is located at the perimeter of Quarry 3. COP GWCS exceedances for 2,4-dimethylphenol and benzene were reported for the March 2021 MW-11S sample analysis. A COP GWCS exceedance for 2,4-dimethylphenol was reported for the September 2021 MW-11S sample analysis. All other organic constituent concentrations were either below the COP GWCS or not detected. Naphthalene concentrations in MW-11S groundwater samples have not been detected above the COP GWCS since August 2013.

MW-11D

Monitoring well MW-11D is located at the perimeter of Quarry 3. COP GWCS exceedances for 2,4-dimethylphenol, benzene, and naphthalene were reported for samples collected from monitoring well MW-11D during the 2021 sampling events. All other organic constituent concentrations were below the COP GWCS or not detected. 2-Methylphenol and 4-methylphenol concentrations in MW-11D groundwater samples have not been detected above the COP GWCS since March 2014.

[3] The original extent of plume (EOP) wells definition presented in the Feasibility Study Report included the center of plume wells also. By letter dated November 30, 2015, USEPA requested that analytical results should only be compared to the appropriate GWCS (either center of plume or extent of plume standards). The letter identified MW-6, MW-7, MW-11S, MW-11D, MW-13S, and MW-13D as center of plume wells.

MW-13S

Monitoring well MW-13S is located at the perimeter of Quarry 2. COP GWCS exceedances for 2,4-dimethylphenol, 2-methylphenol, 4-methylphenol, benzene, naphthalene, and phenol, were reported for samples collected from monitoring well MW-13S during the 2021 sampling events. Acetone was detected above the COP GWCS during the March 2021 sampling event, but below the COP GWCS during the September 2021 sampling event. Quarry 2 was capped in late 2019 and continued monitoring will determine MNA effectiveness.

Extent of Plume Wells

MW-8

An EOP GWCS exceedance for naphthalene was reported for the sample collected from monitoring well MW-8 during the September 2021 sampling event. The EOP standard for naphthalene is 1 µg/l. A duplicate sample was collected at MW-8 during the September 2021 sample event which measured 1.1 µg/l, slightly exceeding the EOP standard of 1 µg/l. All other organic constituent concentrations were either below the EOP GWCS or below detection limits.

MW-17S

All organic constituents analyzed in groundwater samples collected from monitoring well MW-17S for the 2021 sampling events were below the EOP GWCS or below detection limits.

MW-17D

Slight EOP GWCS exceedances for benzene and chloroform were reported during both 2021 sampling events for MW-17D. The chloroform exceedance was likely attributed to regional ambient conditions. All other organic constituent concentrations were below the EOP GWCS or not detected during the 2021 sampling events.

MW-19S

All organic constituents analyzed in groundwater samples collected from monitoring well MW-19S for the 2021 sampling events were below the EOP GWCS or below detection limits.

MW-20S

An EOP GWCS exceedance for benzene was reported for the sample collected from monitoring well MW-20S during the March 2021 sampling event. All other organic constituent concentrations were below the EOP GWCS or not detected during the 2021 sampling events.

MW-21S

All organic constituents analyzed in groundwater samples collected from monitoring well MW-21S for the 2021 sampling events were below the EOP GWCS or below detection limits.

BG-1S and BG-1D

All organic constituents analyzed in groundwater samples collected from monitoring well BG-1S during the March and September 2021 events were below detection limits. Chloroform was the only constituent detected in BG-1D samples and it slightly exceeded the EOP GWCS of 0.015 µg/l during both 2021 sampling events. Chloroform is a common regional and laboratory artifact that may not reflect Site related conditions. Periodic detections of chloroform in BG-1S and BG-1D indicate that chloroform is a regional artifact.

During the 2017 sampling events, acetone (August 2017) and benzene (March and August 2017) were detected below the reporting limit, at trace, estimated levels in BG-1D samples. These anomalous detections were likely a result of field or laboratory contamination. BG-1S and BG-1D were strategically positioned in an unimpacted zone by consideration of potential source zone locations and groundwater flow paths. Monitoring of groundwater flow and MNA parameters suggest that no Site-related impacts exist at BG-1S or BG-1D. Evaluation of BG-1S and BG-1D data indicate that these wells are representative background wells.

Plume Maps

Plume maps have been generated as requested in the USEPA comment letter dated January 19, 2017. Plume maps show the inferred limits for benzene (Figure 5A and 5B), naphthalene (Figures 6A and 6B), total phenolic compounds (Figures 7A and 7B), and total cyanide (Figures 8A and 8B) during the March and September 2021 sampling events relative to their respective COP and EOP GWCS. Multiple potential sources are present at the Site and impacts are generally limited to the immediate vicinity of these potential sources. Attenuation of constituents occurs over a short distance from the source zones.

Figure 9 shows two cross sections that provide a spatial distribution of naphthalene, benzene, arsenic, and selenium concentrations for both 2021 sampling events. Section A-A' runs generally east to west and section B-B' runs generally north to south. The cross sections display the complexity and heterogeneity of the subsurface materials and variation in constituent concentrations with depth and distance from the source areas.

3.3.2 Inorganic Constituents

Metal constituents can occur in groundwater due to natural or anthropogenic sources. Metals most commonly associated with ammonia liquors are typically iron, cadmium, cobalt, chromium, and nickel. The consistent GWCS exceedances detected for many of the inorganic analytes in background well samples collected from BG-1S and BG-1D suggest that these constituents are attributed to naturally occurring geologic conditions.

A review of Quarry 3 soil data was requested by letter dated January 19, 2017, from Joseph McDowell of USEPA to Thomas M. Legel, P.E. of AGC. Metal constituents were detected at lower concentrations in background soil samples compared to Quarry 3 soil samples during the remedial investigation; however, background metal constituent detections provide evidence that metals are naturally occurring in shallow soils. In addition, geologic and geochemical heterogeneity cannot be dismissed as a potential explanation for spatial inorganic constituent variability. Organic constituents such as PAHs and VOCs are clearly anthropogenic; however, the same cannot be said for metal constituents at this time.

During the 2021 sampling events, BG-1S and BG-1D continued to show multiple GWCS exceedances for metals. In addition, it should be recognized that COP and EOP GWCS established for the Site are orders of magnitude less than USEPA maximum contaminant levels in some cases. For example, arsenic has a maximum contaminant level of 10 µg/L, a COP GWCS level of 1 µg/L, and an EOP GWCS level of 0.04 µg/L.

For reference, the United States Geological Society (USGS) in 2017 published a study of arsenic in groundwater which concluded that most arsenic in groundwater in the lower 48 states was presumed to derive from naturally occurring sources such as rocks and minerals (Ayotte et al., 2017). The 2017 USGS arsenic study involved statistical analysis of 20,450 domestic water well sample results, reporting an average concentration of 2 µg/L arsenic and a 90th percentile of 11 µg/L arsenic. An earlier USGS study (Gross and Low, 2013) focused on regional arsenic content reported the following with regard to statistics on arsenic concentrations from 59 Pennsylvania groundwater samples collected within the Conestoga Limestone Formation: 1) a maximum of 67 µg/L arsenic; 2) a median of <4 µg/L arsenic; 3) six samples exceeding 4 µg/L arsenic; and 4) three samples exceeding 10 µg/L arsenic.

Table 5 presents a summary of the 95% upper confidence limit (UCL) of the mean for inorganic COIs in background wells with comparison to GWCS. The 95% UCL of the mean is a statistic that represents the upper limit of a sample mean. ProUCL software was used to identify the appropriate UCL based on sample distribution characteristics. The total analysis result was used rather than the dissolved analysis result for generating UCL values. The inorganic constituent UCLs that exceed GWCS (COP or EOP) at BG-1S and/or BG-1D include the following: arsenic, barium, chromium, iron, manganese, mercury, selenium, thallium, and vanadium. These data indicate that the background concentrations of these metal constituents are greater than their respective GWCS. At the time when a demonstration of the attainment of GWCS is to be made, a comparison of Site concentrations to Site-specific background concentrations will be made to determine if an inorganic analyte in groundwater at the Site is due to naturally occurring conditions or Site-related impacts. Many of the monitoring well samples contained GWCS exceedances for multiple metal constituents. Table 4A, Table 4B, Figure 4A, and Figure 4B show all analytical data with GWCS exceedances highlighted.

The following is a metal GWCS exceedances summary for the 2021 sampling events. These results represent the total metal concentration reported by the laboratory.

- Arsenic
  - March: exceedances were observed in all four COP well samples (MW-6, MW-11S, MW-11D, and MW-13S) and five EOP well samples (MW-8, MW-17D, MW-20S, MW-20, and MW-21S);
  - September: exceedances were observed in all four COP well samples (MW-6, MW-11S, MW-11D, and MW-13S) and four EOP well samples (MW-17D, MW-20S, MW-20, MW-21S);

- Barium
  - March and September: exceedances were observed in two COP well samples (MW-6, and MW-13S);
- Beryllium
  - March and September: exceedances were observed in only one EOP well sample (MW-17D);

- Cadmium
  - March and September: exceedances were observed in one EOP well samples (MW-17D);

- Iron
  - March: exceedances were observed in four COP well samples (MW-6 MW-11S, MW-11D, and MW-13S) and four EOP well samples (MW-17S, MW-17D, MW-20S, and MW-21S);
  - September: exceedances were observed in three COP well samples (MW-6 MW-11S, and MW-11D) and four EOP well samples (MW-17S, MW-17D, MW-20S, and MW-21S);

- Lead
  - March: exceedances were observed for two EOP well samples (MW-17S and MW-17D);
  - September: exceedances were observed for one EOP well sample (MW-17D);

- Manganese
  - March: exceedances were observed for all four COP well samples (MW-6, MW-11S, MW-11D, and MW-13S) and four EOP well samples (MW-17S, MW-17D, MW-19S, and MW-20S);
  - September: exceedances were observed for all four COP well samples (MW-6, MW-11S, MW-11D, and MW-13S) and three EOP well samples (MW-17D, MW-19S, and MW-20S);

- Mercury
  - March 2021: exceedances for all six EOP well samples (MW-8, MW-17S, MW-17D, MW-19S, MW-20S, and MW-21S);

- September 2021: exceedances were observed for five EOP well samples (MW-17S, MW-17D, MW-19S, MW-20S, and MW-21S);

- Selenium
  - March and September: exceedances were observed in all four COP well samples (MW-6, MW-11S, MW-11D, and MW-13S) and all six EOP well samples (MW-8, MW-17S, MW-17D, MW-19S, MW-20S, and MW-21S);

- Thallium
  - March: exceedances were observed in three EOP well samples (MW-17S, MW-17D, and MW-8);
  - September: exceedances were observed in three EOP well samples (MW-17S, MW-17D, and MW-19S);

- Vanadium
  - March exceedances were observed for four EOP well samples (MW-17S, MW-17D, MW-20S, and MW-21S).
  - September exceedances were observed for three EOP well samples (MW-17S, MW-17D, and MW-21S).

A portion of the exceedances listed above were qualified by the laboratory analysis as being estimated values and/or detected in the blank sample analysis.

Iron, manganese, arsenic, selenium, and thallium were among the metals that showed the most frequent GWCS exceedances. The March 2021 and September 2021 results have been plotted for these select metals (included in Appendix C) and the plots yield information regarding current spatial distribution. Non-detected values were plotted at half of their respective detection limits. Arsenic and selenium concentrations appear to be lower in downgradient EOP wells (MW20S, MW-21S, and MW-19S).

Evaluation of the metals data is complicated due to the presence of naturally occurring constituents. Multiple evaluations of inorganic data have been conducted in this report. In many instances, although inorganic constituents were measured at levels greater than the GWCS, the concentrations are consistent with background levels. Section 4.1 presents the results of the Wilcoxon-Mann-Whitney (WMW) statistical analysis. The WMW statistical analysis is a two-sample hypothesis test that is used to compare background concentrations to individual Site well concentrations. This statistical test indicates that many of the inorganic concentration exceedances were not statistically elevated above background concentrations. Section 4.3 presents the Mann-Kendall (M-K) trend analyses that were performed for inorganic constituent concentrations at individual wells, which have exceeded their respective GWCS and were statistically elevated above background levels (determined using the WMW analyses).

Individual total inorganic constituent (i.e., dissolved and undissolved) concentration graphs for each of the sampling events completed since 2010 relative to the GWCS and the average

background concentrations are provided in Appendix D. Non-detected values are displayed as half of the detection limit. Individual inorganic constituent concentration trend graphs for most Site wells show frequent detections at concentrations below the average background well concentrations. Time series graphs for arsenic, selenium, iron, and manganese in each well are shown in Appendix E. The time series graphs show correlations and covariance among constituents. Iron and arsenic show positive correlation in many wells. Wells that exhibit the most pronounced correlation of iron and arsenic include MW-11S, MW-11D, MW-13S, MW-17S, and MW-6. Iron also shows positive correlation with selenium for some wells. Wells that exhibit the most pronounced correlation of iron and selenium include MW-11S, MW-13S, MW-17S, MW-17D, and MW-20S. Manganese correlations are less evident compared to iron correlations. Some wells (MW-11S, MW-13S, and MW-19S) show a weak inverse correlation between manganese and arsenic; however, a weak positive correlation was observed in MW-17S. Further discussion of the data presented in Appendix E is provided in Section 4.2, MNA Process Evaluation.

A Pearson correlation analysis was completed to provide general Site-wide insights regarding constituent associations and is presented in Table 6. A correlation coefficient was calculated for each pair of constituents. The correlation coefficient indicates strength of correlation between two variables on a spectrum ranging from negative one to positive one. A correlation coefficient of positive one indicates model positive correlation; a correlation coefficient of negative one indicates model negative correlation, and a correlation coefficient of zero indicates no correlation. The Pearson correlation analysis was completed by using all groundwater monitoring data collected from 2010 through 2021 from the current monitoring well network. The results of the Pearson correlation analysis generally indicate that inorganic constituents do not correlate with organic constituents with the exception of manganese and barium. A positive correlation coefficient for manganese can be explained by the fact that manganese is a byproduct of organic constituent biodegradation and it is considered a biodegradation indicator.

A positive correlation coefficient for barium was evaluated in more detail and found to be the result of data from a single well: MW-13S. MW-13S was installed in a weathered schist saprolite formation, rather than a limestone formation, and the background comparison testing discussed in Section 4.1 indicated that barium concentration was equivalent to background at all wells except MW-13S. Although the barium concentrations detected in MW-13S samples were higher than other site samples, the MW-13S barium concentrations have not exceeded the national primary drinking water MCL of 2 mg/L since 2013. Furthermore, removing MW-13S data from the correlation analysis changes the result from a positive correlation to a zero correlation for the remaining wells. The weight of evidence, therefore, suggests that barium concentration is not related to organic impacts, but is instead related to a localized, metamorphic, naturally occurring, geologic feature in the vicinity of MW-13S.

The results otherwise show that inorganic constituents typically correlate with each other. The Pearson correlation analysis was completed for screening purposes and further analysis may be necessary to correct for linearity, outlier removal, or data distributions. The results of the correlation analysis suggest that metals are related to naturally occurring conditions at the Site.

For wells in which the sample turbidity is greater than 10 NTU at the conclusion of the purging process, filtered samples were also submitted for inorganic analyses in order to determine if the inorganic constituent concentrations are elevated as a result of the suspended solids in the sample. Filtered samples were analyzed for six wells (BG-1S, MW-11S, MW-17S, MW-17D, MW-20S, and MW-21S) during the March 2021 sampling event and five wells (MW-11S, MW-17D, MW-17S, MW-20S, and MW-21S) during the September 2021 sampling event. High turbidity samples did yield high metals concentrations. Comparison of the filtered and unfiltered metals analysis indicates that a substantial component of the metals exists as suspended solids. Turbidity is associated with natural conditions and thus high metals concentrations associated with high turbidity are considered to be a background condition.

Total cyanide has remained relatively stable and above the GWCS for COP wells MW-6, MW-11S, MW-11D, and MW-13S. Sporadic detections of total cyanide are observed in MW-17D. MW-17D had a GWCS exceedance of total cyanide in both the March and September sampling events and MW-21S saw a GWCS exceedance of total cyanide in the March 2021 sampling event.

4.0 DATA EVALUATION

In accordance with the MNAWP, this section presents an evaluation of Site-specific evidence of natural attenuation based on data trends and concentrations using historical and newly acquired data. The primary line of evidence for determining the occurrence and effectiveness of natural attenuation is downward trends in constituent concentrations. A secondary line of evidence is spatial trends in natural attenuation indicator parameters. For this data evaluation, both primary and secondary lines of evidence have been evaluated.

Many of the inorganic COIs for the Site are naturally-occurring. Consequently, a statistical comparison of inorganic constituent concentrations to Site-specific background has been completed, and the results are summarized in Section 4.1. Section 4.2 provides an evaluation of spatial trends in natural attenuation indicator parameters and COIs. Section 4.3 provides a summary of COI temporal trend analyses results based on time series graphs and statistical testing using the M-K procedure. Section 4.4 presents a regression analysis to evaluate COP organic COI degradation.

4.1 BACKGROUND COMPARISON PROCEDURE AND RESULTS

Wilcoxon-Mann-Whitney (WMW) statistical testing was completed to compare concentrations of metals in samples from Site monitoring wells to background concentrations based on sampling of two background wells (BG-1S and BG-1D). The WMW analysis was used to test a null hypothesis that the mean of a given constituent (metal) concentration for a specific Site monitoring well is less than, or equal to, the background mean. The WMW statistical analysis was included in the Monitored Natural Attenuation Work Plan dated May 2010 and is completed on an annual-basis for background comparison purposes.

Historical and recent data collected suggest that BG-1S and BG-1D are representative background wells despite a few anomalous organic constituent detections. All background comparisons and conclusions in this report are qualified as preliminary at this time. Continued monitoring of BG-1S and BG-1D will be used to confirm the validity of the use of these wells as background wells.

Low levels of chloroform have frequently been detected in both BG-1S and BG-1D. However, the United States Geological Survey has previously reported chloroform as being among the most frequently detected VOCs in groundwater and drinking water supply wells in the United States (USGS Circular 1292, 2006). Chloroform is also a common laboratory contaminant, which has historically been detected in QA/QC blanks. The presence of chloroform in samples from these wells is not believed to be Site-related.

BG-1S and BG-1D are located hydraulically upgradient of Quarries 2, 3, and 4. BG-1S and BG-1D are located approximately 400 feet from the upgradient side of Quarry 1 in the side gradient direction (perpendicular to groundwater flow). Consideration of the source area locations and groundwater flow patterns strongly demonstrate that wells BG-1S and BG-1D are located in an area where impacts associated with on-Site releases are not possible.

4.1.1 Background Comparison Procedure

WMW statistical testing was completed to compare concentrations of metals in samples from Site monitoring wells to background concentrations based on the analysis of groundwater samples collected from the two background monitoring wells installed at the Site (BG-1S and BG-1D). The data from each Site monitoring well was compared to data from either BG-1S or BG-1D. The most appropriate background well for comparisons was primarily determined based on well screen elevations. In general, data for shallow monitoring wells were compared with the shallow background well data (BG-1S) and data for deep monitoring wells were compared with the deep background well data (BG-1D). Both background wells appear to be screened in a saprolite zone. Due to the presence of faults and lateral subsurface heterogeneity, not all Site monitoring wells screened at similar elevations are set in saprolite. Site monitoring wells are screened in either saprolite or limestone. However, monitoring wells screened in limestone are comparable to background wells screened in saprolite considering that there is a hydrologic connection between the wells. Site monitoring wells located along flow paths on the downgradient side of source zones, screened in both saprolite and limestone, have yielded samples with detections of COIs, which implies longitudinal groundwater communication between saprolite and limestone zones. Therefore, comparisons between background wells screened in saprolite and monitoring wells screened in limestone are meaningful.

USEPA's ProUCL software was used to complete the background statistical analyses. The WMW test is a non-parametric analog to the student's t-test, which does not require that the underlying data be drawn from populations with defined statistical distributions. It is particularly useful for data sets that contain a substantial proportion of non-detects, or when the samples to be compared do not have equal distributions or variances. In addition, there is little loss of power or accuracy with this test compared to the student's t-test, which is indicated in the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities - Unified Guidance (USEPA, March 2009).

The WMW analysis was used to test a form 1 null hypothesis that the mean and median of a given constituent (metal) concentration for a specific Site monitoring well is less than, or equal to, the background mean and median at an alpha (α) = 0.05 level of significance. A U-statistic is generated during the WMW analysis. ProUCL uses two procedures for calculating the U-statistic depending on the sample size. The U-statistic for small sample data sets, $n < 20$, is calculated slightly differently from large sample data sets, $n \geq 20$. The large sample U-statistic is also referred to as the Z_0 statistic.

The calculated U-statistic is compared to a critical value, which is determined based on the size of the sample data set and level of significance. If the calculated U-statistic is less than the critical value, then the null hypothesis is not rejected. If the calculated U-statistic is greater than the critical value, then the null hypothesis is rejected. The results of WMW analyses are also reported numerically as P-values. P-values are the approximate probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. For a specified $\alpha = 0.05$ level of significance, a P-value less than 0.05 results in rejecting the null hypothesis.

The WMW testing was performed for each of the inorganic COIs and considered only the results for total metals analysis (rather than dissolved), given that the total metals data set is more extensive than the dissolved data set for both the background and Site groundwater. The use of total metals data are in accordance with the USEPA comment letter regarding the Monitored Natural Attenuation Work Plan dated May 2010. Sample results with "B" qualifiers, indicating that a given constituent was detected in the blank sample analysis, were included in the WMW testing as a conservative measure. Sampling data collected since 2010 were used for the WMW analysis.

4.1.2 Background Comparison Results

Monitoring wells BG-1S and BG-1D were used as background wells and the most appropriate background well for each test was determined based on comparable well screen elevations. The 2021 WMW testing results are provided in Table 7. Table 7 also shows September 2021 GWCS exceedances for comparison. A summary of WMW test results from 2012-2021 is provided in Table 8. Table 8 was prepared in response to the USEPA's comment letter dated December 3, 2019. The individual WMW comparison results are included in Appendix F. The results for inorganic COIs for each Site monitoring well are discussed in the remainder of this section. As discussed below, most inorganic constituents analyzed do not exceed the background concentrations.

MW-6

Data from MW-6 were compared with data from BG-1D. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1D mean was not rejected for barium, cadmium, chromium, cobalt, lead, mercury, and thallium; therefore, this WMW testing indicates that these seven inorganic constituents do not exceed the BG-1D samples concentrations. The null hypothesis was rejected for arsenic, iron, manganese, selenium, and vanadium for this location. However, vanadium did not exceed the respective GWCS during the September 2021 sampling event.

MW-8

Data from MW-8 were compared with data from BG-1S. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1S mean was not rejected for arsenic, barium, cadmium, chromium, cobalt, lead, manganese, mercury, thallium, and vanadium; therefore, this WMW testing indicates that these 10 inorganic constituents do not exceed the BG-1S samples concentrations. The null hypothesis was rejected for iron and selenium when compared to the BG-1S samples concentrations. However, iron did not exceed the respective GWCS during the September 2021 sampling event.

MW-11D

Data from MW-11D were compared to data from BG-1D. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1D mean was not rejected for barium,

cadmium, chromium, cobalt, lead, manganese, mercury, thallium, and vanadium; therefore, this WMW testing indicates that these nine inorganic constituents do not exceed the BG-1D samples concentrations. The null hypothesis was rejected for arsenic, iron, and selenium for this location.

MW-11S

Data from MW-11S were compared to data from BG-1S. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1S mean was not rejected for barium, cadmium, chromium, cobalt, lead, mercury, thallium, and vanadium; therefore, this WMW testing indicates that these eight inorganic constituents do not exceed the BG-1S samples concentrations. The null hypothesis was rejected for arsenic, iron, manganese, and selenium for this location.

MW-13S

Data from MW-13S were compared to data from BG-1S. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1S mean was not rejected for cadmium, chromium, lead, mercury, thallium, or vanadium; therefore, this WMW testing indicates that these six inorganic constituents do not exceed the BG-1S samples concentrations. The null hypothesis was rejected for arsenic, barium, iron, manganese, selenium, cobalt, and iron for this location. However, cobalt and iron did not exceed their respective GWCS during the September 2021 sampling event.

MW-17D

Data from MW-17D were compared to data from BG-1D. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1D mean was not rejected for barium, chromium, mercury, and selenium; therefore, this WMW testing indicates that these four inorganic constituents do not exceed the BG-1D samples concentrations. The null hypothesis was rejected for arsenic, cadmium, cobalt, iron, lead, manganese, vanadium, and thallium for this location.

MW-17S

Data from MW-17S were compared to data from BG-1S. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1S mean was not rejected for barium, cadmium, cobalt, manganese, mercury, and selenium; therefore, this WMW testing indicates that these six inorganic constituents do not exceed the BG-1S samples concentrations. The null hypothesis was rejected for arsenic, chromium, iron, lead, thallium, and vanadium. However, chromium and lead did not exceed their respective GWCS during the September 2021 sampling event.

MW-19S

Data from MW-19S were compared to data from BG-1D. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1D mean was not rejected for arsenic, barium, chromium, cobalt, iron, lead, and vanadium; therefore, this WMW testing indicates that

these seven inorganic constituents do not exceed the BG-1D samples concentrations. The null hypothesis was rejected for cadmium, manganese, mercury, selenium, and thallium for this location. However, cadmium did not exceed the respective GWCS during the September 2021 sampling event.

MW-20S

Data from MW-20S were compared to data from BG-1D. MW-20S was compared to BG-1S prior to 2017, however, BG-1D was determined to be more appropriate considering that the BG-1D screen elevation is more comparable to MW-20S. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1D mean was not rejected for arsenic, barium, cadmium, chromium, cobalt, manganese, mercury, and thallium; therefore, this WMW testing indicates that these eight inorganic constituents do not exceed the BG-1D samples concentrations. The null hypothesis was rejected for iron, selenium, lead, and vanadium for this location. However, the lead and vanadium concentrations did not exceed their respective GWCS during the September 2021 sampling event.

MW-21S

Data from MW-21S were compared to data from BG-1S. The null hypothesis that the mean of a given metal concentration is less than, or equal to, the BG-1S mean was not rejected for arsenic, barium, cadmium, chromium, cobalt, manganese, mercury, selenium, thallium, or vanadium; therefore, this WMW testing indicates that these 10 inorganic constituents do not exceed the BG-1S samples concentrations. The null hypothesis was rejected for cadmium, iron, and lead for this location. However, cadmium and lead in the MW-21S sample did not exceed the GWCS during the September 2021 sampling event.

WMW Summary

All background comparisons presented in this report are preliminary, but nevertheless, they provide valuable insight regarding natural conditions. A total of 120 WMW tests were completed (10 wells with 12 constituents each). A total of 35 (out of 120) tests resulted in rejecting the null hypothesis paired with an exceedance of the GWCS during the September 2021 sampling event. A total of 85 (out of 120) tests yielded results that either were equivalent to background concentrations or did not exceed the GWCS during the September 2021 sampling event. This preliminary background comparison demonstrates that most inorganic constituents in groundwater are present at concentrations that are statistically equivalent to background concentrations and are likely naturally occurring.

However, not all inorganic constituents were determined to be statistically equivalent to background well datasets. Iron, manganese, arsenic, and selenium are among the most frequently detected metals exceeding GWCS and background levels. Iron and manganese are byproducts of the natural biodegradation of organic constituents and their presence in the groundwater may be attributable to the ongoing natural attenuation of organic COIs. Furthermore, other metals may be associated with iron and manganese. Section 4.2 of this report discusses the inorganic MNA

process evaluation. At sites with organic constituent impacts, naturally occurring metals found in soil and rock are typically mobilized by the changing geochemistry (redox conditions) that results from organic constituent degradation. However, metals will precipitate out along the flow path, and over time, as geochemistry re-equilibrates.

4.2 MNA PROCESSES EVALUATION

Natural attenuation encompasses physical, chemical, and biological processes that reduce the mass and mobility of constituents in groundwater. The components of a generalized conceptual model for natural attenuation of non-halogenated organic compounds are well established and accepted in the scientific community. Degradable compounds, such as those associated with coke and coke byproducts, dissolve gradually into the groundwater creating a dissolved-phase groundwater plume. The source concentration for each individual constituent is limited to its effective solubility, which is defined as the aqueous solubility of the pure compound multiplied by the mole fraction of the compound in the source material. Dissolved COIs in groundwater will migrate downgradient via advection, and gradual longitudinal/lateral spreading will occur via hydrodynamic dispersion and diffusion. In the absence of attenuating processes and in the presence of a continuing source, the edge of the plume would advance at the same rate as the groundwater flow. However, the dissolved-phase constituents at the Site are being attenuated downgradient of the source via sorption and biodegradation processes such that the extent of the plume is much less than what it would be if the attenuating processes were absent. It is expected that COI concentrations in groundwater in the vicinity of Quarries 1 and 2, where remediation was recently completed in 2020 and 2019, respectively, will dissipate more slowly than in the groundwater in the vicinity of Quarry 3, where potential source materials were removed in 2010.

Biodegradation of organic constituents by aerobic and anaerobic processes can be inferred by evaluating the electron acceptors as well as metabolic byproducts of the primary terminal electron accepting processes (TEAPs). The current protocol is to evaluate the electron acceptors including dissolved oxygen, sulfate, and nitrate, and metabolic byproducts including methane, reduced (i.e., ferrous) iron (II), and dissolved manganese. In addition, groundwater quality parameters such as temperature, pH, and ORP are evaluated to determine whether conditions are favorable for aerobic or anaerobic biodegradation.

Evaluations of trends in geochemical parameters (the secondary line of evidence demonstrating natural attenuation) are described below. Degradation occurs along the groundwater flow path. Comparison of conditions at upgradient locations, at or near the source, downgradient, and cross gradient will identify the dominant attenuation mechanisms currently at work. It is also important to note that not all natural attenuation processes may be occurring at a particular site; therefore, the absence of any of the indicator parameter trends discussed below should not, on its own, be construed as an indication that biodegradation is not occurring.

The analytical results for the MNA indicator parameters are presented in Table 3. Figures 10A and 10B are included to help illustrate the secondary evidence for natural attenuation at the Site for the two most recent sampling events, respectively. These figures display Radar Plots of the most significant MNA indicator parameters at the Site for each monitoring location.

Metabolic byproducts, dissolved iron, and dissolved manganese are indicators of natural degradation in addition to those included in Table 3; these two parameters were analyzed along with the other inorganic COIs. The analytical data for dissolved iron and dissolved manganese are included in Tables 4A and 4B and on the MNA "Radar Plots" on Figures 10A and 10B. A discussion of the MNA indicator parameter results for each related constituent is presented in the following paragraphs.

Dissolved Oxygen

When biodegradation occurs under oxic conditions, aerobic respiration is the dominant TEAP, and dissolved oxygen is consumed. The occurrence of aerobic biodegradation is likely to be indicated by greater dissolved oxygen concentrations in the upgradient locations, with lesser concentrations in monitoring locations within the source areas and dissolved-phase plume, and greater oxygen concentrations at the downgradient locations beyond the edge of the plume. The spatial trend of dissolved oxygen levels in the shallower bedrock monitoring wells is generally consistent with natural attenuation via aerobic respiration. Dissolved oxygen levels in the deeper bedrock monitoring wells are generally low across the Site, which indicates that anaerobic processes play a more significant role in deep zone organic COI degradation.

Methane

Methane is produced from methanogenic bacteria, which are active in anaerobic environments. Source areas typically contain elevated concentrations of methane relative to non-source areas because source areas are depleted in dissolved oxygen as a result of aerobic respiration. The spatial trend of methane concentrations is generally consistent with natural attenuation. Elevated concentrations of methane relative to background are detected in the wells located in close proximity to Quarries 1, 2, and 3 and in the deeper wells.

Nitrate

When dissolved oxygen is absent from groundwater, biodegradation of organics may occur via anaerobic processes. Denitrification is the most thermodynamically favorable anaerobic TEAP and results in the reduction of nitrate. The presence of nitrate in upgradient groundwater and depletion of nitrate in impacted groundwater would generally indicate that degradation via denitrification is occurring. Nitrate concentrations are generally low or below detection limits except for samples from well MW-19S which may be related to fertilizer use at the upgradient golf course. The data suggest that nitrate does not play a significant role in natural attenuation of the Site.

Oxidation-Reduction Potential (ORP)

ORP is a measure of the relative tendency of a solution to accept or transfer electrons. Generally, an area of depressed ORP around the estimated source zone is indicative of more intense electron acceptor utilization and biodegradation. ORP measurements can provide a qualitative indication

of the dominant TEAP and support interpretations of electron acceptor and metabolic byproduct data. Moderate to strongly negative ORP measurements near the source zones support the interpretations that anaerobic processes are occurring. Reduced values of ORP were observed in the vicinity of Quarries 1, 2, and 3, which is consistent with the occurrence of natural attenuation.

Sulfate and Sulfide

Sulfate acts as an oxidizer under anaerobic conditions. During this process, sulfate becomes reduced to sulfide. Therefore, the availability of sulfate in upgradient or unimpacted groundwater, along with the depletion of sulfate and increase in sulfide in impacted groundwater, is an indicator of anaerobic degradation. MW-13S and MW-20S are the only wells where sulfide has been observed relatively frequently. Sulfate concentrations are generally greatest in wells nearest to Quarries 1 and 3 which is opposite of the spatial trend expected for natural attenuation, but this may be due to the presence of sulfate in the material managed within these quarries. Sulfate is known to have been present in the material placed in Quarry 3 and should be used cautiously as an MNA indicator.

Dissolved Iron (II)

Once dissolved oxygen and nitrate have been effectively depleted, iron and manganese reduction are the most thermodynamically favorable terminal electron acceptors. The biodegradation of benzene and polycyclic aromatic hydrocarbons (PAHs) can occur in conjunction with the reduction of ferric iron (III) to ferrous iron (II). Iron (III) occurs as a mineralized species within the aquifer matrix. Iron (II) is a soluble metabolic by-product and, as such, a relatively greater concentration of dissolved iron in source area groundwater as compared to background groundwater is indicative of this process. Elevated concentrations of dissolved iron exist in the wells nearest to, and downgradient of Quarries 1, 2, and 3. This spatial trend is consistent with the occurrence of natural attenuation.

Dissolved Manganese

Manganese reduction from the +4 to +2 valence state occurs under certain environmental and microbial conditions. The biodegradation of benzene and PAHs can occur in conjunction with manganese reduction. Greater concentrations of dissolved manganese (Mn +2) within source or plume areas are one of the indicator parameters that biodegradation is occurring. Elevated concentrations of dissolved manganese exist in the wells nearest to Quarries 1, 2, and 3. This spatial trend is consistent with the occurrence of natural attenuation.

Temporal Analysis

Changes in MNA parameters over time may be attributed to natural degradation, seasonal variability, natural fluctuation, and system disequilibrium. Table 3 includes historical data for field and MNA parameters. Appendix G shows electron acceptors plotted graphically over time for each individual well. Non-detected values are represented by half of the detection limit. Note that sulfate is plotted on a secondary axis. Overall, the electron acceptors in the background wells

show some concentration fluctuation. Fluctuation of electron acceptors shows the natural variability of background MNA parameters. Individual Site wells show some variability in electron acceptors, but lack clear temporal trends at this time.

Spatial Analysis

The COP wells show a distinctly different MNA indicator parameter Radar Plot pattern than the EOP wells and background wells (Figures 10A and 10B). These Radar Plot patterns are indicative of natural degradation in the vicinity of Quarries 1, 2, and 3. Figures 10A and 10B display the expected natural attenuation trends, which include reduced levels of dissolved oxygen, increased levels of methane, increased levels of dissolved iron, and increased levels of dissolved manganese in the vicinity of the source zones. Most deep wells show plot patterns that are indicative of anaerobic conditions, which may be a direct function of their depths. Under reducing conditions, additional metal and cyanide complexes may also be dissolved, which is a pattern that is evident in the analytical data (Tables 4A and 4B). Downgradient of the quarries, geochemistry transitions into a more aerobic state. MW-17S and MW-19S radar plots begin to resemble more aerobic conditions. As degradation occurs along the flow path, the shallow geochemistry reverts back to natural conditions.

Anaerobic conditions near the quarries cause naturally occurring manganese and iron to dissolve as they are chemically reduced into their soluble forms. Iron and manganese oxides typically contain trace concentrations of other metals that become dissolved under anaerobic conditions as well. Appendix E shows iron and manganese concentrations compared to arsenic and selenium concentrations. Iron concentrations correlate with arsenic concentration trends and selenium trends to a lesser degree. Dissolved metals will eventually precipitate out of solution when aerobic zones are encountered. Many metals, including arsenic, undergo co-precipitation with iron and manganese in aerobic or certain anaerobic zones. Dissolved metals that were solubilized by reducing conditions will precipitate out of solution (mineralize) in the downgradient zones that are more aerobic.

Inorganic Constituent Attenuation

Attenuation of metals that are naturally occurring is only anticipated to occur if concentrations are elevated above background levels. Furthermore, attenuation of naturally occurring constituents can only reasonably be expected to attain background concentrations. The Crater Resources Site contains subsurface units with varying lithology. Spatial and temporal geochemical variability exists between and within different geologic units. Naturally occurring constituents are influenced by natural geochemical heterogeneity in addition to any Site related impacts. Attenuation of naturally occurring constituents to concentrations that are less than naturally occurring concentrations is not possible under the natural geochemical regime.

Attenuation of metals can be collectively placed under the sorption (adsorption/ absorption/ desorption) category and precipitation processes category which are generally driven by aquifer composition, changes in groundwater chemistry (primarily redox and pH conditions), and groundwater flow velocity (higher velocity equates to less sorption). Redox conditions are

normally the key controlling factor regarding fate and transport of metals (USEPA, 2015). Most redox sensitive metals typically become soluble in reducing conditions and insoluble in aerobic conditions. Degradation of organic constituents at the Site creates reducing conditions, which can mobilize certain metals. However, Site geochemical conditions will revert to natural aquifer conditions after organic constituent degradation is complete. Site geochemistry also transitions from reducing conditions to more aerobic conditions downgradient of source zones as organic constituent degradation occurs. Redox sensitive metals will become immobilized via precipitation and sorption downgradient of source zones and in source zones after organic constituent degradation is complete. Many metals (iron, manganese, arsenic, selenium, etc.) will precipitate out of solution in these aerobic zones.

Iron, manganese, arsenic, and selenium are among the most frequently detected metals exceeding GWCS at multiple well locations on the Site. These constituents are also detected in background wells at lower levels. The USEPA document *Monitored Natural Attenuation of Inorganic Contaminants in Ground Water, Volume 2, Assessment for Non-Radionuclides Including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Nitrate, Perchlorate, and Selenium (October 2007)*, describes detailed attenuation pathways of arsenic and selenium, some of which are applicable to the Crater Resources Site.

The inorganic MNA conceptual model involves dissolved metals precipitating or sorbing out of solution. Arsenic can attenuate through three different processes: 1) Precipitation of metal arsenates, arsenites, or arsenic sulfides; 2) Co-precipitation of arsenic as a trace component in iron or manganese oxyhydroxides or sulfides; 3) Adsorption or absorption to iron oxyhydroxides, iron sulfides, or other mineral surfaces (USEPA, 2007). Selenium can attenuate through similar processes: 1) Biotic (microbial) or abiotic precipitation through reduction of selenate/selenite to elemental Se(0) and/or selenide by reduced Fe-bearing minerals; 2) Precipitation of metal selenates or selenites due to pH changes; 3) Adsorption to iron oxyhydroxides, iron sulfides, or other mineral surfaces (USEPA, 2007). These attenuation pathways have been laboratory and field-tested.

Geochemical conditions at the Site indicate that arsenic and selenium will co-precipitate and/or sorb with precipitating or existing iron-oxyhydroxide minerals (or other minerals) over time. Appendix E shows covariance of iron and manganese with arsenic and selenium. Pure arsenic or arsenic oxides are not likely to form due to the abundance of naturally occurring iron in the system. Dissolved arsenic is more likely to co-precipitate with, or sorb to, iron bearing minerals. Pure selenium minerals may form in reduced zones; however, sorption to iron oxyhydroxides, iron sulfides, or other mineral surfaces is likely the dominant attenuation pathway for dissolved selenium given the Site conditions. MNA data suggest that attenuation of metals is generally occurring downgradient of the source. A graphical representation of the March and September 2021 metals results is presented in Appendix C. It is difficult to accurately describe broad spatial trends for the inorganic data given that they occur naturally and are generally only present at levels slightly greater than background, but, in general, MW-17S appears to have lower metals concentrations relative to other Site wells. This observation is consistent with the inorganic attenuation conceptual model that involves metals precipitating and/or sorbing out of solution in downgradient aerobic zones. However, elevated turbidity may mask the attenuation of metals by

the precipitation and sorption pathways. Inorganic attenuation in source zones will continue as organic degradation occurs.

Cyanide

Cyanide will attenuate through natural processes over time and along the flow path. EOP wells data indicate many fewer, and much lower, cyanide detections relative to COP wells data, which indicates attenuation is occurring along the flow path. Attenuation of cyanide may occur via adsorption, precipitation, and microbial degradation (Gagnon et al., 2004). Soils containing ilmenite, hematite, bauxite, and pyrite, as well as mineral groups such as feldspars, zeolites, and clays have been shown to effectively adsorb free and metal complexed cyanides (Young et al., 1995). Cyanide, like many other compounds, exists in various forms or species. Common cyanide species include metal cyanide complexes, cyanide amenable to chlorination, weak acid dissociable cyanide, and free cyanide. Most cyanide exists as an anion (except hydrogen cyanide or HCN) and undergoes ion exchange with aquifer media over time which involves removing cyanide from the aqueous phase and adsorption to solid media (Gagnon et al., 2004).

4.3 TREND TESTING

4.3.1 Trend Testing Procedure

Trend analyses for the groundwater analytical data were completed to determine if COI concentrations are increasing, decreasing, or showing no significant temporal trend over time. The trend analyses were completed in accordance with the MNAWP using the commonly accepted M-K trend analysis procedure. A confidence level of 90% was used as specified in the MNAWP.

The M-K test for trend is a non-parametric statistical test that can be used to evaluate trends in data sets that do not follow a known distribution (e.g., normal or log-normal). In addition, the M-K test is not dependent on the magnitude of the data, regularity of monitoring periods, missing data values, or non-detects. The M-K test requires a minimum of four and a maximum of 40 sampling events to be considered valid. Based on these conditions, the test was determined to be applicable for evaluation of the historical Site groundwater data.

In its simplest form, the results of the M-K trend analysis are determined numerically via comparison of an S-statistic for each constituent for each well to a tabulated value. The S-statistic is based on the signs (positive or negative) of successive differences in measurements of the same parameter. The S-statistic is the difference between the number of observed positive signs and the number of observed negative signs when all previous data points are subtracted from each individual data point and the signs are determined. For example, a data set consisting of four data points with value of 4, 3, 2, and 3 would yield results as follows:

Measurement	**Differences**	**Signs**
4	NA	NA
3	-1	1 minus
2	-2, -1	2 minus
3	-1, 0, +1	1 minus, 1 plus
Total		**4 minus, 1 plus (S = -3)**

Intuitively, if concentrations tend to be greater over time, S will be positive; if they tend to be lower over time, S will be negative. Given the number of samples (n) and the level of significance, there is a given probability that S will attain a given positive or negative value simply as a result of random variation.

Detailed discussion of the M-K test is provided in Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987) and Statistical Guidance for Determining Background Ground Water Quality and Degradation (Dai, Welhan, et al., March 2014).

4.3.2 Trend Analysis Results

M-K trend analyses were performed for each organic constituent with concentrations that have exceeded their respective GWCS. Inorganic constituents were also analyzed when concentrations exceeded their respective GWCS and were statistically elevated above background wells defined by the WMW testing. The background comparison procedure and results were described in Section 4.1 of this document. All background comparisons are preliminary at this time, but nevertheless, they provide useful information regarding natural conditions.

The M-K trend analysis was completed as specified in the MNAWP. The data collected from 2010 through 2021 were used for each well to evaluate long term trends. Detection limits were utilized for non-detect results. The test only uses the relative magnitudes for determinations of trends.

A summary of the M-K trend results is presented in Tables 9A and 9B. Documentation for the individual M-K analyses is provided in Appendix H. Table 9A displays M-K test results by well and Table 9B displays M-K test results by analyte. As indicated, trend analysis was conducted for those constituent/well combinations where exceedances of GWCS are observed and background concentrations were exceeded in the case of inorganic constituents. As part of the ProUCL output files presented in Appendix H, regression plots were automatically generated for all M-K tests that were completed. These regression plots were generated through the ProUCL software and must be viewed with caution because non-detected data are not distinguished from detected data and the graph axes are defined by software default settings which may produce visually apparent trends for data with no significant trend because the y-axis range is small. The regression plots shown in Appendix I (discussed in Section 4.4) use more appropriate axes and differentiate between detected and non-detected data.

The M-K test results provide a general indication of trends for the various COIs at the Site. In general, the results do not consistently demonstrate decreasing concentrations for all of the COIs,

which is to be expected given that many of the COIs are naturally-occurring. Attenuation is expected for metals that were solubilized as a result of reducing conditions that were established during organic degradation in the vicinity of source zones. However, attenuation of such metals is only anticipated to decrease to background levels for naturally occurring constituents. The following is a summary of the trend testing results.

- A total of 67 trend tests were performed and constituent trends were classified as increasing, decreasing, or having no trend. Eleven increasing trend conclusions were observed, 32 decreasing trend conclusions were observed, and 24 no trend conclusions were observed. In general, the results for the Site as a whole do not appear to be increasing.

- The S-statistic (i.e., Mann-Kendall test value) reported in Table 9B provides a general indication of trend direction and trend magnitude. The sign of the S-statistic indicates increasing trends (positive values) or decreasing trends (negative values). The absolute value indicates the strength of the trend (higher absolute value indicates a stronger trend). The S-statistic is compared to a critical threshold value at the specified level of confidence to determine an increasing trend, decreasing trend, or no trend. The summation of all S-statistics is -4148 for the 2021 M-K testing which indicates that the Site as a whole exhibits decreasing concentration trends.

- All organic constituents at all wells, for which an M-K test has been performed, exhibit decreasing trends with the exception of MW-20S benzene which resulted in an increasing trend and MW-13S phenol which resulted in no significant trend. The MW-20S benzene dataset mean is 2.3 µg/l and the apparent increasing trend is related to recent samples that yielded benzene at concentrations less than 10 µg/l. With continued monitoring, is anticipated that MW-20S benzene concentrations will decrease over time. The MW-13S phenol dataset trend test yielded a negative S-statistic, indicating a decreasing trend, but the magnitude of the S-statistic did not indicate a statistically significant decreasing trend. With continued monitoring, is anticipated that MW-13S phenol concentrations will decrease over time.

- Most inorganic constituents, for which an M-K test has been performed, exhibit decreasing trends or no significant trend. BG-1S and BG-1D datasets indicated increasing trends for a few inorganic constituents. Increasing trends of naturally occurring inorganic constituents at upgradient monitoring wells indicates ambient changes in groundwater that are not related to the Site. MW-17D is the only Site downgradient monitoring well that exhibited an increase of an inorganic constituent (arsenic). The MW-17D arsenic dataset mean is relatively low (6.9 µg/l) and the apparent increasing trend is related to a few recent samples. With continued monitoring, it is anticipated that MW-17D's arsenic concentrations will stabilize at levels consistent with naturally occurring concentrations over time.

- Table 9B displays mean, standard deviation, and coefficient of variation in addition to the M-K test results. The M-K test is a non-parametric rank test that does not utilize

parametric statistics, however, parametric statistics are useful for further data analysis. The parametric statistics reported in Table 9B are calculated from data collected from 2010 through 2021. The CV is a normalized standard deviation and indicates constituent stability. High coefficient of variation values are reported for wells that sporadically contain high turbidity. Samples containing high turbidity skew data and result in relatively high data variability.

- It is not reasonable to expect natural attenuation of inorganic constituents that are detected in source and downgradient wells at concentrations that are statistically equivalent to background wells. Observed concentration decreases or increases in such cases are likely due to seasonal variability, natural variation (spatially and temporally), and system disequilibrium.

- Any dissolution of naturally occurring metals (for example, iron and manganese) in the subsurface media that occurred as a result of reducing conditions in the shallow source zones will precipitate out of solution in the near downgradient zones as the geochemistry transitions back to a relatively more aerobic condition.

4.4 REGRESSION ANALYSIS

Regression plots were generated for organic COIs detected in the COP wells and the results are presented in Appendix I. Organic constituents typically degrade via a first-order rate model. An exponential trend line was fit to the datasets in order to calculate degradation rates. The slope of the exponential fit line is the first-order degradation rate constant. The first order rate model is as follows:

$$C(t) = C_0 * e^{-kt}$$

Where

C = concentration (µg/L)
C_0 = initial concentration (µg/L)
k = first-order degradation rate constant (days^{-1}) and,
t = time (days)

Non-detect results are represented as open symbols on the regression plots; however, only detected concentrations were used in calculating the degradation rates. Therefore, the calculated degradation rates are a conservative underestimate because they do not consider non-detected results. The GWCS are also displayed on the plots for reference. This degradation rate calculation approach is described as part of the first phase of analysis in the EPA guidance document *Evaluating the Progress of Natural Attenuation in Groundwater (EPA 600/R-11/204).*

A second phase analysis, as described in the EPA guidance document *Evaluating the Progress of Natural Attenuation in Groundwater (EPA 600/R-11/204),* was completed as part of the 2015 MNA report. The second phase analysis was completed in response to the EPA letter dated November 30, 2015, which stated, "The report should determine an estimated time when groundwater cleanup goals will be met." However, the second phase analysis was premature

considering that remediation was incomplete and this approach is still premature given that Quarry 1 and Quarry 2 remediation was completed in 2020 and 2019, respectively. At this time, it remains more appropriate to conduct a regression analysis in order to monitor degradation rates. EPA has acknowledged in a comment letter dated January 19, 2017, that the established schedule for MNA would begin after all source control (remediation) actions had been completed. All source control actions had been completed before the September 2020 monitoring event.

Appendix I contains individual regression plots. The first 11 years of monitoring data were used for the regression plots. Regression plots were completed for benzene, naphthalene, phenol, 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol at MW-6, MW-11S, MW-11D, and MW-13S. Most regression plots were decreasing and/or below the GWCS.

MW-6 (Quarry 1)

MW-6 is adjacent to Quarry 1 which was capped in 2020. All constituents analyzed had decreasing trends except phenol. However, all phenol detections are approximately three to four orders of magnitude below the COP GWCS. Benzene is the only constituent currently exceeding the respective GWCS (during the September 2021 sampling event), however, benzene is degrading. Quarry 1 remediation was completed in 2020 and it is anticipated that groundwater quality will continue to improve as a result of reduced infiltration within the Quarry 1 footprint.

MW-13S (Quarry 2)

MW-13S is adjacent to Quarry 2, which was capped in 2019. Benzene, naphthalene, phenol, 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol all currently exceed the COP GWCS in samples collected from monitoring well MW-13S. However, all constituents exhibit decreasing trends at this monitoring well location.

MW-11D (Quarry 3)

MW-11D is located adjacent to Quarry 3 in the deep zone. Benzene, naphthalene, and 2,4-dimethylphenol currently remain above GWCS. However, benzene, naphthalene, phenol, 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol all exhibit decreasing trends. Quarry 3 was remediated between March 2009 and March 2010. Quarry 1, is located upgradient of Quarry 3. If any plume commingling occurred between Quarry 1 and Quarry 3, then Quarry 1 remediation may assist in groundwater remediation in the vicinity of Quarry 3.

MW-11S (Quarry 3)

MW-11S is located adjacent to Quarry 3 in the shallow zone. Benzene, naphthalene, phenol, 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol all exhibit decreasing trends or are approximately an order of magnitude below COP GWCS. All organic constituent concentrations were below the respective COP GWCS during the September 2021 sampling event.

Constituent Trends

MNA monitoring commenced after remediation of Quarry 3 in November 2010. Regression graphs include data collected from November 2010 through September 2021. Regression graph data does not include any pre-remediation data. However, the initial sampling events following completion of Quarry 3 remediation are similar to pre-remediation conditions. The regression graphs show a first order rate model (i.e., exponential decay). Therefore, concentrations are expected to decline more rapidly initially and then less rapidly as time proceeds.

5.0 SUMMARY

Based on the first 11 years of MNA sampling and analysis, the following observations have been made:

- The presence of organic COIs at concentrations greater than COP GWCS are generally limited to the immediate vicinity of Quarries 1, 2, and 3. The data indicate that organic constituent concentrations are generally decreasing over time albeit to a lesser extent adjacent to Quarries 1 and 2. Source remediation was recently completed at Quarry 1 and Quarry 2, and it is anticipated that groundwater quality will continue to improve as a result of reduced infiltration in these areas.

- Regression analyses of organic constituent sample data for COP wells indicates that concentrations are either below the GWCS or trending downward. Based on the regression analysis, concentrations of organic constituents in groundwater located immediately downgradient of Quarry 3 (MW-11S and MW-11D) have continued to decrease as a result of the source removal remedial action completed for Quarry 3 by the Group. MW-11S and MW-11D contain multiple organic constituents that have already degraded to concentrations below the COP GWCS. The MW-11S sample collected in September 2021 did not yield any COP GWQS organic constituent exceedances. The only other MW-11S sample that did not yield any COP GWQS organic constituent exceedances was collected in March 2020. It is premature to fully evaluate attenuation rates given that Quarries 1 and 2 were recently capped and continued monitoring is required in order to detect beneficial effects on water quality after a new steady state condition is established. However, at this time, the regression analyses performed show attenuation is occurring in all COP wells to varying degrees.

- A total of 67 trend tests were performed and constituent trends were classified as increasing, decreasing, or having no trend. Eleven increasing trend conclusions were observed, 32 decreasing trend conclusions were observed, and 24 trendless conclusions were observed. The S-statistic (i.e., Mann-Kendall test value) reported in Table 9B provides a general indication of trend direction and trend magnitude. The sign of the S-statistic indicates increasing trends (positive values) or decreasing trends (negative values). The absolute value indicates the strength of the trend (higher absolute value indicates a stronger trend). The S-statistic is compared to a critical threshold value at the specified level of confidence to determine an increasing trend, decreasing trend, or no trend. The summation of all S-statistics is -4148 for the 2021 M-K testing which indicates that the Site as a whole exhibits decreasing concentration trends.

- The M-K trend testing presented in Section 4.3 and the regression graphs presented in Section 4.4 are two different approaches for examining concentration trends over time. The M-K trend test is a non-parametric test that is well suited for datasets with non-detect values. The regression graphs as presented in Appendix I use a first-order (or pseudo-first order) rate model which is appropriate for natural attenuation and biodegradation assessments. The regression graphs include non-detected data for

visual purposes, however, only detected data are used for calculation of first-order decay trend lines and rate constants. Both the M-K trend testing and the regression graphs indicate that constituents are naturally attenuating at the Site.

- MNA and field parameter data support natural attenuation conceptual models. The spatial trends for the majority of the natural attenuation indicator parameters are consistent with the continuing occurrence of natural biodegradation. Generally, the COP wells and the EOP deep wells exhibit anaerobic reducing conditions, which may be causing the dissolution of metal and cyanide complexes in addition to degrading organic COIs.

- A correlation analysis presented in Table 6 indicates that there is a general lack of correlation between inorganic constituents and organic constituents from a Site-wide perspective. A lack of correlation between inorganic constituents and organic constituents suggests that inorganic constituents are naturally occurring. Manganese showed some correlation with organic constituents, however, manganese is a biodegradation indicator. Barium showed some correlation with organic constituents, however, this result was due to outlier data for MW-13S which appears to have naturally occurring, localized, higher barium concentrations.

- Evaluation of the data suggests that the background wells are yielding representative background samples. However, all background comparisons are considered preliminary at this time and background samples will continue to be monitored to confirm their representativeness.

- Upper confidence limits (UCL) of the mean for BG-1S and BG-1D arsenic, barium, chromium, iron, manganese, mercury, selenium, thallium, and vanadium all exceed EOP and/or COP GWCS. This finding suggests that most metals naturally occur in groundwater at concentrations greater than site standards.

- MW-20S (benzene) and MW-17D (arsenic) were the only non-background datasets that were detected above GWCS (during September 2021), above background levels (WMW test), and exhibit increasing concentration trends (M-K test).

- All well samples (including background well samples) consistently yield arsenic and selenium exceedances. The WMW tests showed that arsenic and selenium were statistically equivalent to background concentrations for several comparisons. The COP GWCS for arsenic and selenium are 1 µg/L and 0.4 µg/L, respectively. The EOP GWCS for arsenic and selenium are 0.04 µg/L and 0.006 µg/L, respectively. The GWCS for arsenic and selenium are three to four orders of magnitude less than the national primary drinking water MCLs which are 10 µg/L and 50 µg/L for arsenic and selenium, respectively.

- Attenuation of naturally occurring constituents is only anticipated to occur if concentrations are elevated above background levels. Attenuation of naturally

occurring constituents can only reasonably be expected to attain background concentrations, which is consistent with USEPA's ROD which specified that cleanup below background levels would not be required.

- As indicated by EPA's comment letter dated January 19, 2017, the established schedule for MNA began after all source control (remediation) actions were completed. Quarry 1 remediation was completed in 2020. The September 2020 sampling event was the first event following source control and 2021 was the first full year for which all source control actions have been completed.

6.0 RECOMMENDATIONS

It is evident that natural attenuation is occurring, and it is deemed that natural attenuation is an appropriate groundwater remediation approach. Furthermore, remediation of Quarry 1 and Quarry 2 was recently completed. Therefore, it is recommended that MNA be continued at the Crater Resources Superfund Site to further evaluate anticipated groundwater quality improvements. Monitoring will remain on a semi-annual sampling schedule.

It is recommended that background concentration comparisons for naturally occurring constituents that exhibit spatial and temporal variability continue in the future in an effort better understand performance and progress of the natural attenuation remedy. All background comparisons presented in this report are preliminary, but nevertheless, they provide valuable insight regarding natural conditions.

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TABLES

TABLE 1
GROUNDWATER ANALYTICAL PARAMETERS AND METHODS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analytical Parameters	Analytical Methods	Number of Sample Locations (per event)	Number of QA/QC Samples (per event)				Total Number of Samples (per event)
			Field Duplicates	MS/MSDs	Trip Blanks	Equipment Blanks	
Target Compound List (TCL) Volatile Organic Compounds (VOCs)	SW846 8260C	12	1	1	2	2	18
TCL Semi-Volatile Organic Compounds (SVOCs)	SW846 8270C	12	1	1	0	2	16
TAL Metals - total and dissolved*	SW846 6000/7000 series	12	1	1	0	2	16
Available Cyanide	OIA-1677	12	1	1	0	2	16
Total cyanide	SW846 9014	12	1	1	0	2	16
Sulfide	SW846 9034	12	1	1	0	2	16
Nitrate	EPA 300.0	12	1	1	0	2	16
Sulfate	EPA 300.0	12	1	1	0	2	16
Methane	RSK 175	12	1	1	0	2	16
pH	Field Parameter	12	0	0	0	0	12
Conductivity	Field Parameter	12	0	0	0	0	12
Oxidation Reduction Potential (ORP)	Field Parameter	12	0	0	0	0	12
Dissolved Oxygen (DO)	Field Parameter	12	0	0	0	0	12
Temperature	Field Parameter	12	0	0	0	0	12
Turbidity	Field Parameter	12	0	0	0	0	12

* In accordance with USEPA Region 3 recommended procedures, unfiltered groundwater samples will be collected for total metals analysis. An additional filtered sample is to be collected only if sample turbidity exceeds 10 nephelometric turbidity units (NTUs).

Notes:

SW846 = "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, November 1986 and its updates.

Trip blank and equipment blank quantities are estimated based upon the anticipated task duration of two days.

Equipment blanks are to be collected at a rate of one per matrix per day of sampling whenever non-dedicated or non-disposable equipment is used.

TABLE 2A
MARCH 2021 GROUNDWATER ELEVATIONS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well ID	Measuring Point Elevation (ft-msl)	Depth to Water 3/22/21 (ft-toc)	Total Depth 3/22/21 (ft-toc)	PID[1] Reading 3/22/21 (ppm)	GW Elevation 3/22/21 (ft-msl)
AS-1	105.45	22.93	65.05	0.0	82.52
BG-1S	208.18	69.20	108.79	0.0	138.98
BG-1D	208.23	68.30	200.64	0.0	139.93
LMW-1	168.40	87.19	111.20	0.0	81.21
LMW-2	139.04	58.31	172.82	0.0	80.73
LMW-3	144.71	72.27	99.10	0.0	72.44
MW-A	167.08	84.12	204.11	0.0	82.96
MW-B	173.94	90.87	218.43	0.0	83.07
MW-D	160.80	81.26	90.38	0.0	79.54
MW-6	213.91	66.40	213.35	0.0	147.51
MW-7	212.12	78.86	122.58	0.0	133.26
MW-8	213.45	66.43	117.63	0.0	147.02
MW-9	166.72	73.27	245.05	0.0	93.45
MW-10	151.87	59.81	107.39	0.0	92.06
MW-11S	146.88	54.21	108.96	0.0	92.67
MW-11D	146.40	54.50	137.15	0.0	91.90
MW-12	159.10	65.04	245.76	0.0	94.06
MW-13S	180.32	83.80	115.70	0.0	96.52
MW-13D	180.16	83.31	250.26	0.0	96.85
MW-15S	158.07	78.34	112.85	0.0	79.73
MW-15D	158.10	78.28	165.00	0.0	79.82
MW-16S	153.18	71.13	98.65	0.0	82.05
MW-16D	153.26	71.34	251.20	0.0	81.92
MW-17S	140.63	58.31	112.90	0.0	82.32
MW-17D	140.58	58.43	237.05	0.0	82.15
MW-18	125.78	33.40	64.89	0.0	92.38
MW-19S	138.59	50.13	196.38	0.0	88.46
MW-20S	157.25	70.52	219.00	0.0	86.73
MW-21S	174.37	88.15	134.83	0.0	86.22
MW-21D	173.89	89.92	235.25	0.0	83.97
MW-22	142.18	50.61	55.69	0.0	91.57
MW-23	140.51	39.91	63.22	0.0	100.60
MW-24	147.97	63.71	77.70	0.0	84.26

Notes:

ft-toc - Feet below top of casing

ft-msl - Feet mean sea level

ppm - parts per million

[1] - PID reading taken at the top of the well riser.

MW-6 riser was extended and prior to the September 2020 sampling event and was resurveyed

TABLE 2B
SEPTEMBER 2021 GROUNDWATER ELEVATIONS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well ID	Measuring Point Elevation (ft-msl)	Depth to Water 9/13/21 (ft-toc)	Total Depth 9/13/21 (ft-toc)	PID[1] Reading 9/13/21 (ppm)	GW Elevation 9/13/21 (ft-msl)
AS-1	105.45	22.92	64.65	0.0	82.53
BG-1S	208.18	68.13	107.85	0.0	140.05
BG-1D	208.23	68.94	200.50	0.0	139.29
LMW-1	168.40	87.64	111.63	0.0	80.76
LMW-2	139.04	58.33	172.80	0.0	80.71
LMW-3	144.71	72.75	99.11	0.0	71.96
MW-A	167.08	84.39	205.55	0.0	82.69
MW-B	173.94	91.30	219.93	0.0	82.64
MW-D	160.80	81.68	90.38	0.0	79.12
MW-6	213.91	66.61	205.00	0.0	147.30
MW-7	212.12	78.45	122.58	0.0	133.67
MW-8	213.45	73.42	117.46	0.0	140.03
MW-9	166.72	73.21	247.01	0.0	93.51
MW-10	151.87	60.30	107.25	0.0	91.57
MW-11S	146.88	56.67	107.51	0.0	90.21
MW-11D	146.40	56.22	137.11	0.0	90.18
MW-12	159.10	63.46	247.45	0.0	95.64
MW-13S	180.32	84.14	115.23	0.0	96.18
MW-13D	180.16	84.19	250.15	0.0	95.97
MW-15S	158.07	78.78	112.86	0.0	79.29
MW-15D	158.10	78.67	167.92	0.0	79.43
MW-16S	153.18	71.32	98.65	0.0	81.86
MW-16D	153.26	71.36	251.22	0.0	81.90
MW-17S	140.63	58.89	112.90	0.0	81.74
MW-17D	140.58	58.51	236.90	0.0	82.07
MW-18	125.78	34.87	61.17	0.0	90.91
MW-19S	138.59	52.16	196.50	0.0	86.43
MW-20S	157.25	71.65	221.90	0.0	85.60
MW-21S	174.37	87.96	134.71	0.0	86.41
MW-21D	173.89	90.51	235.68	0.0	83.38
MW-22	142.18	51.29	55.55	0.0	90.89
MW-23	140.51	44.90	63.29	0.0	95.61
MW-24	147.97	64.10	77.74	0.0	83.87

Notes:

ft-toc - Feet below top of casing

ft-msl - Feet mean sea level

ppm - parts per million

[1] - PID reading taken at the top of the well riser.

MW-6 riser was extended and prior to the September 2020 sampling event and was resurveyed

TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S	
			11/9/2010		2/23/2011		5/18/2011		8/9/2011		12/7/2011		3/20/2012		5/30/2012		9/5/2012		11/28/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	5.83		5.47		5.59		5.76		5.72		5.72		6.54		6.35		5.73	
Specific Conductivity	-	mS/cm	0.540		0.831		1.097		0.880		0.795		0.750		0.728		0.673		1.242	
Temperature	-	°C	13.55		11.95		14.76		16.23		14.51		15.38		13.82		16.34		13.17	
Turbidity	-	NTU	42.1		46.7		75.0		16.0		26.0		27.1		19.5		6.98		21.7	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	9.09		8.96		8.32		9.04		7.53		7.02		7.06		7.09		5.06	
Methane	> background	µg/L	**0.31**	B	**0.3**	B	**0.13**		**0.66**	B	**0.1**	B	**0.13**	B	**0.12**	B	**0.15**	B	0.67	U
Nitrate	< background	mg/L	**2.1**		**1.8**	J	**1.4**		**1.7**		**1.4**		**1.9**		**1.7**		**1.7**		**1.4**	
Oxidation Reduction Potential	< background	mV	28.8		-181.9		-38.1		148.5		189.6		163.5		-162.7		-54.2		75.9	
Sulfate	< background	mg/L	**59**		**54**		**69**		**58**		**54**	J	**47**		**45**		**45**		**48**	
Sulfide	> background	mg/L	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
Bold - Indicates positive detection for lab analyzed parameters
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - Result is rejected.
mg/L - milligrams per liter
µg/L - micrograms per liter
mS/cm - milliSiemens per centimeter
mV - millivolts
s.u. - standard units
°C - degrees Celsius
ORP - oxidation reduction potential
NTU - Nephelometric Turbidity Units
pH calibration issues identified during the August 2017 event for MW-20S, MW-19S, and MW-17S.
*values indicative of degradation (NJDEP, 2012)

TABLE 3
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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S	
			2/26/2013		8/27/2013		3/25/2014		8/26/2014		Duplicate		3/31/2015		Duplicate		8/26/2015		03/29/16		Duplicate	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	5.71		5.81		5.09		5.61		-		5.80		-		5.54		5.63		-	
Specific Conductivity	-	mS/cm	0.805		0.976		0.933		1.144		-		1.21		-		1.189		0.976		-	
Temperature	-	°C	12.10		14.42		13.01		13.32		-		13.18		-		14.33		14.66		-	
Turbidity	-	NTU	3.46		16.98		8.36		7.53		-		9.02		-		7.88		25.7		-	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	5.17		5.72		2.01		0.98		-		4.91		-		5.04		6.53		-	
Methane	> background	µg/L	0.28	U	**2.6**	B	5	U	5	U	5	U	**0.08**	JB	**0.078**	JB	0.5	U	**0.1**	JB	**0.21**	JB
Nitrate	< background	mg/L	**1.6**		**1.5**		**0.99**		**1**		**0.99**		**1.1**		**1.1**		**0.84**		**0.91**		**1.1**	
Oxidation Reduction Potential	< background	mV	161.7		124.8		246.5		58.2		-		94.6		-		48.1		93.3		-	
Sulfate	< background	mg/L	**55**		**51**		**54**		**59**		**59**		**53**		**52**		**48**		**52**		**51**	
Sulfide	> background	mg/L	2	U	2	U	3	U	3	UL	3	UL	3	U	**0.91**	J	3	U	3	U	3	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
Bold - Indicates positive detection for lab analyzed parameters
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - Result is rejected.
mg/L - milligrams per liter
µg/L - micrograms per liter
mS/cm - milliSiemens per centimeter
mV - millivolts
s.u. - standard units
°C - degrees Celsius
ORP - oxidation reduction potential
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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S	
			08/30/16		3/21/2017		08/10/17		3/20/2018		09/05/18		3/20/2019		09/17/19		03/10/20		09/22/20	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	5.55		5.63		5.00		5.41		6.70		5.82		6.54		5.82		6.09	
Specific Conductivity	-	mS/cm	0.935		1.022		1.062		1.389		1.668		1.503		1.915		1.504		1.42	
Temperature	-	°C	15.06		13.21		14.52		16.11		18.25		16.55		16.83		16.40		17.11	
Turbidity	-	NTU	10.60		7.31		52.80		5.17		9.01		8.71		8.98		7.69		125.0	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	5.14		4.36		4.20		6.79		4.65		4.54		6.51		6.50		5.05	
Methane	> background	µg/L	**0.085**	**JB**	**0.18**	**J**	**0.26**	**JB**	1	U	1	U	1	U	**0.19**	**J**	**0.19**	**J**	**0.18**	**JB**
Nitrate	< background	mg/L	**0.8**		**0.86**		**1**		**1.1**	**L**	**1.13**		**1.06**		**0.558**		**1.34**		**1.38**	
Oxidation Reduction Potential	< background	mV	13.2		66.9		90.1		366.8		-69.4		-72.7		334.0		165.2		128.4	
Sulfate	< background	mg/L	**51**		**64**		**61**		**70**		**63.2**		**57.2**		**59.1**		**44.5**		**45**	
Sulfide	> background	mg/L	3	U	3	U	3	U	**0.92**	**JB**	1	U	3	U	3	U	3	U	3	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
Bold - Indicates positive detection for lab analyzed parameters
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mS/cm - milliSiemens per centimeter
mV - millivolts
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°C - degrees Celsius
ORP - oxidation reduction potential
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pH calibration issues identified during the August 2017 event for MW-20S, MW-19S, and MW-17S.
*values indicative of degradation (NJDEP, 2012)

TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	BG-1S		BG-1S		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D	
			03/23/21		09/15/21		2/23/2011		5/18/2011		8/10/2011		12/8/2011		3/20/2012		5/31/2012		9/6/2012		11/28/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	5.81		5.44		6.36		4.62		6.07		6.06		5.22		6.29		6.68		5.35	
Specific Conductivity	-	mS/cm	1.278		1.248		0.517		0.534		0.555		0.560		0.548		0.570		0.427		0.852	
Temperature	-	°C	16.37		15.10		9.50		16.95		19.12		15.71		14.57		13.61		14.22		11.96	
Turbidity	-	NTU	196.0		4.29		16.1		15.9		8.40		7.08		8.58		9.16		6.71		8.97	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	4.76		5.90		1.75		1.12		1.10		1.08		0.81		0.78		0.61		0.97	
Methane	> background	µg/L	1	U	1	U	**450**		**100**		**78**		**27**		**48**		**130**		**54**	J	**17**	
Nitrate	< background	mg/L	**1.57**		**1.34**		1	UJ	**0.534**		1	U	1	U	**1.3**		**1.2**		**1.2**		**1**	J
Oxidation Reduction Potential	< background	mV	162.0		188.8		-141.9		-59.2		-48.2		-54.6		130.6		-275.3		-156.8		52.6	
Sulfate	< background	mg/L	**54.9**		**51.8**		**16**		**22**		**26**	J	**29**		**31**		**32**		**30**		**32**	
Sulfide	> background	mg/L	3	UJ	3	U	2	U	2	U	**2**		2	U	**2**		**2.4**		**3.2**		2	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
Bold - Indicates positive detection for lab analyzed parameters
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pH calibration issues identified during the August 2017 event for MW-20S, MW-19S, and MW-17S.
*values indicative of degradation (NJDEP, 2012)

TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D	
			2/26/2013		8/27/2013		3/25/2014		8/26/2014		3/31/2015		8/25/2015		03/30/16		08/30/16		03/22/17		08/10/17	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	5.81		6.05		5.32		5.01		5.95		5.94		6.31		5.42		6.35		5.62	
Specific Conductivity	-	mS/cm	0.446		0.476		0.602		0.719		0.650		0.785		0.785		0.907		0.867		0.937	
Temperature	-	°C	9.07		13.78		10.33		13.15		11.64		14.97		10.17		16.69		12.47		15.35	
Turbidity	-	NTU	6.74		8.21		3.03		5.48		6.53		4.09		9.15		5.18		8.31		9.48	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.95		0.79		0.97		0.39		0.69		0.87		0.42		2.88		0.49		1.2	
Methane	> background	µg/L	2.9	U	**2.5**	B	5	U	5	U	**4.7**		**1.3**	B	**3.7**		**6.7**		**140**		**110**	
Nitrate	< background	mg/L	1	U	1	U	**0.58**		**1.1**		**0.38**		**1.3**		**0.041**	J	**0.7**		**0.33**		**0.72**	
Oxidation Reduction Potential	< background	mV	33.0		52.8		13.5		-8.3		-47.6		17.8		-54.1		-102.6		-222.0		32.4	
Sulfate	< background	mg/L	**30**		**24**		**37**		**43**		**31**		**43**	J	**11**		**46**		**19**		**28**	
Sulfide	> background	mg/L	2	U	2	U	3	U	3	UL	**0.99**	J	3	U	**4.5**		3	U	**2.2**	J	**0.82**	JB

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		BG-1D		MW-6	
			03/20/18		09/05/18		3/20/2019		09/17/19		03/10/20		09/23/20		03/23/21		09/15/21		2/24/2011	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	5.26		6.48		5.58		5.43		5.79		5.08		5.40		5.03		7.45	
Specific Conductivity	-	mS/cm	1.107		1.149		0.983		0.931		1.094		1.26		1.081		1.21		0.879	
Temperature	-	°C	9.71		14.79		12.64		11.58		12.53		14.60		12.51		20.10		10.17	
Turbidity	-	NTU	4.46		3.74		5		2.40		4.95		11.80		8.10		5.06		21.7	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	5.11		1.72		0.80		2.64		1.16		3.28		1.94		4.07		1.24	
Methane	> background	µg/L	1	U	1	U	**2**		**2.9**		**3.3**		**3.2**		**1.6**		**3.8**		**1400**	
Nitrate	< background	mg/L	**1.4**		**1.46**		**1.12**		0.1	U	**0.552**		**1.5**		**1.57**		**1.77**		1	U
Oxidation Reduction Potential	< background	mV	383.3		-9.7		-7.8		-111.5		-87.6		155.7		-51.0		97.6		-295.5	
Sulfate	< background	mg/L	**54**		**52.6**		**49.2**		**50.6**		**50.6**		**59**		**57.8**		**54**		**90**	
Sulfide	> background	mg/L	**0.84**	**JB**	1	U	3	U	3	U	3	U	3	U	3	UJ	**2.7**	**J**	**5.6**	

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6	
			5/18/2011		8/10/2011		12/8/2011		3/21/2012		Duplicate		5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	7.55		7.52		7.66		7.28		-		7.34		7.55		7.7		7.62		7.41	
Specific Conductivity	-	mS/cm	0.913		0.909		0.858		0.882		-		0.734		17.85		0.812		0.642		0.844	
Temperature	-	°C	12.63		23.00		9.81		12.49		-		12.93		15.92		11.25		9.87		15.11	
Turbidity	-	NTU	20.0		37.9		18.5		12.3		-		19.3		15.4		11.0		12.6		16.1	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.67		1.04		0.28		0.34		-		0.18		1.1		1.3		1.2		0.85	
Methane	> background	µg/L	**1700**		**1400**		**1200**		**1500**		**1600**		**1200**		**1400**	J	**1500**		**1800**		**1100**	
Nitrate	< background	mg/L	0.5	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Oxidation Reduction Potential	< background	mV	-121.9		-30.8		-117.3		-110.1		-		-109.6		-41.2		-137.2		-164.4		-141	
Sulfate	< background	mg/L	**130**		**96**	J	**100**		**120**	J	**110**	J	**94**		**85**		**98**		**110**	J	**100**	
Sulfide	> background	mg/L	2	U	**2**		**5.2**	J	**2.8**		2	U	**6**		**7.2**		**2**		2	U	2	U

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Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

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			3/26/2014		8/26/2014		4/1/2015		8/26/2015		03/30/16		08/31/16		Duplicate		03/22/17		8/11/2017	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	7.73		7.67		7.46		7.60		7.79		7.49		-		8.22		7.49	
Specific Conductivity	-	mS/cm	0.927		0.670		0.581		0.842		0.876		0.844		-		0.851		0.819	
Temperature	-	°C	9.24		13.66		8.58		13.27		17.43		14.96		-		11.12		15.67	
Turbidity	-	NTU	19.8		6.99		4.85		8.89		4.35		3.02		-		3.71		5.71	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	0.65		0.68		1.93		0.73		0.06		1.28		-		0.83		0.67	
Methane	> background	µg/L	**180**		**450**		**700**		**1300**		**800**		**740**		**890**		**450**		**150**	
Nitrate	< background	mg/L	0.1	U	0.1	U	**0.022**	**JB**	**0.014**	**JB**	**0.026**	**J**	NA		NA		0.1	U	0.1	U
Oxidation Reduction Potential	< background	mV	-75.0		-167.3		-116.9		-126.5		-113.1		-40.8		-		-28.2		-435.7	
Sulfate	< background	mg/L	**110**		**110**		**100**		**100**		**94**		NA		NA		**110**		**111**	
Sulfide	> background	mg/L	3	U	3	UL	3	U	**0.72**	**J**	3	U	3	U	3	U	3	U	3	U

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Upper Merion Township, Pennsylvania

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			03/21/18		Duplicate		9/6/2018		Duplicate		3/20/2019		Duplicate		09/18/19		03/10/20		09/23/20	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	7.57		-		7.60		-		7.43		-		7.43		7.51		7.38	
Specific Conductivity	-	mS/cm	0.913		-		0.924		-		0.957		-		0.678		0.951		0.92	
Temperature	-	°C	5.25		-		27.10		-		14.44		-		17.03		13.51		16.60	
Turbidity	-	NTU	9.53		-		6.38		-		6.69		-		4.75		7.55		4.01	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	2.78		-		2.44		-		0.61		-		0.88		1.65		0.38	
Methane	> background	µg/L	**410**		**410**		**610**		**610**		**730**		**610**		**570**		**940**		**850**	
Nitrate	< background	mg/L	0.1	U	0.1	U	0.1	U	0.1	U	**0.0887**	**JB**	**0.0887**	**JB**	0.1	U	0.1	U	0.5	U
Oxidation Reduction Potential	< background	mV	-107.9		-		-53.4		-		102.1		-		-52.7		-136.3		-163.6	
Sulfate	< background	mg/L	**130**		**130**		**124**		**121**		**126**		**126**		**109**		**117**		**107**	
Sulfide	> background	mg/L	**2.8**	**JB**	**1.6**	**JB**	1	U	1	U	3	U	3	U	3	U	3	U	3	U

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Parameters	Values Indicating of Degradation*	Units	MW-6		MW-6		MW-6		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8	
			03/24/21		03/24/21		09/15/21		2/23/2011		5/17/2011		Duplicate		8/10/2011		12/8/2011		3/21/2012		5/31/2012	
			Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	7.43		-		7.49		6.43		6.48		-		6.14		6.50		6.31		6.38	
Specific Conductivity	-	mS/cm	0.8		-		0.86		0.345		0.540		-		0.642		0.591		0.663		0.637	
Temperature	-	°C	11.16		-		18.80		11.27		14.16		-		16.85		13.28		14.27		15.67	
Turbidity	-	NTU	3.30		-		6.72		19.8		18.9		-		11.8		16.30		11.90		15.8	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.81		-		0.23		0.75		0.64		-		0.61		0.40		0.50		1.14	
Methane	> background	µg/L	**1200**		**1200**		**1300**		**8.4**		**11**		**10**		**10**		**9.3**		**11**		**12**	
Nitrate	< background	mg/L	0.1	U	0.1	U	0.1	U	1	UJ	1	U	1	U	1	U	1	U	**1.1**		1	U
Oxidation Reduction Potential	< background	mV	-142.9		-		-136.5		106.5		100.6		-		98.9		123.2		119.5		72.7	
Sulfate	< background	mg/L	**108**		**109**		**92.4**		**60**		**86**		**83**		**89**	**J**	**110**		**98**	**J**	**100**	
Sulfide	> background	mg/L	3	UJ	3	UJ	**2.6**	**J**	2	U	2	U	2	U	**2**		2.0	U	**2.4**		**2.8**	

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Parameters	Values Indicating of Degradation*	Units	MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8	
			9/5/2012		11/29/2012		Duplicate		2/27/2013		Duplicate		8/27/2013		3/25/2014		8/26/2014		3/31/2015		8/26/2015	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	6.51		6.64		-		6.57		-		6.75		6.37		6.35		6.53		6.90	
Specific Conductivity	-	mS/cm	1.018		0.623		-		0.506		-		0.559		0.555		0.656		0.561		0.548	
Temperature	-	°C	18.47		10.38		-		11.32		-		14.21		11.03		14.37		10.92		13.68	
Turbidity	-	NTU	10.72		12.3		-		6.2		-		7.21		3.52		3.36		5.13		6.24	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	1.25		1.48		-		0.89		-		0.62		1.06		0.41		1.03		0.91	
Methane	> background	µg/L	**14**	B	**11**		**8.4**		**10**		**9.1**		**8.5**		5	U	5	U	**5.2**		**4.4**	
Nitrate	< background	mg/L	1	U	1	U	1	U	1	U	1	U	1	U	**1.3**		**0.47**		**0.4**		**0.021**	JB
Oxidation Reduction Potential	< background	mV	58.6		61.3		-		27.8		-		23.5		68.3		-95.8		17.3		-73.2	
Sulfate	< background	mg/L	**87**		**90**		**94**		**100**	J	**100**	J	**110**		**100**		**91**		**76**		**70**	
Sulfide	> background	mg/L	2	U	2	U	2	U	2	U	2	U	2	U	3	U	3	UL	3	U	**1.5**	J

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Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-8 Duplicate		MW-8 03/29/16		MW-8 08/30/16		MW-8 03/23/17		MW-8 08/11/17		MW-8 03/20/18		MW-8 09/05/18		MW-8 3/19/2019		MW-8 09/17/19	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	-		6.50		6.53		6.58		5.76		6.39		6.76		6.48		6.37	
Specific Conductivity	-	mS/cm	-		0.585		0.56		0.561		0.592		0.596		0.608		0.553		0.518	
Temperature	-	°C	-		10.46		16.25		10.90		15.13		7.21		16.45		12.10		12.66	
Turbidity	-	NTU	-		4.93		5.02		2.73		13.10		1.97		5.17		3.71		2.30	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	-		1.61		2.14		0.82		1.75		2.92		1.18		1.99		1.60	
Methane	> background	µg/L	**4.9**		**3.8**		**2.1**		**1.7**		**1.8**		**3.5**		**3.1**		**4.7**		**3.1**	
Nitrate	< background	mg/L	**0.014**	**JB**	**0.057**	**J**	**0.18**		0.1	U	0.1	U	**0.12**		**0.977**		**0.0361**	**J**	**0.0439**	**J**
Oxidation Reduction Potential	< background	mV	**-**		-49.2		-137.6		7.6		89.8		312.8		-59.9		-36.0		12.8	
Sulfate	< background	mg/L	**69**		**64**		**69**		**83**		**75.7**		**71**		**72.3**		**67.4**		**61.5**	
Sulfide	> background	mg/L	**1**	**J**	3	U	3	U	3	U	3	U	**1.5**	**JB**	1	U	3	U	3	U

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TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-8		MW-8		MW-8		MW-8		MW-8		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S	
			03/10/20		09/22/20		03/24/21		09/14/21		Duplicate		2/23/2011		5/18/2011		8/10/2011		12/7/2011		Duplicate	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	6.46		6.76		6.41		6.24		-		7.21		7.25		7.33		7.38		-	
Specific Conductivity	-	mS/cm	0.560		0.513		0.511		0.547		-		1.249		1.315		1.256		1.021		-	
Temperature	-	°C	12.40		13.16		11.87		15.60		-		12.23		13.13		14.11		11.11		-	
Turbidity	-	NTU	6.08		20.90		3.97		2.71		-		5		15.0		27		8.9		-	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	2.49		1.38		1.84		0.84		-		0.17		0.50		0.15		1.71		-	
Methane	> background	µg/L	**2.5**		**3.4**		**10**		**5.2**		**6.8**		**1500**		**900**		**800**		**1200**		**1100**	
Nitrate	< background	mg/L	0.1	U	**0.117**		**0.391**		**0.0963**	**J**	**0.0936**	**J**	**1.3**	**J**	**1.44**		**3**		1	U	1	U
Oxidation Reduction Potential	< background	mV	-10.6		41.7		64.3		21.2		-		-293.4		-101.4		-60.4		-110.9		-	
Sulfate	< background	mg/L	**61.5**		**59.9**		**64.8**		**69.6**		**66.6**		**450**		**190**		**150**	**J**	**110**	**J**	**120**	**J**
Sulfide	> background	mg/L	3	U	3	U	3	UJ	3	U	3	U	**5.2**		2	U	2	U	**2**	**J**	2	U

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S	
			3/21/2012		5/31/2012		Duplicate		9/5/2012		Duplicate		11/29/2012		2/27/2013		8/28/2013		Duplicate		3/26/2014	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	7.22		6.97		-		7.32		-		7.56		7.4		7.13		-		7.58	
Specific Conductivity	-	mS/cm	0.839		0.974		-		1.31		-		1.247		1.215		1.065		-		0.901	
Temperature	-	°C	12.73		12.77		-		18.12		-		12.86		12.14		14.63		-		12.30	
Turbidity	-	NTU	51.2		25.3		-		15.2		-		25.4		27.7		20.6		-		30.1	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.47		0.22		-		0.6		-		1.09		0.23		0.56		-		0.88	
Methane	> background	µg/L	**1200**		**990**		**1200**		**240**	J	**350**	J	**1300**		**1200**		**1200**		**1100**		**82**	
Nitrate	< background	mg/L	**1.3**		**1.8**		**1.7**		**7.2**		**6.2**		1	U	1	U	1	U	1	U	0.1	U
Oxidation Reduction Potential	< background	mV	-18.7		-120.6		-		82.0		-		-122.9		-82.8		-139.1		-		-72.6	
Sulfate	< background	mg/L	**120**	J	**150**		**140**		**160**		**160**		**150**		**130**	J	**98**	L	**100**		**85**	
Sulfide	> background	mg/L	**3.6**		**2.8**	J	**4.8**	J	2	U	2	U	2	U	2	U	2	U	2	U	**13**	

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S	
			8/27/2014		4/1/2015		8/26/2015		03/29/16		08/30/16		03/22/17		08/11/17		03/21/18		09/05/18	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	7.22		7.26		7.46		7.36		8.64		7.37		6.9		7.89		7.91	
Specific Conductivity	-	mS/cm	0.972		0.889		0.869		0.784		0.959		0.856		0.731		0.748		0.779	
Temperature	-	°C	13.52		10.07		17.12		12.75		18.20		12.10		13.84		11.14		13.79	
Turbidity	-	NTU	37.9		40.1		57.1		20.9		27.5		29.3		19.2		16.1		27.3	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	0.46		0.61		0.70		0.64		1.08		0.30		0.36		1.34		0.60	
Methane	> background	µg/L	**410**		**740**		**1100**		**950**		**520**		**520**		**270**		**410**		**530**	
Nitrate	< background	mg/L	0.1	U	**0.016**	**JB**	0.1	U	0.1	U	**1.3**		0.1	U	0.1	U	**0.054**	**JB**	**0.102**	
Oxidation Reduction Potential	< background	mV	-182.6		-36.7		-67.9		-88.5		-61.3		-121.6		-2.8		78.2		-111.3	
Sulfate	< background	mg/L	**94**		**90**		**91**		**64**		**84**		**88**		**50.8**		**68**		**67.4**	
Sulfide	> background	mg/L	3	U	3	U	3	U	3	U	3	U	3	U	3	U	**1.9**	**JB**	1	U

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11D		MW-11D	
			3/19/2019		09/18/19		03/10/20		03/10/20		09/23/20		03/24/21		09/14/21		2/23/2011		5/18/2011	
			Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	7.30		7.02		7.23		-		8.01		7.29		7.06		8.00		7.91	
Specific Conductivity	-	mS/cm	0.689		0.774		0.805		-		0.823		0.768		0.859		1.305		1.351	
Temperature	-	°C	12.81		10.21		15.10		-		13.87		10.89		15.10		11.59		15.82	
Turbidity	-	NTU	24.4		35.3		24.60		-		78.00		53.40		21.2		25		24.6	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	0.28		0.80		0.30		-		1.03		1.52		0.57		1.44		0.16	
Methane	> background	µg/L	**390**		**1100**		**800**		**770**		**920**		**460**		**420**		**1600**		**1300**	
Nitrate	< background	mg/L	**0.665**		**1.04**		**0.36**		**0.366**		**0.437**		**0.296**		**4.26**		1	UJ	0.5	UJ
Oxidation Reduction Potential	< background	mV	-17.9		-65.0		48.6		-		-118.2		21.8		106.8		-194.0		-129.6	
Sulfate	< background	mg/L	**78.6**		**74.9**		**75.4**		**75.2**		**89.4**		**66.6**		**88.6**		**400**		**220**	
Sulfide	> background	mg/L	3	U	3	U	3	U	3	U	3	U	3	UJ	3	U	**8.8**		**5.6**	

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D	
			8/10/2011		12/8/2011		3/21/2012		5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013		3/26/2014		8/27/2014	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	8.07		7.99		7.80		7.78		8.18		8.31		8.14		7.67		8.25		8.06	
Specific Conductivity	-	mS/cm	1.392		1.213		1.022		1.097		2.181		1.227		1.32		1.331		1.220		1.226	
Temperature	-	°C	15.90		9.74		13.16		12.94		16.10		13.79		12.40		13.82		11.31		13.52	
Turbidity	-	NTU	20.0		20.7		27.9		9.15		13.50		22.50		9.62		8.37		17.6		9.8	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.09		2.01		0.42		0.28		0.7		0.14		0.15		0.29		0.86		0.21	
Methane	> background	µg/L	**1400**		**1000**		**1100**		**940**		**840**	J	**1100**		**910**		**760**		**230**		**420**	
Nitrate	< background	mg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.1	U	0.1	U
Oxidation Reduction Potential	< background	mV	-194.4		-112.9		-106.7		-179.9		-40.8		-135.2		-165.2		-193.8		-109.8		-222.8	
Sulfate	< background	mg/L	**180**	J	**230**		**220**	J	**200**		**180**		**190**		**200**	J	**180**		**170**		**180**	
Sulfide	> background	mg/L	**2.8**		**2.8**	J	**6**		**5.2**		**3.2**		2	U	2	U	2	U	**0.82**	JB	**0.85**	J

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Upper Merion Township, Pennsylvania

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			4/1/2015		8/26/2015		03/29/16		08/30/16		03/22/17		08/11/17		03/21/18		09/06/18		3/20/2019	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	8.23		8.29		7.98		9.6		8.41		7.95		8.17		9.65		8.41	
Specific Conductivity	-	mS/cm	1.185		1.116		1.130		1.186		1.107		1.104		1.118		1.117		0.979	
Temperature	-	°C	11.07		18.46		16.10		15.68		12.41		14.26		10.13		13.05		12.88	
Turbidity	-	NTU	20.7		37.3		20.2		22.5		9.02		12.7		8.49		5.63		2.8	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	0.66		0.39		0.97		0.64		0.28		0.21		0.98		0.80		0.49	
Methane	> background	µg/L	**430**		**740**		**540**		**510**		**300**		**370**		**1100**		**1300**		**1300**	
Nitrate	< background	mg/L	**0.012**	**JB**	0.1	U	0.1	U	**0.19**		0.1	U	0.1	U	0.1	U	0.1	U	**0.0992**	**JB**
Oxidation Reduction Potential	< background	mV	-38.9		-83.3		8.9		-108.4		-50.3		39.6		138.6		-205.1		-37.7	
Sulfate	< background	mg/L	**150**		**140**		**130**		**100**		**120**		**108**		**100**		**97**		**84.4**	
Sulfide	> background	mg/L	**0.99**	**JB**	3	U	3	U	3	U	3	U	3	U	**2.6**	**JB**	1	U	3	U

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			09/18/19		03/10/20		09/23/20		03/24/21		09/14/21		2/24/2011		5/19/2011		8/11/2011		12/8/2011		3/21/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	8.00		8.03		8.82		8.56		8.47		6.65		6.43		6.48		6.67		6.66	
Specific Conductivity	-	mS/cm	0.966		1.066		0.971		0.958		0.947		10.02		10.25		10.53		9.237		9.765	
Temperature	-	°C	11.22		12.97		15.57		10.45		15.30		8.64		14.20		17.00		9.67		17.37	
Turbidity	-	NTU	5.36		6.38		4.55		6.02		6.38		21.9		14.0		29		9.22		15.40	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.75		0.55		1.48		3.29		0.31		0.92		0.92		0.10		1.72		0.04	
Methane	> background	µg/L	**930**		**1400**		**1200**		**930**		**1500**		**300**		**350**		**370**		**330**		**310**	
Nitrate	< background	mg/L	0.1	UJ	0.1	U	0.1	U	0.1	U	0.1	U	1	UJ	1	U	1	U	1	U	1	U
Oxidation Reduction Potential	< background	mV	-105.5		-59.3		-129.7		5.4		-84.5		-200.5		-164.9		-101.1		-232.9		-122.6	
Sulfate	< background	mg/L	**76.3**		**72.2**		**70**		**60.5**		**53**		**5.8**		**6**	**L**	**6.1**		**4.3**		**5.1**	**J**
Sulfide	> background	mg/L	3	U	3	U	3	U	3	UJ	3	U	**32**		**8**		**4**		**34**	**J**	**6.8**	

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			5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013		3/26/2014		8/27/2014		4/1/2015		8/26/2015	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	6.60		7.44		6.87		7.16		7.28		7.32		7.33		7.41		7.37	
Specific Conductivity	-	mS/cm	8.893		18.28		12.05		7.066		14.49		9.316		8.692		7.285		9.116	
Temperature	-	°C	16.81		18.80		11.92		10.61		19.17		10.37		18.88		11.81		26.12	
Turbidity	-	NTU	12.2		31.5		44.5		33.2		27.9		33.5		7.52		5.35		12.6	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	4.18		0.97		1.49		0.5		0.96		0.12		0.46		0.69		0.25	
Methane	> background	µg/L	**340**		**320**	J	**280**		**310**		**320**		**310**		**100**		**260**		**500**	
Nitrate	< background	mg/L	1	U	1	U	1	U	1	U	1	U	0.1	U	0.5	U	**0.16**	J	**0.07**	J
Oxidation Reduction Potential	< background	mV	-139.2		-223.9		-116.7		-198.2		-244.3		-241.4		-334.6		-339.2		-229.2	
Sulfate	< background	mg/L	**4.7**		**4.8**		**5.1**		**7.5**	J	**11**		**2.7**		**13**		**18**		**18**	
Sulfide	> background	mg/L	**6.8**		**4.8**		**4**		**2.4**		**10**		3	U	**8.8**		**35**		**17**	

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TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S	
			03/30/16		08/31/16		3/22/2017		Duplicate		08/11/17		03/21/18		09/06/18		3/20/2019		09/18/19	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	7.69		8.29		11.36		-		6.85		9.72		8.11		7.44		7.41	
Specific Conductivity	-	mS/cm	6.325		9.473		9.615		-		8.925		9.481		9.850		9.269		8.947	
Temperature	-	°C	14.21		21.26		11.95		-		20.98		10.16		15.70		14.08		15.86	
Turbidity	-	NTU	46.2		70.2		25.3		-		26.7		11.96		6.55		13		19.6	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	0.30		0.29		0.09		-		0.27		0.65		0.40		0.18		0.60	
Methane	> background	µg/L	**120**		**90**		**170**		**160**		**180**		**490**		**650**		**940**		**430**	
Nitrate	< background	mg/L	0.5	U	NA		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	**0.357**	**JB**	1	U
Oxidation Reduction Potential	< background	mV	-101.1		-146.4		-123.4		-		-430.7		-351.7		-420.2		-384.6		-329.9	
Sulfate	< background	mg/L	**20**		NA		**29**		**30**		**40.1**		**34**		**31.1**		**33.4**		**30.6**	
Sulfide	> background	mg/L	**3.3**		3	U	**1.1**	**J**	**2.4**	**J**	**3.9**		**1.5**	**JB**	**7.1**		**17**		**15**	

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-13S		MW-13S		MW-13S		MW-13S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S	
			03/10/20		09/23/20		03/24/21		09/14/21		11/9/2010		2/22/2011		5/17/2011		8/10/2011		12/8/2011		3/21/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	8.15		8.84		8.41		8.38		8.75		9.89		8.42		8.45		8.70		8.15	
Specific Conductivity	-	mS/cm	9.772		10.09		8.724		9.067		0.456		1.717		2.307		2.589		1.059		1.827	
Temperature	-	°C	14.30		23.60		11.82		16.80		16.75		10.20		16.10		18.19		14.13		14.43	
Turbidity	-	NTU	70.7		8.38		8.00		5.42		17.9		49.9		793		143		22.3		3.97	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.48		0.07		3.09		0.48		0.71		0.89		0.68		1.12		0.67		0.69	
Methane	> background	µg/L	**340**		**390**		**510**		**680**		**3.8**		**0.61**	**J**	**5.2**		**1.1**	**B**	**8.7**		**3.9**	
Nitrate	< background	mg/L	0.5	U	1	U	1	U	0.5	U	1	U	1	U	1	U	1	U	1	U	**1.2**	
Oxidation Reduction Potential	< background	mV	-179.2		-373.6		-118.1		-227.0		-18.3		-300.1		119.6		-67.8		30.5		129.2	
Sulfate	< background	mg/L	**48.2**		**39.6**		**34.6**		**32.1**		**9.2**		**12**	**J**	**16**		**14**	**J**	**12**		**13**	**J**
Sulfide	> background	mg/L	**5.9**		3	U	**5.1**	**J**	3	U	**2**		2	U	2	U	2	U	2	U	2	U

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S	
			5/30/2012		9/5/2012		11/29/2012		2/27/2013		8/28/2013		3/25/2014		8/26/2014		3/31/2015		8/26/2015		03/30/16	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	8.95		8.56		8.71		8.82		8.39		8.45		8.17		8.27		8.13		7.88	
Specific Conductivity	-	mS/cm	0.432		2.395		1.212		1.047		1.46		0.897		0.696		0.472		0.487		0.633	
Temperature	-	°C	21.24		20.70		13.50		8.89		16.98		15.35		16.89		12.59		19.75		12.84	
Turbidity	-	NTU	147		1792		26		19.8		183		455		71.2		618		120		102.4	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	3.26		1.20		1.10		8.87		1.61		5.67		0.64		3.24		2.78		3.37	
Methane	> background	µg/L	**1.3**	B	**2.2**	B	**2.4**		0.36	U	**3.6**		5	U	5	U	**0.28**	JB	**0.7**		**0.39**	
Nitrate	< background	mg/L	**1.1**		**1.1**		1	U	1	U	**1**		**0.95**		**1.1**		**1.4**		**1.1**		**0.96**	
Oxidation Reduction Potential	< background	mV	38.4		30.7		19.9		101.1		-93.1		18.3		-129.2		-65.9		47.2		95.2	
Sulfate	< background	mg/L	**6.7**		**11**		**9.5**		**25**	J	**12**		**9.7**		**12**		**7.6**		**6.6**		**5.7**	
Sulfide	> background	mg/L	2	U	2	U	2	U	2	U	2	U	3	U	**1.8**	L	3	U	3	U	3	U

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Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S	
			08/31/16		03/21/17		08/10/17		03/20/18		09/05/18		10/30/18		10/30/18		3/20/2019		09/18/19	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	8.07		8.44		14.6		7.78		7.77		7.86		-		7.70		7.80	
Specific Conductivity	-	mS/cm	0.346		0.336		0.340		0.377		0.609		0.870		-		0.827		6.451	
Temperature	-	°C	32.95		13.18		16.64		2.95		34.20		15.28		-		11.31		17.89	
Turbidity	-	NTU	3.68		45.1		110		135		81		26.4		-		52.1		>1000	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	4.35		4.31		2.77		2.65		0.55		0.56		-		2.51		2.51	
Methane	> background	µg/L	**0.5**	**JB**	**0.087**	**J**	**0.32**	**JB**	**14**		**12**		**110**		**110**		**91**		**94**	**R**
Nitrate	< background	mg/L	NA		**1.1**		**1.3**		**1.7**		**1.56**		**0.77**		**0.753**		**0.742**		**0.808**	
Oxidation Reduction Potential	< background	mV	-71.8		201.2		-117.7		82.4		-37.5		151.3		-		12.8		99.5	
Sulfate	< background	mg/L	NA		**3.7**		**5.2**		**7.7**		**13.6**		**20.6**		**21.6**		**19.2**		**11.4**	
Sulfide	> background	mg/L	3	U	3	U	3	U	**1.2**	**JB**	1	U	3	U	3	U	3	U	3	U

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Parameters	Values Indicating of Degradation*	Units	MW-17S		MW-17S		MW-17S		MW-17S		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D	
			03/10/20		09/22/20		03/23/21		09/14/21		2/22/2011		5/17/2011		8/9/2011		12/7/2011		3/20/2012		5/30/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	7.70		8.83		7.76		7.62		8.50		8.00		7.72		8.50		8.20		8.09	
Specific Conductivity	-	mS/cm	0.445		0.44		1.134		0.477		28.32		15.13		7.839		7.121		4.671		1.985	
Temperature	-	°C	15.14		17.40		17.12		22.50		3.28		14.12		21.00		13.19		13.93		18.73	
Turbidity	-	NTU	83.1		7.41		97.10		121		9.28		189		48.7		131		120		168	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	3.55		1.44		2.68		0.80		7.70		1.40		1.36		2.50		1.68		1.59	
Methane	> background	µg/L	**5.6**		**0.21**	**JB**	**57**		**4.1**		**83**	**J**	**260**		**210**		**140**		**39**		**100**	
Nitrate	< background	mg/L	**1.62**		**1.64**		**1.5**		**1.62**		10	UJ	1	U	1	U	1	U	**1.5**		**1.3**	
Oxidation Reduction Potential	< background	mV	33.1		-130.7		93.5		71.6		187.7		215.4		-68.9		-53.4		144.1		41.9	
Sulfate	< background	mg/L	**7.72**		**5.12**		**5.99**		**5.34**		**450**	**J**	**180**		**83**		**120**	J	**22**		**12**	
Sulfide	> background	mg/L	3	U	3	U	3	UJ	3	U	**3.6**		2	U	2.0	U	2	U	2	U	2	U

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Parameters	Values Indicating of Degradation*	Units	MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D	
			9/5/2012		11/28/2012		2/26/2013		8/27/2013		3/25/2014		8/26/2014		3/31/2015		8/25/2015		3/29/2016	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	8.16		8.00		7.92		7.85		7.97		7.35		7.69		7.95		7.89	
Specific Conductivity	-	mS/cm	7.274		3.458		1.997		2.703		2.497		1.234		1.649		2.809		2.065	
Temperature	-	°C	20.07		6.69		7.96		21.31		4.85		16.51		11.85		25.41		11.98	
Turbidity	-	NTU	172		318		68.7		623.0		327		15.7		30.5		>2500		1178.0	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	4.14		2.65		7.37		2.94		2.81		1.12		1.58		1.99		1.62	
Methane	> background	µg/L	**31**		**98**		2.6	U	**98**		5	U	**6.1**		**260**		**100**		460	U
Nitrate	< background	mg/L	1	U	1	UJ	1	U	1	U	**0.027**	**JB**	**0.046**	**JB**	**0.84**		**0.09**	**J**	**0.1**	**U**
Oxidation Reduction Potential	< background	mV	68.4		188.0		87.1		-91.2		58.8		-59.2		-55.5		-24.3		27.2	
Sulfate	< background	mg/L	**37**		**48**		**32**		**57**		**43**		**53**		**28**		**50**	**J**	**40**	
Sulfide	> background	mg/L	2	U	2	U	2	U	2	U	3	U	3	UL	3	U	3	U	3	U

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Parameters	Values Indicating of Degradation*	Units	MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D		MW-17D	
			8/31/2016		3/21/2017		8/11/2017		3/20/2018		9/5/2018		10/30/2018		3/19/2019		09/17/19		03/10/20	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	7.33		12.10		7.65		7.89		7.75		8.51		7.88		7.76		7.58	
Specific Conductivity	-	mS/cm	2.522		2.331		2.194		2.352		2.421		0.766		1.492		1.405		1.581	
Temperature	-	°C	36.08		14.76		19.70		7.42		24.42		15.16		11.55		17.55		14.54	
Turbidity	-	NTU	14.8		11.91		20.1		2960		3475		29.8		29.5		>1000		190	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	1.78		1.68		1.01		0.76		0.62		0.93		1.93		3.72		4.10	
Methane	> background	µg/L	**450**		**290**		**310**		**1200**		**690**		**99**		**260**		**130**		**160**	
Nitrate	< background	mg/L	**NA**		0.1	U	0.1	U	**0.083**	**J**	0.1	U	**1.05**		0.1	U	**0.0326**	**J**	0.1	U
Oxidation Reduction Potential	< background	mV	-52.5		-112.3		-497.9		-51.7		-68.1		179.9		20.4		58.1		33.8	
Sulfate	< background	mg/L	**NA**		**45**		**33.9**		**44**		**48.6**		**34.2**		**48**		**51.2**		**50.8**	
Sulfide	> background	mg/L	3	U	3	U	3	U	**1.9**	**JB**	**1.5**		3	U	3	U	3	U	3	U

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TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-17D		MW-17D		MW-17D		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S	
			09/22/20		03/23/21		09/14/21		11/10/2010		2/22/2011		Duplicate		5/17/2011		8/9/2011		12/7/2011		3/20/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	7.58		7.75		7.47		6.53		7.95		-		6.40		6.23		6.49		6.54	
Specific Conductivity	-	mS/cm	1.7		3.912		3.34		1.073		1.200		-		1.187		1.095		1.083		1.126	
Temperature	-	°C	15.30		12.08		24.10		12.21		10.95		-		11.41		16.39		12.60		14.96	
Turbidity	-	NTU	28.90		33.90		11.79		1.01		1.01		-		2.00		4.61		2.50		3.80	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	1.52		3.43		1.60		0.54		0.25		-		0.97		1.27		0.21		1.43	
Methane	> background	µg/L	**140**		**130**		**650**		**2.5**		**0.88**		**0.85**		**0.77**		**3.9**	**B**	**0.91**		**4.5**	
Nitrate	< background	mg/L	0.1	U	**0.698**		0.25	U	**26**		**31**	**J**	**31**	**J**	**28**	**J**	**26**		**30**		**19**	
Oxidation Reduction Potential	< background	mV	-21.2		195.4		27.2		-69.8		-419.2		-		-63.8		94.1		82.9		131.9	
Sulfate	< background	mg/L	**48.2**		**26.1**		**26.7**		**44**		**46**	**J**	**46**	**J**	**52**		**44**		**51**	**J**	**71**	
Sulfide	> background	mg/L	3	U	3	UJ	3	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U

Notes:
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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S	
			5/30/2012		9/5/2012		11/28/2012		2/26/2013		8/28/2013		3/25/2014		Duplicate		8/26/2014		3/31/2015		8/25/2015	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	7.40		7.14		6.90		6.55		6.54		6.93		-		6.53		6.74		6.22	
Specific Conductivity	-	mS/cm	1.216		1.19		1.117		1.174		1.099		0.935		-		1.052		0.905		1.006	
Temperature	-	°C	11.44		12.99		11.27		11.29		14.03		11.10		-		13.51		8.80		14.17	
Turbidity	-	NTU	5.15		4.90		8.59		0.91		0.80		1.99		-		2.12		3.17		4.34	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	1.48		0.91		2.58		0.7		0.49		1.32		-		0.42		0.94		0.90	
Methane	> background	µg/L	**1.6**	B	**1.4**	B	4.2	U	0.72	U	**1.4**	B	5	U	5	U	5	U	**2.1**		**14**	
Nitrate	< background	mg/L	**25**	J	**25**	J	**18**		**24**		**20**	J	**22**		**22**		**17**	L	**16**		**13**	
Oxidation Reduction Potential	< background	mV	14.9		144.2		86.3		132.7		6.7		83.8		-		-109.1		-66.8		-33.1	
Sulfate	< background	mg/L	**50**		**48**		**62**		**54**		**60**		**60**		**63**		**64**		**61**		**70**	J
Sulfide	> background	mg/L	2	U	2	U	2	U	2	U	2	U	3	U	3	U	3	UL	3	U	3	U

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S		MW-19S	
			03/30/16		08/30/16		03/22/17		08/10/17		Duplicate		03/20/18		09/05/18		3/20/2019		09/17/19		03/10/20	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	6.90		6.72		7.33		12.12		-		7.03		6.77		6.88		7.16		6.96	
Specific Conductivity	-	mS/cm	1.067		1.016		1.033		1.003		-		0.988		0.995		1.056		1.060		1.023	
Temperature	-	°C	12.76		16.26		9.93		12.81		-		6.65		23.20		11.43		23.36		14.10	
Turbidity	-	NTU	0.77		4.8		8.35		5.29		-		3.33		4.19		3.11		51.6		2.69	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.26		4.78		3.1		1.75		-		1.07		2.61		1.09		0.53		0.21	
Methane	> background	µg/L	**7.5**		**45**		**22**		**16**		**13**		**710**		**8.5**		**43**		**100**		**140**	
Nitrate	< background	mg/L	**12**	J	**7.4**		**14**		**12**		**12**		**0.92**		**9.31**		**0.106**	B	0.1	U	**2.87**	
Oxidation Reduction Potential	< background	mV	39.8		-94.9		49.5		-80.2		-		-107.3		-132.1		-146.1		-256.3		-176.6	
Sulfate	< background	mg/L	**61**		**61**		**62**		**66**		**66**		**51**		**69.9**		**49.8**		**32.4**		**46.8**	
Sulfide	> background	mg/L	3	U	3	U	3	U	3	U	3	U	**0.77**	JB	1	U	**2.6**	J	**2.1**	J	3	U

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			09/22/20		Duplicate		03/23/21		09/15/21		2/23/2011		5/18/2011		8/9/2011		12/7/2011		3/20/2012		5/30/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	8.02		-		7.06		6.69		6.74		6.82		6.67		6.54		7.12		6.47	
Specific Conductivity	-	mS/cm	1.09		-		0.713		1.11		0.252		1.007		0.884		0.443		0.75		0.609	
Temperature	-	°C	14.90		-		13.68		20.40		9.38		17.04		28.71		11.91		16.26		20.10	
Turbidity	-	NTU	15.90		-		5.20		2.33		228		NM		NM		4.2		>1000		3218	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.42		-		1.48		0.31		0.16		0.19		1.06		2.34		0.05		0.72	
Methane	> background	µg/L	**52**		**59**		**110**		**47**		**1800**		**2200**		**3200**		**3200**		**4200**		**4000**	
Nitrate	< background	mg/L	**8.84**		**9.22**		**0.116**		**8**		1	UJ	0.5	U	1	U	1	U	1	U	1	U
Oxidation Reduction Potential	< background	mV	-77.5		-		-103.1		-18.0		-165.5		-88.4		-120.3		-78.9		-189.3		-45.7	
Sulfate	< background	mg/L	**37.4**		**36.1**		**30.4**		**47.1**		**3**		**2.9**		**8.9**		2	U	**2.8**		**4.2**	
Sulfide	> background	mg/L	3	U	3	U	3	UJ	3	U	**8.8**		**17**		**2.4**		**2**	**J**	**2.8**		**72**	

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Upper Merion Township, Pennsylvania

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			9/6/2012		11/28/2012		2/26/2013		8/27/2013		3/25/2014		8/26/2014		3/31/2015		8/25/2015		03/29/16		08/30/16	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	6.91		6.98		7.87		7.93		8.80		7.92		8.97		7.36		8.92		9.58	
Specific Conductivity	-	mS/cm	12.13		0.600		0.783		0.502		1.533		1.013		2.272		1.861		2.659		2.862	
Temperature	-	°C	16.05		10.98		10.86		21.43		9.44		19.89		12.52		25.88		11.33		23.20	
Turbidity	-	NTU	7.52		-		3572		482		>1000		>1000		12.4		>2500		> 4000		>1000	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	2.41		0.09		0.67		0.61		0.19		0.35		0.41		0.59		0.36		0.38	
Methane	> background	µg/L	**5800**	**J**	**3300**		**1100**		**3200**		**2000**		**670**		**1800**		**3700**		**2100**		**1800**	
Nitrate	< background	mg/L	1	U	1	U	1	U	1	U	0.1	U	**0.037**	**JB**	**0.053**	**JB**	**0.89**		0.25	U	0.25	U
Oxidation Reduction Potential	< background	mV	-77.4		-49.0		-100.8		-124.7		-135.0		-218.5		-209.6		-117.2		-73.6		-136.4	
Sulfate	< background	mg/L	2	U	2	U	2	U	2	U	**2.8**		**1.1**		**5.2**		**5**	**J**	**7.7**		**1.5**	**J**
Sulfide	> background	mg/L	**3.2**		**4**		2	U	2	U	**1.1**	**JB**	3	UL	**1.2**	**J**	**4.2**		**2.8**	**J**	**10**	

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			03/21/17		08/10/17		03/21/18		10/30/18		3/19/2019		09/17/19		03/10/20		09/22/20		03/23/21	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	12.75		14.70		7.12		6.98		6.46		6.54		6.66		7.23		6.69	
Specific Conductivity	-	mS/cm	3.130		2.826		9.080		1.071		0.882		0.277		0.571		0.381		1.977	
Temperature	-	°C	14.17		16.40		1.25		13.41		16.35		21.46		14.62		20.90		19.21	
Turbidity	-	NTU	>1000		52.1		27.3		>4000		57		532		61.4		72.20		668.0	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	0.85		2.0		1.25		0.28		2.48		2.20		2.87		0.63		0.62	
Methane	> background	µg/L	**170**		**1400**		**1000**		**1900**		**2900**		**1400**		**4700**		**3800**		**6000**	
Nitrate	< background	mg/L	0.25	U	0.1	U	**0.3**	J	**0.117**		0.1	U	**0.0741**	J	0.1	U	0.1	U	0.1	U
Oxidation Reduction Potential	< background	mV	-45.3		-141.2		-105.3		-138.2		-89.1		-53.9		-98.1		-139.5		-123.2	
Sulfate	< background	mg/L	**11**		**5.3**		**36**		**17.1**		**3.33**		**1.43**		**3.81**		**0.526**	J	**3.14**	
Sulfide	> background	mg/L	**27**		**3.8**		**2.6**	JB	3	U	3	U	3	U	3	U	3	U	3	UJ

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			09/14/21		11/10/2010		Duplicate		2/22/2011		5/18/2011		8/10/2011		12/6/2011		3/20/2012		5/30/2012		9/5/2012	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																						
pH	5-9	s.u.	6.50		6.8		-		6.27		6.17		6.03		6.11		6.20		6.43		6.42	
Specific Conductivity	-	mS/cm	0.396		0.379		-		0.180		0.193		0.199		0.179		0.187		0.185		0.294	
Temperature	-	°C	24.50		14.86		-		14.28		16.16		17.48		15.55		18.04		17.50		16.57	
Turbidity	-	NTU	14.5		113		-		116		1148		213		57.0		41.9		56.0		35.2	
MNA Indicator Parameters																						
Dissolved Oxygen	< background	mg/L	0.36		0.55		-		1.63		1.44		0.38		0.40		0.41		0.39		0.24	
Methane	> background	µg/L	**6200**		**160**		**180**		**86**		**4.6**		**64**		**150**		**570**		**180**		**160**	
Nitrate	< background	mg/L	**0.0362**	J	1	U	1	U	1	U	0.837		1	U	1	U	**1.2**		1	U	**1.3**	
Oxidation Reduction Potential	< background	mV	-115.1		-46.2		-		-194.3		156.7		37.8		-27.3		8.3		-239.5		-99.1	
Sulfate	< background	mg/L	1	U	**36**		**33**		**18**	J	**21**		**11**	J	**15**		**14**		**12**		**5.1**	
Sulfide	> background	mg/L	3	U	**2**	B	**2**	B	2	U	2	U	**2**		2	U	2	U	2	U	2	U

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			11/28/2012		2/26/2013		8/27/2013		3/25/2014		8/27/2014		3/31/2015		8/25/2015		03/29/16		09/01/16	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																				
pH	5-9	s.u.	6.42		6.08		6.3		6.60		6.40		6.39		6.01		6.19		6.35	
Specific Conductivity	-	mS/cm	0.195		0.233		0.285		0.365		0.487		0.625		1.161		0.801		3.438	
Temperature	-	°C	15.42		13.98		19.85		13.36		17.84		13.70		21.93		16.09		26.55	
Turbidity	-	NTU	86.6		47.7		42.9		72.3		28.2		28.4		20.7		405		3.73	
MNA Indicator Parameters																				
Dissolved Oxygen	< background	mg/L	1.77		0.8		0.85		0.26		0.84		2.61		0.89		0.63		1.28	
Methane	> background	µg/L	**1000**		**410**		**790**		**410**		**250**	**J**	**1300**		**900**		**1500**		**52**	
Nitrate	< background	mg/L	1	U	**1.1**		1	U	**0.039**	**JB**	**0.048**	**JB**	**0.074**	**JB**	**0.1**		**0.047**	**J**	**0.17**	**J**
Oxidation Reduction Potential	< background	mV	46.3		90.9		-48.9		58.2		34.4		6.5		30.1		62.3		-40.9	
Sulfate	< background	mg/L	**10**		**6.5**		**39**		**23**		**28**		**27**		**27**	**J**	**13**		**25**	
Sulfide	> background	mg/L	2	U	2	U	2	U	**2.2**	**JB**	**0.99**	**J**	3	U	3	U	3	U	3	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
Bold - Indicates positive detection for lab analyzed parameters
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - Result is rejected.
mg/L - milligrams per liter
µg/L - micrograms per liter
mS/cm - milliSiemens per centimeter
mV - millivolts
s.u. - standard units
°C - degrees Celsius
ORP - oxidation reduction potential
NTU - Nephelometric Turbidity Units
pH calibration issues identified during the August 2017 event for MW-20S, MW-19S, and MW-17S.
*values indicative of degradation (NJDEP, 2012)

TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S	
			03/21/17		08/10/17		03/20/18		09/05/18		3/19/2019		09/18/19		Duplicate	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters																
pH	5-9	s.u.	6.55		6.28		5.85		6.62		6.46		6.40		-	
Specific Conductivity	-	mS/cm	1.771		1.735		1.42		1.286		1.236		0.967		-	
Temperature	-	°C	14.93		20.20		12.71		16.09		15.57		15.50		-	
Turbidity	-	NTU	9.14		4.57		7.1		4.77		21.48		9.51		-	
MNA Indicator Parameters																
Dissolved Oxygen	< background	mg/L	1.03		0.93		1.68		0.89		2.48		0.79		-	
Methane	> background	µg/L	**180**		**660**		**1600**		**1800**		**880**		**3200**		**3200**	
Nitrate	< background	mg/L	**0.092**	J	**0.086**	J	**0.059**	J	**0.0417**	J	**0.121**		**0.0794**	JB	**0.0914**	JB
Oxidation Reduction Potential	< background	mV	-351.8		98.3		322.3		-73.8		-13.7		12.3		-	
Sulfate	< background	mg/L	**19**		**18**		**19**		**16.4**		**17.7**		**8.25**		**10.1**	
Sulfide	> background	mg/L	3	U	3	U	**2.2**	JB	1	U	**2.1**	J	3	U	3	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
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L - result biased low
K - result biased high
R - Result is rejected.
mg/L - milligrams per liter
µg/L - micrograms per liter
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mV - millivolts
s.u. - standard units
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pH calibration issues identified during the August 2017 event for MW-20S, MW-19S, and MW-17S.
*values indicative of degradation (NJDEP, 2012)

TABLE 3
HISTORICAL FIELD AND MONITORED NATURAL ATTENUATION INDICATOR PARAMETERS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Parameters	Values Indicating of Degradation*	Units	MW-21S		MW-21S		MW-21S		MW-21S	
			03/10/20		09/22/20		03/23/21		09/15/21	
			Result	Q	Result	Q	Result	Q	Result	Q
Field Measured Parameters										
pH	5-9	s.u.	7.06		7.15		10.08		7.29	
Specific Conductivity	-	mS/cm	0.695		0.665		0.518		0.292	
Temperature	-	°C	18.60		15.81		10.10		18.50	
Turbidity	-	NTU	37.1		86.50		15.1		179	
MNA Indicator Parameters										
Dissolved Oxygen	< background	mg/L	1.38		0.87		6.92		4.53	
Methane	> background	µg/L	**820**		**1400**		**2.4**		**260**	
Nitrate	< background	mg/L	**0.177**		**0.535**		**0.352**	**J**	**0.225**	
Oxidation Reduction Potential	< background	mV	-15.5		19.80		68.4		72.50	
Sulfate	< background	mg/L	**7.87**		**3.24**		**4.46**		**5.27**	
Sulfide	> background	mg/L	3	U	3	U	3	UJ	3	U

Notes:
Refer to Table 4 for dissolved iron and dissolved manganese
Bold - Indicates positive detection for lab analyzed parameters
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - Result is rejected.
mg/L - milligrams per liter
µg/L - micrograms per liter
mS/cm - milliSiemens per centimeter
mV - millivolts
s.u. - standard units
°C - degrees Celsius
ORP - oxidation reduction potential
NTU - Nephelometric Turbidity Units
pH calibration issues identified during the August 2017 event for MW-20S, MW-19S, and MW-17S.
*values indicative of degradation (NJDEP, 2012)

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	BG-1S 11/9/2010 Result	Q	BG-1S 2/23/2011 Result	Q	BG-1S 5/18/2011 Result	Q	BG-1S 8/9/2011 Result	Q	BG-1S 12/7/2011 Result	Q	BG-1S 3/20/2012 Result	Q	BG-1S 5/30/2012 Result	Q	BG-1S 9/5/2012 Result	Q	BG-1S 11/28/2012 Result	Q	BG-1S 2/26/2013 Result	Q	BG-1S 8/27/2013 Result	Q	BG-1S 3/25/2014 Result	Q	BG-1S 8/26/2014 Result	Q	BG-1S 8/26/2014 Duplicate	Q	BG-1S 3/31/2015 Result	Q	BG-1S 3/31/2015 Duplicate	Q	BG-1S 8/26/2015 Result	Q	BG-1S 3/29/2016 Result	Q	BG-1S 3/29/2016 Duplicate	Q	BG-1S 8/30/2016 Result	Q	BG-1S 3/21/2017 Result	Q
Semivolatile Organic Compounds																																												
2,4-Dimethylphenol	µg/L	1.15	0.52	U	0.5	U	2	U	2	U	2.1	U	2.1	U	2.1	U	0.52	U	0.53	U	0.51	U	0.52	U	0.93	U	1	U	0.96	U	0.96	U	0.93	U	1	U	0.96	U	0.96	U	0.96	U	1.9	U
2-Methylphenol	µg/L	12.5	0.52	U	0.5	U	0.5	U	0.5	U	0.52	UJ	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	UJ	0.93	U	1	U	0.96	U	0.96	U	0.93	U	1	U	0.96	U	0.96	U	0.96	U	0.96	U
4-Methylphenol	µg/L	47.7	0.52	U	0.5	U	0.5	U	0.5	U	0.52	UJ	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	UJ	0.93	U	1	U	0.96	U	0.96	U	0.93	U	0.23	J	0.96	U	0.96	U	0.96	U	1.9	U
Dibenzofuran	µg/L	12	0.52	U	0.5	U	0.5	U	0.5	U	0.52	U	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	U	0.93	U	1	U	0.96	U	0.96	U	0.93	U	1	U	0.96	U	0.96	U	0.093	U	0.13	U
Naphthalene	µg/L	5	0.52	U	0.5	U	0.5	U	0.5	U	0.52	U	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	U	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U	0.052	J	0.19	U	0.19	U	0.19	U	0.19	U
Phenol	µg/L	7860	2.1	U	2	U	2	U	2	U	2.1	UJ	2.1	U	2.1	U	2.1	U	2.1	U	2	U	2.1	UJ	0.93	U	1	U	0.96	U	0.96	U	0.93	U	0.73	J	0.96	U	0.96	U	0.96	U	0.96	U
Volatile Organic Compounds																																												
Acetone	µg/L	95.9	5	UJ	5	UJ	10	U	5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U	5	U	5	U	5	U	5	U	5	U	5	U	4.1	JB	5	U	2.7	JB	3.8	JB
Benzene	µg/L	5	0.02		0.02	UJ	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.032		0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chloroform	µg/L	1	0.83		0.29		0.15		0.13		0.13		0.078	B	0.058		0.06		0.01	U	0.01	U	0.01	U	0.051	B	0.033	B	0.031	B	0.057	B	0.049	B	0.029		0.028	B	0.028	B	0.019	JB	0.025	B
Total Inorganics																																												
Arsenic	µg/L	1	0.406	J	1.04		0.48	J	0.47	B	1	U	1	U	1	U	0.143		1	U	0.63	J	1.3		1	U	0.35	JB	1	UJ	0.51	J	0.77	J	1.4	B	1.3		1.1		1.3		0.4	J
Barium	µg/L	40	52		79		66		68		62		53		55		57		66		67		78		69		65	J	64	J	71		73		69		66		71		63		75	
Beryllium	µg/L	4	0.75	U	0.23	J	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	U	0.75	U	0.75	UJ	1	U	1	UJ	1	UJ	0.099	JB	0.046	JB	1	U	1	U	1	U	1	U	1	U
Cadmium	µg/L	--	1	U	1	U	0.34	B	1	U	1	B	1	U	1	B	1	U	1	U	1	U	1	U	0.25	J	0.27	J	0.22	J	1	U	1	U	1	U	0.12	J	1	U	0.15	U	0.11	J
Chromium	µg/L	8	3.6	J	120		33	B	1.1	B	1.7		1		1.4	B	0.22	J	1.4		1	B	7.9		3.2	B	1.3	J	0.88	J	2.5	B	2.6	B	8.8	B	2.2	LB	1.6	LB	2	U	6.4	
Cobalt	µg/L	--	10	U	4.4	J	3.3	J	3.4	B	10	B	10	B	1.4	J	2.6	J	10	U	1.3	J	10	B	1.7		1.5	J	1.6	J	1.8		2.2		1.9		1.7		1.7		2.1		2.2	L
Iron	µg/L	250	710	J	1300		610	B	60	J	230		150	J	150	U	150	B	300		150	B	1100		13	J	50	UJ	50	UJ	43	JB	46	JB	100	B	78		77		52		110	
Lead	µg/L	15	5	U	2.8	J	3.2	J	2.2	J	2.2	J	1.1	J	1.3	J	1.5	J	5	U	2.2	J	10		0.074	J	0.067	JB	0.03	JB	0.097	JB	0.1	JB	0.18	JB	0.2	K	0.16	K	0.073	J	0.34	J
Manganese	µg/L	66.8	200		330		280	B	320		230		180		190		230		260		260		290		260		260	J	260	J	300		310		330		340		340		350		450	
Mercury	µg/L	--	0.12		0.416		0.368		0.402		0.279		0.416		0.579		0.563		0.555		0.67		1.1		1.01		0.965		0.914		0.471		0.463		0.903		1.04		1.04		0.577		0.83	J
Nickel	µg/L	--	10	U	88	J	26		7.9	J	4.8	J	4.6	J	4.4	J	4.8	J	4.9	J	5.9	J	11	J	5.8		4.5	J	4.8	J	5.2		6.3		6.3		4.7		4.8		5.1		13	
Selenium	µg/L	0.4	1.03		1.59		1.91		1.62		2.14		1.1		0.867		1		1.62		2.33		1.93		1.4		1.39	J	1.76	J	5.86		6.09		1.68		0.86		0.814		1.29		0.849	
Thallium	µg/L	--	0.1	J	1.5	B	0.24	B	1.5	U	1.5	B	1.5	U	1.5	B	0.37	J	1.5	U	0.12	J	1.5	U	0.096	JB	0.082	JB	0.11	JB	0.1	JB	0.030	JB	0.038	JB	0.017	JB	0.05	JB	0.036	U	0.053	U
Vanadium	µg/L	--	2.1		1	U	1.2	B	0.6	B	1.4		0.72	J	1	B	0.61	J	0.81	J	0.29	J	5.2	B	5.38	JB	1	UJ	0.098	J	1	U	1	U	3.3		0.73	L	0.48	L	0.79	JB	0.5	U
Zinc	µg/L	--	25	U	17	J	10	J	15	B	25	B	25	B	25	B	25	B	13	J	8.5	J	25	U	15		6	JB	5.5	JB	7.1	B	8.5	B	7.1	B	5.4	BK	7.4	BK	7.1		6.1	
Dissolved Inorganics																																												
Arsenic	µg/L	1	0.195	J	0.084	J	0.44	J	1	U	1	U	1	U	1	U	--	NA	0.92	J	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.95	J	0.91	J	1.2		--	NA
Barium	µg/L	40	48		61		59		65		60		50		54		--	NA	62		--	NA	72		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	73		71		66		--	NA
Beryllium	µg/L	4	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	--	NA	0.75	U	--	NA	0.75	UJ	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	1	U	--	NA
Cadmium	µg/L	--	1	U	1	U	0.29	B	1	U	1	U	1	U	1	B	--	NA	1	U	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	0.15	U	--	NA
Chromium	µg/L	8	1	UJ	16		0.48	B	0.26	J	1	U	1	U	1	U	--	NA	1	B	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.55	L	0.58	L	2	U	--	NA
Cobalt	µg/L	--	10	U	2.9	J	3	J	3.1	J	10	B	10	B	1.4	J	--	NA	2.4	J	--	NA	10	B	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1.3		1.5		2.3		--	NA
Iron	µg/L	250	150	UJ	150	B	150	U	150	U	150	U	150	U	150	U	150	U	20	J	150	U	150	U	50	U	50	UJ	50	UJ	50	U	50	UJ	7.6	JB	50	U	50	U	15	JB	50	U
Lead	µg/L	15	5	U	1.3	J	2	J	1.5	J	1.6	J	5	U	2.1	J	--	NA	2.1	J	--	NA	11		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	0.12	KB	1	U	--	NA
Manganese	µg/L	66.8	200		300		290	B	310		230		180		210		220		250		260		290		250	J	250	J	260	J	310		310		340		340		310		360		450	
Mercury	µg/L	--	0.0162		0.0353		0.0235		0.264		0.144		0.297		0.516		--	NA	0.334		--	NA	0.799		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.0438		0.148		0.0505		--	NA
Nickel	µg/L	--	10	U	19	J	6.2	J	7.2	J	5.4	J	4	J	4.3	J	--	NA	6.1	J	--	NA	9.9	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	3.7		3.9		5.9		--	NA
Selenium	µg/L	0.4	0.845	J	0.865		1.6		1.55		1.73		1.12		0.882		--	NA	1.5		--	NA	1.74		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.675		0.778		1.23		--	NA
Thallium	µg/L	--	0.13	J	1.5	B	0.22	B	0.13	B	1.5	U	1.5	U	1.5	B	--	NA	1.5	U	--	NA	1.5	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.12	J	0.015	JB	0.036	U	--	NA
Vanadium	µg/L	--	0.27	J	1	U	1	U	0.17	B	1	U	1	U	0.22	J	--	NA	1	B	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.12	L	0.25	L	0.52	JB	--	NA
Zinc	µg/L	--	25	U	13	J	8.4	J	16	B	25	B	25	B	6.4	J	--	NA	25	JB	--	NA	25	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	5.5	KB	6	KB	8.7	B	--	NA
Conventionals																																												
Total Cyanide	µg/L	10	10	U	10	U	20	UJ	56		21		20	U	20	U	20	U	20	U	20	U	20	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	2	J

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	BG-1S 8/10/2017 Result	Q	BG-1S 3/20/2018 Result	Q	BG-1S 9/5/2018 Result	Q	BG-1S 3/20/2019 Result	Q	BG-1S 9/17/2019 Result	Q	BG-1S 3/10/2020 Result	Q	BG-1S 9/22/2020 Result	Q	BG-1S 3/23/2021 Result	Q	BG-1S 9/15/2021 Result	Q
Semivolatile Organic Compounds																				
2,4-Dimethylphenol	µg/L	1.15	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	UJ
2-Methylphenol	µg/L	12.5	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	UJ
4-Methylphenol	µg/L	47.7	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	U
Dibenzofuran	µg/L	12	0.12	U	0.07	U	0.068	U	0.068	U	0.07	U	0.07	U	0.068	U	0.07	U	0.19	U
Naphthalene	µg/L	5	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.19	UJ
Phenol	µg/L	7860	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	UJ
Volatile Organic Compounds																				
Acetone	µg/L	95.9	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
Benzene	µg/L	5	0.02	U	0.02	U	0.011	JB	0.04	U	0.04	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	µg/L	1	0.014	JB	0.085	B	0.068	B	0.035	J	0.035	J	0.12		0.067	U	0.067	U	0.067	U
Total Inorganics																				
Arsenic	µg/L	1	1	B	1.4		1.1		1.3		1.4		3.5		2.8		2.7		1.6	
Barium	µg/L	40	68		75		90		98		93		95		99		110		97	
Beryllium	µg/L	4	1	U	1	U	1	U	1	U	1	U	0.22	JB	0.19	J	1	U	1	U
Cadmium	µg/L	--	0.078	U	0.13	U	0.13	J	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U
Chromium	µg/L	8	0.65	JB	16		63		22		4.3	B	77		32		95		2	U
Cobalt	µg/L	--	2.9		2.7		2.8		2.3		2.1		2.8		4.9		3.3		1.6	
Iron	µg/L	250	99		130	L	490		460	B	69		2200		660		1600	L	100	
Lead	µg/L	15	1	U	1.1		0.34	J	0.38	J	0.14	J	1.5		0.71	J	1.6		0.21	J
Manganese	µg/L	66.8	450		430		430		360		290		240		200		220		190	
Mercury	µg/L	--	0.478		0.418		0.407	L	0.53		0.532		0.0315		0.67		0.616		0.535	
Nickel	µg/L	--	6.7		20		51		19		7.5		55		25		65		5	
Selenium	µg/L	0.4	1.05		0.965	J	1.39	J	1.97		1.54		1.4		1.28		1.18		0.978	
Thallium	µg/L	--	0.053	U	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.29	J	0.15	U	0.15	U
Vanadium	µg/L	--	1.6	B	1.2		3.1		2.8		2		7.6		3.9		7		2.5	
Zinc	µg/L	--	10		48		21		9	B	11	B	12		12		11		7.8	
Dissolved Inorganics																				
Arsenic	µg/L	1	0.94	JB	--	NA	--	NA	--	NA	--	NA	--	NA	1.9		1.5		--	NA
Barium	µg/L	40	68		--	NA	--	NA	--	NA	--	NA	--	NA	96		90		--	NA
Beryllium	µg/L	4	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	--	NA
Cadmium	µg/L	--	0.078	U	--	NA	--	NA	--	NA	--	NA	--	NA	0.22	U	0.22	U	--	NA
Chromium	µg/L	8	0.39	JB	--	NA	--	NA	--	NA	--	NA	--	NA	6.9		6.6		--	NA
Cobalt	µg/L	--	3		--	NA	--	NA	--	NA	--	NA	--	NA	4.5		2.2		--	NA
Iron	µg/L	250	50	U	57		100		24	JB	50	U	130		81		100		50	U
Lead	µg/L	15	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	--	NA
Manganese	µg/L	66.8	460		440		440		350		280		240		200		210		200	
Mercury	µg/L	--	0.0323		--	NA	--	NA	--	NA	--	NA	--	NA	0.164		0.0251		--	NA
Nickel	µg/L	--	6.7		--	NA	--	NA	--	NA	--	NA	--	NA	19		18		--	NA
Selenium	µg/L	0.4	1.03		--	NA	--	NA	--	NA	--	NA	--	NA	1.24		1.19		--	NA
Thallium	µg/L	--	0.053	U	--	NA	--	NA	--	NA	--	NA	--	NA	0.15	U	0.15	U	--	NA
Vanadium	µg/L	--	1.7	B	--	NA	--	NA	--	NA	--	NA	--	NA	1.2		0.99	U	--	NA
Zinc	µg/L	--	8.1	B	--	NA	--	NA	--	NA	--	NA	--	NA	8.7		9.1		--	NA
Conventionals																				
Total Cyanide	µg/L	10	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U

Analyte	BG-1D 11/9/2010 Result	Q	BG-1D 2/23/2011 Result	Q	BG-1D 5/18/2011 Result	Q	BG-1D 8/10/2011 Result	Q	BG-1D 12/8/2011 Result	Q	BG-1D 3/20/2012 Result	Q	BG-1D 5/31/2012 Result	Q	BG-1D 9/6/2012 Result	Q	BG-1D 11/28/2012 Result	Q	BG-1D 2/26/2013 Result	Q	BG-1D 8/27/2013 Result	Q	BG-1D 3/25/2014 Result	Q	BG-1D 8/26/2014 Result	Q
Semivolatile Organic Compounds																										
2,4-Dimethylphenol	0.52	U	0.51	U	2.1	U	2	U	2.1	U	2	U	2	U	0.51	U	0.53	U	0.51	U	0.51	U	0.96	U	0.96	U
2-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.52	UJ	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	UJ	0.96	U	0.96	U
4-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.52	UJ	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	UJ	0.96	U	0.96	U
Dibenzofuran	0.52	U	0.51	U	0.52	U	0.5	U	0.52	U	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	U	0.96	U	0.96	U
Naphthalene	0.52	U	0.51	U	0.52	U	0.5	U	0.5	J	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	UJ	0.033	J	0.035	J
Phenol	2.1	U	2	U	2.1	U	2	U	2.1	UJ	2	U	2	U	2	U	2.1	U	2	U	2	UJ	0.96	U	0.96	U
Volatile Organic Compounds																										
Acetone	5	UJ	5	UJ	10	U	5.9	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U	5	U	5	U
Benzene	0.05		0.02	J	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chloroform	1.4		1.2		2.4		1		0.78		0.01	U	0.12	B	0.3		0.14		0.41		0.43		0.17	B	0.1	B
Total Inorganics																										
Arsenic	1.36	J	1.23		0.86	J	1	B	1	U	1	U	0.48	J	0.414		1	U	0.28	J	1	U	1	U	0.32	JB
Barium	140		160		120		150		150		150		160		170		180		170		170	B	170		160	J
Beryllium	0.75	U	0.75	U	0.75	U	0.28	J	0.21	J	0.35	J	0.43	J	0.44	J	0.56	J	0.44	J	0.75	UJ	0.52	J	0.53	J
Cadmium	1	U	1	U	0.2	B	1	U	1	B	1	U	0.14	J	0.23	J	1	U	0.21	J	1	U	0.23	J	0.43	J
Chromium	65	J	150		18	B	4.4		2.9		0.4	J	0.6	J	0.95	J	0.94	J	1	B	10		3.6	B	1.4	J
Cobalt	10	U	3.7	J	2.8	J	3.7	J	5.3	J	5.4	J	4.9	J	7.1	J	5.6	J	6.3	J	10	B	6.9		6.2	J
Iron	21000	J	21000		13000	B	12000		4400		5300		6400		3000		3100		1500		1800		630		1500	J
Lead	5	U	5	U	1.6	J	5	U	5	U	5	U	1.1	J	5	U	5	U	5	U	6.4		0.1	J	0.13	JB
Manganese	1400		1300		890	B	940		770		600		570		600		520		550		560		310		290	J
Mercury	0.0136		0.016		0.042		0.0275		0.0163		0.541		0.775		0.55		0.612		0.125		0.108		0.377		0.743	
Nickel	37		96	J	16		13		21		20		19		25		23	J	26		29	J	25		21	J
Selenium	0.253	J	0.365	J	0.488		0.274	J	0.328		0.755		0.713		0.664		1.06		0.541	J	0.364		0.799		1.19	
Thallium	1.5	U	1.5	B	0.21	B	1.5	U	1.5	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	0.026	JB	0.016	JB
Vanadium	1	U	1	U	1.3	B	1.2		0.88	J	1	U	0.15	J	0.33	J	0.15	J	0.48	J	1	U	6.5	JB	0.16	J
Zinc	25	U	9.9	J	7.8	J	8.7	B	20	J	25	B	13	J	16	J	20	J	25		25	U	22		19	JB
Dissolved Inorganics																										
Arsenic	0.761	J	1.26		0.72	J	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Barium	170		20	J	130		--	NA	150		--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Beryllium	0.75	U	0.75	U	0.75	U	--	NA	0.18	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Cadmium	1	U	1	U	1	U	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Chromium	3.5	J	1	U	1.2	B	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Cobalt	10	U	1.5	J	2.5	J	--	NA	5.2	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Iron	22000	J	3800		13000	B	14000		3700		6300		6200		3100		2300		800		1700		520		1600	J
Lead	5	U	1.6	J	1.7	J	--	NA	5	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Manganese	1600		150		940	B	930		760		670		560		610		510		520		540		290	J	290	J
Mercury	0.0031		0.016		0.0039		--	NA		NA	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Nickel	10	U	10	UJ	6.5	J	--	NA	20		--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Selenium	0.231	J	0.331	J	0.411		--	NA		NA	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Thallium	1.5	U	1.5	B	0.2	B	--	NA	1.5	B	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Vanadium	0.81	J	1	U	1	B	--	NA	1	B	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Zinc	25	U	25	U	25	U	--	NA	19	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Conventionals																										
Total Cyanide	10	U	10	U	20	UJ	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	10	U	10	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	BG-1D 3/31/2015 Result	Q	BG-1D 8/25/2015 Result	Q	BG-1D 3/30/2016 Result	Q	BG-1D 8/30/2016 Result	Q	BG-1D 3/22/2017 Result	Q	BG-1D 8/10/2017 Result	Q	BG-1D 3/20/2018 Result	Q	BG-1D 9/5/2018 Result	Q	BG-1D 3/20/2019 Result	Q	BG-1D 9/17/2019 Result	Q	BG-1D 3/10/2020 Result	Q	BG-1D 9/23/2020 Result	Q	BG-1D 3/23/2021 Result	Q	BG-1D 9/15/2021 Result	Q
Semivolatile Organic Compounds																														
2,4-Dimethylphenol	µg/L	1.15	1	U	1	U	0.96	U	1	U	1.9	U	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U
2-Methylphenol	µg/L	12.5	1	U	1	U	0.96	U	1	U	0.93	U	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U
4-Methylphenol	µg/L	47.7	1	U	1	U	0.96	U	1	U	0.85	JB	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U
Dibenzofuran	µg/L	12	1	U	1	U	0.96	U	0.097	U	0.13	U	0.12	U	0.073	U	0.068	U	0.073	U	0.07	U	0.068	U	0.068	U	0.07	U	0.18	U
Naphthalene	µg/L	5	0.21	U	0.2	U	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
Phenol	µg/L	7860	1	U	1	U	0.96	U	1	U	0.93	U	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U
Volatile Organic Compounds																														
Acetone	µg/L	95.9	5	U	5	U	5	U	3.7	JB	5.9	B	4.7	J	5	U	5	U	5	U	8.6		5	U	5	UJ	5	U	5	U
Benzene	µg/L	5	0.02	U	0.02	U	0.02	U	0.02	U	0.018	J	0.017	J	0.02	U	0.04	U	0.0079	JB	0.0066	J	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	µg/L	1	0.34		0.084		0.28		0.067	B	0.082	B	0.072	B	0.072	B	0.062	B	0.058		0.052		1.9		0.067	U	0.099	J	0.079	J
Total Inorganics																														
Arsenic	µg/L	1	0.47	J	0.85	J	0.75	J	1.8		1.2		0.78	JB	1.8		1.2		0.89	J	1.1		2.3		7.4		2.4		4.2	
Barium	µg/L	40	170		160		170	B	170		150		130		150		160		150		180		190		140		170		160	
Beryllium	µg/L	4	0.45	JB	0.61	J	0.66	K	1		0.93	J	0.52	J	1.1		1.2		1.1		1.3		1.3	B	1.3		1.4		1.7	
Cadmium	µg/L	--	0.20	J	0.32	J	0.17	J	0.36	J	0.26	J	0.15	J	0.82	J	0.63	J	0.53	J	0.16	J	0.33	J	0.75	J	0.28	J	0.69	J
Chromium	µg/L	8	2.3	B	6.4	B	2.3		4.1		2		7.5		9.9		13		11		7.2		20		4.6		20		1.9	J
Cobalt	µg/L	--	7.7		10		6		14		10		4.7		9.5		8.9		9		9		9.2		8.5		9.3		7.9	
Iron	µg/L	250	1000		820		1500		340		770		990		130	L	170		450	B	940		390		1400		310	L	420	
Lead	µg/L	15	0.063	JB	0.24	JB	0.91	J	1.7		1.1		2.2		6.5		1.1		0.71	J	0.61	J	0.81	J	22		3.2		36	
Manganese	µg/L	66.8	340		340		440		290		290		340		250		280		230		280		280		240		260		220	
Mercury	µg/L	--	0.085		0.803		0.514		0.148		0.299		0.243		0.375		0.183	L	0.32		0.222		0.183		0.583		0.327		0.794	
Nickel	µg/L	--	26		34		22		34		28		23		40		40		39		35		51		33		44		25	
Selenium	µg/L	0.4	2.71		1.31		0.249		1.67		1.11		1.32		1.62		1.29	J	1.55		0.357		0.715		1.69		NA		1.45	
Thallium	µg/L	--	0.072	JB	0.023	JB	0.015	JB	0.036	U	0.053	U	0.053	U	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
Vanadium	µg/L	--	1	U	3.1	B	1.6	B	0.87	JB	1		1.8	B	0.9	U	1.8		1.3		0.99	U	0.99	U	2		0.99	U	0.99	U
Zinc	µg/L	--	18		51	J	22	B	61		31		26		100		62		48		35		35		200		43		62	
Dissolved Inorganics																														
Arsenic	µg/L	1	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	--	NA	6		--	NA	--	NA
Barium	µg/L	40	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	--	NA	140		--	NA	--	NA
Beryllium	µg/L	4	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	--	NA	1.2		--	NA	--	NA
Cadmium	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	--	NA	0.72	J	--	NA	--	NA
Chromium	µg/L	8	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	--	NA	2	U	--	NA	--	NA
Cobalt	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	--	NA	8.4		--	NA	--	NA
Iron	µg/L	250	720		800		1500		240		680		320		62		85		390	B	950		330		300		280		270	
Lead	µg/L	15	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	17		--	NA	--	NA
Manganese	µg/L	66.8	310		340		500		250		290		310		250		290		240		290		270		230		260		220	
Mercury	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	0.0286		--	NA	--	NA
Nickel	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	32		--	NA	--	NA
Selenium	µg/L	0.4	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	1.59		1.2		--	NA
Thallium	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	0.15	U	--	NA	--	NA
Vanadium	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	0.99	U	--	NA	--	NA
Zinc	µg/L	--	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	--	NA	--	NA	200		--	NA	--	NA
Conventionals																														
Total Cyanide	µg/L	10	10	U	10	U	10	U	10	U	10	U	3.6	J	10	U	10	U	10	U	5.1	J	10	U	10	U	10	U	10	U

Analyte	Units	MW-6 7/17/2008 Result	Q	MW-6 11/11/2010 Result	Q	MW-6 2/24/2011 Result	Q	MW-6 5/18/2011 Result	Q	MW-6 8/10/2011 Result	Q	MW-6 12/8/2011 Result	Q	MW-6 3/21/2012 Result	Q	MW-6 3/21/2012 Duplicate	Q
Semivolatile Organic Compounds																	
2,4-Dimethylphenol	µg/L	100	U	5	U	5.2	U	11	J	10		12		11		11	
2-Methylphenol	µg/L	8.2	J	5	U	5.2	U	10		7.5		8.9		7.5		7.2	
4-Methylphenol	µg/L	100	U	5	U	5.2	U	5.2	U	2.4		2.6	U	1.2	B	1.2	B
Dibenzofuran	µg/L	2.4	J	5	U	5.2	U	2.9	J	1.1		2.6	U	0.75		0.73	
Naphthalene	µg/L	1000		880		1200		1500		900		710		630	D	640	D
Phenol	µg/L	100	U	20	U	21	U	21	U	2	U	10	U	2.1	U	2	U
Volatile Organic Compounds																	
Acetone	µg/L	25	R	5	UJ	5	UJ	10	U	5.9	U	20	U	10	U	10	U
Benzene	µg/L	21		23		29	J	27		27		27		25		24	
Chloroform	µg/L	25	U	0.01	B	0.01	B	0.01	UJ	0.02	R	0.01	U	0.01	U	0.01	U
Total Inorganics																	
Arsenic	µg/L	2.2	U	2.58	J	3.02		2.1	J	2.9		2.4		2		1.5	
Barium	µg/L	0.1	U	120	J	120		130		130		120		140		130	
Beryllium	µg/L	0.32	U	0.75	U	0.45	J	0.43	J	0.94		0.72	J	0.49	J	0.2	J
Cadmium	µg/L	0.23	U	1	U	1	U	0.24	B	0.18	J	0.11	J	1	U	1	U
Chromium	µg/L	1.2	U	13		2.1		5	B	2.9		4.1		1.9		1.8	
Cobalt	µg/L	0.7	U	10	U	3.6	J	3.7	J	4.7	J	3.7	J	10	B	10	B
Iron	µg/L	1930	J	4400		2300		2000	B	3300		3200		2500		2500	
Lead	µg/L	2.4	U	5	U	4.9	J	3.5	J	4.8	J	2.3	J	3.2	J	3.1	J
Manganese	µg/L	1680		790		880		1300	B	1000		870		1100		1100	
Mercury	µg/L	0.055	U	0.0034		0.008		0.0137		0.0142		0.049		0.0116		0.0125	
Nickel	µg/L	1.1	U	15		7.6	J	9.6	J	10		10		9.9	J	9.7	J
Selenium	µg/L	19.6		8.25	J	14.8		19		15.4		19.1		18.2		19	
Thallium	µg/L	3.1	U	1.5	U	1.5	B	0.21	B	1.5	U	1.5	B	1.5	U	1.5	U
Vanadium	µg/L	1	U	5		5.2		5.9	B	6.4		5.6		5.5		5.3	
Zinc	µg/L	1.3	U	25	U	31		31		60	B	58		29		29	
Dissolved Inorganics																	
Arsenic	µg/L	--	NA	2.39	J	2.78		2.2		2.4	B	2.1		1.5		1.6	
Barium	µg/L	--	NA	120	J	120		130		130		110		130		130	
Beryllium	µg/L	--	NA	0.75	U	0.19	J	0.29	J	0.4	J	0.25	J	0.28	J	0.35	J
Cadmium	µg/L	--	NA	1	U	1	U	0.16	B	1	U	1	U	1	U	1	U
Chromium	µg/L	--	NA	1	U	1	U	0.73	B	0.46	J	0.34	J	1	U	1	U
Cobalt	µg/L	--	NA	10	U	2.7	J	2.9	J	3.5	J	2.5	J	10	B	10	B
Iron	µg/L	479		1300		1400		1300	B	1600		1600		1800		1700	
Lead	µg/L	--	NA	5	U	1.9	J	1.5	J	1.3	J	5	U	1.2	J	1.6	J
Manganese	µg/L	1620		780		890		1300	B	1100		820		1000		1000	
Mercury	µg/L	--	NA	0.0009		0.002		0.0042		0.002		0.0078		0.0037		0.00345	
Nickel	µg/L	--	NA	10	U	4	J	4.9	J	5	J	5.3	J	6.9	J	6.7	J
Selenium	µg/L	--	NA	10.7	J	13.8		18.3		15.7		19.7		18.3		18.3	
Thallium	µg/L	--	NA	1.5	U	1.5	B	0.19	B	1.5	UL	1.5	B	1.5	U	1.5	U
Vanadium	µg/L	--	NA	4.6		5.2		5.7	B	5.4		5.2		5.1		5	
Zinc	µg/L	--	NA	25	U	8	J	25	U	14	B	25	B	25	B	25	B
Conventionals																	
Total Cyanide	µg/L	198	J	21		210		260	J	240		240		250		230	

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

non responsive based performed he analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-6	
			5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013		3/26/2014		8/26/2014		4/1/2015		8/26/2015		3/30/2016		8/31/2016		8/31/2016		3/22/2017		8/11/2017		3/21/2018		3/21/2018		9/6/2018		9/6/2018		3/20/2019		3/20/2019	
		Center of Plume	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Duplicate	Q	Result	Q	Duplicate	Q
Semivolatile Organic Compounds																																										
2,4-Dimethylphenol	µg/L	1.15	9.4		12		9.6		9.3		9.4		54		4.3		5.7		7.3		4.9		6.6		6.8		8.9		5		3.9	J	5.1	J	4.8		5.2		2.9	J	6.1	J
2-Methylphenol	µg/L	12.5	0.51	U	8.2		7.6		5.1	J	0.54	U	3.6		1		4.6	U	5	U	4.8	U	1.6	J	1.2		0.89	U	3.5		0.93	U	0.93	U	0.3	J	0.41	J	0.93	UJ	1.9	J
4-Methylphenol	µg/L	47.7	0.51	U	1.8		4.6		1.7	J	0.54	U	6		0.76	J	4.6	U	1.3	J	1.2	J	2.8	JB	1.5	JB	1.4	J	12		0.7	J	1		0.86	J	1.1		0.41	J	4.7	J
Dibenzofuran	µg/L	12	0.74		0.87		0.6		0.84		0.78		2.8		0.17	J	4.6	U	5	U	4.8	U	0.48	U	0.39	J	0.42	J	0.11	U	0.068	U	0.35	J	0.3	J	0.32	J	0.22	J	0.27	J
Naphthalene	µg/L	5	670	D	600		650		700	D	840		56		91		6.8		3.2		1.3		1.3		1.2		1.2		0.78		0.53		0.65		0.61	J	0.79	J	0.4	J	0.63	J
Phenol	µg/L	7860	2	U	0.87	J	2.1	U	0.44	J	2.2	U	1		0.96	U	4.6	U	1.7	J	1.3	J	5.2	JB	2.3	JB	0.87	J	18		1	B	1.8		1.2	B	2.3	B	0.74	J	10	J
Volatile Organic Compounds																																										
Acetone	µg/L	95.9	10	U	10	U	50	U	50	U	10	U	10	U	7	JB	2.9	J	15	U	15	U	50	U	50	U	15	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
Benzene	µg/L	5	25		24		19		23		23	J	16		20		20		20		27		11		10		11		7.6		6.2		5.6		11		13		15		15	
Chloroform	µg/L	1	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.02	U	0.017	JB	0.02	U	0.02	U	0.02	U	0.08	U	0.08	U	0.06	U	0.015	U	0.003	U	0.003	U	0.08	U	0.08	U	0.08	U	0.08	U
Total Inorganics																																										
Arsenic	µg/L	1	2.5		2.68		2.2		2.3		2.7		5.4		2.4	J	2.2		3.8	B	2.5		2.4		2		1.9		2.4	J	3		3		1.8		1.8		2.1		2	
Barium	µg/L	40	130		130		140	J	130		140		33		110	J	110		120		130	B	110		110		110		110		110		110		120		110		120		110	
Beryllium	µg/L	4	0.57	J	0.46	J	0.44	J	0.52	J	0.75	UJ	0.062	J	0.49	J	0.28	JB	0.40	JB	0.46	K	0.4	J	0.34	J	0.3	J	0.33	J	0.3	J	0.32	J	0.4	J	0.39	J	0.27	J	0.21	J
Cadmium	µg/L	--	1	U	1	U	1	U	1	U	1	U	1	U	0.19	J	1	U	1	U	1	U	0.15	U	0.15	U	0.078	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Chromium	µg/L	8	1.8		2.3		1	B	1.5		4.1		3.5	B	4.1	J	2.4	B	8.9	B	4.1		0.54	J	0.87	J	0.74	J	1	J	4.4	B	5.3	B	2.4	B	2.1	B	3	B	3.3	B
Cobalt	µg/L	--	3.7	J	3.3	J	2.6	J	1.5	J	3.2	J	2		2	J	1.6		2.1		2		2		1.8		2		1.9		1.7		1.7		1.9		1.8		1.8		1.6	
Iron	µg/L	250	4700		2400		2200		2200		2600		6700		2600	J	1800		3500		2600		2600		2500		2600		2500		3700	L	3800	L	3600	K	3300	K	3000		3000	
Lead	µg/L	15	4.2	J	2.9	J	5	U	2.6	J	8.9		0.13	J	0.54	JB	0.029	JB	0.18	JB	0.32	J	0.26	J	0.22	J	0.39	J	0.36	J	0.37	J	0.41	J	1.9		1.8		0.21	J	0.21	J
Manganese	µg/L	66.8	1100		1200		1100		1100		1100		260		850	J	880		1000		1000		900		840		860		900		880		890		950	L	990	L	820		770	
Mercury	µg/L	--	0.0036		0.0046	J	0.001		0.0027		0.0018	J	0.00104		0.002		0.00067	B	0.00188		0.00143	B	0.0021		0.0018	B	0.0242		0.0012	B	0.00174		0.00207		0.0159	L	0.016	L	0.00156	B	0.00133	B
Nickel	µg/L	--	11		8.9	J	6.3	J	6.4	J	8.1	J	3.8		5.8	J	1.9		4.5		5.7		3		2.7		4.9		3.3		4.1		4.2		4.2		4		3.8		3.4	
Selenium	µg/L	0.4	16.6		15.1		14.8		15.1		16.5		9.65		14.3		14		14.8		8.51		13.2		14.1		12		12		12.3		12		9.51		9.23		11.2		11.0	
Thallium	µg/L	--	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	0.026	JB	0.019	JB	1	U	1	U	1	U	0.036	U	0.036	U	0.053	U	0.053	U	0.063	U	0.063	U	0.063	U	0.063	U	0.13	U	0.13	U
Vanadium	µg/L	--	5.6		5.8		6.2		5.8		6		0.082	JB	4.2	J	3.7		10		5.5	B	5.5		4.8		4.8		5.9		7.4	B	7.2	B	6.2	B	5.9	B	4.6		4.3	
Zinc	µg/L	--	30	J	22	J	11	J	10	J	25	U	2.4	JB	10	JB	1.9	JB	2.8	JB	9.7	B	7.7	B	6.9	B	7.8		5.8	B	5.9		5.7		20		18		4.6	JB	4.2	JB
Dissolved Inorganics																																										
Arsenic	µg/L	1	2.3		2.49		2		2.3		2.4		4.6		--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Barium	µg/L	40	130		130		140	J	140		140		30		--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Beryllium	µg/L	4	0.22	J	0.39	J	0.23	J	0.31	J	0.75	UJ	1	U	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Cadmium	µg/L	--	1	U	1	U	1	U	1	U	1	U	1	U	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Chromium	µg/L	8	1	U	0.59	J	1	B	0.31	J	1	U	1.8	JB	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Cobalt	µg/L	--	2.7	J	3.2	J	2.4	J	1.4	J	2.8	J	1.7		--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Iron	µg/L	250	1700		1800		1900		1900		1900		2200		2100	J	2600		3200		2100		2200		2300		2100		2200		3000		3100		1900		2000		2700		2600	
Lead	µg/L	15	1.3	J	1.9	J	5	U	5	U	7		0.047	J	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Manganese	µg/L	66.8	1100		1100		1100		1100		1100		230		840	J	900		1100		1000		870		880		890		900		900		870		1000		1000		790		770	
Mercury	µg/L	--	0.001		0.0004	B	0.0004	J	0.0014		0.0006	JB	0.00079		--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Nickel	µg/L	--	6	J	6.7	J	5	J	5	J	4.4	J	1.4		--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Selenium	µg/L	0.4	16.7		15		14.5		15		16.2		9.22		--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Thallium	µg/L	--	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	1	U	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Vanadium	µg/L	--	5.5		5.2		5.9		5.9		5.4		0.44	JB	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Zinc	µg/L	--	25	JB	25	B	25	U	25	U	25	U	2.4	JB	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Conventionals																																										
Total Cyanide	µg/L	10	230		260		230		220		230		680		190		210		210		230		210	J	220	J	140		210		200		210		230		240		200		210	

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-6		MW-6		MW-6		MW-6		MW-6		MW-6		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S	
			9/18/2019		3/10/2020		9/23/2020		3/24/2021		3/24/2021		9/15/2021		7/18/2008		11/11/2010		2/23/2011		5/18/2011		8/10/2011		12/7/2011		12/7/2011		3/21/2012		5/31/2012		5/31/2012		9/5/2012		9/5/2012		11/29/2012		2/27/2013	
		Center of Plume	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																										
2,4-Dimethylphenol	µg/L	1.15	7.2		5.4		4.2		2.8		2.9		0.93	U	83		62		75		53		35		40		34		21		41		37		2.7	J	11	J	49		39	
2-Methylphenol	µg/L	12.5	0.96	U	0.93	U	0.93	U	0.93	U	0.31	J	0.93	U	20	U	1.5	U	0.52	U	0.76		0.65		0.53	U	0.54	U	0.7	B	0.52	U	4.5		0.75		1		11		0.61	J
4-Methylphenol	µg/L	47.7	0.96	U	0.93	U	0.83	J	1.5		1.3		0.93	U	20	U	1.5	U	0.52	U	1		0.5	U	0.53	U	0.54	U	0.92	B	0.52	U	14		1.1		1.6		1.9		1.9	J
Dibenzofuran	µg/L	12	0.33	J	0.068	U	0.27	J	0.29	J	0.28	J	0.18	U	10	J	16		20		19		11		21		19		8.2		15		12		3.5	J	7.8	J	19		18	
Naphthalene	µg/L	5	0.82		0.51		0.47		0.54		0.56		0.27		1	U	22		13		12		4.1		9.9		11		2		6		4.9		0.29	J	0.81		6.4		8	
Phenol	µg/L	7860	2.2		1.7		1.2		1.6		1.4		0.93	U	1.2	J	6	U	2.1	U	2	U	2	U	2.1	U	2.2	U	2	B	2.1	U	11		0.58	J	2.1	U	2	U	2	UJ
Volatile Organic Compounds																																										
Acetone	µg/L	95.9	5	U	5	U	5	UJ	5	UJ	5	UJ	25	U	5	R	5	UJ	5	UJ	10	U	5.9	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Benzene	µg/L	5	10		17		16		12	J	20	J	23		21		19		20	J	15		12		10		10		9.5		12		12		4.3		5.8		13		14	
Chloroform	µg/L	1	0.008	U	0.067	U	0.067	U	0.067	U	0.067	U	0.067	U	5	U	0.01	U	0.01	U	0.01	UJ	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Total Inorganics																																										
Arsenic	µg/L	1	1.9		2.1		2		2.1		2.1		2.1		31.2		15.7	J	24.4		15	J	19		18		18		48		20		21		14		16.6		28		31	
Barium	µg/L	40	100		120		110		110		110		110		0.1	U	60	J	52		53		47		35		34		46		45		48		38		42		52	J	46	
Beryllium	µg/L	4	0.42	JB	0.51	J	0.21	J	0.29	J	0.28	J	0.26	J	0.32	U	0.75	U	0.59	J	0.32	J	0.6	J	0.3	J	0.31	J	0.88	J	0.6	J	0.68	J	0.45	J	0.46	J	0.47	J	0.57	J
Cadmium	µg/L	–	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.23	U	1	U	1	U	0.36	B	0.23	J	1	B	1	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chromium	µg/L	8	2	U	3		2	U	3.2		2.1		2	U	1.2	U	1.7		14		3.3	B	3.2		0.47	J	0.6	J	2.2		0.69	J	1.1		0.25	J	0.23	J	1	B	1.3	
Cobalt	µg/L	–	1.4		1.9		1.5		2.2		1.9		1.3		0.7	U	13		8.9	J	11		9.6	J	10	B	10	B	10	B	4.9	J	5.4	J	3.9	J	4.4	J	3.1	J	1.7	J
Iron	µg/L	250	2400		4900		2700		3200		3200		2600		4570		3700		6000		3300	B	4400		3500		3500		10000		4800		5700		2800		3200		7500		7000	
Lead	µg/L	15	0.29	J	0.48	J	0.27	J	0.29	J	0.25	J	0.39	J	2.4	U	5	U	1.7	J	3.2	J	1.4	J	2.2	J	2.1	J	1.2	J	2.3	J	1.8	J	1.5	J	5	U	5	U	1.7	J
Manganese	µg/L	66.8	760		840		740		780		770		790		3320		4800		4300		3900	B	4200		3300		3300		3700		3700		3900		3300		3600		4200		3700	
Mercury	µg/L	–	0.00234		0.0013		0.00996		0.00815	J	0.006	J	0.00285		0.055	U	0.0031		0.0065		0.0065		0.0029		0.002	J	0.00135	J	0.0029		0.0035		0.00319		0.002		0.00161		0.0003	J	0.0006	
Nickel	µg/L	–	4.5		5.4		2.6		4.7		3.8		2.7		1.1	U	15		22	J	12		14		1.6	J	1.6	J	10		6.8	J	8.9	J	4.7	J	4.9	J	5.2	J	6.3	J
Selenium	µg/L	0.4	7.12		7.8		12		12.3		12.2		10.3		18.8		12.5	J	14.5		16.7		16		12.2		13.4		17.3		14.2		12.4		12		12.3		9.63		11.1	
Thallium	µg/L	–	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	3.1	U	0.47	J	1.5	B	0.8	B	0.68	B	1.5	B	1.5	B	1.5	U	1.5	B	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U
Vanadium	µg/L	–	4.2		3.8		3.2		3.3		3.3		3.3		1	U	0.52	J	0.65	J	0.74	B	0.54	B	0.63	J	0.65	J	0.89	J	0.87	J	1		0.46	J	0.59	J	1.1		1	
Zinc	µg/L	–	8.4		7.4		11		4.1	J	5	U	4.9	J	1.3	U	25	U	8.7	J	5.5	J	6.9	B	25	B	25	B	25	B	25	JB	11	J	25	B	25	B	25	B	1.6	J
Dissolved Inorganics																																										
Arsenic	µg/L	1	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	2.2	U	2.7	J	–	NA	7.8		6.7		28		30		9.2		13		13		3.75	J	5.97	J	19		21	
Barium	µg/L	40	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	0.1	U	58	J	–	NA	48		47		37	B	37	B	38		50		51		43	J	44	J	49	J	45	
Beryllium	µg/L	4	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	0.32	U	0.75	U	–	NA	0.75	U	0.31	J	0.61	J	0.75	U	0.45	J	0.21	J	0.28	J	0.27	J	0.32	J	0.47	J	0.57	J
Cadmium	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	0.23	U	1	U	–	NA	0.35	B	1	U	1	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chromium	µg/L	8	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	1.2	U	1	U	–	NA	0.52	B	0.28	J	4.6		4.6		0.45	J	1	U	1	U	1	U	1	B	1	B	0.22	J
Cobalt	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	0.7	U	13		–	NA	10		11		10	B	2.8	J	10	B	6.9	J	7.2	J	2.8	J	3	J	2.7	J	1.7	J
Iron	µg/L	250	1200		3400		2100		2900		2900		2100		286		880		5000		1500	B	1700		6500		6400		2100		3000		3100		2100		2200		5400		4200	
Lead	µg/L	15	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	2.4	U	5	U	–	NA	2.7	J	1.6	J	3.3	J	2.8	J	5	U	1.5	J	1.4	J	5	U	5	U	5	U	1.5	J
Manganese	µg/L	66.8	800		820		740		770		750		770		3430		4800		4400		3600	B	4300		3400		3400		3700		3800		3900		3600		3700		4100		3800	
Mercury	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	0.2	U	0.0008		–	NA	0.0028		0.0008			NA		NA	0.0005		0.0007		0.00066		0.0005		0.00055		0.0002	U	0.0003	J
Nickel	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	1.1	U	12		–	NA	8.2	J	10		8.5	J	8.6	J	3.7	J	5.8	J	6.4	J	2.2	J	2.4	J	1.7	J	10	U
Selenium	µg/L	0.4	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	14.4		14.5	J	–	NA	15.2		12.5			NA		NA	9.61		12.8		11.7		10.2		10.4		7.89		9.08	
Thallium	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	3.1	U	0.61	J	–	NA	0.84	B	0.74	B	1.5	U	1.5	U	1.5	U	1.5	B	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U
Vanadium	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	1	U	0.16	J	–	NA	0.61	B	0.35	J	0.94	J	0.75	J	0.13	J	0.5	J	0.52	J	0.37	J	0.39	J	1	B	0.77	J
Zinc	µg/L	–	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA	1.3	U	25	U	–	NA	4.7	J	15	B	25	B	25	B	25	B	25	JB	25	JB	25	B	25	B	25	U	25	U
Conventionals																																										
Total Cyanide	µg/L	10	190		200		220		250		240		210	L	691		600		570		640	J	560		620		610		630		600		630		720		730		690		570	

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11S		MW-11D	
			8/28/2013		8/28/2013		3/26/2014		8/27/2014		4/1/2015		8/26/2015		3/29/2016		8/30/2016		3/22/2017		8/11/2017		3/21/2018		9/5/2018		3/19/2019		9/18/2019		3/10/2020		3/10/2020		9/23/2020		3/24/2021		9/14/2021		7/18/2008	
		Center of Plume	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																										
2,4-Dimethylphenol	µg/L	1.15	25		25		9.7		11		10		7.1		9.5		11		21		11		10	J	7.3		5.6		5.9	J	0.89	J	7.8		7.7		6.8		1		320	
2-Methylphenol	µg/L	12.5	0.51	U	3.2		0.87	J	0.96	U	0.70	J	0.23	J	0.3	J	1.4		1.6		0.96	U	2.2		1.1		0.88	J	0.69	J	0.96	U	0.46	J	0.51	J	0.5	J	0.96	U	780	
4-Methylphenol	µg/L	47.7	1		10	J	1.1		0.96	U	0.84	J	0.37	J	0.44	J	2		3.5		0.96	U	1.7		1.5		1.4		1.2	J	0.96	U	0.64	J	0.77	J	0.52	J	0.96	U	1300	
Dibenzofuran	µg/L	12	20		20		8.4		9		8.2		3.8		8.3		3.1		16		12		13		0.43	J	4.5		5	J	1.6	J	4.8	J	9		1.4		0.34	J	12	J
Naphthalene	µg/L	5	5.8		5.8		2.5		1.4		1.4		0.12	J	2		0.2		3.2		2	J	2.1		0.12	J	0.1	J	0.41	J	0.074	J	0.18	U	0.65		0.18	U	0.079	JB	1200	
Phenol	µg/L	7860	2	U	5.3		0.64	J	0.48	J	0.80	J	0.48	J	0.93	U	0.48	J	4.1		0.96	U	0.55	JB	0.72	JB	1	U	1	J	0.96	U	0.96	U	0.96	U	0.93	U	0.96	U	1000	
Volatile Organic Compounds																																										
Acetone	µg/L	95.9	10	U	10	U	5	U	2.5	J	10	U	6.7	B	6.3	B	4.3	JB	3.5	JB	25	U	5	U	11	B	5	U	3.8	J	5	U	5	U	5	UJ	5	UJ	5	U	20	R
Benzene	µg/L	5	8.2	J	8.7	J	5.6		5.6		4.9		4.6		7.1		2.6		4.9		2.7	J	2.9		4		3.1		2		4.8		5.5		4.1		5.4		3.3		39	
Chloroform	µg/L	1	0.01	U	0.01	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.015	U	0.015	U	0.011	JB	0.008	U	0.016	U	0.008	U	0.067	U	0.067	U	0.067	U	0.067	U	0.07	U	10	U
Total Inorganics																																										
Arsenic	µg/L	1	40		41		44		47	J	33		71		33		24		48		33	J	21		16		24		77		18		17		30		33		15		2.2	U
Barium	µg/L	40	40		40		37		35	J	34		43		33		29		35		26		24		28		30		47		35		36		42		38		37		0.1	U
Beryllium	µg/L	4	0.75	UJ	0.75	UJ	0.81	J	0.88	J	0.66	J	1.2		0.54	J	0.47	J	0.8	J	0.6	J	0.36	J	0.31	J	0.42	J	1.4		0.4	JB	0.36	J	0.48	J	0.61	J	0.31	J	0.32	U
Cadmium	µg/L	--	1	U	1	U	0.11	J	1	UJ	1	U	1	U	1	U	0.15	U	0.078	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.23	U
Chromium	µg/L	8	1	U	1	U	3.8	B	5.1	J	4.2	B	6.8	B	3.6	LB	2	U	1.6	J	1.6	J	2	U	2	B	2	U	5.2		3.5		3.4		3.5		2	U	2	U	1.2	U
Cobalt	µg/L	--	2.9	J	3	J	2.5		2.6	J	2.4		3.5		2.1		2		2.7		1.6		1.5		1.3		2		3		2.6		2.5		2.8		2.9		3		0.7	U
Iron	µg/L	250	8300		8300		8100		10000	J	6500		16000		5700	J	3900		10000		5700		3300	L	3300	K	4100		10000		3600		3400		6800		7400		3300		5450	
Lead	µg/L	15	6.7		8.5		0.11	J	0.086	JB	0.12	JB	0.18	JB	0.11	KB	1	U	1	U	1	U	1	U	0.14	JB	1	U	0.15	J	1	U	1	U	0.13	J	0.19	J	1	U	2.4	U
Manganese	µg/L	66.8	3500		3500		2900		3100	J	3000		4100		3000		2800		3000		2400		2300		2200	L	2400		2600		2500		2500		2800		2500		2300		213	
Mercury	µg/L	--	0.0045	J	0.00385	J	0.0109		0.0128		0.00162	B	0.00192		0.00192		0.0009		0.00194		0.001	B	0.00067		0.00069	LB	0.00474		0.00213		0.00032	J	0.00047		0.00038	JB	0.00104		0.0002	J	0.055	U
Nickel	µg/L	--	7	J	7.1	J	8.5		10	J	7.3		12		7.6		4.4		9.1		4.9		4.2		3.7		6.1		15		6.8		5.9		7.6		6.1		4.5		1.1	U
Selenium	µg/L	0.4	10.7		11		13		13.8		10.7		14.7		8.81		8.79		9.64		8.07		9.89		8.64		11.5		12.9		10.1		10.5		13.2		16		11.3		13.9	
Thallium	µg/L	--	1.5	U	1.5	U	0.019	JB	0.03	J	0.027	JB	0.044	JB	1	U	0.036	U	0.053	U	0.053	U	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.28	JB	0.15	U	3.1	U
Vanadium	µg/L	--	1.4		1.4		2.9	B	0.87	J	1	U	2.7		0.91	L	0.91	JB	1.3		1.8	B	0.9	U	2	B	1.1		2.8		0.99	U	0.99	U	0.99	U	0.99	U	0.99	U	1	U
Zinc	µg/L	--	25	U	25	U	3.2	JB	3.7	JB	5.1	B	3.8	JB	2.8	KB	11		5	U	2.9	JB	5	U	8.1	B	4.2	J	5.1		5	U	5	U	5	U	5	U	5	U	1.3	U
Dissolved Inorganics																																										
Arsenic	µg/L	1	18		19		13		13	J	6		13		13		2.1		18		18	J	6.6		4.4		7.2		20		2.6		2.6		2.1		2.2		1.3		--	NA
Barium	µg/L	40	36		36		32		29	J	30		34		32		28		30		25		23		27		24		37		32		34		34		32		32		--	NA
Beryllium	µg/L	4	0.75	UJ	0.75	UJ	0.33	J	0.16	J	0.19	JB	0.20	JB	0.26	J	0.2	J	0.27	J	0.27	J	0.23	J	0.14	J	0.2	J	0.21	JB	0.24	JB	0.23	J	1	U	1	U	1	U	--	NA
Cadmium	µg/L	--	1	U	1	U	1	J	1	UJ	1	U	1	U	1	U	0.15	U	0.078	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	--	NA
Chromium	µg/L	8	1	U	1	U	1.6	JB	0.67	J	1.9	JB	5.9		0.75	L	2	U	2	U	2	U	2	U	1.6	JB	2	U	2	U	2	U	2	U	2	U	2	U	2	U	--	NA
Cobalt	µg/L	--	2.6	J	2.4	J	2.2		1.9	J	2.1		2.7		1.7		1.8		2.3		1.5		1.6		1.6		1.5		2.1		2.1		2.3		2.2		2.2		2.7		--	NA
Iron	µg/L	250	3700		3700		2600		2500	J	790		2600		2400	J	260		3900		2800		1100		540		660		990		280		330		300		260		200		2850	
Lead	µg/L	15	6.9		8.1		0.025	J	1	UJ	0.089	JB	0.029	JB	1	U	1	U	0.36	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	--	NA
Manganese	µg/L	66.8	3400		3400		2800		2900	J	3200		4100		3300		2700		3000		2400		2200		2400		2400		2500		2400		2600		2800		2400		2300		185	
Mercury	µg/L	--	0.0004	UJ	0.00044	U	0.0007		0.0009		0.00033	JB	0.00029	J	0.00026	JB	0.0005		0.00031	J	0.0005	LB	0.00027	JB	0.00035	J	0.00026	J	0.00078	J	0.00042	U	0.00032	J	0.00041	U	0.00029	J	0.00014	J	--	NA
Nickel	µg/L	--	2	J	2.2	J	2.2		2.5	J	3		3.9		2.6		2.7		1.7		1.6		1.9	B	2		1.9		4.5		4.1		4.1		2.7		2		2.9		--	NA
Selenium	µg/L	0.4	8.11		7.9		10.4		7.59		6.68		7.31		6.02		5.88		6.03		6.23	L	7.29		5.43		7.35		6.79		7.59		7.72		8.04		9		8.24		--	NA
Thallium	µg/L	--	1.5	U	1.5	U	1	U	0.037	J	1	U	0.026	JB	1	U	0.036	U	0.053	U	0.053	U	0.1	J	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	--	NA
Vanadium	µg/L	--	1	U	1	U	2.1	B	1	UJ	0.26	JB	1	U	0.15	L	0.34	JB	0.6	J	1.3	B	0.9	U	1.8	B	0.9	U	1.6		0.99	U	0.99	U	0.99	U	0.99	U	0.99	U	--	NA
Zinc	µg/L	--	25	U	25	U	4.4	JB	2.6	JB	3.6	JB	5	U	2.3	KB	13	B	5	U	3.6	JB	5	U	5.4	B	5	U	3.5	J	3.4	J	4.9	J	5	U	5	U	5	U	--	NA
Conventionals																																										
Total Cyanide	µg/L	10	590		580		570		570		570		520		480		400		260		360		390		340		430		430		450		430		400		340		430		973	

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed he analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D	
			11/11/2010		2/23/2011		5/18/2011		8/10/2011		12/8/2011		3/21/2012		5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013		3/26/2014		8/27/2014		4/1/2015		8/26/2015		3/29/2016		8/30/2016		3/22/2017		8/11/2017		3/21/2018		9/6/2018	
		Center of Plume	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																										
2,4-Dimethylphenol	µg/L	1.15	100		180		190		180		140		95		130		110		150		120		130		10	J	50		56		86		65		78		100		73		59		41	
2-Methylphenol	µg/L	12.5	27		180		170		68		11		1.5	B	0.5	U	6.8		11		2.7	J	9		40		0.96	U	4.8	U	5	U	4.6	U	5.2	U	4.6	U	4.8	U	4.6	U	4.6	U
4-Methylphenol	µg/L	47.7	69		280		180		60		16		11	J	0.5	U	8.7		15		6.7	J	8.5		110		5.8		11		7		7.6		5.2	U	4.7	J	4.8	U	4.6		7.3	
Dibenzofuran	µg/L	12	6.5		1.5	U	3.7		5		4.6		4.8		2.8		4.3		3.4		4		3.6		25	U	2	K	2.1	J	3.2	J	2	J	1.7	J	3	J	2.3	J	2.3	J	1.7	J
Naphthalene	µg/L	5	190		270		300		260		200		130		170		120		180		160		180		260		63		71		110		71		69		120		80		75		52	
Phenol	µg/L	7860	34		250		210		73		2.6		2	B	1.4	J	1.9	J	3.3		0.37	J	2.1	U	510		0.96	U	0.78	J	1.5	J	4.6	U	5.2	U	4.6	U	4.8	U	4.6	U	4.6	U
Volatile Organic Compounds																																										
Acetone	µg/L	95.9	5	UJ	5	UJ	12		5.9	U	10	U	10	U	18		17		10	U	10	U	10	U	25	U	10	U	10	U	15	U	15	U	15	U	15	U	3.9	JB	5	U	5	U
Benzene	µg/L	5	27		36	J	32		29		29		27		31		25		25		29		26	J	15		17		17		17		20		11		12		17		11		13	
Chloroform	µg/L	1	0.01	U	0.01	B	1	U	0.05	R	0.01	U	0.01	U	0.01	U	0.01	U	0.05	U	0.01	U	0.01	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	UL	0.16	U	0.06	U	0.03	U	0.003	U	0.008	U
Total Inorganics																																										
Arsenic	µg/L	1	5.06	J	4.08		3	J	3.7		3		2.8		3.1		3.95		2.9		3.5		5.5		3		4.7	J	3.9		5.3		3.9		3.7		3.5		3.7	J	4.7		0.32	U
Barium	µg/L	40	33	J	20	J	19	J	26		31		35		26		29		24	J	28		27		130		26	J	24		24		21		16		16		15		15		100	
Beryllium	µg/L	4	4.4		0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	UJ	0.75	UJ	0.75	U	0.75	UJ	0.5	J	0.038	J	0.13	JB	0.045	JB	1	U	1	U	1	U	1	UJ	1	U	0.3	J
Cadmium	µg/L	--	1.4		1	U	0.19	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.86	J	1	UJ	1	U	1	U	1	U	0.15	U	0.078	U	0.078	U	0.13	U	0.59	J
Chromium	µg/L	8	15		0.55	J	0.92	B	1.2	B	1	U	1.2		0.37	J	0.97	J	1.2	B	0.81	J	3.2		8.7		1	J	5.5	B	6.7	B	3.4	LB	2.3		0.63	J	2	U	2	B	1.7	JB
Cobalt	µg/L	--	12		1.8	J	2.2	J	1.9	J	1.3	J	10	B	1.6	J	1.5	J	1.2	J	10	U	3.5	J	2.5		1.7	J	1.9		2.1		1.8		2		2.2		2.3		2		2.6	
Iron	µg/L	250	39000		7700		8900	B	5700		4100		7700		6300		4700		4400		5200		8600		2500		4200	J	2900		3200		1600	J	2300		3000		2400		2100	L	22	JK
Lead	µg/L	15	11		1.7	J	2.2	J	2.1	J	5	U	1.6	J	1.2	J	5	U	5	U	1.9	J	8.9		0.77	J	0.026	JB	0.13	JB	0.17	JB	0.03	KB	1	U	1	U	1	U	0.12	J	1	U
Manganese	µg/L	66.8	590		190		210	B	230		260		300		210		220		180		210		260		1000		220	J	180		200		130		130		120		130		120		650	L
Mercury	µg/L	--	0.0964		0.0018		0.0016		0.0022		0.0032		0.00185	B	0.00113		0.0004	U	0.0002	U	0.00111		0.0059	J	0.00289		0.00208		0.00146		0.00045		0.0009		0.0008		0.00053		0.00108	JB	0.00135		0.00074	LB
Nickel	µg/L	--	52		4	J	4.2	J	2.7	J	1.4	J	4.3	J	2.5	J	1.9	J	10	U	2.4	J	8.6	J	8.8		2	J	3.8		3.2		2.9		1.8		2.1		1.3		1.5	B	35	
Selenium	µg/L	0.4	12.3	J	12.4		13.4		13.9		22.5		21.3		15.3		16.7		11.2		12.7		10.1		9.55		8.09		6.98		7.31		6.3		4.99		5.13		5.21		5.26		4.13	
Thallium	µg/L	--	0.23	J	1.5	B	0.21	B	1.5	U	1.5	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	0.015	JB	1	UJ	1	U	1	U	1	U	0.036	U	0.1	JB	0.053	U	0.063	U	0.41	J
Vanadium	µg/L	--	2.1		1	U	0.37	B	1	U	0.12	J	1	U	1	U	1	U	1	B	0.31	J	1	U	5.5	B	1	UJ	1	U	2.5		0.12	L	0.69	JB	0.6	J	1.7	B	3.1	B	1.9	B
Zinc	µg/L	--	180		5.1	J	25	U	25	U	25	B	25	B	25	JB	25	B	25	U	2.9	J	20	J	14		2.2	JB	2.8	JB	1.3	JB	13		5.8		5	U	3.5	JB	5	U	64	
Dissolved Inorganics																																										
Arsenic	µg/L	1	1.98	J	1.93		2.6		3.4		3.6		2.6		--	NA	2.36		2.3		--	NA	--	NA	1.8		--	NA	3.7		5.2		4.2		3.5		--	NA	3.5	J	--	NA	--	NA
Barium	µg/L	40	29	J	180		19	J	25		31		35		--	NA	28		23	J	--	NA	--	NA	130		--	NA	28		23		21		18		--	NA	15		--	NA	--	NA
Beryllium	µg/L	4	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	--	NA	0.75	UJ	0.75	UJ	--	NA	--	NA	0.49	J	--	NA	0.044	JB	0.069	JB	1	U	1	U	--	NA	1	UJ	--	NA	--	NA
Cadmium	µg/L	--	1	U	1	U	1	U	1	U	1	U	1	U	--	NA	1	U	1	U	--	NA	--	NA	0.28	J	--	NA	1	U	1	U	1	U	0.15	U	--	NA	0.078	U	--	NA	--	NA
Chromium	µg/L	8	1.1		1	U	0.9	B	1	U	3.9		1	U	--	NA	0.39	J	1	J	--	NA	--	NA	3.2	B	--	NA	2.7	B	7.6		0.89	L	2	U	--	NA	2	U	--	NA	--	NA
Cobalt	µg/L	--	10	U	2.1	J	2.1	J	2.2	B	1.4	J	10	B	--	NA	1.6	J	1.2	J	--	NA	--	NA	2.3		--	NA	1.7		2.2		1.8		2.1		--	NA	2.3		--	NA	--	NA
Iron	µg/L	250	5800		21000		3300	B	3700		6800		4500		4100		3700		2700		3400		3200		2100		2400	J	980		2600		730	J	920		1200		1200		930		1000	
Lead	µg/L	15	5	U	5	U	2	J	5	U	5	U	5	U	--	NA	1.4	J	5	U	--	NA	--	NA	0.28	J	--	NA	1	U	0.060	JB	0.028	KB	1	U	--	NA	1	U	--	NA	--	NA
Manganese	µg/L	66.8	220		1400		160	B	210		290		270		180		200		180		200		180		980		200	J	170		190		150		120		98		110		120		110	
Mercury	µg/L	--	0.00048		0.0003	J	0.0003	J	0.0004	U	0.0003	J	0.00034	J	--	NA	0.0004	U	0.0002	U	--	NA	--	NA	0.00032	J	--	NA	0.00032	JB	0.00022	J	0.00025	JB	0.0004	U	--	NA	0.00204	UL	--	NA	--	NA
Nickel	µg/L	--	10	U	7.8	J	1.1	J	10	U	4.3	J	1.6	J	--	NA	10	U	10	U	--	NA	--	NA	4.8		--	NA	1.7		2.6		1.4	K	1.1		--	NA	0.61	J	--	NA	--	NA
Selenium	µg/L	0.4	8.86	J	11.2		12.9		13.7		20.9		19.7		--	NA	16.3		11.9		--	NA	--	NA	8.42		--	NA	6.94		7.42		5.33		5.36		--	NA	5.12	L	--	NA	--	NA
Thallium	µg/L	--	1.5	U	1.5	B	0.19	B	1.5	UL	1.5	B	1.5	U	--	NA	1.5	U	1.5	U	--	NA	--	NA	0.11	JB	--	NA	1	U	1	U	1	U	0.036	U	--	NA	0.053	U	--	NA	--	NA
Vanadium	µg/L	--	1	U	0.41	J	0.4	B	1	U	0.16	J	1	U	--	NA	1	U	1	B	--	NA	--	NA	6.5	B	--	NA	1	U	2.2		1	UL	0.62	JB	--	NA	1.5	B	--	NA	--	NA
Zinc	µg/L	--	25	U	5.6	J	25	U	15	B	25	B	25	B	--	NA	25	B	25	U	--	NA	--	NA	9.1		--	NA	1.7	JB	1.6	JB	2	KB	3.1	JB	--	NA	5	U	--	NA	--	NA
Conventionals																																										
Total Cyanide	µg/L	10	10	U	880		990	J	940		1200		730		860		880		760		890		760		220		600		620		630		650		630		440		570		560		640	

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
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D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-11D		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S		MW-13S	
		Center of Plume	3/20/2019		9/18/2019		3/10/2020		9/23/2020		3/24/2021		9/14/2021		7/18/2008		11/11/2010		2/24/2011		5/19/2011		8/11/2011		12/8/2011		3/21/2012		5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013		3/26/2014		8/27/2014		4/1/2015	
			Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																												
2,4-Dimethylphenol	µg/L	1.15	54		32		35		37		30		36		2.8	J	1700		100	U	1,500		2500		2400		1900	D	2200		1900		2000		1900		2500		1200		1100		710	J
2-Methylphenol	µg/L	12.5	4.8	U	5	U	4.8	U	4.8	U	4.6	U	4.8	U	29		11000		10000		9000		13000		12000		8500	D	10000		9800		10000		8600		11000		7900		6300		5100	
4-Methylphenol	µg/L	47.7	22		5	U	5.9		12		5		6.7		67		37000		32000		29000		44000		38000		28000	D	31000		30000		34000		23000	D	32000	D	29000		22000		17000	
Dibenzofuran	µg/L	12	2.1	J	1.4	J	2.1	J	2	J	2	J	2.2	J	10	U	130	U	100	U	0.51	U	0.51	U	260	U	2.6	U	100	U	10	U	5.6	U	53	U	52	U	380	U	50	U	93	U
Naphthalene	µg/L	5	76		0.95	U	53		0.91	U	44		54		10	U	330		150		190		280		310		220		290		250		260		310		450		200		120		110	
Phenol	µg/L	7860	4.8	U	5	U	4.8	U	4.8	U	4.6	U	4.8	U	26		29000		25000		24000		31000		30000		20000	D	23000		25000		31000		18000		20000		40000		29000		24000	
Volatile Organic Compounds																																												
Acetone	µg/L	95.9	5	U	5	U	5	U	8.2	J	5.4	JB	5	U	5	R	230	J	180	J	200		360		280		240		610		630		290		310		340		200		270	K	220	
Benzene	µg/L	5	13		9.2		12		7.7		9.7		11		1.1		370		380	J	330		640		590		520		1100		1200		430		480		560	J	640		420		420	
Chloroform	µg/L	1	0.08	U	0.008	U	0.067	U	0.067	U	0.067	U	0.07	U	5	U	0.29	B	0.33	J	0.01	U	0.01	U	0.05	U	0.05	U	0.1	U	0.05	U	0.05	U	0.05	U	0.01	U	0.012	JB	0.016	JB	0.02	U
Total Inorganics																																												
Arsenic	µg/L	1	4		3		4.8		5		3.5		3.7		2.2	U	1.38	J	0.941	J	1.5	J	1	U	0.4	J	1	U	1	U	1.1		6.1		4.5		1	U	24	L	24	J	2.7	J
Barium	µg/L	40	16		13		22		22		16		17		0.1	U	2500	J	2400		2400	B	2400		2100		2300		2100		2100		2300	J	2200		2100		1500	L	1700	J	1700	
Beryllium	µg/L	4	1	U	1	U	0.58	J	1	U	1	U	1	U	0.32	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.18	J	0.75	UJ	0.21	J	0.75	UJ	0.75	U	0.75	UJ	0.11	L	1	UJ	0.45	JB
Cadmium	µg/L	--	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U	0.23	U	1.1		0.71	J	1.1	L	0.95	J	0.67	J	0.53	J	1		1	U	1	U	1	U	1	U	5.4	L	0.63	J	5	U
Chromium	µg/L	8	1.9	JB	2	U	2	U	1.5	J	2	U	2	U	1.2	U	12		19		2.4	B	2.3		1	U	0.9	J	2.8		2.1		6.2		4.9		2		19	L	2	J	4.0	JB
Cobalt	µg/L	--	1.9		1.7		2.2		1.9		2.2		2.1		0.7	U	120		120		20	B	41		3.5	J	52		30		39		68		35		15		210	L	11	J	5.5	
Iron	µg/L	250	1700		2500		1700		2500		1100		1000		119		3900		3500		1700	B	2200		1400		2300		1600		2400		2500		1800		750		5800	L	460	J	460	
Lead	µg/L	15	1	U	1	U	0.33	J	0.19	J	1	U	1	U	2.4	U	20	U	8.9	J	16	J	9.8	J	20	U	20	U	20	U	20	U	20	U	8.6	J	20	U	0.51	L	0.1	JB	0.17	JB
Manganese	µg/L	66.8	110		120		110		110		98		95		475		9900		9700		10000	B	10000		9500		9900		9000		9300		9300		9300		9400		7900	L	8500	J	7700	
Mercury	µg/L	--	0.00088	B	0.00081		0.00269		0.00016	JB	0.00237		0.00017	J	0.055	U	0.0623		0.0005	UJ	0.0083		0.0021		0.0073	U	0.027		0.0047	J	0.0013	U	0.0027	L	0.0009	U	0.0013	UJ	0.00245		0.0002	U	0.0005	U
Nickel	µg/L	--	2		2.9		2.6		3		1.6		1.5		1.1	U	19		21	J	10	U	3	J	10	U	5	J	2.4	J	2.8	J	8.7	J	3.9	J	3.1	J	29	L	10	UJ	3.1	J
Selenium	µg/L	0.4	4.74		3.89		4.35		4.63		4.48		3.7		11.1		23.3	J	16.5		10.3		15.1		9.84		13.5		10.8		13.5		13.6		22.9		10.5		12.3		9.48		12.2	
Thallium	µg/L	--	0.13	U	0.15	U	0.48	J	0.15	U	0.15	JB	0.15	U	3.1	U	1.5	U	15	U	0.21	B	1.5	U	1.5	B	1.5	U	1.5	B	0.18	J	1.5	U	6	U	1.5	U	0.25	LB	1	UJ	5	U
Vanadium	µg/L	--	1		0.99	U	0.99	U	0.99	U	0.99	U	0.99	U	1	U	0.28	J	1	U	0.48	B	0.37	J	0.27	J	1	U	0.41	J	0.69	J	1		1.1		1	U	4.6	LB	0.29	J	5	U
Zinc	µg/L	--	4.8	J	4.8	J	5	U	5	U	5	U	5	U	1.3	U	100	U	6.5	J	100	U	120	U	25	B	25	B	25	JB	25	B	7.7	J	4.3	J	100	U	9.5	L	7.6	JB	5.6	JB
Dissolved Inorganics																																												
Arsenic	µg/L	1	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1.82	J	0.738	J	0.94	J	0.64	B	1	U	1	U	0.64	J	1.03		2.8		2.1		1.1		20	L	--	NA	--	NA
Barium	µg/L	40	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	2500	J	2400		2300		2400		2100		2300		2100		2100		2300	J	2200		2100		1800	L	--	NA	--	NA
Beryllium	µg/L	4	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	UJ	0.23	J	0.75	U	0.75	UJ	0.054	L	--	NA	--	NA
Cadmium	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.71	J	0.44	J	1	B	0.88	J	0.64	J	0.31	J	0.9	J	1	U	1	U	1	U	1	U	1.1	L	--	NA	--	NA
Chromium	µg/L	8	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	0.79	J	0.65	B	0.4	B	2.8		1	U	0.42	J	0.82	J	1.8	B	1.2		1.1		3	L	--	NA	--	NA
Cobalt	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	10	U	5.5	J	7.5	J	7.3	J	22		10	B	3.9	J	3.8	J	3.2	J	1.7	J	4.6	J	7.3	L	--	NA	--	NA
Iron	µg/L	250	880	B	930		910		570		250		240		15.8	U	1600		1300		1300	B	1500		2100		1200		860		650		870		610		150	J	290	L	28	J	250	U
Lead	µg/L	15	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	20	U	20	U	16	B	25	U	20	U	20	U	20	U	20	U	6.2	J	20	U	20	U	0.031	L	--	NA	--	NA
Manganese	µg/L	66.8	100		110		110		93		86		84		472		9800		9300		9500	B	10000		9300		9900		9100		9300		9400		9600		9600		7900	L	8500	J	7300	
Mercury	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.0005	U	0.0005	UJ	0.0005	U	0.0005	U	--	NA	0.016	U	0.008	U	0.0013	U	0.001	UL	0.0009	U	0.0013	UJ	0.0006		--	NA	--	NA
Nickel	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	10	U	10	UJ	10	U	10	U	2.2	J	10	U	10	U	10	U	10	U	10	U	1.8	J	3.5	L	--	NA	--	NA
Selenium	µg/L	0.4	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	7.55	J	8.45		7.37		11.8		--	NA	9.77		6.7		8.79		7.53		8.23		8.14		8.15		--	NA	--	NA
Thallium	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1.5	U	1.5	B	0.29	B	1.5	UL	1.5	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	0.038	LB	--	NA	--	NA
Vanadium	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	0.12	J	0.31	B	0.26	J	0.37	J	1	U	0.27	J	0.4	J	1	B	0.94	J	1	U	4	LB	--	NA	--	NA
Zinc	µg/L	--	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	100	U	5.5	J	100	U	120	U	25	B	25	B	25	JB	25	B	25	U	25	U	100	U	4.4	LB	--	NA	--	NA
Conventionals																																												
Total Cyanide	µg/L	10	510	J	500		500		420		480		430	L	1.7	U	18		110		21000	J	20	U	7.7		2200		6200		1600		610		270		2800		39		24	J	5.3	J

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

ϕ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4A "CENTER OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	MW-13S 8/26/2015 Result	Q	MW-13S 3/30/2016 Result	Q	MW-13S 8/31/2016 Result	Q	MW-13S 3/22/2017 Result	Q	MW-13S 3/22/2017 Duplicate	Q	MW-13S 8/11/2017 Result	Q	MW-13S 3/21/2018 Result	Q	MW-13S 9/6/2018 Result	Q	MW-13S 3/20/2019 Result	Q	MW-13S 9/18/2019 Result	Q	MW-13S 3/10/2020 Result	Q	MW-13S 9/23/2020 Result	Q	MW-13S 3/24/2021 Result	Q	MW-13S 9/14/2021 Result	Q
Semivolatile Organic Compounds																														
2,4-Dimethylphenol	µg/L	1.15	940	J	1000		850	J	3000	J	2900	J	940	J	650	J	880	J	830	J	1500		910	J	990		620	J	840	J
2-Methylphenol	µg/L	12.5	5500		5900		5700		17000		18000		6200		4400		5100		4900		7700		4700		6200		5100		6700	
4-Methylphenol	µg/L	47.7	18000		20000		18000		37000		43000		21000		14000		18000		17000		26000		15000		20000		16000		19000	
Dibenzofuran	µg/L	12	1000	U	960	U	93	U	330	U	320	U	110	U	68	U	68	U	70	U	70	U	70	U	68	U	68	U	180	U
Naphthalene	µg/L	5	130	J	110	J	100	J	480	U	460	U	180	U	73	J	98	J	88	J	130	J	69	J	99	J	73	J	110	J
Phenol	µg/L	7860	25000		28000		27000		61000		64000		32000		21000		24000		21000		32000		20000		27000		21000		27000	
Volatile Organic Compounds																														
Acetone	µg/L	95.9	280		570		470	J	520	J	530	J	210		230		260		77	J	230		99		210	J	190	J	69	
Benzene	µg/L	5	450		180		160		140		130		240		200		300		290		210		170		210		280		360	
Chloroform	µg/L	1	0.4	U	1	U	0.8	U	0.3	U	0.3	U	0.6	U	0.015	U	1.6	U	1.6	U	0.008	U	0.067	U	0.067	U	0.067	U	0.07	U
Total Inorganics																														
Arsenic	µg/L	1	8.4		6.4		1.7		2.2	U	2.2	U	1.3	J	1.8	B	0.98	J	1.2		1.1		1.9	J	1.6	J	1.3		1.1	
Barium	µg/L	40	1700		1700		1600		1400		1400		1400		1200		1400		1500		1300		1400		1600		1500		1700	
Beryllium	µg/L	4	0.14	JB	1	U	1	U	10	U	10	U	1	UJ	1	U	0.074	J	1	U	0.57	JB	5	U	5	U	1	U	1	U
Cadmium	µg/L	--	1	U	1	U	0.15	U	0.78	U	0.78	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	1.1	U	1.1	U	0.22	U	0.22	U
Chromium	µg/L	8	8.3	B	3.8		2.7		20	U	20	U	2.7		2.9	B	2.8	B	5.4	B	8		18		10	U	2.3		2	U
Cobalt	µg/L	--	31		16		5.5		7		6.3		4.7		8.5		6.2		7.2		29		11		2.6		1.8		1.3	
Iron	µg/L	250	1400		950		900		780		740		670		720	L	460	K	490	B	1600		880		300		480		220	
Lead	µg/L	15	0.17	JB	0.2	JB	0.083	J	10	U	10	U	0.39	J	0.096	J	0.1	JB	1	U	0.17	J	1.1	J	5	U	0.27	J	0.17	J
Manganese	µg/L	66.8	8900		3800		3200		3200		3100		6200		3800		5500	L	4800		4300		1500		1200		1400		1400	
Mercury	µg/L	--	0.00215		0.004	U	0.004	U	0.004	U	0.004	U	0.0016	B	0.00096		0.00037	LB	0.00127	JB	0.00091		0.00105	U	0.0338		0.00394		0.00158	U
Nickel	µg/L	--	4.6		5.4		2.7		3.4	J	3.6	J	5.4		3.5		1.8		3.2		6.9		13		2.9	J	2.6		1.9	
Selenium	µg/L	0.4	10.3		5.93		7.94		5.33		5.51		5.57		8.09		6.9		8.57		6.44		7.02		6		12.7		5.4	J
Thallium	µg/L	--	0.038	JB	0.042	JB	0.036	U	0.53	U	0.53	U	0.053	U	0.063	U	0.063	U	0.13	U	1.3	B	0.74	U	0.74	U	0.15	U	0.15	U
Vanadium	µg/L	--	5.7		2.6	B	1.1	B	5	U	5	U	1.6	B	2.9	B	2.6	B	1.6		2.1		5	U	5	U	0.99	U	1.7	
Zinc	µg/L	--	2.7	JB	4	JB	11	B	50	U	50	U	14	B	250		8.5	B	9.2	B	6.3		25	U	25	U	7.7		5	
Dissolved Inorganics																														
Arsenic	µg/L	1	11		7.2		1		2.2	U	2.2	U	1.1	JB	1.6	B	--	NA	1		0.89	J	1.6	U	--	NA	--	NA	--	NA
Barium	µg/L	40	1800		1700		1500		1400		1400		1400		1200		--	NA	1400		1500		1500		--	NA	--	NA	--	NA
Beryllium	µg/L	4	0.14	JB	1	U	1	U	10	U	10	U	1	UJ	1	U	--	NA	1	U	0.36	JB	5	U	--	NA	--	NA	--	NA
Cadmium	µg/L	--	1	U	1	UL	0.15	U	0.78	U	0.78	U	0.078	U	0.13	U	--	NA	0.13	U	0.13	U	1.1	U	--	NA	--	NA	--	NA
Chromium	µg/L	8	8.5		0.87	J	2	U	20	U	20	U	0.88	J	1.8	JB	--	NA	2.1	B	2	U	10	U	--	NA	--	NA	--	NA
Cobalt	µg/L	--	13		1.8		1.5		2.9	J	2.7	J	1.9		1.4		--	NA	1.4		0.79		0.89	J	--	NA	--	NA	--	NA
Iron	µg/L	250	660		33	JB	63	B	500	U	500	U	99		50	U	61		19	JB	50	U	250	U	250	U	50	U	50	U
Lead	µg/L	15	0.12	JB	1	U	1	U	10	U	10	U	1	U	1	U	--	NA	1	U	1	U	5	U	--	NA	--	NA	--	NA
Manganese	µg/L	66.8	8500		4300		3000		3500		3500		5700		3900		5600		4500		4300		1500		1200		1400		1300	
Mercury	µg/L	--	0.00261		0.0004	U	0.004	U	0.004	U	0.004	U	0.0004	UL	0.00042	U	--	NA	0.00103	J	0.00077		0.00105	U	--	NA	--	NA	--	NA
Nickel	µg/L	--	3.1		2.2		1.8		10	U	10	U	3.7		1		--	NA	1	B	1.6	B	2.2	J	--	NA	--	NA	--	NA
Selenium	µg/L	0.4	9.81		4.88		7.31		5.27		4.97		5.08	L	8.59		--	NA	7.41		6.32		6.16		--	NA	--	NA	--	NA
Thallium	µg/L	--	0.022	JB	1	U	0.036	U	0.53	U	0.53	U	0.053	U	0.063	U	--	NA	0.13	U	0.29	JB	0.74	U	--	NA	--	NA	--	NA
Vanadium	µg/L	--	4.3		1.8	B	0.56	JB	5	U	5	U	1.4	B	2.4	B	--	NA	1.2	B	0.99	U	5	U	--	NA	--	NA	--	NA
Zinc	µg/L	--	3.1	JB	16	B	5	U	50	U	50	U	3.2	JB	5	U	--	NA	5	U	5	U	25	U	--	NA	--	NA	--	NA
Conventionals																														
Total Cyanide	µg/L	10	49		34		27	J	190	J	120	J	130		120		29		34		27		440		7500		280		2000	L

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection

¢ - Indicates exceedance of GW Cleanup Standards - Center of plume

NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.

Brooks Rand performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S		BG-1S	
			11/9/2010		2/23/2011		5/18/2011		8/9/2011		12/7/2011		3/20/2012		5/30/2012		9/5/2012		11/28/2012		2/26/2013		8/27/2013		3/25/2014		8/26/2014		8/26/2014		3/31/2015		3/31/2015		8/26/2015		3/29/2016		3/29/2016		8/30/2016		3/21/2017	
		Extent of Plume	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																												
2,4-Dimethylphenol	µg/L	1	0.52	U	0.5	U	2	U	2	U	2.1	U	2.1	U	2.1	U	0.52	U	0.53	U	0.51	U	0.52	U	0.93	U	1	U	0.96	U	0.96	U	0.93	U	1	U	0.96	U	0.96	U	0.96	U	1.9	U
2-Methylphenol	µg/L	1	0.52	U	0.5	U	0.5	U	0.5	U	0.52	UJ	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	UJ	0.93	U	1	U	0.96	U	0.96	U	0.93	U	1	U	0.96	U	0.96	U	0.96	U	0.96	U
4-Methylphenol	µg/L	1	0.52	U	0.5	U	0.5	U	0.5	U	0.52	UJ	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	UJ	0.93	U	1	U	0.96	U	0.96	U	0.93	U	0.23	J	0.96	U	0.96	U	0.96	U	1.9	U
Dibenzofuran	µg/L	0.86	0.52	U	0.5	U	0.5	U	0.5	U	0.52	U	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	U	0.93	U	1	U	0.96	U	0.96	U	0.93	U	1	U	0.96	U	0.96	U	0.093	U	0.13	U
Naphthalene	µg/L	1	0.52	U	0.5	U	0.5	U	0.5	U	0.52	U	0.52	U	0.53	U	0.52	U	0.53	U	0.51	U	0.52	U	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U	0.052	J	0.19	U	0.19	U	0.19	U	0.19	U
Phenol	µg/L	--	2.1	U	2	U	2	U	2	U	2.1	UJ	2.1	U	2.1	U	2.1	U	2.1	U	2	U	2.1	UJ	0.93	U	1	U	0.96	U	0.96	U	0.93	U	0.73	J	0.96	U	0.96	U	0.96	U	0.96	U
Volatile Organic Compounds																																												
Acetone	µg/L	24	5	UJ	5	UJ	10	U	5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U	5	U	5	U	5	U	5	U	5	U	5	U	4.1	JB	5	U	2.7	JB	3.8	JB
Benzene	µg/L	0.04	0.02		0.02	UJ	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.032		0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chloroform	µg/L	0.015	0.83		0.29		0.15		0.13		0.13		0.078	B	0.058		0.06		0.01	U	0.01	U	0.01	U	0.051	B	0.033	B	0.031	B	0.057	B	0.049	B	0.029		0.028	B	0.028	B	0.019	JB	0.025	B
Total Inorganics																																												
Arsenic	µg/L	0.04	0.406	J	1.04		0.48	J	0.47	B	1	U	1	U	1	U	0.143		1	U	0.63	J	1.3		1	U	0.35	JB	1	UJ	0.51	J	0.77	J	1.4	B	1.3		1.1		1.3		0.4	J
Barium	µg/L	450	52		79		66		68		62		53		55		57		66		67		78		69		65	J	64	J	71		73		69		66		71		63		75	
Beryllium	µg/L	4	0.75	U	0.23	J	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	U	0.75	U	0.75	UJ	1	U	1	UJ	1	UJ	0.099	JB	0.046	JB	1	U	1	U	1	U	1	U	1	U
Cadmium	µg/L	0.62	1	U	1	U	0.34	B	1	U	1	B	1	U	1	B	1	U	1	U	1	U	1	U	0.25	J	0.27	J	0.22	J	1	U	1	U	1	U	0.12	J	1	U	0.15	U	0.11	J
Chromium	µg/L	12	3.6	J	120		33	B	1.1	B	1.7		1		1.4	B	0.22	J	1.4		1	B	7.9		3.2	B	1.3	J	0.88	J	2.5	B	2.6	B	8.8	B	2.2	LB	1.6	LB	2	U	6.4	
Cobalt	µg/L	22	10	U	4.4	J	3.3	J	3.4	B	10	B	10	B	1.4	J	2.6	J	10	U	1.3	J	10	B	1.7		1.5	J	1.6	J	1.8		2.2		1.9		1.7		1.7		2.1		2.2	L
Iron	µg/L	2300	710	J	1300		610	B	60	J	230		150	J	150	U	150	B	300		150	B	1100		13	J	50	UJ	50	UJ	43	JB	46	JB	100	B	78		77		52		110	
Lead	µg/L	15	5	U	2.8	J	3.2	J	2.2	J	2.2	J	1.1	J	1.3	J	1.5	J	5	U	2.2	J	10		0.074	J	0.067	JB	0.03	JB	0.097	JB	0.1	JB	0.18	JB	0.2	K	0.16	K	0.073	J	0.34	J
Manganese	µg/L	310	200		330		280	B	320		230		180		190		230		260		260		290		260		260	J	260	J	300		310		330		340		340		350		450	
Mercury	µg/L	0.004	0.12		0.416		0.368		0.402		0.279		0.416		0.579		0.563		0.555		0.67		1.1		1.01		0.965		0.914		0.471		0.463		0.903		1.04		1.04		0.577		0.83	J
Nickel	µg/L	260	10	U	88	J	26		7.9	J	4.8	J	4.6	J	4.4	J	4.8	J	4.9	J	5.9	J	11	J	5.8		4.5	J	4.8	J	5.2		6.3		6.3		4.7		4.8		5.1		13	
Selenium	µg/L	0.006	1.03		1.59		1.91		1.62		2.14		1.1		0.867		1		1.62		2.33		1.93		1.4		1.39	J	1.76	J	5.86		6.09		1.68		0.86		0.814		1.29		0.849	
Thallium	µg/L	0.17	0.1	J	1.5	B	0.24	B	1.5	U	1.5	B	1.5	U	1.5	B	0.37	J	1.5	U	0.12	J	1.5	U	0.096	JB	0.082	JB	0.11	JB	0.1	JB	0.030	JB	0.038	JB	0.017	JB	0.05	JB	0.036	U	0.053	U
Vanadium	µg/L	0.41	2.1		1	U	1.2	B	0.6	B	1.4		0.72	J	1	B	0.61	J	0.81	J	0.29	J	5.2	B	5.38	JB	1	UJ	0.098	J	1	U	1	U	3.3		0.73	L	0.48	L	0.79	JB	0.5	U
Zinc	µg/L	170	25	U	17	J	10	J	15	B	25	B	25	B	25	B	25	B	13	J	8.5	J	25	U	15		6	JB	5.5	JB	7.1	B	8.5	B	7.1	B	5.4	BK	7.4	BK	7.1		6.1	
Dissolved Inorganics																																												
Arsenic	µg/L	0.04	0.195	J	0.084	J	0.44	J	1	U	1	U	1	U	1	U	--	NA	0.92	J	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.95	J	0.91	J	1.2		--	NA
Barium	µg/L	450	48		61		59		65		60		50		54		--	NA	62		--	NA	72		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	73		71		66		--	NA
Beryllium	µg/L	4	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	--	NA	0.75	U	--	NA	0.75	UJ	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	1	U	--	NA
Cadmium	µg/L	0.62	1	U	1	U	0.29	B	1	U	1	U	1	U	1	B	--	NA	1	U	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	0.15	U	--	NA
Chromium	µg/L	12	1	UJ	16		0.48	B	0.26	J	1	U	1	U	1	U	--	NA	1	B	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.55	L	0.58	L	2	U	--	NA
Cobalt	µg/L	22	10	U	2.9	J	3	J	3.1	J	10	B	10	B	1.4	J	--	NA	2.4	J	--	NA	10	B	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1.3		1.5		2.3		--	NA
Iron	µg/L	2300	150	UJ	150	B	150	U	150	U	150	U	150	U	150	U	150	U	20	J	150	U	150	U	50	U	50	UJ	50	UJ	50	U	50	UJ	7.6	JB	50	U	50	U	15	JB	50	U
Lead	µg/L	15	5	U	1.3	J	2	J	1.5	J	1.6	J	5	U	2.1	J	--	NA	2.1	J	--	NA	11		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	0.12	KB	1	U	--	NA
Manganese	µg/L	310	200		300		290	B	310		230		180		210		220		250		260		290		250	J	250	J	260	J	310		310		340		340		310		360		450	
Mercury	µg/L	0.004	0.0162		0.0353		0.0235		0.264		0.144		0.297		0.516		--	NA	0.334		--	NA	0.799		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.0438		0.148		0.0505		--	NA
Nickel	µg/L	260	10	U	19	J	6.2	J	7.2	J	5.4	J	4	J	4.3	J	--	NA	6.1	J	--	NA	9.9	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	3.7		3.9		5.9		--	NA
Selenium	µg/L	0.006	0.845	J	0.865		1.6		1.55		1.73		1.12		0.882		--	NA	1.5		--	NA	1.74		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.675		0.778		1.23		--	NA
Thallium	µg/L	0.17	0.13	J	1.5	B	0.22	B	0.13	B	1.5	U	1.5	U	1.5	B	--	NA	1.5	U	--	NA	1.5	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.12	J	0.015	JB	0.036	U	--	NA
Vanadium	µg/L	0.41	0.27	J	1	U	1	U	0.17	B	1	U	1	U	0.22	J	--	NA	1	B	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.12	L	0.25	L	0.52	JB	--	NA
Zinc	µg/L	170	25	U	13	J	8.4	J	16	B	25	B	25	B	6.4	J	--	NA	25	JB	--	NA	25	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	5.5	KB	6	KB	8.7	B	--	NA
Conventionals																																												
Total Cyanide	µg/L	13	10	U	10	U	20	UJ	56		21		20	U	20	U	20	U	20	U	20	U	20	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	2	J

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	BG-1S 8/10/2017 Result	Q	BG-1S 3/20/2018 Result	Q	BG-1S 9/5/2018 Result	Q	BG-1S 3/20/2019 Result	Q	BG-1S 9/17/2019 Result	Q	BG-1S 3/10/2020 Result	Q	BG-1S 9/22/2020 Result	Q	BG-1S 3/23/2021 Result	Q	BG-1S 9/15/2021 Result	Q
Semivolatile Organic Compounds																				
2,4-Dimethylphenol	µg/L	1	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	UJ
2-Methylphenol	µg/L	1	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	UJ
4-Methylphenol	µg/L	1	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	U
Dibenzofuran	µg/L	0.86	0.12	U	0.07	U	0.068	U	0.068	U	0.07	U	0.07	U	0.068	U	0.07	U	0.19	U
Naphthalene	µg/L	1	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.19	UJ
Phenol	µg/L	–	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.96	U	1	UJ
Volatile Organic Compounds																				
Acetone	µg/L	24	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
Benzene	µg/L	0.04	0.02	U	0.02	U	0.011	JB	0.04	U	0.04	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	µg/L	0.015	0.014	JB	0.085	B	0.068	B	0.035	J	0.035	J	0.12		0.067	U	0.067	U	0.067	U
Total Inorganics																				
Arsenic	µg/L	0.04	1	B	1.4		1.1		1.3		1.4		3.5		2.8		2.7		1.6	
Barium	µg/L	450	68		75		90		98		93		95		99		110		97	
Beryllium	µg/L	4	1	U	1	U	1	U	1	U	1	U	0.22	JB	0.19	J	1	U	1	U
Cadmium	µg/L	0.62	0.078	U	0.13	U	0.13	J	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U
Chromium	µg/L	12	0.65	JB	16		63		22		4.3	B	77		32		95		2	U
Cobalt	µg/L	22	2.9		2.7		2.8		2.3		2.1		2.8		4.9		3.3		1.6	
Iron	µg/L	2300	99		130	L	490		460	B	69		2200		660		1600	L	100	
Lead	µg/L	15	1	U	1.1		0.34	J	0.38	J	0.14	J	1.5		0.71	J	1.6		0.21	J
Manganese	µg/L	310	450		430		430		360		290		240		200		220		190	
Mercury	µg/L	0.004	0.478		0.418		0.407	L	0.53		0.532		0.0315		0.67		0.616		0.535	
Nickel	µg/L	260	6.7		20		51		19		7.5		55		25		65		5	
Selenium	µg/L	0.006	1.05		0.965	J	1.39	J	1.97		1.54		1.4		1.28		1.18		0.978	
Thallium	µg/L	0.17	0.053	U	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.29	J	0.15	U	0.15	U
Vanadium	µg/L	0.41	1.6	B	1.2		3.1		2.8		2		7.6		3.9		7		2.5	
Zinc	µg/L	170	10		48		21		9	B	11	B	12		12		11		7.8	
Dissolved Inorganics																				
Arsenic	µg/L	0.04	0.94	JB	--	NA	--	NA	--	NA	--	NA	--	NA	1.9		1.5		--	NA
Barium	µg/L	450	68		--	NA	--	NA	--	NA	--	NA	--	NA	96		90		--	NA
Beryllium	µg/L	4	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	--	NA
Cadmium	µg/L	0.62	0.078	U	--	NA	--	NA	--	NA	--	NA	--	NA	0.22	U	0.22	U	--	NA
Chromium	µg/L	12	0.39	JB	--	NA	--	NA	--	NA	--	NA	--	NA	6.9		6.6		--	NA
Cobalt	µg/L	22	3		--	NA	--	NA	--	NA	--	NA	--	NA	4.5		2.2		--	NA
Iron	µg/L	2300	50	U	57		100		24	JB	50	U	130		81		100		50	U
Lead	µg/L	15	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	1	U	--	NA
Manganese	µg/L	310	460		440		440		350		280		240		200		210		200	
Mercury	µg/L	0.004	0.0323		--	NA	--	NA	--	NA	--	NA	--	NA	0.164		0.0251		--	NA
Nickel	µg/L	260	6.7		--	NA	--	NA	--	NA	--	NA	--	NA	19		18		--	NA
Selenium	µg/L	0.006	1.03		--	NA	--	NA	--	NA	--	NA	--	NA	1.24		1.19		--	NA
Thallium	µg/L	0.17	0.053	U	--	NA	--	NA	--	NA	--	NA	--	NA	0.15	U	0.15	U	--	NA
Vanadium	µg/L	0.41	1.7	B	--	NA	--	NA	--	NA	--	NA	--	NA	1.2		0.99	U	--	NA
Zinc	µg/L	170	8.1	B	--	NA	--	NA	--	NA	--	NA	--	NA	8.7		9.1		--	NA
Conventionals																				
Total Cyanide	µg/L	13	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U

Analyte	BG-1D 11/9/2010 Result	Q	BG-1D 2/23/2011 Result	Q	BG-1D 5/18/2011 Result	Q	BG-1D 8/10/2011 Result	Q	BG-1D 12/8/2011 Result	Q	BG-1D 3/20/2012 Result	Q	BG-1D 5/31/2012 Result	Q	BG-1D 9/6/2012 Result	Q	BG-1D 11/28/2012 Result	Q	BG-1D 2/26/2013 Result	Q	BG-1D 8/27/2013 Result	Q	BG-1D 3/25/2014 Result	Q	BG-1D 8/26/2014 Result	Q
Semivolatile Organic Compounds																										
2,4-Dimethylphenol	0.52	U	0.51	U	2.1	U	2	U	2.1	U	2	U	2	U	0.51	U	0.53	U	0.51	U	0.51	U	0.96	U	0.96	U
2-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.52	UJ	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	UJ	0.96	U	0.96	U
4-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.52	UJ	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	UJ	0.96	U	0.96	U
Dibenzofuran	0.52	U	0.51	U	0.52	U	0.5	U	0.52	U	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	U	0.96	U	0.96	U
Naphthalene	0.52	U	0.51	U	0.52	U	0.5	U	0.5	J	0.51	U	0.51	U	0.51	U	0.53	U	0.51	U	0.51	UJ	0.033	J	0.035	J
Phenol	2.1	U	2	U	2.1	U	2	U	2.1	UJ	2	U	2	U	2	U	2.1	U	2	U	2	UJ	0.96	U	0.96	U
Volatile Organic Compounds																										
Acetone	5	UJ	5	UJ	10	U	5.9	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U	5	U	5	U
Benzene	0.05		0.02	J	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chloroform	1.4		1.2		2.4		1		0.78		0.01	U	0.12	B	0.3		0.14		0.41		0.43		0.17	B	0.1	B
Total Inorganics																										
Arsenic	1.36	J	1.23		0.86	J	1	B	1	U	1	U	0.48	J	0.414		1	U	0.28	J	1	U	1	U	0.32	JB
Barium	140		160		120		150		150		150		160		170		180		170		170	B	170		160	J
Beryllium	0.75	U	0.75	U	0.75	U	0.28	J	0.21	J	0.35	J	0.43	J	0.44	J	0.56	J	0.44	J	0.75	UJ	0.52	J	0.53	J
Cadmium	1	U	1	U	0.2	B	1	U	1	B	1	U	0.14	J	0.23	J	1	U	0.21	J	1	U	0.23	J	0.43	J
Chromium	65	J	150		18	B	4.4		2.9		0.4	J	0.6	J	0.95	J	0.94	J	1	B	10		3.6	B	1.4	J
Cobalt	10	U	3.7	J	2.8	J	3.7	J	5.3	J	5.4	J	4.9	J	7.1	J	5.6	J	6.3	J	10	B	6.9		6.2	J
Iron	21000	J	21000		13000	B	12000		4400		5300		6400		3000		3100		1500		1800		630		1500	J
Lead	5	U	5	U	1.6	J	5	U	5	U	5	U	1.1	J	5	U	5	U	5	U	6.4		0.1	J	0.13	JB
Manganese	1400		1300		890	B	940		770		600		570		600		520		550		560		310		290	J
Mercury	0.0136		0.016		0.042		0.0275		0.0163		0.541		0.775		0.55		0.612		0.125		0.108		0.377		0.743	
Nickel	37		96	J	16		13		21		20		19		25		23	J	26		29	J	25		21	J
Selenium	0.253	J	0.365	J	0.488		0.274	J	0.328		0.755		0.713		0.664		1.06		0.541	J	0.364		0.799		1.19	
Thallium	1.5	U	1.5	B	0.21	B	1.5	U	1.5	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	0.026	JB	0.016	JB
Vanadium	1	U	1	U	1.3	B	1.2		0.88	J	1	U	0.15	J	0.33	J	0.15	J	0.48	J	1	U	6.5	JB	0.16	J
Zinc	25	U	9.9	J	7.8	J	8.7	B	20	J	25	B	13	J	16	J	20	J	25		25	U	22		19	JB
Dissolved Inorganics																										
Arsenic	0.761	J	1.26		0.72	J	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Barium	170		20	J	130		--	NA	150		--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Beryllium	0.75	U	0.75	U	0.75	U	--	NA	0.18	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Cadmium	1	U	1	U	1	U	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Chromium	3.5	J	1	U	1.2	B	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Cobalt	10	U	1.5	J	2.5	J	--	NA	5.2	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Iron	22000	J	3800		13000	B	14000		3700		6300		6200		3100		2300		800		1700		520		1600	J
Lead	5	U	1.6	J	1.7	J	--	NA	5	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Manganese	1600		150		940	B	930		760		670		560		610		510		520		540		290	J	290	J
Mercury	0.0031		0.016		0.0039		--	NA		NA	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Nickel	10	U	10	UJ	6.5	J	--	NA	20		--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Selenium	0.231	J	0.331	J	0.411		--	NA		NA	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Thallium	1.5	U	1.5	B	0.2	B	--	NA	1.5	B	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Vanadium	0.81	J	1	U	1	B	--	NA	1	B	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Zinc	25	U	25	U	25	U	--	NA	19	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Conventionals																										
Total Cyanide	10	U	10	U	20	UJ	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	10	U	10	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	BG-1D 3/31/2015 Result	Q	BG-1D 8/25/2015 Result	Q	BG-1D 3/30/2016 Result	Q	BG-1D 8/30/2016 Result	Q	BG-1D 3/22/2017 Result	Q	BG-1D 8/10/2017 Result	Q	BG-1D 3/20/2018 Result	Q	BG-1D 9/5/2018 Result	Q	BG-1D 3/20/2019 Result	Q	BG-1D 9/17/2019 Result	Q	BG-1D 3/10/2020 Result	Q	BG-1D 9/23/2020 Result	Q	BG-1D 3/23/2021 Result	Q	BG-1D 9/15/2021 Result	Q	MW-8 7/17/2008 Result	Q	MW-8 7/17/2008 Duplicate	Q	MW-8 11/10/2010 Result	Q	MW-8 2/23/2011 Result	Q	MW-8 5/17/2011 Result	Q
Semivolatile Organic Compounds																																								
2,4-Dimethylphenol	µg/L	1	1	U	1	U	0.96	U	1	U	1.9	U	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U	10	U	10	U	0.51	U	0.52	U	0.53	U
2-Methylphenol	µg/L	1	1	U	1	U	0.96	U	1	U	0.93	U	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U	10	U	10	U	0.51	U	0.52	U	0.53	U
4-Methylphenol	µg/L	1	1	U	1	U	0.96	U	1	U	**0.85**	JB	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U	**0.6**	J	**0.8**	J	0.51	U	0.52	U	0.53	U
Dibenzofuran	µg/L	0.86	1	U	1	U	0.96	U	0.097	U	0.13	U	0.12	U	0.073	U	0.068	U	0.073	U	0.07	U	0.068	U	0.068	U	0.07	U	0.18	U	10	U	10	U	0.51	U	0.52	U	0.53	U
Naphthalene	µg/L	1	0.21	U	0.2	U	0.19	U	0.2	U	0.19	U	0.19	U	0.19	U	0.18	U	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	**8.6**	J	**9.7**	J	**10**		0.52	U	**3.2**	
Phenol	µg/L	--	1	U	1	U	0.96	U	1	U	0.93	U	1	U	1	U	0.93	U	1	U	0.96	U	0.93	U	0.93	U	0.96	U	0.93	U	10	U	10	U	2	U	2.1	U	2.1	U
Volatile Organic Compounds																																								
Acetone	µg/L	24	5	U	5	U	5	U	**3.7**	JB	**5.9**	B	**4.7**	J	5	U	5	U	5	U	**8.6**		5	U	5	UJ	5	U	5	U	5	R	5	R	5	UJ	5	UJ	10	U
Benzene	µg/L	0.04	0.02	U	0.02	U	0.02	U	0.02	U	**0.018**	J	**0.017**	J	0.02	U	0.04	U	**0.0079**	JB	**0.0066**	J	0.1	U	0.1	U	0.1	U	0.1	U	1	U	1	U	**0.09**		**0.04**	J	0.02	U
Chloroform	µg/L	0.015	**0.34**		**0.084**		**0.28**		**0.067**	B	**0.082**	B	**0.072**	B	**0.072**	B	**0.062**	B	**0.058**		**0.052**		**1.9**		0.067	U	**0.099**	J	**0.079**	J	5	U	5	U	0.01	U	0.01	U	0.01	U
Total Inorganics																																								
Arsenic	µg/L	0.04	**0.47**	J	**0.85**	J	**0.75**	J	**1.8**		**1.2**		**0.78**	JB	**1.8**		**1.2**		**0.89**	J	**1.1**		**2.3**		**7.4**		**2.4**		**4.2**		2.2	U	2.2	U	**0.515**	J	**0.444**		**0.41**	B
Barium	µg/L	450	**170**		**160**		**170**	B	**170**		**150**		**130**		**150**		**160**		**150**		**180**		**190**		**140**		**170**		**160**		0.1	U	0.1	U	25	U	**24**	J	**20**	J
Beryllium	µg/L	4	**0.45**	JB	**0.61**	J	**0.66**	K	**1**		**0.93**	J	**0.52**	J	**1.1**		**1.2**		**1.1**		**1.3**		**1.3**	B	**1.3**		**1.4**		**1.7**		0.32	U	0.32	U	0.75	U	0.75	U	0.75	U
Cadmium	µg/L	0.62	**0.20**	J	**0.32**	J	**0.17**	J	**0.36**	J	**0.26**	J	**0.15**	J	**0.82**	J	**0.63**	J	**0.53**	J	**0.16**	J	**0.33**	J	**0.75**	J	**0.28**	J	**0.69**	J	0.23	U	0.23	U	1	U	1	U	**0.46**	B
Chromium	µg/L	12	**2.3**	B	**6.4**	B	**2.3**		**4.1**		**2**		**7.5**		**9.9**		**13**		**11**		**7.2**		**20**		**4.6**		**20**		**1.9**	J	1.2	U	1.2	U	1	U	1	U	**1.4**	B
Cobalt	µg/L	22	**7.7**		**10**		**6**		**14**		**10**		**4.7**		**9.5**		**8.9**		**9**		**9**		**9.2**		**8.5**		**9.3**		**7.9**		0.7	U	0.7	U	10	U	**0.37**	J	**0.36**	J
Iron	µg/L	2300	**1000**		**820**		**1500**		**340**		**770**		**990**		**130**	L	**170**		**450**	B	**940**		**390**		**1400**		**310**	L	**420**		**1150**	J	**1230**	J	**1000**		**560**		**450**	B
Lead	µg/L	15	**0.063**	JB	**0.24**	JB	**0.91**	J	**1.7**		**1.1**		**2.2**		**6.5**		**1.1**		**0.71**	J	**0.61**	J	**0.81**	J	**22**		**3.2**		**36**		2.4	U	2.4	U	5	U	5	U	**1.9**	J
Manganese	µg/L	310	**340**		**340**		**440**		**290**		**290**		**340**		**250**		**280**		**230**		**280**		**280**		**240**		**260**		**220**		0.32	U	0.32	U	25	U	**33**		**25**	J
Mercury	µg/L	0.004	**0.085**		**0.803**		**0.514**		**0.148**		**0.299**		**0.243**		**0.375**		**0.183**	L	**0.32**		**0.222**		**0.183**		**0.583**		**0.327**		**0.794**		0.055	U	0.055	U	**0.001**		**0.0033**		**0.0018**	
Nickel	µg/L	260	**26**		**34**		**22**		**34**		**28**		**23**		**40**		**40**		**39**		**35**		**51**		**33**		**44**		**25**		1.1	U	1.1	U	10	U	10	UJ	10	U
Selenium	µg/L	0.006	**2.71**		**1.31**		**0.249**		**1.67**		**1.11**		**1.32**		**1.62**		**1.29**	J	**1.55**		**0.357**		**0.715**		**1.69**		NA		**1.45**		**53.5**		**55.1**		**16.6**	J	**22.7**		**27.5**	
Thallium	µg/L	0.17	**0.072**	JB	**0.023**	JB	**0.015**	JB	0.036	U	0.053	U	0.053	U	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	3.1	U	3.1	U	**1.5**	B	**1.5**	B	**0.31**	B
Vanadium	µg/L	0.41	1	U	**3.1**	B	**1.6**	B	**0.87**	JB	**1**		**1.8**	B	0.9	U	**1.8**		**1.3**		0.99	U	0.99	U	**2**		0.99	U	0.99	U	1	U	1	U	**0.63**	J	**0.58**	J	**0.51**	B
Zinc	µg/L	170	**18**		**51**	J	**22**	B	**61**		**31**		**26**		**100**		**62**		**48**		**35**		**35**		**200**		**43**		**62**		1.3	U	1.3	U	25	U	**16**	J	**10**	J
Dissolved Inorganics																																								
Arsenic	µg/L	0.04	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	-	NA	**6**		--	NA	--	NA	--	NA	--	NA	**0.31**	J	**0.244**	J	**1.4**	B
Barium	µg/L	450	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	-	NA	**140**		--	NA	--	NA	--	NA	--	NA	--	NA	**24**	J	**19**	J
Beryllium	µg/L	4	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	-	NA	**1.2**		--	NA	--	NA	--	NA	--	NA	--	NA	0.75	U	0.75	U
Cadmium	µg/L	0.62	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	-	NA	**0.72**	J	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	**0.45**	B
Chromium	µg/L	12	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	-	NA	2	U	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	**0.89**	B
Cobalt	µg/L	22	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	-	NA	-	NA	-	NA	**8.4**		--	NA	--	NA	--	NA	--	NA	--	NA	**0.71**	J	10	U
Iron	µg/L	2300	**720**		**800**		**1500**		**240**		**680**		**320**		**62**		**85**		**390**	B	**950**		**330**		**300**		**280**		**270**		**816**		**807**		**470**		**150**	J	**140**	B
Lead	µg/L	15	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	**17**		--	NA	--	NA	--	NA	--	NA	--	NA	5	U	5	U
Manganese	µg/L	310	**310**		**340**		**500**		**250**		**290**		**310**		**250**		**290**		**240**		**290**		**270**		**230**		**260**		**220**		0.32	U	0.32	U	25	U	**34**		**23**	J
Mercury	µg/L	0.004	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	**0.0286**		--	NA	--	NA	--	NA	--	NA	**0.0003**	J	**0.001**		**0.0007**	
Nickel	µg/L	260	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	**32**		--	NA	--	NA	--	NA	--	NA	--	NA	10	UJ	10	U
Selenium	µg/L	0.006	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	**1.59**		**1.2**		--	NA	--	NA	--	NA	**13.6**	J	**19.6**		**23.9**	
Thallium	µg/L	0.17	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	0.15	U	--	NA	--	NA	--	NA	--	NA	--	NA	**1.5**	B	**0.31**	B
Vanadium	µg/L	0.41	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	0.99	U	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	**0.15**	B
Zinc	µg/L	170	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	--	NA	--	NA	-	NA	-	NA	**200**		--	NA	--	NA	--	NA	--	NA	--	NA	**12**	J	**9.7**	B
Conventionals																																								
Total Cyanide	µg/L	13	10	U	10	U	10	U	10	U	10	U	**3.6**	J	10	U	10	U	10	U	**5.1**	J	10	U	10	U	10	U	10	U	**11.8**	J	1.7	UJ	2000	U	10	U	20	UJ

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
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NA - Not Analyzed
U - non-detect at reporting limit
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[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8		MW-8	
			5/17/2011		8/10/2011		12/8/2011		3/21/2012		5/31/2012		9/5/2012		11/29/2012		11/29/2012		2/27/2013		2/27/2013		8/27/2013		3/25/2014		8/26/2014		3/31/2015		8/26/2015		8/26/2015		3/29/2016		8/30/2016		3/23/2017		8/11/2017	
		Extent of Plume	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																										
2,4-Dimethylphenol	µg/L	1	0.52	U	2	U	0.3	J	4.6		2.1	U	0.52	U	0.4	J	0.44	J	0.52	U	0.54	U	0.51	U	0.96	U	1	U	1	U	1	U	1	U	1	UJ	1	U	0.7	J	1	U
2-Methylphenol	µg/L	1	0.52	U	0.51	U	0.51	UJ	9		0.52	U	0.52	U	0.53	U	0.56	U	0.52	U	0.54	U	0.51	UJ	0.22	J	1	U	1	U	1	U	1	U	0.25	J	0.26	J	0.96	U	1	U
4-Methylphenol	µg/L	1	0.52	U	0.51	U	0.51	UJ	6.2	B	0.52	U	0.52	U	0.53	U	0.763		0.33	J	0.54	U	0.6	J	0.49	J	0.5	J	0.45	J	1	U	1	U	1.1	J	0.69	J	1.4	JB	0.74	J
Dibenzofuran	µg/L	0.86	0.52	U	0.51	U	0.32	J	0.53	U	0.52	U	0.52	U	0.53	U	0.56	U	0.52	U	0.54	U	0.51	U	0.96	U	1	U	1	U	1	U	1	U	1	UJ	0.1	U	0.13	U	0.12	U
Naphthalene	µg/L	1	3.5		2.3		4.6		5.9		5.6		0.52	U	0.92		0.48	J	5.7		4.9		6.4		1.3		1.3		1.6		0.041	J	0.046	J	1.8	J	1.5		6.2		0.28	
Phenol	µg/L	--	2.1	U	2	U	2	UJ	6.4	B	2.1	U	2.1	U	2.1	U	2.2	U	2.1	U	2.2	U	2	UJ	0.96	U	0.29	J	0.3	J	1	U	1	U	1	J	0.94	J	0.96	U	0.49	J
Volatile Organic Compounds																																										
Acetone	µg/L	24	10	U	5.9	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	5	U	5	U	5	U	5	U	2.7	JB	3.1	JB	5	U	3.8	JB	5	U
Benzene	µg/L	0.04	0.02	U	0.062		0.049		4.3		0.28		0.29		0.11		0.1		0.062		0.06		0.13		0.052		0.11	K	0.034		0.030		0.029		0.17		0.054		0.061		0.049	
Chloroform	µg/L	0.015	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.0093	JB	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.008	U	0.003	U	0.003	U
Total Inorganics																																										
Arsenic	µg/L	0.04	0.98	B	1.2	B	0.49	J	1	U	0.87	J	26.3	U	0.4	J	0.4	J	0.43	J	0.43	J	1	U	0.72	J	2.4	J	0.50	J	1.6	B	1.5	B	1.1		0.73	J	0.41	J	0.57	JB
Barium	µg/L	450	20	J	19	J	20	J	20	J	17	J	17	J	18	J	18	J	18	J	18	J	20	J	17		14	J	20		19		19		21		22		17		19	
Beryllium	µg/L	4	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	UJ	0.75	UJ	0.75	UJ	0.75	U	0.75	U	0.75	UJ	0.038	J	1	UJ	0.061	JB	0.056	JB	0.042	JB	1	U	1	U	1	U	1	UJ
Cadmium	µg/L	0.62	0.46	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	UJ	1	U	1	U	1	U	1	U	0.15	U	0.078	U	0.078	U
Chromium	µg/L	12	1.8	B	2.8		1		1.4		1.6		1.3		1	B	1	B	0.75	J	0.58	J	1	U	2.8	B	0.99	J	3.2	B	9.1	JB	6.7	JB	2.3	LB	0.66	J	1.3	J	1.9	J
Cobalt	µg/L	22	10	U	0.3	B	10	U	10	B	10	U	10	U	10	U	10	U	10	U	10	U	1.7	JB	0.2	J	0.18	J	0.28	JB	0.47	J	0.32	JB	0.33	J	0.22	J	0.5	U	0.18	J
Iron	µg/L	2300	480	B	570		830		1200		750		560		420		380		480		470		560		300		520	J	450		1600		1600		1500	J	980		550		810	
Lead	µg/L	15	5	U	5	U	5	U	1.9	J	1.3	J	5	U	5	U	5	U	5	U	5	U	4.7	J	0.14	J	0.12	JB	0.31	J	0.57	J	0.54	J	0.84	K	0.22	J	1	U	0.86	J
Manganese	µg/L	310	26		17	J	18	J	18	J	25	B	14	J	12	J	13	J	9.3	J	8.5	J	25	B	6.5		4.5	J	6.3		10	B	10	B	16		12		3.9	J	6.2	
Mercury	µg/L	0.004	0.00193		0.0008		0.0014		0.0136		0.0029		0.0039		0.0031		0.00278		0.001		0.00096		0.0007	B	0.00342		0.00338		0.0311		0.0147	J	0.0263	J	0.0055		0.00958		0.00089		0.00106	B
Nickel	µg/L	260	10	U	2.3	J	1	J	3.4	J	0.89	J	10	U	10	U	10	U	10	U	10	U	10	UJ	0.68	J	0.32	J	0.87	J	1.9	B	1.5	B	1.4	K	0.96	J	0.8	J	1.4	
Selenium	µg/L	0.006	29.7		25.5		43.5		37.2		34.6		40.3	J	19.5		19.5		30.4		29.9		34.1		35.1		22.7		26.3		26.4		25.7		26.9		23.7		20		19	
Thallium	µg/L	0.17	0.33	B	1.5	U	1.5	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U	0.016	JB	0.099	JB	0.035	JB	0.50	JB	0.079	JB	1	U	0.036	U	0.053	U	0.053	U
Vanadium	µg/L	0.41	0.63	B	0.51	B	0.99	J	0.84	J	0.44	J	0.55	J	1	B	1	B	0.52	J	0.54	J	1	U	5.6	JB	0.092	J	0.46	JB	11	J	2.1	J	2.1		1.5	B	0.64	J	1.7	B
Zinc	µg/L	170	11	J	9.8	B	16	J	24	J	25	JB	20	J	25	B	25	B	3.9	J	4.1	J	25	U	7.1	B	3.6	JB	8.5	B	9.0	B	12	B	14		22		5	U	5.8	B
Dissolved Inorganics																																										
Arsenic	µg/L	0.04	0.79	B	0.56	B	0.8	J	1	U	0.98	J	26.3	U	0.28	J	0.25	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.8		--	NA	0.33	J	0.46	JB
Barium	µg/L	450	19	J	18	J	19	J	20	J	16	J	18	J	17	J	18	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	18		--	NA	17		19	
Beryllium	µg/L	4	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	UJ	0.75	UJ	0.75	UJ	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	--	NA	1	U	1	UJ
Cadmium	µg/L	0.62	0.47	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	--	NA	0.078	U	0.078	U
Chromium	µg/L	12	0.85	B	0.47	J	0.25	J	1	U	1	U	1	B	1	B	1	B	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1.1	J	--	NA	2	U	0.86	J
Cobalt	µg/L	22	10	U	0.71	B	10	U	10	B	10	U	10	U	10	U	10	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.15	JB	--	NA	0.23	J	0.13	J
Iron	µg/L	2300	70	B	120	J	160	B	190		380		290		160		160		260		280		330		67		380	J	320		1200		1200		520	J	740		480		710	
Lead	µg/L	15	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	--	NA	1	U	1	U
Manganese	µg/L	310	23	J	15	J	16	J	15	J	8.8	J	14	J	12	J	12	J	8.4	J	8.5	J	5.4	J	5.8	J	3.9	J	6.9		8.7		8.8		16		11		3.7	J	6.3	
Mercury	µg/L	0.004	0.00078		0.0004	U	0.0005		0.0029		0.0004	J	0.0012		0.0011		0.00099		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.00113		--	NA	--	NA	0.0003	LB
Nickel	µg/L	260	10	U	10	U	0.61	J	0.96	J	10	U	10	U	10	U	10	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.6	K	--	NA	0.54	J	1.7	
Selenium	µg/L	0.006	24.6		23.8		40.7		33.4		31.9		71.6	U	20.2		18		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	21.4		--	NA	--	NA	15.2	L
Thallium	µg/L	0.17	0.32	B	0.15	B	1.5	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	--	NA	0.053	U	0.053	U
Vanadium	µg/L	0.41	0.23	B	0.12	J	0.31	J	1	U	0.091	J	0.52	J	1	B	1	B	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	0.83	L	--	NA	1.2		1.1	B
Zinc	µg/L	170	9.6	B	12	B	12	J	25	B	25	JB	16	J	5.4	J	5.3	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	1.5	KB	--	NA	5	U	4.7	JB
Conventionals																																										
Total Cyanide	µg/L	13	27	J	20	U	20	U	20	U	20	U	21		20	U	20	U	20	U	20	U	20	U	11		10		6.4	J	10	U	10	U	4.5	J	10		7.5	J	8.5	J

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
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L - result biased low
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D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted] erformed the analyses for:
ury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-8 3/20/2018 Result	Q	MW-8 9/5/2018 Result	Q	MW-8 3/19/2019 Result	Q	MW-8 9/17/2019 Result	Q	MW-8 3/10/2020 Result	Q	MW-8 9/22/2020 Result	Q	MW-8 3/24/2021 Result	Q	MW-8 9/14/2021 Result	Q	MW-8 9/14/2021 Duplicate	Q	MW-17S 7/17/2008 Result	Q	MW-17S 11/9/2010 Result	Q	MW-17S 2/22/2011 Result	Q	MW-17S 5/17/2011 Result	Q	MW-17S 8/10/2011 Result	Q	MW-17S 12/8/2011 Result	Q	MW-17S 3/21/2012 Result	Q	MW-17S 5/30/2012 Result	Q	MW-17S 9/5/2012 Result	Q
Semivolatile Organic Compounds																																						
2,4-Dimethylphenol	µg/L	1	1	U	0.22	J	1	U	1	U	0.13	J	0.93	U	0.93	U	1	U	0.93	U	10	U	0.52	U	0.52	U	0.53	U	2	U	2.1	U	2.1	U	2.1	U	0.51	UJ
2-Methylphenol	µg/L	1	1	U	0.15	J	1	U	1	U	0.96	U	0.93	U	0.33	J	0.32	J	0.31	J	10	U	0.52	U	0.52	U	0.53	U	0.5	U	0.53	U	0.52	U	0.53	U	0.51	UJ
4-Methylphenol	µg/L	1	1	U	1	U	0.82	J	1	U	0.74	J	0.7	J	0.59	J	1		1.1		10	U	0.52	U	0.52	U	0.53	U	0.5	U	0.53	U	0.52	U	0.53	U	0.51	UJ
Dibenzofuran	µg/L	0.86	0.12	J	0.076	U	0.073	U	0.076	U	0.07	U	0.081	J	0.068	U	0.19	U	0.18	U	10	U	0.52	U	0.52	U	0.53	U	0.5	U	0.43	J	0.52	U	0.53	U	0.51	UJ
Naphthalene	µg/L	1	3.5		0.2		2.3		0.063	JB	1.5		0.61		0.18	U	2		1.3		10	U	0.52	U	0.54		0.53	U	0.5	U	1.9		0.52	U	0.53	U	0.51	UJ
Phenol	µg/L	--	1	U	1	U	1	U	0.52	J	0.96	U	0.93	U	0.93	U	0.61	JB	0.48	JB	10	U	2.1	U	2.1	U	2.1	U	2	U	2.1	U	2.1	U	2.1	U	2	UJ
Volatile Organic Compounds																																						
Acetone	µg/L	24	5	U	5	U	5	U	5	U	5	U	5	U	5	UJ	5	U	5	U	5	R	5	UJ	10	UJ	10	U	5.9	U	10	U	10	U	10	UJ	10	U
Benzene	µg/L	0.04	0.057		0.045		0.065		0.044		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	1	U	0.02		0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.022	
Chloroform	µg/L	0.015	0.003	U	0.008	U	0.008	U	0.008	U	0.067	U	0.067	U	0.067	U	0.07	U	0.07	U	5	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Total Inorganics																																						
Arsenic	µg/L	0.04	0.32	U	0.44	J	0.46	J	0.39	J	0.63	J	1.6		1.2		0.31	U	0.36	J	2.2	U	0.548	J	0.557		2.9	J	4.2		0.76	J	1	U	2.1		2.21	
Barium	µg/L	450	19		19		18		23		20		24		22		21		21		0.1	U	25	U	14	J	37		46		8.5	J	13	J	9	J	72	
Beryllium	µg/L	4	1	U	1	U	1	U	1	U	0.21	JB	0.25	J	1	U	1	U	1	U	0.32	U	0.75	U	0.21	J	0.86		3.4		0.75	U	0.75	U	0.4	J	2.2	J
Cadmium	µg/L	0.62	0.13	U	0.13	U	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.23	U	1	U	1	U	0.67	B	0.42	J	1	U	1	U	1	B	0.36	J
Chromium	µg/L	12	0.96	J	2.2	B	3.5		9		3.5		11		12		1.5	J	2	U	1.2	U	9.9	J	35		180	B	180		4.5		4.7		30		160	
Cobalt	µg/L	22	0.14	J	0.14	J	0.092	J	0.24	J	0.27	J	0.24	J	1.3		0.15	J	0.14	J	0.7	U	10	U	1.5	J	18		27		0.43	J	10	B	4.1	J	39	
Iron	µg/L	2300	440	L	340		660		850		750		2400		500		570		500		1210		2700	J	1200		15000	B	30000		640		510		3100		25000	
Lead	µg/L	15	0.21	J	0.21	J	0.2	J	0.23	J	0.34	J	0.77	J	0.4	J	0.29	J	1	U	2.4	U	6.2		1.9	J	34		58		5	U	2.6	J	7.1		61	
Manganese	µg/L	310	8.9		14		4.3	J	5.1		3.9	J	5.8		7.6		7.7		6.2		28.8		110		89		490		610		29		63		83		1200	
Mercury	µg/L	0.004	0.00068		0.00086	LB	0.0003	J	0.00366		0.00273		0.00163		0.0138		0.00064		0.0006		0.055	U	0.041		0.00986	B	0.066		0.0486		0.0142		0.00831		0.0489		0.144	
Nickel	µg/L	260	1.8	B	1.1		2		6.2		2.8		5.5		8		2.9	J	1.1	J	1.1	U	10	U	20		130		140		1.5	J	5.1	J	21		120	
Selenium	µg/L	0.006	26.1		19.9		19.7		13.7		17.4		22.9		23.6		13	J	19.3	J	2.5	U	0.287	J	0.199	J	1.59		0.313	J	0.222		0.132		0.549		1.12	
Thallium	µg/L	0.17	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.41	J	0.35	JB	0.15	U	0.15	U	3.1	U	1.5	U	1.5	B	0.64	B	0.68	B	1.5	B	1.5	U	1.5	B	0.59	J
Vanadium	µg/L	0.41	0.9	U	2.3		0.91	J	0.99	U	0.99	U	1.8		0.99	U	0.99	U	0.99	U	1	U	1.8		1	U	5.2	B	10		3.1		0.37	J	7		16	
Zinc	µg/L	170	2.4	J	9.9	B	3.4	J	6.4	B	4.2	J	5	U	4.3	J	21	J	5	UJ	28.2		49		19	J	280		420	J	14	J	25	B	53		360	
Dissolved Inorganics																																						
Arsenic	µg/L	0.04	--	NA	--	NA	--	NA	--	NA	--	NA	0.31	J	--	NA	--	NA	--	NA	2.2	U	0.784	J	0.4		0.73	B	0.84	B	0.38	J	--	NA	1.4		0.456	
Barium	µg/L	450	--	NA	--	NA	--	NA	--	NA	--	NA	23		--	NA	--	NA	--	NA	0.1	U	25	U	13	J	13	J	12	J	7.9	J	--	NA	25	B	9	J
Beryllium	µg/L	4	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	--	NA	--	NA	--	NA	0.32	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	--	NA	0.75	U	0.75	UJ
Cadmium	µg/L	0.62	--	NA	--	NA	--	NA	--	NA	--	NA	0.22	U	--	NA	--	NA	--	NA	0.23	U	1	U	1	U	0.46	B	1	U	1	U	--	NA	1	B	1	U
Chromium	µg/L	12	--	NA	--	NA	--	NA	--	NA	--	NA	2	U	--	NA	--	NA	--	NA	1.2	U	1	UJ	1	U	3.7	B	1.5		1	U	--	NA	4.6		1	B
Cobalt	µg/L	22	--	NA	--	NA	--	NA	--	NA	--	NA	0.5	U	--	NA	--	NA	--	NA	0.7	U	10	U	10	U	0.64	J	0.83	B	10	U	--	NA	0.36	J	10	U
Iron	µg/L	2300	340		150		480		730		540		260		130	B	380		390		15.8	U	150	UJ	150	U	150	U	110	J	150	U	150	U	130	J	150	B
Lead	µg/L	15	--	NA	--	NA	--	NA	--	NA	--	NA	1	U	--	NA	--	NA	--	NA	2.4	U	5	U	5	U	5	U	5	U	5	U	--	NA	1.3	J	5	U
Manganese	µg/L	310	8		16		3.8	J	4.7	J	3.4	J	3.5	J	6		5.7		6		0.32	U	65		68		98		67		21	J	51		11	J	56	
Mercury	µg/L	0.004	--	NA	--	NA	--	NA	--	NA	--	NA	0.00041	U	--	NA	--	NA	--	NA	0.055	U	0.0142		0.00262		0.00139		0.0022		0.00557		--	NA	0.00952		0.00246	
Nickel	µg/L	260	--	NA	--	NA	--	NA	--	NA	--	NA	0.45	J	--	NA	--	NA	--	NA	1.1	U	10	U	2.6	J	4.5	J	1.8	J	10	U	--	NA	3.1	J	1.9	J
Selenium	µg/L	0.006	--	NA	--	NA	--	NA	--	NA	--	NA	20		--	NA	--	NA	--	NA	2.5	U	0.153	J	0.474	U	0.099		0.716	U	0.2		--	NA	0.105	B	0.716	U
Thallium	µg/L	0.17	--	NA	--	NA	--	NA	--	NA	--	NA	0.19	J	--	NA	--	NA	--	NA	3.1	U	1.5	U	1.5	B	0.45	B	0.49	B	1.5	B	--	NA	1.5	B	0.17	J
Vanadium	µg/L	0.41	--	NA	--	NA	--	NA	--	NA	--	NA	0.99	U	--	NA	--	NA	--	NA	1	U	0.52	J	1	B	0.38	B	0.49	J	1.1		--	NA	4.7		0.95	J
Zinc	µg/L	170	--	NA	--	NA	--	NA	--	NA	--	NA	5	U	--	NA	--	NA	--	NA	1.3	U	25	U	25	U	25	U	11	B	25	B	--	NA	3.5	J	25	B
Conventionals																																						
Total Cyanide	µg/L	13	5.7	J	7.4	JB	8.8	J	11		6.9	JB	7.4	J	8	J	10	U	8.2	J	1.7	UJ	10	U	10	U	20	UJ	20	U	20	U	20	U	20	U	20	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
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[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S		MW-17S	
			11/29/2012		2/27/2013		8/28/2013		3/25/2014		8/26/2014		3/31/2015		8/26/2015		3/30/2016		8/31/2016		3/21/2017		8/10/2017		3/20/2018		9/5/2018		10/30/2018		10/30/2018		3/20/2019		9/18/2019		3/10/2020	
		Extent of Plume	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																						
2,4-Dimethylphenol	µg/L	1	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U	0.96	U	1	U	0.96	U	0.96	U	1.8	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	1	U	1	U	1	U
2-Methylphenol	µg/L	1	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U	0.96	U	1	U	0.96	U	0.96	U	0.89	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	1	U	1	U	1	U
4-Methylphenol	µg/L	1	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U	0.96	U	1	U	0.96	U	0.96	U	1.8	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	1	U	1	U	1	U
Dibenzofuran	µg/L	0.86	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U	0.96	U	1	U	0.96	U	0.093	U	0.12	U	0.11	U	0.068	U	0.068	U	0.068	U	0.068	U	0.073	U	0.073	U	0.073	U
Naphthalene	µg/L	1	0.5	U	0.51	U	0.52	U	0.19	U	0.19	U	0.19	U	0.2	U	0.046	J	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.19	U	0.19	U	0.19	U
Phenol	µg/L	--	2	U	2	U	2.1	U	0.96	U	0.96	U	0.96	U	0.32	J	0.96	U	0.96	U	0.6	J	0.93	U	0.93	U	0.28	JB	0.93	U	0.93	U	1	U	1	U	1	U
Volatile Organic Compounds																																						
Acetone	µg/L	24	10	U	10	U	10	U	5	U	3.1	JB	5	U	4.2	JB	6.3	B	5	U	3.5	JB	5	U	5	U	5.5	B	5	U	5	U	5	U	11	J	5	U
Benzene	µg/L	0.04	0.02	U	0.02	U	0.02	UJ	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.015	JB	0.02	U	0.02	U	0.0087	JB	0.023	JB	0.037	J	0.017	JB	0.023	J	0.1	U
Chloroform	µg/L	0.015	0.076		0.01	U	0.01	U	0.02	U	0.02	U	0.02	U	0.019	J	0.031		0.027	B	0.051	B	0.003	U	0.003	U	0.008	U	3.6		3.8		0.43		0.13		0.12	
Total Inorganics																																						
Arsenic	µg/L	0.04	0.4	J	0.82	J	2.4		0.57	J	0.44	JB	2.8		3.5	B	1.7		0.23	JB	0.57	J	0.43	J	4.2		6		0.53	J	0.64	J	1.4		18		1.9	
Barium	µg/L	450	9.6	J	9.1	J	23	J	11		12	J	18		25		17	B	12		25		11		42		86		29		28		29		220		26	
Beryllium	µg/L	4	0.75	UJ	0.75	U	0.75	UJ	0.29	J	0.14	J	0.76	J	0.63	J	0.46	K	1	U	0.2	J	1	U	1.2		1.5		1	U	0.12	JB	0.25	J	9.8		0.65	JB
Cadmium	µg/L	0.62	1	U	1	U	1	U	1	U	1	UJ	1	U	0.15	JB	1	U	0.15	U	0.15	J	0.078	U	0.2	J	0.35	J	0.13	U	0.13	U	0.13	U	1.9		0.22	U
Chromium	µg/L	12	12		88		51		96		33	J	70		130		310		1.2	J	9.2		1.4	J	55		23		0.74	J	0.73	J	3.8	B	56		5	
Cobalt	µg/L	22	10	U	10	U	11		3.1		1.6	J	9.4		9.9		8.3		0.16	JB	8.9	L	2.2		17		26		1.4		1.3		3.7		110		7.6	
Iron	µg/L	2300	270		1600		6900		2500		1100	J	8500		9300		5100		100		2400		460		15000	L	20000	K	910		930		3700		73000		5700	
Lead	µg/L	15	5	U	1.9	J	22		3.8		2.3	J	15		13		8.5		0.24	J	19		3.9		27		51		2.9		3		7.1		220		12	
Manganese	µg/L	310	28		41		300		71		89	J	210		200		71		5.7		290		55		440		930	L	170		170		230		3500		220	
Mercury	µg/L	0.004	0.00688		0.00544		0.0116		0.0196		0.00834		0.0313		0.00625		0.0131		0.00165		0.0151	J	0.0173		0.0373		0.0187	L	0.00606		0.00557		0.00883		0.256		0.00722	
Nickel	µg/L	260	7.1	J	59		37		52		17	J	41		62		170		0.51	J	17		2.4		44		31		1.2		2.2		5.6		130		10	
Selenium	µg/L	0.006	0.242	U	0.275	J	0.392		0.224	J	0.135	J	3.63		0.125	J	0.108	J	0.127	JB	0.092	U	0.093	J	0.46	U	0.46	U	0.114		0.116		0.089	B	0.176		0.039	J
Thallium	µg/L	0.17	1.5	B	1.5	U	1.5	U	0.2	J	0.31	JB	0.27	JB	0.86	J	0.16	JB	0.085	J	0.16	J	0.13	JB	0.3	J	0.55	J	0.13	JB	0.2	JB	0.45	J	1.8	B	0.33	J
Vanadium	µg/L	0.41	1		4.4		2.7		7.2	J	1	UJ	2.8		8.7		1	U	0.67	JB	1.5		1.8		14		12		1.3		1.1		2.1		30		3.1	
Zinc	µg/L	170	25	B	22	J	81		36		15	JB	97		100		49	B	2.4	JB	75		17		190		520		17		17		52	B	1000		120	
Dissolved Inorganics																																						
Arsenic	µg/L	0.04	0.3	J	0.36	J	1	U	1	U	0.33	JB	0.4	J	2.4		1	U	-	NA	0.24	J	0.31	J	0.32	U	0.36	J	0.35	J	0.36	J	0.38	J	0.69	J	0.31	U
Barium	µg/L	450	8.8	J	25	U	14	J	7.3	J	10	J	5.9	J	16		9.9	J	-	NA	8.3	J	6.9	J	10		20		26		24		27		60		15	
Beryllium	µg/L	4	0.75	UJ	0.75	U	0.75	UJ	1	U	1	UJ	1	U	0.35	JB	1	U	-	NA	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.29	JB	1	U
Cadmium	µg/L	0.62	1	U	1	U	1	U	1	U	1	UJ	1	U	1	U	1	U	-	NA	0.078	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.22	U
Chromium	µg/L	12	1	B	5.4		1	U	5.6	B	2.5	J	2.6	B	54		2.1		-	NA	1.2	J	0.43	J	2	U	2.4	B	2	U	2	U	2.1	B	2	U	2	U
Cobalt	µg/L	22	10	U	10	U	10	U	0.32	J	0.54	J	0.32	JB	5.0		0.62		-	NA	0.55	L	0.18	J	0.35	J	0.78		0.96		0.5		0.74		0.62		0.5	U
Iron	µg/L	2300	150	U	52	J	150	U	16	J	50	UJ	29	JB	4800		12	JB	50	U	130		50	U	14	J	220		50	U	50	U	24	JB	50	U	50	U
Lead	µg/L	15	5	U	5	U	4.1	J	0.034	J	0.037	JB	0.23	J	6.7		0.022	JB	-	NA	0.5	J	1	U	1	U	0.73	JB	0.18	J	0.19	J	1	U	1	U	1	U
Manganese	µg/L	310	20	J	5.6	J	25		12	J	63	J	16		99		42		0.52	JB	6.7		7		31		44		140		150		160		170		15	
Mercury	µg/L	0.004	0.00265		0.00296		0.00174	J	0.00314		0.00095		0.00138		0.00098		0.0006	B	-	NA	0.00158	J	0.00076		0.00126	J	0.00085		0.00076		0.00093		0.00049	B	0.00463		0.00037	J
Nickel	µg/L	260	10	U	2.6	J	10	U	3.6		2.5	J	3.3	B	26		8.2		-	NA	3.3	B	1	U	0.86	JB	0.79	J	0.59	J	0.58	J	0.82	JB	2.3		1	U
Selenium	µg/L	0.006	0.242	U	0.277	J	0.125	J	0.101	U	0.105	U	0.316	U	0.074	U	0.132	J	-	NA	0.092	U	0.092	U	0.46	UJ	0.46	U	0.109		0.121		0.076	B	0.086		0.043	J
Thallium	µg/L	0.17	1.5	B	1.5	U	1.5	U	0.16	J	0.3	JB	0.17	JB	0.33	JB	0.08	JB	-	NA	0.079	J	0.096	JB	0.074	J	0.33	J	0.11	JB	0.15	JB	0.46	J	0.15	U	0.26	J
Vanadium	µg/L	0.41	1	B	1.4		1	U	8.2	J	1.1	J	0.52	JB	6.2		1.6	B	-	NA	0.5	U	1	B	0.9	U	2.4	B	1.2		1		1.2	B	1.1		0.99	U
Zinc	µg/L	170	25	U	25	U	25	U	3	JB	2.2	JB	4.1	JB	55		1.1	JB	-	NA	4.4	J	2.8	JB	5	U	7.5	B	4.5	J	4.6	J	5.2	B	3.6	J	3.8	J
Conventionals																																						
Total Cyanide	µg/L	13	20	U	20	U	20	U	2.9	J	10	U	10	U	10	U	10	U	10	U	10	U	10	U	7	J	3.1	JB	9.2	J	18		5.3	J	11		10	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted]erformed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-17S 9/22/2020 Result	Q	MW-17S 3/23/2021 Result	Q	MW-17S 9/14/2021 Result	Q	MW-17D 7/16/2008 Result	Q	MW-17D 11/11/2010 Result	Q	MW-17D 2/22/2011 Result	Q	MW-17D 5/17/2011 Result	Q	MW-17D 8/9/2011 Result	Q	MW-17D 12/7/2011 Result	Q	MW-17D 3/20/2012 Result	Q	MW-17D 5/30/2012 Result	Q	MW-17D 9/5/2012 Result	Q	MW-17D 11/28/2012 Result	Q	MW-17D 2/26/2013 Result	Q	MW-17D 8/27/2013 Result	Q	MW-17D 3/25/2014 Result	Q	MW-17D 8/26/2014 Result	Q	MW-17D 3/31/2015 Result	Q	MW-17D 8/25/2015 Result	Q
Semivolatile Organic Compounds																																								
2,4-Dimethylphenol	µg/L	1	0.93	U	0.93	U	0.93	U	10	U	0.51	U	0.52	U	0.53	U	2.2	U	0.22	J	2	U	2.1	U	0.51	U	0.54	U	0.51	U	0.53	U	0.93	U	0.96	U	0.93	U	1	U
2-Methylphenol	µg/L	1	0.93	U	0.93	U	0.93	U	10	U	0.51	U	0.52	U	0.53	U	0.54	U	0.28	U	0.51	U	0.53	U	0.51	U	0.54	U	0.51	U	0.53	UJ	0.93	U	0.96	U	0.93	U	1	U
4-Methylphenol	µg/L	1	0.93	U	0.93	U	0.93	U	10	U	0.51	U	0.52	U	0.53	U	0.54	U	0.28	U	0.51	U	0.53	U	0.51	U	0.54	U	0.51	U	0.53	U	0.93	U	0.96	U	0.93	U	1	U
Dibenzofuran	µg/L	0.86	0.068	U	0.068	U	0.18	U	10	U	0.51	U	0.52	U	0.53	U	0.54	U	0.28	U	0.51	U	0.53	U	0.51	U	0.54	U	0.51	U	0.53	U	0.11	J	0.96	U	0.93	U	1	U
Naphthalene	µg/L	1	0.18	U	0.18	U	0.18	U	10	U	0.51	U	0.52	U	0.53	U	0.54	U	0.28	U	0.51	U	0.53	U	0.51	U	0.54	U	0.51	U	0.53	U	0.26		0.19	U	0.027	J	0.2	U
Phenol	µg/L	--	0.93	U	0.93	U	0.93	U	10	U	2	U	2.1	U	0.34	J	2.2	U	0.59	J	2	U	2.1	U	2	U	2.2	U	2	U	2.1	UJ	0.094	J	0.96	U	0.2	J	0.16	J
Volatile Organic Compounds																																								
Acetone	µg/L	24	5	U	5	U	5	U	5	R	5	UJ	10	UJ	11	B	5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U	5	U	5	U	5	U	5	U
Benzene	µg/L	0.04	0.1	U	0.1	U	0.1	U	1	U	0.11		0.16		0.02	U	0.2		0.17		0.087		0.13		0.2		0.16		0.048		0.17		0.085		0.11		0.29		0.28	
Chloroform	µg/L	0.015	0.1	U	0.067	U	0.07	U	5	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.02	U	0.014	JB	0.02	U	0.02	U
Total Inorganics																																								
Arsenic	µg/L	0.04	0.31	U	5.8		2.7		4.7	B	0.773	J	18.7	J	4	B	3.4		4		2.8		1.4		0.82		2.6		1.3		5.4		1.1		1.8	J	1.6		15	
Barium	µg/L	450	18		48		25		41.1	B	500	J	190		230		190		130		67		56		69		81		140		98		150		100	J	76		200	
Beryllium	µg/L	4	1	U	1.4		0.78	J	0.1	U	80		58		1.5		0.35	J	5.1		3.5	J	3.5		7	J	6.4		0.68	J	4.7	J	0.6	J	0.16	J	0.81	J	61	
Cadmium	µg/L	0.62	0.22	U	0.32	J	0.22	U	0.5	U	14		12		0.56	B	0.24	J	1.4		0.55	J	1	B	1.1		0.94	J	0.19	J	1	U	0.16	J	0.12	J	0.30	J	12	
Chromium	µg/L	12	2	U	15		5.7		17.1		380		130		4.8	B	1.7		15		25		8.9		9.1		9		1.4	B	8.3		4.6	B	1.3	J	4.6	B	18	B
Cobalt	µg/L	22	0.5	U	23		8.2		4.6	B	380		80		22		20		37		21		17		39		35		8.3	J	32		13		11	J	8.9		240	
Iron	µg/L	2300	43	J	18000	L	7400		3040		260000		57000		5900	B	1400		19000		14000		11000		20000		18000		850		15000		2100		980	J	2900		16000	
Lead	µg/L	15	0.15	J	36		13		2.5	B	650		130		20		4.5	J	54		30		28		63		57		6.9		54		5		1.5	J	7.0		220	
Manganese	µg/L	310	12		1100		260		603		2800		830		1200		1400		880		480		290		300		340		740		330		1000		780	J	650		1900	
Mercury	µg/L	0.004	0.00196		0.0239		0.0107		0.1	U	0.0503		0.51		0.0207		0.00737		0.0236		0.0282		0.0806		0.19		0.0939		0.0113		0.119		0.0091		0.00605		0.00761		0.494	
Nickel	µg/L	260	0.66	J	30		11		5.5	B	1100		220		46		30		98		57		49		110		100	J	18		87	J	25		16	J	19		600	
Selenium	µg/L	0.006	0.056	JB	0.055	J	0.063		4.8	U	4.23	J	23.2	J	1.4	J	0.722		0.852		0.586		4.8		0.716	U	10.1		1.85		7.25		1.14		0.408		1.62		4.32	
Thallium	µg/L	0.17	0.29	J	0.53	J	0.38	J	4.8	U	150	U	2.5	J	0.35	B	0.31	B	1.5	B	1.5	B	1.5	B	0.31	J	0.23	J	0.21	J	1.5	U	0.2	J	0.22	JB	0.17	JB	2.3	
Vanadium	µg/L	0.41	0.99	U	7		3		1.5	U	130		78	B	3.9	B	1.1		7.9		5.5		5.5		8.7		7.2		0.61	J	6.6		6.8	J	0.4	J	0.95	J	13	
Zinc	µg/L	170	4.2	J	270		96		52		7400		7100		250		85	J	790		610	J	470		710		750		62		520		98		35	JB	81		2700	J
Dissolved Inorganics																																								
Arsenic	µg/L	0.04	-	NA	0.48	J	0.31	U	2.2	U	0.896	J	1.69	J	3.3	B	3.2		2.2		0.8	J	0.34	J	1.94		0.62	J	0.3	J	1	U	0.96	J	1.7	J	0.69	J	7.0	
Barium	µg/L	450	-	NA	19		16		0.1	U	180	J	690		240		180		64		49		46		60	J	69		120		92		140		97	J	74		110	
Beryllium	µg/L	4	-	NA	1	U	1	U	0.32	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	U	0.75	U	0.75	UJ	0.32	J	1	UJ	0.056	JB	10	
Cadmium	µg/L	0.62	-	NA	0.22	U	0.22	U	0.23	U	1	U	0.54	J	2	U	1	U	1	U	1	U	1	B	1	U	1	U	1	U	1	U	0.15	J	1	UJ	1	U	2.3	
Chromium	µg/L	12	-	NA	2	U	2	U	2.8	U	3.5		1	U	0.38	B	0.28	B	1	U	37		0.34	J	3.3	B	1	U	0.27	J	1	U	3.8	B	2	UJ	1.9	JB	12	B
Cobalt	µg/L	22	-	NA	0.19	J	0.5	U	4.6	U	10	U	13	J	12		18		3.9	J	10	B	1.2	J	1.7	J	1.4	J	5.2	J	4.8		12		9.6	J	5.1		49	
Iron	µg/L	2300	50	U	50	U	50	U	2080	J	2600		600	U	150	U	180		150	B	44	J	63	J	150	B	71	J	150	U	28	J	1100		370	J	42	JB	10000	
Lead	µg/L	15	-	NA	1	U	1	U	2.5	U	7.9		5.9	J	2.9	J	1.6	J	2.6	J	5	U	5	U	5	U	1.7	J	1.6	J	5.3		2.6		1	UJ	0.2	JB	90	
Manganese	µg/L	310	7.5		20		6.1		618		95		1400		1200		1400		350		140		110		130		130		640		240		1000	J	730	J	630		790	
Mercury	µg/L	0.004	-	NA	0.00043		0.00041	U	0.055	U	0.0004	J	0.00057		0.00037	J	0.00045		0.00058		0.00199		0.0003	J	0.00048		0.00053		0.00026	J	0.00051	B	0.00034	J	0.0006		0.00025	J	0.0007	
Nickel	µg/L	260	-	NA	1	U	1	U	1.1	U	14		18	J	18		23		7.9	J	3.3	J	1.5	J	2.6	J	3	J	9.9	J	6.7	J	21		13	J	9.6		120	
Selenium	µg/L	0.006	-	NA	0.037	J	0.04	J	2.5	U	1.52	J	0.598	J	1.79	U	0.4	J	0.254		0.222		0.105	U	0.367	J	0.265	J	1.1		0.349	J	0.221	J	0.163	J	0.316	U	0.269	
Thallium	µg/L	0.17	-	NA	0.33	J	0.31	J	3.1	U	1.5	U	3	B	0.44	B	0.27	B	1.5	U	1.5	U	1.5	B	0.19	J	0.081	J	25	B	1.5	U	0.18	J	0.22	JB	0.084	JB	0.63	J
Vanadium	µg/L	0.41	-	NA	0.99	U	0.99	U	1	U	1.5		1	B	0.81	B	0.4	B	1.6		1	U	0.22	J	0.34	J	1	B	0.17	J	1	U	5.8	J	1	UJ	1	U	10	B
Zinc	µg/L	170	-	NA	5	U	4	J	5.8	U	88		31	J	19	B	34	B	21	J	25	B	8	J	17	J	20	J	23	J	25	U	55		19	JB	14	B	620	J
Conventionals																																								
Total Cyanide	µg/L	13	10	U	10	U	10	U	15.9		13		600		140	J	20	U	63		25		20	U	44		51		20	U	47		11		15		10		40	

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
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[redacted] erformed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-17D 3/29/2016 Result	Q	MW-17D 8/31/2016 Result	Q	MW-17D 3/21/2017 Result	Q	MW-17D 8/11/2017 Result	Q	MW-17D 3/20/2018 Result	Q	MW-17D 9/5/2018 Result	Q	MW-17D 10/30/2018 Result	Q	MW-17D 3/19/2019 Result	Q	MW-17D 9/17/2019 Result	Q	MW-17D 3/10/2020 Result	Q	MW-17D 9/22/2020 Result	Q	MW-17D 3/23/2021 Result	Q	MW-17D 9/14/2021 Result	Q	MW-19S 7/17/2008 Result	Q	MW-19S 11/10/2010 Result	Q	MW-19S 2/22/2011 Result	Q	MW-19S 2/22/2011 Duplicate	Q	MW-19S 5/17/2011 Result	Q	MW-19S 8/9/2011 Result	Q
Semivolatile Organic Compounds																																								
2,4-Dimethylphenol	µg/L	1	0.96	U	0.93	U	1.9	U	0.96	U	0.96	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	10	U	0.5	U	0.51	U	0.51	U	0.54	U	2	U
2-Methylphenol	µg/L	1	0.96	U	0.93	U	0.96	U	0.96	U	0.96	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U
4-Methylphenol	µg/L	1	0.96	U	0.22	JB	1.9	U	0.96	U	0.96	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U
Dibenzofuran	µg/L	0.86	0.96	U	0.089	U	0.13	U	0.11	U	0.07	U	0.068	U	0.068	U	0.068	U	0.068	U	0.068	U	0.068	U	0.068	U	0.18	U	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U
Naphthalene	µg/L	1	0.094	J	0.06	J	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U
Phenol	µg/L	--	0.96	U	0.79	JB	0.96	U	0.96	U	0.96	U	0.21	JB	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	0.93	U	10	U	2	U	2	U	2.1	U	2.2	U	2	U
Volatile Organic Compounds																																								
Acetone	µg/L	24	5	U	3.5	JB	81		4.2	JB	5	U	5	U	5	U	5	U	6.1		5	U	5	U	5	U	5	U	5	R	5	UJ	10	UJ	10	UJ	10	U	5.9	U
Benzene	µg/L	0.04	0.048		0.092		0.18	B	0.2		0.43		0.3		0.18	J	0.098	J	0.11		0.13		0.1	U	0.2		0.27		1	U	0.02		0.02		0.02		0.024		0.068	
Chloroform	µg/L	0.015	0.02	U	0.008	U	0.013	JB	0.003	U	0.003	U	0.008	U	13		3.7		0.94		1.1		0.49		2		1.2		5	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Total Inorganics																																								
Arsenic	µg/L	0.04	3.7		1.9		9.7		2	J	31		37		1.8		2.5		11		15		9.1		10		24		2.2	U	0.097	J	0.094	J	0.12	J	0.6	B	0.39	B
Barium	µg/L	450	110		100		110		82		460		460		74		110		200		200		220		180		260		0.1	U	110		100		100		93		100	
Beryllium	µg/L	4	2.6		0.13	J	11		0.58	J	84		80		0.7	J	1.3		12		11		5.4		5.8		15		0.32	U	0.95		0.82		0.8		0.67	J	0.95	
Cadmium	µg/L	0.62	0.5	J	0.15	U	2.1		0.12	J	12		14		0.14	J	0.22	J	2.4		1.6		0.75	J	1.2		2.2		0.23	U	0.88	J	1.1		0.8	J	1.2	B	0.78	J
Chromium	µg/L	12	5.7		1.2	J	12		2.5		100		110		2.4		3.2		6.3	B	7.3		4.9		9		15		1.2	U	1	U	1	U	1	U	0.73	B	0.36	B
Cobalt	µg/L	22	16		12		52	L	3.6		320		270		5.3		6.9		52		43		24		31		65		0.7	U	10	U	1.7	J	1.6	J	1.4	J	2.3	B
Iron	µg/L	2300	7300	J	1300		18000		1200		81000	L	79000		2200		3500		10000		16000		9600		17000	L	30000		15.8	U	150	U	150	U	150	U	150	U	24	J
Lead	µg/L	15	22		1.3		100		4.4		150		350		9		12		95		75		39		51		110		2.4	U	5	U	5	U	5	U	2.1	J	5	U
Manganese	µg/L	310	840		1000		740		1100		3800		3900		100		350		900		820		720		410		850		2830		370		310		300		330		410	
Mercury	µg/L	0.004	0.068		0.00147		0.184	J	0.0718		0.108		0.511	L	0.00854		0.208		0.314		0.09		0.0953		0.137		0.112		5.6		18.1		16.1		16.7		14.3		11.9	
Nickel	µg/L	260	36		16		150		9.6		910		740		13		18		120		120		63		84		170		74.9		39	J	37		36		34		41	
Selenium	µg/L	0.006	1.16		0.207	JB	0.355		0.27	J	0.76	J	0.46	U	0.418		0.518		0.686		0.265		0.443		0.645		0.295		2.5	U	3.55	J	3.75		3.91		4.14		3.52	
Thallium	µg/L	0.17	0.25	J	0.083	J	0.55	J	0.053	U	2.5	J	3.5	J	0.13	JB	0.13	U	0.62	J	0.68	J	0.37	J	0.79	J	0.72	J	3.1	U	1.5	B	1.5	B	1.5	B	0.69	B	0.48	B
Vanadium	µg/L	0.41	2.6		0.53	JB	6.2		1.8	B	40		59		1.7		2.2		6		7.4		4.7		7.8		14		1	U	1	U	1	B	1	B	0.14	B	1	U
Zinc	µg/L	170	180		13	B	860		54		5400		4500		61		100		570		570		330		490		960		99.3		86		86		85		72		80	J
Dissolved Inorganics																																								
Arsenic	µg/L	0.04	2		1.2		1.3		1.8	J	1.4		1.9		1.2		2		2.5		2.3		2.1		0.89	J	1.7		--	NA	0.097	J	--	NA	--	NA	0.5	B	--	NA
Barium	µg/L	450	110		99		100		75		88		120		73		130		160		170		210		160		220		--	NA	--	NA	--	NA	--	NA	88		--	NA
Beryllium	µg/L	4	0.079	JB	1	U	0.15	J	1	UJ	0.069	J	0.095	J	1	U	1	U	1	U	0.37	JB	1	U	1	U	1	U	--	NA	--	NA	--	NA	--	NA	0.6	J	--	NA
Cadmium	µg/L	0.62	1	U	0.15	U	0.078	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.22	U	0.22	U	0.31	J	0.22	U	--	NA	--	NA	--	NA	--	NA	1.1	B	--	NA
Chromium	µg/L	12	1	L	2	U	2	U	0.68	J	2	U	1.5	JB	2	U	2	U	1.5	JB	2	U	2	U	2	U	2	U	--	NA	--	NA	--	NA	--	NA	0.38	B	--	NA
Cobalt	µg/L	22	7.1		11		2.9	L	0.93		1.7		2.3		2		2.3		4.8		4.5		4.4		2.1		4		--	NA	--	NA	--	NA	--	NA	1.3	J	--	NA
Iron	µg/L	2300	340	J	250		160		310		480		93		26	J	170		50	U	50	U	50	U	50	U	47	J	15.8	U	150	U	150	U	150	U	150	U	200	J
Lead	µg/L	15	0.22	KB	1	U	0.92	J	1	U	0.24	J	0.45	J	0.29	J	0.17	J	0.32	J	0.49	J	1	U	0.34	J	1	U	--	NA	--	NA	--	NA	--	NA	2.1	J	--	NA
Manganese	µg/L	310	870		1000		510		1200		830		350		77		430		590		560		610		290		550		2820		320		340		340		320		460	
Mercury	µg/L	0.004	0.00065		0.0004	U	0.00012	J	0.00143	L	0.107	J	0.00158	J	0.00071		0.00715		0.00025	J	0.00051		0.00041	U	0.00045		0.00041	U	--	NA	13.1		--	NA	--	NA		NA	--	NA
Nickel	µg/L	260	11		16		7.9	B	2.3		2.6	B	4.3		3.8		3.6		7.3		8.1		7.2		4.8		7		--	NA	--	NA	--	NA	--	NA	32		--	NA
Selenium	µg/L	0.006	0.274		0.219	J	0.159	J	0.201	L	0.765	J	0.46	U	0.378		0.208		0.471		0.22		0.337		0.263		0.169		--	NA	3.72	J	--	NA	--	NA		NA	--	NA
Thallium	µg/L	0.17	0.078	JB	0.075	J	0.053	U	0.053	U	0.063	U	0.063	U	0.09	JB	0.13	U	0.2	J	0.27	J	0.18	J	0.61	J	0.15	J	--	NA	--	NA	--	NA	--	NA	0.64	B	--	NA
Vanadium	µg/L	0.41	1	UL	0.3	U	0.5	U	1.5	B	0.9	U	1.9	B	1.1		0.9	U	1		0.99	U	0.99	U	0.99	U	0.99	U	--	NA	--	NA	--	NA	--	NA	0.14	B	--	NA
Zinc	µg/L	170	13	BK	3.6	JB	8.5		5.6	B	2.7	J	7.2	B	9.3		6.1		14	B	11		8.2		6.5		5	U	--	NA	--	NA	--	NA	--	NA	69		--	NA
Conventionals																																								
Total Cyanide	µg/L	13	10		9	J	19		13		110		81		5.8	J	12		20		10	U	17		15		17		1.7	UJ	2000	U	10	U	10	U	20	UJ	20	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
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NA - Not Analyzed
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L - result biased low
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[redacted] erformed the analyses for: Arsenic, Mercury, and Selenium.

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-19S 12/7/2011 Result	Q	MW-19S 3/20/2012 Result	Q	MW-19S 5/30/2012 Result	Q	MW-19S 9/5/2012 Result	Q	MW-19S 11/28/2012 Result	Q	MW-19S 2/26/2013 Result	Q	MW-19S 8/27/2013 Result	Q	MW-19S 3/25/2014 Result	Q	MW-19S 3/25/2014 Duplicate	Q	MW-19S 8/26/2014 Result	Q	MW-19S 3/31/2015 Result	Q	MW-19S 8/25/2015 Result	Q	MW-19S 3/30/2016 Result	Q	MW-19S 8/30/2016 Result	Q	MW-19S 3/22/2017 Result	Q	MW-19S 8/10/2017 Result	Q	MW-19S Duplicate Result	Q	MW-19S 3/20/2018 Result	Q	MW-19S 9/5/2018 Result	Q
Semivolatile Organic Compounds																																								
2,4-Dimethylphenol	µg/L	1	2.1	U	2	U	2.1	U	0.52	U	0.51	U	0.51	U	0.51	U	0.96	U	0.93	U	1	U	0.96	UJ	1	UJ	0.96	U	0.96	U	1.9	U	0.96	U	0.93	U	0.93	U	0.93	U
2-Methylphenol	µg/L	1	0.53	U	0.5	U	0.53	U	0.52	U	0.51	U	0.51	U	0.51	UJ	0.96	U	0.93	U	1	U	0.96	U	1	UJ	0.96	U	0.96	U	0.93	U	0.96	U	0.93	U	0.93	U	0.93	U
4-Methylphenol	µg/L	1	0.53	U	0.5	U	0.53	U	0.52	U	0.51	U	0.51	U	0.51	UJ	0.96	U	0.93	U	1	U	0.96	U	1	UJ	0.96	U	0.96	U	1.9	U	0.96	U	0.93	U	0.93	U	0.93	U
Dibenzofuran	µg/L	0.86	0.53	U	0.5	U	0.53	U	0.52	U	0.51	U	0.51	U	0.51	U	0.96	U	0.93	U	1	U	0.96	U	1	UJ	0.96	U	0.093	U	0.13	U	0.11	U	0.11	U	**0.12**	J	0.068	U
Naphthalene	µg/L	1	0.53	U	0.5	U	0.53	U	0.52	U	0.51	U	0.51	U	**0.28**	J	0.19	U	0.19	U	0.2	U	0.19	U	0.2	UJ	0.19	U	0.19	U	0.19	U	0.18	U	0.18	U	0.18	U	0.18	U
Phenol	µg/L	--	2.1	U	2	U	2.1	U	2.1	U	2	U	2	U	2	UJ	0.96	U	0.93	U	**0.13**	J	0.96	U	1	UJ	0.96	U	0.96	U	0.93	U	0.96	U	**0.39**	J	0.93	U	**0.3**	JB
Volatile Organic Compounds																																								
Acetone	µg/L	24	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	**5.4**		5	U
Benzene	µg/L	0.04	**0.045**		**0.37**		**0.066**		**0.073**		**0.33**		**0.024**		0.02	U	**0.03**		**0.028**		**0.084**		**0.025**		**0.23**		**0.059**		**0.05**		**0.057**		**0.033**		**0.032**		**0.042**		**0.021**	JB
Chloroform	µg/L	0.015	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	**0.012**	JB	**0.011**	JB	0.02	U	0.02	U	**0.0088**	JB	**0.011**	J	**0.014**	JB	**0.014**	JB	**0.014**	JB	**0.015**	JB	**0.01**	JB	**0.0082**	JB
Total Inorganics																																								
Arsenic	µg/L	0.04	**0.36**	J	1	U	1	U	**0.074**	J	1	U	**0.19**	J	1	U	**0.53**	J	**0.86**	J	**3.3**	J	**0.83**	J	**1.4**		**0.97**	J	**0.29**	J	**0.3**	J	**0.36**	J	**0.36**	J	0.32	U	**0.41**	J
Barium	µg/L	450	**110**		**100**		**100**		**110**		**110**		**110**		**120**		**100**		**100**		**91**	J	**95**		**100**		**110**	B	**100**		**99**		**110**		**110**		**88**		**100**	
Beryllium	µg/L	4	**0.76**		**0.82**	J	**0.66**	J	**0.97**	J	**0.5**	J	**0.63**	J	**0.75**	B	**0.67**	J	**0.71**	J	**0.62**	J	**0.53**	J	**0.25**	J	**0.59**	K	**0.55**	J	**0.56**	J	**0.56**	J	**0.54**	J	**0.38**	J	**0.39**	J
Cadmium	µg/L	0.62	**0.9**	J	**0.82**	J	**1**	B	**0.84**	J	**0.78**	J	**0.81**	J	1	U	**0.54**	J	**0.55**	J	**0.67**	J	**0.72**	J	**1.1**		**0.67**	J	**0.36**	J	**0.65**	J	**0.56**	J	**0.55**	J	**0.25**	J	**0.51**	J
Chromium	µg/L	12	**0.43**	J	**1.4**		**1**	B	1	U	1	U	**1**	B	1	U	**2.6**	B	**2.6**	B	**0.6**	J	**1.3**	JB	**5.6**	B	**0.61**	J	**1.9**	J	2	U	2	U	2	U	**0.87**	J	**2.3**	B
Cobalt	µg/L	22	**10**	B	**10**	B	**1.6**	J	**2.6**	J	**1.6**	J	10	U	**3.8**		**1.5**		**1.4**		**2.4**	J	**2.9**		**5.0**		**3.9**		**4.5**		**2.9**		**1.7**		**1.7**		**2.1**		**2.5**	
Iron	µg/L	2300	150	U	**150**	B	150	U	150	U	150	U	150	U	150	U	50	U	50	U	50	UJ	50	U	**11**	J	50	U	**90**		**220**		**110**		**100**		**150**	L	**260**	
Lead	µg/L	15	**1.6**	J	5	U	5	U	5	U	5	U	5	U	**3.7**	J	1	U	1	U	1	UJ	1	U	**0.080**	JB	1	U	1	U	**0.34**	J	1	U	1	U	**0.19**	J	**14**	
Manganese	µg/L	310	**390**		**1500**		**460**		**450**		**1100**		**470**		**620**		**350**		**360**		**770**	J	**860**		**1400**		**1500**		**1200**		**750**		**470**		**500**		**920**		**620**	
Mercury	µg/L	0.004	**18.8**		**3.51**		**14.3**		**13.6**		**3.58**		**6.06**		**4.13**	J	**3.36**		**3.02**		**2.28**		**1.85**		**1.98**		**1.24**		**1.23**		**5.85**		**8.61**	J	**6.16**	J	**0.699**		**1.87**	L
Nickel	µg/L	260	**41**		**38**		**39**		**42**		**42**	J	**41**		**42**	J	**33**		**34**		**34**	J	**37**		**50**		**44**		**42**		**47**		**41**		**43**		**33**		**39**	
Selenium	µg/L	0.006	**5.89**		**4.14**		**3.93**		**4.11**		**4.01**		**5.61**		**4.61**		**4.89**		**5.89**		**3.57**		**3.87**		**3.59**		**2.99**		**1.85**		**4.9**		**4.24**		**4.46**		**2.58**		**6.32**	
Thallium	µg/L	0.17	**1.5**	B	**1.5**	B	**1.5**	B	**0.5**	J	**0.59**	J	**0.31**	J	1.5	U	**0.29**	J	**0.27**	J	**0.34**	JB	**0.25**	JB	**0.39**	JB	**0.3**	J	**0.29**	J	**0.13**	JB	**0.25**	JB	**0.24**	JB	**0.082**	J	**0.39**	J
Vanadium	µg/L	0.41	**1**	B	1	U	**1**	B	1	U	1	U	**0.2**	J	1	U	**9.4**	J	**8.1**	J	1	UJ	1	U	**2.2**	B	**1.1**	B	**0.48**	JB	0.5	U	**0.73**	J	**0.71**	J	0.9	U	**2.1**	
Zinc	µg/L	170	**81**		**71**	J	**77**		**83**		**75**		**73**		**63**		**51**		**53**		**51**	JB	**36**		**72**	J	**62**	B	**66**		**75**		**74**		**80**		**30**		**61**	K
Dissolved Inorganics																																								
Arsenic	µg/L	0.04	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Barium	µg/L	450	**100**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Beryllium	µg/L	4	0.75	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Cadmium	µg/L	0.62	**0.69**	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Chromium	µg/L	12	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Cobalt	µg/L	22	**10**	B	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Iron	µg/L	2300	150	U	150	U	150	U	**150**	B	**22**	J	150	U	150	U	50	U	50	U	**7.6**	J	50	U	50	U	50	U	**44**	JB	**33**	J	**32**	J	**32**	J	**56**		**21**	J
Lead	µg/L	15	**1.6**	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Manganese	µg/L	310	**380**		**1600**		**530**		**490**		**1100**		**460**		**610**		**350**	J	**350**	J	**770**	J	**970**		**1600**		**1500**		**1300**		**620**		**440**		**440**		**930**		**610**	
Mercury	µg/L	0.004		NA	--	NA	--	NA	--	NA	--	NA	--	NA	**4.29**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Nickel	µg/L	260	**41**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Selenium	µg/L	0.006		NA	--	NA	--	NA	--	NA	--	NA	--	NA	**4.56**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Thallium	µg/L	0.17	**0.084**	J	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Vanadium	µg/L	0.41	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Zinc	µg/L	170	**81**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Conventionals																																								
Total Cyanide	µg/L	13	20	U	20	U	20	U	20	U	20	U	20	U	20	U	**2.5**	J	**3.1**	J	**4.2**	J	10	U	**7.2**	J	**7.7**	J	**9.6**	J	**4.2**	J	**5.7**	J	**5.5**	J	**5.2**	J	**3.2**	JB

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted]erformed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-19S 3/20/2019 Result	Q	MW-19S 9/17/2019 Result	Q	MW-19S 3/10/2020 Result	Q	MW-19S 9/22/2020 Result	Q	MW-19S Duplicate Result	Q	MW-19S 3/23/2021 Result	Q	MW-19S 9/15/2021 Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	µg/L	1	0.96	U	1	U	0.93	UJ	0.93	U	0.93	U	0.93	U	0.93	U
2-Methylphenol	µg/L	1	0.96	U	1	U	0.93	UJ	0.93	U	0.93	U	0.93	U	0.93	U
4-Methylphenol	µg/L	1	0.96	U	1	U	0.93	UJ	0.93	U	0.93	U	0.93	U	0.93	U
Dibenzofuran	µg/L	0.86	0.073	J	0.073	U	0.068	UJ	0.068	U	0.068	U	0.13	J	0.18	U
Naphthalene	µg/L	1	0.18	U	0.19	U	0.18	UJ	0.18	U	0.18	U	0.18	U	0.18	U
Phenol	µg/L	--	0.96	U	1	U	0.93	UJ	0.93	U	0.93	U	0.93	U	0.93	U
Volatile Organic Compounds																
Acetone	µg/L	24	5	U	5	U	5	U	5	U	5	U	5	U	5	U
Benzene	µg/L	0.04	0.024	JB	0.021	J	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	µg/L	0.015	0.008	U	0.021	J	0.067	U	0.067	U	0.067	U	0.067	U	0.067	U
Total Inorganics																
Arsenic	µg/L	0.04	0.43	J	0.51	J	0.46	J	0.32	J	0.31	J	0.31	U	0.31	U
Barium	µg/L	450	73		74		79		99		98		58		96	
Beryllium	µg/L	4	0.49	J	0.45	J	0.9	J	0.71	J	0.68	J	0.34	J	0.58	J
Cadmium	µg/L	0.62	0.35	J	0.35	J	0.57	J	1.7		1.5		0.5	J	0.38	J
Chromium	µg/L	12	8.7		2.7	B	2	U	2	U	2	U	3.9		2	U
Cobalt	µg/L	22	1.9		1.2		1.2		1.3		1.2		1.2		1.5	
Iron	µg/L	2300	590	B	290		160		170		140		250	L	61	
Lead	µg/L	15	0.22	J	0.48	J	0.33	J	0.45	J	0.37	J	0.29	J	1	U
Manganese	µg/L	310	670		680		500		320		310		520		400	
Mercury	µg/L	0.004	3.11		2.1		0.596		11.1		11.2		0.773		2.33	
Nickel	µg/L	260	27		11		22		36		34		17		31	
Selenium	µg/L	0.006	1.40		0.725		3.08		5.26		5		1.22		4.49	
Thallium	µg/L	0.17	0.2	J	0.23	J	0.44	J	0.54	J	0.52	J	0.15	U	0.4	J
Vanadium	µg/L	0.41	1.6		1		0.99	U	0.99	U	0.99	U	0.99	U	0.99	U
Zinc	µg/L	170	24		29		38		99		88		17		54	
Dissolved Inorganics																
Arsenic	µg/L	0.04	-	NA	0.32	U	-	NA	0.31	U	0.31	U	--	NA	--	NA
Barium	µg/L	450	-	NA	69		-	NA	97		97		--	NA	--	NA
Beryllium	µg/L	4	-	NA	0.41	J	-	NA	0.5	J	0.47	J	--	NA	--	NA
Cadmium	µg/L	0.62	-	NA	0.13	U	-	NA	0.61	J	0.69	J	--	NA	--	NA
Chromium	µg/L	12	-	NA	2	U	-	NA	2	U	2	U	--	NA	--	NA
Cobalt	µg/L	22	-	NA	0.55	B	-	NA	0.99		0.98		--	NA	--	NA
Iron	µg/L	2300	540	B	82		110		50	U	20	J	220		46	J
Lead	µg/L	15	-	NA	1	U	-	NA	1	U	1	U	--	NA	--	NA
Manganese	µg/L	310	660		670		470		300		300		520		390	
Mercury	µg/L	0.004	-	NA	0.341		-	NA	0.729		0.658		--	NA	--	NA
Nickel	µg/L	260	-	NA	1.8		-	NA	32		31		--	NA	--	NA
Selenium	µg/L	0.006	-	NA	0.581		-	NA	4.35		5		--	NA	--	NA
Thallium	µg/L	0.17	-	NA	0.15	U	-	NA	0.36	J	0.36	J	--	NA	--	NA
Vanadium	µg/L	0.41	-	NA	0.99	U	-	NA	0.99	U	0.99	U	--	NA	--	NA
Zinc	µg/L	170	-	NA	13	B	-	NA	77		77		--	NA	--	NA
Conventionals																
Total Cyanide	µg/L	13	5.4	J	8.9	J	10	U	10	U	10	U	10	U	10	R

Analyte	MW-20S 7/17/2008 Result	Q	MW-20S 11/10/2010 Result	Q	MW-20S 2/23/2011 Result	Q	MW-20S 5/18/2011 Result	Q	MW-20S 8/9/2011 Result	Q	MW-20S 12/7/2011 Result	Q	MW-20S 3/20/2012 Result	Q	MW-20S 5/30/2012 Result	Q	MW-20S 9/6/2012 Result	Q	MW-20S 11/28/2012 Result	Q	MW-20S 2/26/2013 Result	Q	MW-20S 8/27/2013 Result	Q
Semivolatile Organic Compounds																								
2,4-Dimethylphenol	3.1	J	0.52	U	0.51	U	0.65	J	0.26	J	0.94	J	1	J	1.5	J	0.51	U	0.51	U	0.51	U	0.51	U
2-Methylphenol	15		0.52	U	0.51	U	1.1		0.77		0.55	UJ	0.53	U	0.5	U	0.26	J	0.51	U	0.51	U	0.51	UJ
4-Methylphenol	0.3	J	0.52	U	0.51	U	0.52	U	0.35	U	0.55	UJ	0.53	U	0.5	U	0.51	U	0.51	U	0.51	U	0.51	UJ
Dibenzofuran	10	U	0.52	U	0.51	U	0.52	U	0.35	U	0.55	U	0.53	U	0.5	U	0.51	U	0.51	U	0.51	U	0.51	U
Naphthalene	9.8	J	0.52	U	1.5		2		0.93		0.55	U	0.29	J	0.42	J	0.53		0.5	J	0.47	J	0.54	
Phenol	10	U	2.1	U	2	U	2.1	U	1.4	U	2.2	UJ	2.1	U	2	U	2	U	2	U	2	U	2	UJ
Volatile Organic Compounds																								
Acetone	5	R	5	UJ	5	UJ	10		5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U
Benzene	29		0.29		3.7	J	4.4		3.9		1.1		0.58		1.5	J	1.7		0.45		1.8		1.7	
Chloroform	5	U	0.02		0.02	B	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.066		0.086		0.01	U	0.01	U
Total Inorganics																								
Arsenic	2.2	U	0.181	J	0.627		0.55	J	6.8		1	U	0.49	J	18		0.191		1.3	U	1.2		1	U
Barium	0.1	U	61		130		180		370		57		76		1100		50		230		87		88	
Beryllium	0.32	U	0.75	U	0.33	J	1.1	J	4		0.75	U	0.34	J	11		0.75	UJ	1	J	0.73	J	0.75	UJ
Cadmium	0.23	U	1	U	1	U	1.2	B	1.1		1	B	1	U	4.2		1	U	0.83	J	0.17	J	1	U
Chromium	1.2	U	880		64		44	B	15		0.44	J	490		190		1	U	65		2.4		1.5	
Cobalt	0.7	U	10	U	2.5	J	20		7.6	J	10	B	10	B	39	J	10	U	8.7	J	10	U	3	
Iron	21300	J	23000		48000		81000	B	69000		14000		23000		240000		5500		83000		28000		21000	
Lead	2.4	U	5	U	9.1		29		81		1.2	J	3.7	J	220		5	U	59		6.5		8.8	
Manganese	1110		330		460		370	B	1200		220		330		2500		230		520		360		300	
Mercury	0.055	U	4.25		0.243		4.13		0.0728		0.0026		0.0223		5.5		0.00326		1.12		0.154		0.0406	
Nickel	1.1	U	440	J	32	J	39		27		10	U	290		130		10	U	27	J	4.6	J	2.2	J
Selenium	2.5	U	8.7	J	2.06		20.7		3.4		0.91		0.596		24.8		0.481		15.1		7.89		1.24	
Thallium	3.1	U	1.5	B	1.5	B	0.31	B	0.53	J	1.5	B	1.5	U	3.4	J	1.5	U	2	U	1.5	U	1.5	U
Vanadium	1	U	1	U	9.4		18	B	13		1	B	1	U	110		1	U	54		2.9		1.8	B
Zinc	61.2		25	U	21	J	88		300	J	25	B	25	B	390		33		140		50		24	J
Dissolved Inorganics																								
Arsenic	--	NA	0.093	J	0.227	J	0.85	J	0.73	B	1	U	0.29	J	0.41	J	--	NA	0.37	J	0.21	J	1	U
Barium	--	NA	66		130		110		94		57		67		100		--	NA	110		72		80	
Beryllium	--	NA	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	--	NA	0.75	U	0.75	U	0.75	UJ
Cadmium	--	NA	1	U	1	U	1	U	1	U	1	U	1	U	1	B	--	NA	1	U	1	U	1	U
Chromium	--	NA	1.2		1	U	0.57	B	0.31	B	1.7		1	U	0.95	J	--	NA	1	U	1	U	1	U
Cobalt	--	NA	10	U	10	U	0.79	J	2.5	B	10	B	10	B	0.74	J	--	NA	1.9	J	10	U	2.8	
Iron	20200		18000		41000		32000	B	21000		15000		17000		22000		4100		41000		22000		22000	
Lead	--	NA	5	U	5	U	1.4	J	1.8	J	1.7	J	5	U	1.3	J	--	NA	5	U	5	U	5	
Manganese	1090		210		500		390	B	560		220		270		470		230		370		280		300	
Mercury	--	NA	0.00683		0.00082		0.00035	J	0.00018	J		NA	0.0017		0.00048		--	NA	0.00016	U	0.00462		0.00039	B
Nickel	--	NA	10	U	10	UJ	10	U	1.4	J	1.3	J	3.4	J	10	U	--	NA	10	U	10	U	1.3	J
Selenium	--	NA	0.743	J	1.06		3.2	J	1.21			NA	0.327	J	0.305	B	--	NA	0.298	J	1.81		0.649	
Thallium	--	NA	0.19	J	1.5	B	0.18	B	1.5	U	1.5	U	1.5	U	1.5	B	--	NA	1.5	U	1.5	U	1.5	U
Vanadium	--	NA	1	U	1	U	0.25	B	1	U	1	U	1	U	0.22	J	--	NA	1	U	1	U	1	U
Zinc	--	NA	25	U	7.5	J	10	J	21	B	25	B	25	B	17	J	--	NA	28	J	19	J	25	U
Conventionals																								
Total Cyanide	25.5	J	59000		10	U	20	UJ	20	U	21		20	U	40		20	U	20	U	20	U	20	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
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B - detected in blank
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[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-20S 3/25/2014 Result	Q	MW-20S 8/26/2014 Result	Q	MW-20S 3/31/2015 Result	Q	MW-20S 8/25/2015 Result	Q	MW-20S 3/29/2016 Result	Q	MW-20S 8/30/2016 Result	Q	MW-20S 3/21/2017 Result	Q	MW-20S 8/10/2017 Result	Q	MW-20S 3/21/2018 Result	Q	MW-20S 10/30/2018 Result	Q	MW-20S 3/19/2019 Result	Q	MW-20S 9/17/2019 Result	Q	MW-20S 3/10/2020 Result	Q	MW-20S 9/22/2020 Result	Q	MW-20S 3/23/2021 Result	Q	MW-20S 9/14/2021 Result	Q	MW-21S 7/15/2008 Result	Q	MW-21S 11/10/2010 Result	Q	MW-21S 11/10/2010 Duplicate	Q
Semivolatile Organic Compounds																																								
2,4-Dimethylphenol	µg/L	1	0.2	J	0.96	U	0.26	J	1	U	0.22	J	0.93	U	2	U	0.19	J	0.23	J	0.15	J	0.29	J	0.14	J	0.66	J	0.93	U	0.36	J	0.93	UJ	10	U	0.5	U	0.5	U
2-Methylphenol	µg/L	1	0.93	U	0.96	U	0.93	U	1	U	0.93	U	0.93	U	1	U	0.93	U	0.2	J	0.93	U	0.96	U	0.96	U	0.93	U	0.93	U	0.93	U	0.93	UJ	10	U	0.5	U	0.5	U
4-Methylphenol	µg/L	1	0.93	U	0.96	U	0.93	U	1	U	0.93	U	0.93	U	2	U	0.93	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.93	U	0.93	U	0.93	UJ	10	U	0.5	U	0.5	U
Dibenzofuran	µg/L	0.86	0.93	U	0.96	U	0.93	U	1	U	0.93	U	0.089	U	0.14	U	0.11	U	0.068	U	0.068	U	0.07	U	0.07	U	0.068	U	0.068	U	0.068	U	0.18	U	10	U	0.5	U	0.5	U
Naphthalene	µg/L	1	0.32		0.23		0.42		0.33		0.31		0.37		0.52		0.35		0.28		0.66		0.72		0.74		2.2		0.34		1.7		0.46	J	10	U	0.5	U	0.5	U
Phenol	µg/L	--	0.93	U	0.96	U	0.26	J	1	U	0.93	U	0.93	U	1	U	0.93	U	0.93	U	0.93	U	0.96	U	0.96	U	0.93	U	0.93	U	0.93	U	0.93	UJ	10	U	2	U	2	U
Volatile Organic Compounds																																								
Acetone	µg/L	24	8.1	J	5.9	B	11		3.5	JB	5.8	B	6.8	B	4.8	JB	13	J	7.3		5	U	5	U	11		5	U	5	U	5	U	5	U	5	R	5	UJ	5	UJ
Benzene	µg/L	0.04	1.3		1.6		1.5		1.8		1.6		1.5		0.87		1.9		1.6		2.7		2.2		1.5		6.7		3.3		9.6		3.6		1	UJ	0.02	U	0.02	U
Chloroform	µg/L	0.015	0.02	U	0.018	JB	0.02	U	0.010	JB	0.02	U	0.016	U	0.003	U	0.0093	JB	0.003	U	0.02	JB	0.18		0.012	J	0.067	U	0.067	U	0.067	U	0.07	U	5	UJ	0.05		0.05	
Total Inorganics																																								
Arsenic	µg/L	0.04	1.9		1.8	J	0.86	J	1.6		3.2		1.3		3		2.4		0.77	JB	1.6		0.47	J	0.95	J	0.7	J	0.44	J	1.1		0.37	J	6.3		1.22	J	1.24	J
Barium	µg/L	450	130		110	J	62		180		200		210		210		210		480		98		60		73		110		89		150		89		56.2	J	25	U	25	U
Beryllium	µg/L	4	1.1		0.83	J	0.066	JB	3.7		1.8		2.5		2.6		3.3	J	0.12	J	0.17	JB	1	U	0.23	J	0.22	JB	1	U	0.18	J	1	U	2.7		0.75	U	0.85	
Cadmium	µg/L	0.62	0.27	J	0.31	J	1	U	0.41	J	0.29	J	0.39	J	0.25	J	0.6	J	0.13	U	0.13	U	0.22	J	0.18	J	0.22	U	0.22	U	0.22	U	0.22	U	0.5	U	1	U	1	U
Chromium	µg/L	12	13		15	J	1.8	JB	7.1	B	8.3		2.3		3.3		3.8		2.3	B	5.6		3.2		4.4	B	2.4		2	U	2.7		1.5	J	8	J	4		4.4	
Cobalt	µg/L	22	2.3		3.2	J	0.11	JB	7.2		2.9		7.8		4.1	L	7.8		0.65		1		0.74		1.8		1.1		0.64		1.4		0.53		3.5	U	10	U	10	U
Iron	µg/L	2300	21000		34000	J	1300		68000		28000	J	68000		42000		76000		26000	L	30000		27000		41000		45000		36000		50000	L	40000		13800		3200		3400	
Lead	µg/L	15	16		16	J	0.30	J	11		16		7.4		23		22		1.7		64		3.6		12		3.6		2.1		5.8		2.2		21		5.6		6.2	
Manganese	µg/L	310	390		290	J	150		1200		750		830		650		730		760		420		420		350		470		350		460		360		330		100		100	
Mercury	µg/L	0.004	0.207		0.188		0.00499		0.501		0.0946		0.8		1.03	J	0.581		0.0063		0.058		0.0217		0.758		0.0171		0.0148		0.0429		0.0131		0.1	U	0.00885		0.0088	
Nickel	µg/L	260	8.1		8.9	J	0.51	J	18		9.2		17		21		24		2.3	B	4.5		3		3.6		2.5		1.4		3.3		1.4		17.7	J	10	U	10	U
Selenium	µg/L	0.006	3.02		1.65		1.04		1.26		0.813		2.09		0.801		0.608		0.506	J	0.771		0.925		0.609		1.31		0.608		1.32		0.62		4.8	U	0.709	J	0.789	J
Thallium	µg/L	0.17	0.11	JB	0.12	JB	1	U	0.024	JB	0.1	JB	0.036	U	0.053	U	0.13	JB	0.13	J	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	4.8	U	1.5	B	1.5	U
Vanadium	µg/L	0.41	12	J	11	J	1	U	7.0		6.3		7.1		5		12		1.7	B	3.6		1.4		3.3		1		0.99	U	1.5		0.99	U	20.2	J	8.5		8.7	
Zinc	µg/L	170	35		33	JB	3.7	JB	110	J	46		61		83		100		36		77		50		27		24		58		31		29		59.8	U	26		25	U
Dissolved Inorganics																																								
Arsenic	µg/L	0.04	1	U	1.1	J	0.98	J	1.3		1.5		0.51	JB	0.7	J	0.84	J	0.34	JB	0.32	U	0.41	J	0.32	U	0.31	U	0.31	U	0.31	U	0.31	U	4.5	U	0.436	J	0.426	J
Barium	µg/L	450	53		64	J	59		100		130		93		56		76		480		85		59		71		110		96		160		100		7.6	J	25	U	25	U
Beryllium	µg/L	4	1	U	1	UJ	0.061	JB	0.51	J	1	U	1	U	1	U	1	UJ	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.1	U	0.75	U	0.75	U
Cadmium	µg/L	0.62	1	U	1	UJ	1	U	0.13	J	1	U	0.15	U	0.078	U	0.078	U	0.13	U	0.13	U	0.13	U	0.13	U	0.22	U	0.22	U	0.22	U	0.22	U	0.5	U	1	U	1	U
Chromium	µg/L	12	2.6	B	2	UJ	1.5	JB	7.3	B	0.96	L	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2.8	U	1	U	1	U
Cobalt	µg/L	22	0.6		0.61	J	0.3	J	2.2		0.57		0.43	J	0.62	L	0.65		0.33	J	0.65		0.7		0.4	JB	0.41	J	0.26	J	0.25	J	0.16	J	3.5	U	10	U	10	U
Iron	µg/L	2300	3900		17000	J	46	JB	30000		33	JB	8400		110		230		17000		25000		26000		35000		44000		37000		48000		40000		347		150	U	150	U
Lead	µg/L	15	1	U	1	UJ	0.11	JB	6.7		0.04	KB	1	U	1	U	1	U	1	U	0.12	J	1	U	1	U	1	U	1	U	1	U	1	U	2.2	U	5	U	5	U
Manganese	µg/L	310	210	J	240	J	140		500		240		270		140		150		770		410		440		360		490		380		520		380		53		25	U	25	U
Mercury	µg/L	0.004	0.00155		0.0008		0.00129		0.00042	U	0.0011		0.00041	U	0.00112	J	0.0123		0.00019	JB	0.00042	U	0.00042	U	0.00058		0.00021	J	0.00042	U	0.00023	J	0.00042	U	0.1	U	0.00059		0.00024	J
Nickel	µg/L	260	0.72	J	0.6	J	0.65	JB	4.6		0.35	K	0.66	J	2.8	B	0.44	J	0.69	JB	1	U	0.94	J	0.59	J	0.44	J	0.54	J	1	U	0.35	J	3.9	U	10	U	10	U
Selenium	µg/L	0.006	0.548		0.441		0.316	U	0.464		0.463		0.454		0.291		0.447		0.46	U	0.712		0.932		0.605		1.22		0.619		1.11		0.563		4.8	U	0.168	J	0.192	J
Thallium	µg/L	0.17	1	U	1	UJ	0.057	JB	0.027	JB	1	U	0.036	U	0.053	U	0.053	U	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	4.8	U	0.21	J	0.2	J
Vanadium	µg/L	0.41	6.7	J	1	UJ	1	U	5.4	B	1	UL	0.3	U	0.5	U	0.55	JB	0.9	U	0.9	U	0.9	U	0.99	U	0.99	U	0.99	U	0.99	U	0.99	U	1.5	U	0.23	J	0.22	J
Zinc	µg/L	170	9.5	B	5	JB	4.2	JB	23	J	1.2	BK	2.4	JB	5	U	5	U	16		12		44		19	B	13		42		12		17		5.8	U	25	U	25	U
Conventionals																																								
Total Cyanide	µg/L	13	2.5	J	10	UJ	10	U	10	U	10	U	10	U	10	U	3.9	J	10	U	10	U	7.5	J	6.2	J	10	U	10	U	10	U	10	U	1.1		2000	U	2000	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted] performed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards	MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S		MW-21S	
			2/22/2011		5/18/2011		8/10/2011		12/6/2011		3/20/2012		5/30/2012		9/5/2012		11/28/2012		2/26/2013		8/27/2013		3/25/2014		8/27/2014		3/31/2015		8/25/2015		3/29/2016		9/1/2016		3/21/2017		8/10/2017	
		Extent of Plume	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																						
2,4-Dimethylphenol	µg/L	1	0.52	U	2.1	U	2.1	U	2	U	2	U	2.1	U	0.51	U	0.51	U	0.51	U	0.5	U	0.96	U	1	U	0.93	U	1	U	1	U	1	U	1.9	U	0.96	U
2-Methylphenol	µg/L	1	0.52	U	0.53	U	0.52	U	0.5	U	0.5	U	0.53	U	0.51	U	0.51	U	0.51	U	0.5	UJ	0.96	U	0.25	J	0.93	U	1	U	1	U	1	U	0.96	U	0.96	U
4-Methylphenol	µg/L	1	0.52	U	0.53	U	0.52	U	0.5	U	0.5	U	0.53	U	0.51	U	0.51	U	0.51	U	0.5	UJ	0.96	U	0.7	J	0.93	U	1	U	1	U	1	U	1.9	U	0.96	U
Dibenzofuran	µg/L	0.86	0.52	U	0.53	U	0.52	U	0.5	U	0.5	U	0.53	U	0.51	U	0.51	U	0.51	U	0.5	U	0.96	U	1	U	0.93	U	1	U	1	U	0.097	U	0.13	U	0.11	U
Naphthalene	µg/L	1	0.52	U	0.53	U	0.52	U	0.5	U	0.5	U	0.53	U	0.51	U	0.51	U	0.51	U	0.5	U	0.19	U	0.062	J	0.19	U	0.2	U	0.2	U	0.041	J	0.19	U	0.18	U
Phenol	µg/L	--	2.1	U	2.1	U	2.1	U	2	U	2	U	2.1	U	2	U	2	U	2	U	2	UJ	0.96	U	1.8		0.93	U	1	U	1	U	1	U	0.96	U	0.96	U
Volatile Organic Compounds																																						
Acetone	µg/L	24	10	UJ	10	U	5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U	5	U	2.7	K	2.8	J	5	U	3.3	JB	2.6	JB	4.2	JB	5	U
Benzene	µg/L	0.04	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.035		0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chloroform	µg/L	0.015	0.13		0.01	U	0.082	B	0.075		0.068	B	0.086		0.01	U	0.01	U	0.01	U	0.41		0.13	B	0.1	B	0.044	B	0.042	B	0.033	B	0.046	B	0.053	B	0.026	B
Total Inorganics																																						
Arsenic	µg/L	0.04	1.64		0.67	J	1.8	B	0.59	J	0.54	J	0.61	J	0.362		1	U	0.34	J	1	U	1	UL	0.94	JB	0.76	J	0.77	J	1.5		0.29	JB	0.33	J	0.58	JB
Barium	µg/L	450	23	J	32		24	J	12	J	11	J	11	J	7.1	J	8	J	7.5	J	25	B	7	L	7.7	J	14		29		34		230		64		61	
Beryllium	µg/L	4	0.96		0.78		0.77		0.75	U	0.35	J	0.29	J	0.75	UJ	0.75	U	0.17	J	0.75	UJ	0.14	L	0.041	J	0.12	JB	1	U	0.24	J	0.64	J	1	U	0.13	J
Cadmium	µg/L	0.62	0.67	J	0.66	B	1	U	0.18	J	1	U	1	B	1	U	1	U	0.28	J	1	U	0.26	L	0.38	J	0.55	J	0.71	J	0.52	J	2.1		1.7		1.3	
Chromium	µg/L	12	2.2		8.4	B	300		4.5		1.3		1.8		1	U	0.37	J	7.5	B	1		16	L	26	J	130		8.8	B	5.4		2	U	0.56	J	5	
Cobalt	µg/L	22	1	J	2.1	B	5		10	B	10	B	0.55	J	1.2	J	10	U	10	U	2.4		0.74	L	0.67	J	1.9		1.4		3		17		2.5	L	2.6	
Iron	µg/L	2300	2500		3200	B	4900		1400		1100		1400		2600		1400		2100		1300		1200	L	880	J	1300		950		4700	J	420		4000		2400	
Lead	µg/L	15	5.5		9		6.9		3.7	J	1.9	J	2.2	J	1.7	J	5	U	5	U	5	U	0.93	L	0.84	JB	1.1		1.1		3.6		0.27	J	34		3	
Manganese	µg/L	310	130		140	B	210		130		130		130		150		160		170		100		120	L	87	J	94		140		330		500		430		330	
Mercury	µg/L	0.004	0.0038	B	0.0145		0.0053		0.0013		0.0025	B	0.0158		0.0043		0.001		0.0008		0.003		0.0018		0.0017		0.0027		0.00168		0.00811		0.0027		0.00748	J	0.0052	
Nickel	µg/L	260	4.1	J	12		200		5.1	J	2.6	J	3.7	J	10	U	10	UJ	10	U	3.1	J	9.7	L	14	J	60		5.5		5.8		24		8.8	B	12	
Selenium	µg/L	0.006	0.509		2.8	J	1.08		0.544		0.129		0.105	U	0.075	J	0.242	U	0.716	U	0.531		0.181	J	0.284	J	0.392		0.091		0.07	J	0.185	B	0.149	J	0.093	J
Thallium	µg/L	0.17	1.5	B	0.35	B	1.5	U	1.5	U	1.5	U	1.5	B	0.1	J	0.1	J	1.5	U	1.5	U	0.022	UL	1	UJ	1	U	0.029	JB	0.097	JB	0.11	J	0.053	U	0.053	U
Vanadium	µg/L	0.41	2.8		4.1	B	1	U	0.63	J	0.8	J	1.3	B	0.56	J	0.49	J	0.66	J	2.5	B	2	JB	0.76	J	1	U	7.9		5.4		0.42	J	0.5	U	2.1	B
Zinc	µg/L	170	20	J	39		22	B	25	B	25	B	12	J	16	J	12	J	6.6	J	20	J	10	BL	4.5	JB	7.2	B	11	JB	22		40		10		17	
Dissolved Inorganics																																						
Arsenic	µg/L	0.04	0.319		0.45	J	0.53	B	1	U	1	U	1	U	0.105		0.18	J	0.16	J	1	U	1	UL	1	JB	0.33	J	0.65	J	0.35	J	-	NA	-	NA	-	NA
Barium	µg/L	450	1.9	J	2.4	J	25	U	25	B	25	B	5.2	J	6.3	J	6.4	J	4.9	J	4.5		5.1	L	5.6	J	11		27		23	B	-	NA	-	NA	-	NA
Beryllium	µg/L	4	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	U	0.75	UJ	0.75	U	0.75	U	0.75	UJ	1	UL	1	UJ	1	U	1	U	1	U	-	NA	-	NA	-	NA
Cadmium	µg/L	0.62	1	U	0.19	B	1	U	1	U	1	U	1	B	1	U	1	U	0.23	J	1	U	1	UL	0.21	J	0.19	J	0.75	J	0.4	J	-	NA	-	NA	-	NA
Chromium	µg/L	12	1	U	0.52	B	1	U	1	U	1	U	0.27	J	1	U	1	B	1	U	1	U	1.8	BL	0.65	J	2.4	B	9.3	B	2	UL	-	NA	-	NA	-	NA
Cobalt	µg/L	22	10	U	1.1	B	0.52	B	10	B	10	B	10	U	10	U	10	U	10	U	1.8		0.78	L	0.62	J	1		1.5		1.9		-	NA	-	NA	-	NA
Iron	µg/L	2300	250		73	B	220		260		330		580		2100		990		1600		120	J	740	L	200	J	180		1100		2500	J	190		3400		2500	
Lead	µg/L	15	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	0.039	BL	0.033	JB	0.088	JB	0.84	J	0.064	KB	-	NA	-	NA	-	NA
Manganese	µg/L	310	38		17	B	37		67		80		92		150		140		150		68		130	J	88	J	89		170		220		490		410		360	
Mercury	µg/L	0.004	0.0002	J	0.0004	U	0.0004	U	0.0003	J	0.0025		0.0014		0.0007		0.0002	U	0.0009		0.0004	B	0.0003	J	0.0001	UJ	0.00015	J	0.00039	J	0.00041	U	-	NA	-	NA	-	NA
Nickel	µg/L	260	10	U	3.9	J	3.1	J	1.1	J	1.6	J	1.2	J	10	U	10	U	10	U	1.6	J	2.2	L	2.5	J	4.5		3.9		3.4		-	NA	-	NA	-	NA
Selenium	µg/L	0.006	0.474	U	3.58	U	0.716	U	0.114		0.093		0.105	U	0.143	U	0.242	U	0.716	U	0.245	J	0.101	U	0.138	J	0.316	U	0.099		0.077	J	-	NA	-	NA	-	NA
Thallium	µg/L	0.17	1.5	B	0.29	B	1.5	UL	1.5	U	1.5	U	1.5	B	0.37	J	1.5	U	1.5	U	1.5	U	1	UL	1	UJ	0.015	JB	0.028	JB	0.066	JB	-	NA	-	NA	-	NA
Vanadium	µg/L	0.41	1	B	0.43	B	1	U	1	U	1	U	1	B	1	U	1	B	0.32	J	1	U	0.56	JB	1	UJ	1	U	1	U	0.15	L	-	NA	-	NA	-	NA
Zinc	µg/L	170	25	U	5.2	J	7.2	B	25	B	25	B	2.8	J	25	B	25	JB	5.6	J	25	U	3.4	BL	3.2	JB	4.2	JB	9.9	J	17	B	-	NA	-	NA	-	NA
Conventionals																																						
Total Cyanide	µg/L	13	10	U	20	UJ	20	U	360		20	U	20	U	20	U	20	U	20	U	20	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
¢ - Indicates exceedance of GW Cleanup Standards - Center of plume
NA - Not Analyzed
U - non-detect at reporting limit
J - quantitative estimate.
B - detected in blank
L - result biased low
K - result biased high
R - result is rejected.
D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted]erformed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 4B "EXTENT OF PLUME" CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Extent of Plume	MW-21S 3/20/2018 Result	Q	MW-21S 9/5/2018 Result	Q	MW-21S 3/19/2019 Result	Q	MW-21S 9/18/2019 Result	Q	MW-21S 9/18/2019 Duplicate	Q	MW-21S 3/10/2020 Result	Q	MW-21S 9/22/2020 Result	Q	MW-21S 3/23/2021 Result	Q	MW-21S 9/15/2021 Result	Q
Semivolatile Organic Compounds																				
2,4-Dimethylphenol	µg/L	1	0.96	U	**0.046**	J	0.96	U	1	U	1	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
2-Methylphenol	µg/L	1	0.96	U	**0.1**	J	0.96	U	1	U	1	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
4-Methylphenol	µg/L	1	0.96	U	0.93	U	0.96	U	1	U	1	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
Dibenzofuran	µg/L	0.86	0.07	U	0.068	U	0.07	U	0.073	U	0.076	U	0.068	U	0.068	UJ	**0.32**	J	0.18	U
Naphthalene	µg/L	1	**0.088**	J	0.18	U	0.18	U	0.19	U	0.2	U	0.18	U	0.18	UJ	**0.094**	J	0.18	U
Phenol	µg/L	--	0.96	U	**0.32**	JB	0.96	U	1	U	1	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
Volatile Organic Compounds																				
Acetone	µg/L	24	5	U	**8**	B	5	U	**3.7**	J	5	U	5	U	5	UJ	5	U	5	U
Benzene	µg/L	0.04	0.02	U	**1.2**		0.04	U	**0.0065**	J	**0.007**	J	0.1	U	0.05	U	0.1	U	0.1	U
Chloroform	µg/L	0.015	**0.082**	B	**0.12**	B	**0.042**		**0.032**	J	**0.028**	J	0.067	U	0.067	U	0.067	U	0.067	U
Total Inorganics																				
Arsenic	µg/L	0.04	**0.36**	J	**0.5**	J	**0.53**	J	**0.45**	J	**0.49**	J	**0.47**	J	**0.7**	J	**4.3**		**2.7**	
Barium	µg/L	450	**56**		**45**		**46**		**30**		**32**		**12**		**39**		**14**		**21**	
Beryllium	µg/L	4	**0.11**	J	**0.093**	J	1	U	1	U	**0.58**	JB	1	U	1	U	**0.29**	J	**0.58**	J
Cadmium	µg/L	0.62	**0.55**	J	**0.48**	J	**0.53**	J	**0.23**	J	**0.29**	J	0.22	U	**0.26**	J	0.22	U	0.22	U
Chromium	µg/L	12	**3**		**2.2**	B	**2.9**		**2.9**	J	**11**	J	**14**		**3.8**		**15**		**9.5**	
Cobalt	µg/L	22	**3.4**		**1.8**		**0.82**		**0.62**		**0.5**		**0.36**	J	**1.5**		**0.87**		**0.95**	
Iron	µg/L	2300	**3200**	L	**4200**		**2400**		**1100**		**1200**		**1000**		**4400**		**11000**	L	**15000**	
Lead	µg/L	15	**0.48**	J	**0.25**	J	**1.5**		**0.36**	J	**0.64**	J	**0.63**	J	**1**		**6**		**7**	
Manganese	µg/L	310	**310**		**270**		**190**		**100**		**99**		**42**		**240**		**29**		**37**	
Mercury	µg/L	0.004	**0.00385**		**0.00502**	L	**0.00084**		**0.0215**		**0.0208**		**0.00476**		**0.00202**		**0.0236**		**0.0311**	
Nickel	µg/L	260	**8**		**4.4**		**3.2**		**5.9**		**6.1**		**9.3**		**4.4**		**4.8**		**4.3**	
Selenium	µg/L	0.006	**0.598**	J	0.46	U	**0.156**		**0.042**	J	**0.094**		**0.054**	J	**0.049**	JB	**0.164**		**0.125**	
Thallium	µg/L	0.17	0.063	U	0.063	U	0.13	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
Vanadium	µg/L	0.41	0.9	U	**2.6**		**1.8**		**1.4**		**1.2**		**1.8**		**2.5**		**30**		**29**	
Zinc	µg/L	170	**8.2**		**14**	B	**9.4**		**8.1**		**9.3**		**3.6**	J	**9.6**		**16**		**24**	
Dissolved Inorganics																				
Arsenic	µg/L	0.04	-	NA	-	NA	0.32	U	-	NA	-	NA	0.31	U	**0.42**	J	**2.7**		0.31	U
Barium	µg/L	450	-	NA	-	NA	**50**		-	NA	-	NA	**10**		**43**		**5.1**	J	**7**	J
Beryllium	µg/L	4	-	NA	-	NA	1	U	-	NA	-	NA	1	U	**0.28**	J	1	U	1	U
Cadmium	µg/L	0.62	-	NA	-	NA	**0.32**	J	-	NA	-	NA	0.22	U	**0.36**	J	0.22	U	0.22	U
Chromium	µg/L	12	-	NA	-	NA	2	U	-	NA	-	NA	2	U	2	U	2	U	2	U
Cobalt	µg/L	22	-	NA	-	NA	**0.83**		-	NA	-	NA	**0.27**	J	**2.3**		0.5	U	0.5	U
Iron	µg/L	2300	**2900**		**4000**		**850**		**1100**		**1100**		**220**		**4200**		**200**		50	U
Lead	µg/L	15	-	NA	-	NA	1	U	-	NA	-	NA	1	U	1	U	**0.15**	J	1	U
Manganese	µg/L	310	**300**		**260**		**230**		**120**		**120**		**43**		**310**		**1.5**	J	**7.4**	
Mercury	µg/L	0.004	-	NA	-	NA	**0.0003**	J	-	NA	-	NA	**0.00067**		**0.00014**	J	**0.00311**		**0.0006**	
Nickel	µg/L	260	-	NA	-	NA	**2.4**		-	NA	-	NA	**7.7**		**3.6**		1	U	**0.46**	J
Selenium	µg/L	0.006	-	NA	-	NA	**0.105**		-	NA	-	NA	**0.056**	J	**0.046**	JB	**0.203**		**0.112**	
Thallium	µg/L	0.17	-	NA	-	NA	0.13	U	-	NA	-	NA	0.15	U	**0.36**	J	**0.45**	J	**0.18**	J
Vanadium	µg/L	0.41	-	NA	-	NA	0.9	U	-	NA	-	NA	0.99	U	0.99	U	**5.7**		**1.4**	
Zinc	µg/L	170	-	NA	-	NA	**5.4**		-	NA	-	NA	5	U	**7.7**		5	U	5	U
Conventionals																				
Total Cyanide	µg/L	13	**4.5**	J	10	U	10	U	10	U	10	U	10	U	10	U	**24**	J	10	U

Notes:

MW-11S and MW-13S samples were suspected to be switched for the 3/26/2014 event, the corrected data is displayed in this table

Bold - Indicates positive detection
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NA - Not Analyzed
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L - result biased low
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D - Initial result was over the calibration limit; result is taken from diluted sample.
[redacted] erformed the analyses for: Arsenic, Mercury, and Selenium.

TABLE 5
BACKGROUND WELL UPPER CONFIDENCE LIMIT OF MEANS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Constituent	COP GWCS (µg/L)	EOP GWCS (µg/L)	BG-1S		BG-1D	
			Suggested UCL	95% UCL of the mean (µg/L)	Suggested UCL	95% UCL of the mean (µg/L)
Arsenic	1	0.04	95% GROS Adjusted Gamma UCL	1.569	95% GROS Adjusted Gamma UCL	2.038
Barium	40	450	95% H-UCL	79.77	95% Student's-t UCL	164.4
Cadmium	--	0.62	Gamma Adjusted KM-UCL	0.305	95% GROS Adjusted Gamma UCL	0.46
Chromium	8	12	95% KM (Chebyshev) UCL	45.8	95% Adjusted Gamma UCL	23.19
Cobalt	--	22	KM H-UCL	3.965	95% KM (t) UCL	8.071
Iron	250	2300	KM H-UCL	1096	95% H-UCL	9374
Lead	15	15	Gamma Adjusted KM-UCL	2.353	95% KM (Chebyshev) UCL	9.876
Manganese	66.8	310	95% Student's-t UCL	318.2	95% Chebyshev (Mean, Sd) UCL	762.5
Mercury	--	0.004	95% Student's-t UCL	0.66	95% Student's-t UCL	0.421
Selenium	0.4	0.006	95% Adjusted Gamma UCL	1.841	95% Student's-t UCL	1.16
Thallium	--	0.17	Gamma Adjusted KM-UCL	0.526	Gamma Adjusted KM-UCL	0.536
Vanadium	--	0.41	95% KM (t) UCL	2.796	95% GROS Adjusted Gamma UCL	1.751

Notes:

COP GWCS exceedance

EOP GWCS exceedance

COP and EOP GWCS exceedance

TABLE 6

PEARSON CORRELATION COEFFICIENT ANALYSIS

2021 Annual Monitored Natural Attenuation Report

Crater Resources Superfund Site, Upper Merion Township, Pennsylvania

	2,4-Dimethylphenol	2-Methylphenol	4-Methylphenol	Dibenzofuran	Naphthalene	Phenol	Acetone	Benzene	Chloroform	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Thallium	Vanadium	Zinc	Total Cyanide
2,4-Dimethylphenol	1.00	0.96	0.95	0.58	0.27	0.88	0.91	0.90	0.00	-0.03	0.91	-0.03	0.02	-0.06	0.20	-0.08	-0.01	0.82	-0.08	-0.07	0.15	0.00	-0.07	-0.04	0.13
2-Methylphenol	0.96	1.00	1.00	0.65	0.25	0.95	0.91	0.90	0.00	-0.04	0.97	-0.03	0.03	-0.05	0.26	-0.08	-0.01	0.84	-0.08	-0.07	0.15	0.02	-0.07	-0.04	0.13
4-Methylphenol	0.95	1.00	1.00	0.66	0.24	0.96	0.90	0.89	0.00	-0.03	0.97	-0.03	0.03	-0.05	0.27	-0.08	-0.01	0.84	-0.08	-0.07	0.15	0.02	-0.06	-0.04	0.12
Dibenzofuran	0.58	0.65	0.66	1.00	0.16	0.74	0.51	0.60	0.05	0.10	0.60	-0.02	0.06	-0.04	0.30	-0.06	-0.03	0.54	-0.07	-0.05	0.10	0.00	-0.04	-0.04	0.02
Naphthalene	0.27	0.25	0.24	0.16	1.00	0.22	0.25	0.27	-0.04	-0.06	0.24	-0.05	0.01	-0.07	0.02	-0.07	-0.05	0.23	-0.10	-0.08	0.28	0.00	-0.01	-0.05	0.02
Phenol	0.88	0.95	0.96	0.74	0.22	1.00	0.85	0.84	0.00	-0.01	0.93	-0.03	0.05	-0.05	0.28	-0.08	-0.02	0.78	-0.08	-0.07	0.13	0.01	-0.06	-0.04	0.11
Acetone	0.91	0.91	0.90	0.51	0.25	0.85	1.00	0.97	0.00	-0.03	0.88	-0.03	0.03	-0.05	0.20	-0.07	-0.01	0.79	-0.07	-0.07	0.15	0.01	-0.06	-0.04	0.12
Benzene	0.90	0.90	0.89	0.60	0.27	0.84	0.97	1.00	-0.01	-0.01	0.86	-0.04	0.05	-0.05	0.24	-0.07	-0.01	0.79	-0.08	-0.07	0.16	0.01	-0.06	-0.04	0.11
Chloroform	0.00	0.00	0.00	0.05	-0.04	0.00	0.00	-0.01	1.00	-0.03	0.01	0.00	-0.04	-0.02	0.00	-0.02	0.00	-0.03	-0.05	0.00	-0.13	-0.02	-0.03	-0.01	-0.02
Arsenic	-0.03	-0.04	-0.03	0.10	-0.06	-0.01	-0.03	-0.01	-0.03	1.00	-0.03	0.18	0.20	-0.03	0.16	0.11	0.13	0.32	-0.11	0.09	0.19	-0.02	0.11	0.13	-0.02
Barium	0.91	0.97	0.97	0.60	0.24	0.93	0.88	0.86	0.01	-0.03	1.00	0.05	0.10	-0.01	0.32	0.05	0.09	0.84	-0.05	0.01	0.13	0.07	0.06	0.03	0.13
Beryllium	-0.03	-0.03	-0.03	-0.02	-0.05	-0.03	-0.03	-0.04	0.00	0.18	0.05	1.00	0.93	0.29	0.79	0.61	0.87	0.06	-0.02	0.85	-0.02	0.62	0.76	0.95	-0.01
Cadmium	0.02	0.03	0.03	0.06	0.01	0.05	0.03	0.05	-0.04	0.20	0.10	0.93	1.00	0.31	0.81	0.59	0.81	0.13	0.05	0.79	0.07	0.58	0.73	0.90	0.01
Chromium	-0.06	-0.05	-0.05	-0.04	-0.07	-0.05	-0.05	-0.05	-0.02	-0.03	-0.01	0.29	0.31	1.00	0.28	0.38	0.35	-0.03	0.03	0.65	-0.07	0.32	0.35	0.30	0.66
Cobalt	0.20	0.26	0.27	0.30	0.02	0.28	0.20	0.24	0.00	0.16	0.32	0.79	0.81	0.28	1.00	0.57	0.84	0.36	-0.05	0.79	0.01	0.69	0.64	0.74	0.00
Iron	-0.08	-0.08	-0.08	-0.06	-0.07	-0.08	-0.07	-0.07	-0.02	0.11	0.05	0.61	0.59	0.38	0.57	1.00	0.81	0.04	0.01	0.64	0.00	0.61	0.87	0.59	0.01
Lead	-0.01	-0.01	-0.01	-0.03	-0.05	-0.02	-0.01	-0.01	0.00	0.13	0.09	0.87	0.81	0.35	0.84	0.81	1.00	0.11	-0.01	0.87	-0.05	0.78	0.84	0.82	-0.01
Manganese	0.82	0.84	0.84	0.54	0.23	0.78	0.79	0.79	-0.03	0.32	0.84	0.06	0.13	-0.03	0.36	0.04	0.11	1.00	-0.10	0.03	0.20	0.09	0.03	0.05	0.11
Mercury	-0.08	-0.08	-0.08	-0.07	-0.10	-0.08	-0.07	-0.08	-0.05	-0.11	-0.05	-0.02	0.05	0.03	-0.05	0.01	-0.01	-0.10	1.00	0.06	-0.09	-0.01	0.01	-0.01	0.06
Nickel	-0.07	-0.07	-0.07	-0.05	-0.08	-0.07	-0.07	-0.07	0.00	0.09	0.01	0.85	0.79	0.65	0.79	0.64	0.87	0.03	0.06	1.00	-0.12	0.73	0.69	0.79	0.24
Selenium	0.15	0.15	0.15	0.10	0.28	0.13	0.15	0.16	-0.13	0.19	0.13	-0.02	0.07	-0.07	0.01	0.00	-0.05	0.20	-0.09	-0.12	1.00	0.00	0.04	0.00	0.03
Thallium	0.00	0.02	0.02	0.00	0.00	0.01	0.01	0.01	-0.02	-0.02	0.07	0.62	0.58	0.32	0.69	0.61	0.78	0.09	-0.01	0.73	0.00	1.00	0.62	0.66	0.00
Vanadium	-0.07	-0.07	-0.06	-0.04	-0.01	-0.06	-0.06	-0.06	-0.03	0.11	0.06	0.76	0.73	0.35	0.64	0.87	0.84	0.03	0.01	0.69	0.04	0.62	1.00	0.77	-0.03
Zinc	-0.04	-0.04	-0.04	-0.04	-0.05	-0.04	-0.04	-0.04	-0.01	0.13	0.03	0.95	0.90	0.30	0.74	0.59	0.82	0.05	-0.01	0.79	0.00	0.66	0.77	1.00	-0.01
Total Cyanide	0.13	0.13	0.12	0.02	0.02	0.11	0.12	0.11	-0.02	-0.02	0.13	-0.01	0.01	0.66	0.00	0.01	-0.01	0.11	0.06	0.24	0.03	0.00	-0.03	-0.01	1.00

Notes

Data collected from 2010-2021 was used for this analysis.

The Pearson correlation coefficient indicates strength of correlation between two variables on a spectrum ranging from -1 to +1

A Pearson correlation coefficient of +1 indicates model positive correlation

A Pearson correlation coefficient of -1 indicates model negative correlation

A Pearson correlation coefficient of 0 indicates no correlation

Color gradient settings are as follows:

+1 = green

0 = white

-1 = red

The Pearson correlation coefficient assumes linear relationships, no significant outliers, and approximate normal distribution.

This analysis was completed for screening purposes and further analysis may be necessary to correct for linearity, outlier removal, or distribution evaluation.

TABLE 7
SUMMARY OF 2021 WILCOXON-MANN-WHITNEY TESTING RESULTS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter 2021 Flags	Number of Well Samples Analyzed	Number of NDs in Well	Well Detects Mean Concentration (ug/l)	Background Well Detects Mean Concentration (ug/L)	Well Detects Standard Deviation	Background Well Detects Standard Deviation	Well Rank Sum W-Stat	WMW Test U-Stat	WMW Critical Value (0.050)	Approximate P-Value	2021 Results of Null Hypothesis (site is ≤ background at 95% Confidence)	Is September 2021 Concentration Greater Than GW Cleanup Standards from ROD?
MW-8 and BG-1S	Arsenic	27	5	0.796	1.206	0.524	0.858	677.5	-1.138	1.645	0.873	NOT REJECTED	NO
	Barium	27	1	19.54	74.3	2.319	15.71	378	-6.324	1.645	1	NOT REJECTED	NO
	Cadmium	27	26	0.46	0.366	N/A	0.369	650	-2.479	1.645	0.993	NOT REJECTED	NO
	Chromium	27	3	3.215	20.27	3.375	33.01	639	-1.803	1.645	0.964	NOT REJECTED	NO
	Cobalt	27	7	0.858	3.388	2.189	2.645	448	-5.503	1.645	1	NOT REJECTED	NO
	Iron	27	0	763	438.6	460.2	560.6	948.5	3.556	1.645	1.88E-04	REJECTED	NO
	Lead	27	8	0.816	1.396	1.091	2.064	662	-1.42	1.645	0.922	NOT REJECTED	NO
	Manganese	27	1	12.27	291.5	7.887	81.37	378	-6.701	1.645	1	NOT REJECTED	NO
	Mercury	27	0	0.00472	0.573	0.00674	0.264	378	-6.315	1.645	1	NOT REJECTED	NO
	Selenium	27	0	25.49	1.564	7.854	0.951	1107	6.298	1.645	1.51E-10	REJECTED	YES
	Thallium	27	16	0.702	0.458	0.65	0.602	734.5	-0.165	1.645	0.566	NOT REJECTED	NO
	Vanadium	27	6	1.651	2.427	2.443	2.1	623.5	-2.079	1.645	0.981	NOT REJECTED	NO
MW-20S and BG-1D	Arsenic	27	3	2.104	1.504	3.669	1.587	765	0.382	1.645	0.351	NOT REJECTED	YES
	Barium	27	0	181.1	159.3	208.6	15.67	654	-1.545	1.645	0.939	NOT REJECTED	NO
	Cadmium	27	12	0.761	0.385	1.014	0.252	713	-0.531	1.645	0.702	NOT REJECTED	NO
	Chromium	27	2	73.16	13.76	196.6	30.05	764	0.363	1.645	0.358	NOT REJECTED	NO
	Cobalt	27	3	6.003	7.369	8.414	2.551	580	-2.858	1.645	0.998	NOT REJECTED	NO
	Iron	27	0	46993	3861	44539	5938	1084	5.901	1.645	1.80E-09	REJECTED	YES
	Lead	27	2	25	4.551	45.71	9.117	926	3.604	1.645	1.57E-04	REJECTED	NO
	Manganese	27	0	570.4	495.6	468.5	318.2	797	0.935	1.645	0.175	NOT REJECTED	YES
	Mercury	27	0	0.736	0.334	1.455	0.263	680.5	-1.081	1.645	0.86	NOT REJECTED	YES
	Selenium	27	0	3.845	0.964	6.372	0.596	862	2.059	1.645	0.0198	REJECTED	YES
	Thallium	27	15	0.78	0.54	1.021	0.722	812.5	1.461	1.645	0.072	NOT REJECTED	NO
	Vanadium	27	6	13.48	1.448	24.9	1.521	936	3.543	1.645	1.98E-04	REJECTED	NO
MW-21S and BG-1S	Arsenic	27	3	0.956	1.206	0.918	0.858	709	-0.59	1.645	0.722	NOT REJECTED	YES
	Barium	27	1	33.47	74.3	43.67	15.71	418	-5.624	1.645	1	NOT REJECTED	NO
	Cadmium	27	9	0.687	0.366	0.527	0.369	912	3.286	1.645	5.09E-04	REJECTED	NO
	Chromium	27	2	23.05	20.27	63.05	33.01	754	0.19	1.645	0.424	NOT REJECTED	NO
	Cobalt	27	3	3.016	3.388	3.94	2.645	619.5	-2.166	1.645	0.985	NOT REJECTED	NO
	Iron	27	0	3083	438.6	3187	560.6	1064	5.556	1.645	1.38E-08	REJECTED	YES
	Lead	27	3	4.107	1.396	6.858	2.064	821	2.183	1.645	0.0145	REJECTED	NO
	Manganese	27	0	177.7	291.5	116.9	81.37	512.5	-3.991	1.645	1	NOT REJECTED	NO
	Mercury	27	0	0.00686	0.573	0.00778	0.264	378	-6.315	1.645	1	NOT REJECTED	YES
	Selenium	27	4	0.392	1.564	0.588	0.951	412	-5.729	1.645	1	NOT REJECTED	YES
	Thallium	27	18	0.587	0.458	0.69	0.602	703.5	-0.779	1.645	0.782	NOT REJECTED	NO
	Vanadium	27	4	4.783	2.427	8.101	2.1	759.5	0.286	1.645	0.387	NOT REJECTED	YES

Notes:
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Reject Null Hypothesis
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TABLE 7
SUMMARY OF 2021 WILCOXON-MANN-WHITNEY TESTING RESULTS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter 2021 Flags	Number of Well Samples Analyzed	Number of NDs in Well	Well Detects Mean Concentration (ug/l)	Background Well Detects Mean Concentration (ug/L)	Well Detects Standard Deviation	Background Well Detects Standard Deviation	Well Rank Sum W-Stat	WMW Test U-Stat	WMW Critical Value (0.050)	Approximate P-Value	2021 Results of Null Hypothesis (site is ≤ background at 95% Confidence)	Is September 2021 Concentration Greater Than GW Cleanup Standards from ROD?
MW-17S and BG-1S	Arsenic	27	2	2.467	1.206	3.556	0.858	850.5	1.865	1.645	0.0311	REJECTED	YES
	Barium	27	1	29.67	74.3	41.68	15.71	421	-5.572	1.645	1	NOT REJECTED	NO
	Cadmium	27	18	0.574	0.366	0.568	0.369	767	0.504	1.645	0.307	NOT REJECTED	NO
	Chromium	27	1	59.51	20.27	76.38	33.01	898.5	2.692	1.645	0.00355	REJECTED	NO
	Cobalt	27	4	14.15	3.388	22.98	2.645	834.5	1.587	1.645	0.0562	NOT REJECTED	NO
	Iron	27	0	8894	438.6	15015	560.6	1023	4.846	1.645	6.31E-07	REJECTED	YES
	Lead	27	2	23.14	1.396	44.3	2.064	949	4.327	1.645	7.56E-06	REJECTED	NO
	Manganese	27	0	369.1	291.5	694.4	81.37	602	-2.441	1.645	0.993	NOT REJECTED	NO
	Mercury	27	0	0.0322	0.573	0.0534	0.264	387	-6.159	1.645	1	NOT REJECTED	YES
	Selenium	27	3	0.421	1.564	0.772	0.951	430.5	-5.408	1.645	1	NOT REJECTED	YES
	Thallium	27	4	0.622	0.458	0.545	0.602	936	3.462	1.645	2.68E-04	REJECTED	YES
	Vanadium	27	4	5.858	2.427	6.723	2.1	845.5	1.779	1.645	0.0376	REJECTED	YES
MW-17D and BG-1D	Arsenic	27	0	6.903	1.504	7.79	1.587	1014	4.684	1.645	1.41E-06	REJECTED	YES
	Barium	27	0	162.3	159.3	108.4	15.67	683.5	-1.033	1.645	0.849	NOT REJECTED	NO
	Cadmium	27	2	2.712	0.385	4.425	0.252	898	2.697	1.645	0.0035	REJECTED	YES
	Chromium	27	0	29.3	13.76	76.03	30.05	818	1.298	1.645	0.0972	NOT REJECTED	YES
	Cobalt	27	0	59.07	7.369	95.53	2.551	1024	4.854	1.645	6.06E-07	REJECTED	YES
	Iron	27	0	23749	3861	50440	5938	959.5	3.746	1.645	8.98E-05	REJECTED	YES
	Lead	27	0	74.06	4.551	127	9.117	1066	5.593	1.645	1.12E-08	REJECTED	YES
	Manganese	27	0	946.3	495.6	791.1	318.2	927.5	3.194	1.645	7.03E-04	REJECTED	YES
	Mercury	27	0	0.113	0.334	0.135	0.263	537.5	-3.555	1.645	1	NOT REJECTED	YES
	Selenium	27	1	2.635	0.964	4.845	0.596	749.5	0.112	1.645	0.455	NOT REJECTED	YES
	Thallium	27	4	0.782	0.54	0.784	0.722	983	4.408	1.645	5.21E-06	REJECTED	YES
	Vanadium	27	0	13.74	1.448	28.04	1.521	1032	5.028	1.645	2.48E-07	REJECTED	YES
MW-19S and BG-1D	Arsenic	27	7	0.596	1.504	0.711	1.587	576.5	-2.927	1.645	0.998	NOT REJECTED	NO
	Barium	27	0	97.59	159.3	13.69	15.67	378.5	-6.342	1.645	1	NOT REJECTED	NO
	Cadmium	27	1	0.73	0.385	0.321	0.252	984.5	4.245	1.645	1.09E-05	REJECTED	NO
	Chromium	27	10	2.118	13.76	2.193	30.05	486.5	-4.457	1.645	1	NOT REJECTED	NO
	Cobalt	27	2	2.908	7.369	2.378	2.551	468	-4.906	1.645	1	NOT REJECTED	NO
	Iron	27	13	181.1	3861	145.6	5938	397.5	-6.03	1.645	1	NOT REJECTED	NO
	Lead	27	15	1.982	4.551	3.935	9.117	620.5	-2.233	1.645	0.987	NOT REJECTED	NO
	Manganese	27	0	679.3	495.6	366.8	318.2	895	2.631	1.645	0.00426	REJECTED	YES
	Mercury	27	0	6.421	0.334	5.963	0.263	1095	6.09	1.645	5.65E-10	REJECTED	YES
	Selenium	27	0	3.786	0.964	1.37	0.596	1075	5.744	1.645	4.63E-09	REJECTED	YES
	Thallium	27	2	0.584	0.54	0.487	0.722	994	4.615	1.645	1.96E-06	REJECTED	YES
	Vanadium	27	14	1.688	1.448	2.4	1.521	697	-0.851	1.645	0.803	NOT REJECTED	NO

Notes:
ug/L - micrograms per liter
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Reject Null Hypothesis
GWCS Exceedance
Reject Null Hypothesis and GWCS Exceedance

TABLE 7
SUMMARY OF 2021 WILCOXON-MANN-WHITNEY TESTING RESULTS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter 2021 Flags	Number of Well Samples Analyzed	Number of NDs in Well	Well Detects Mean Concentration (ug/l)	Background Well Detects Mean Concentration (ug/L)	Well Detects Standard Deviation	Background Well Detects Standard Deviation	Well Rank Sum W-Stat	WMW Test U-Stat	WMW Critical Value (0.050)	Approximate P-Value	2021 Results of Null Hypothesis (site is ≤ background at 95% Confidence)	Is September 2021 Concentration Greater Than GW Cleanup Standards from ROD?
MW-6 and BG-1D	Arsenic	27	0	2.392	1.504	0.456	1.587	1023	4.843	1.645	6.38E-07	REJECTED	YES
	Barium	27	0	120.7	159.3	11.07	15.67	401	-5.97	1.645	1	NOT REJECTED	YES
	Cadmium	27	22	0.316	0.385	0.308	0.252	519.5	-4.248	1.645	1	NOT REJECTED	NO
	Chromium	27	3	3.591	13.76	2.918	30.05	626	-2.026	1.645	0.979	NOT REJECTED	NO
	Cobalt	27	1	2.685	7.369	1.741	2.551	441	-5.389	1.645	1	NOT REJECTED	NO
	Iron	27	0	2911	3861	790.5	5938	884.5	2.45	1.645	0.00714	REJECTED	YES
	Lead	27	2	1.774	4.551	2.179	9.117	786	0.748	1.645	0.227	NOT REJECTED	NO
	Manganese	27	0	944.1	495.6	144.1	318.2	1024	4.857	1.645	5.95E-07	REJECTED	YES
	Mercury	27	0	0.00718	0.334	0.0102	0.263	389	-6.124	1.645	1	NOT REJECTED	NO
	Selenium	27	0	13.1	0.964	3.369	0.596	1107	6.298	1.645	1.50E-10	REJECTED	YES
	Thallium	27	21	0.791	0.54	0.78	0.722	707	-0.831	1.645	0.797	NOT REJECTED	NO
	Vanadium	27	0	5.337	1.448	1.412	1.521	1082	5.899	1.645	1.83E-09	REJECTED	NO
MW-13S and BG-1S	Arsenic	27	5	4.336	1.206	6.696	0.858	851.5	1.895	1.645	0.029	REJECTED	YES
	Barium	27	0	1822	74.3	403.2	15.71	1107	6.304	1.645	1.45E-10	REJECTED	YES
	Cadmium	27	18	1.343	0.366	1.536	0.369	808	1.46	1.645	0.0722	NOT REJECTED	NO
	Chromium	27	4	5.935	20.27	5.653	33.01	715	-0.486	1.645	0.686	NOT REJECTED	NO
	Cobalt	27	0	33.4	3.388	47.51	2.645	1024	4.855	1.645	6.03E-07	REJECTED	NO
	Iron	27	0	1504	438.6	1289	560.6	1007	4.57	1.645	2.44E-06	REJECTED	NO
	Lead	27	10	2.755	1.396	4.861	2.064	632.5	-1.943	1.645	0.974	NOT REJECTED	NO
	Manganese	27	0	6615	291.5	3211	81.37	1107	6.3	1.645	1.49E-10	REJECTED	YES
	Mercury	27	12	0.00616	0.573	0.0101	0.264	379	-6.342	1.645	1	NOT REJECTED	NO
	Selenium	27	0	10.74	1.564	4.761	0.951	1104	6.246	1.645	2.11E-10	REJECTED	YES
	Thallium	27	19	0.628	0.458	0.674	0.602	691	-1.039	1.645	0.851	NOT REJECTED	NO
	Vanadium	27	8	1.652	2.427	1.506	2.1	633.5	-1.92	1.645	0.973	NOT REJECTED	NO

Notes:
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Reject Null Hypothesis
GWCS Exceedance
Reject Null Hypothesis and GWCS Exceedance

TABLE 7
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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter 2021 Flags	Number of Well Samples Analyzed	Number of NDs in Well	Well Detects Mean Concentration (ug/l)	Background Well Detects Mean Concentration (ug/L)	Well Detects Standard Deviation	Background Well Detects Standard Deviation	Well Rank Sum W-Stat	WMW Test U-Stat	WMW Critical Value (0.050)	Approximate P-Value	2021 Results of Null Hypothesis (site is ≤ background at 95% Confidence)	Is September 2021 Concentration Greater Than GW Cleanup Standards from ROD?
MW-11S and BG-1S	Arsenic	27	0	31.11	1.206	16.33	0.858	1107	6.305	1.645	1.44E-10	REJECTED	YES
	Barium	27	0	39.52	74.3	8.959	15.71	384.5	-6.205	1.645	1	NOT REJECTED	NO
	Cadmium	27	23	0.425	0.366	0.397	0.369	689	-1.284	1.645	0.9	NOT REJECTED	NO
	Chromium	27	6	3.286	20.27	2.996	33.01	629	-1.979	1.645	0.976	NOT REJECTED	NO
	Cobalt	27	0	4.352	3.388	3.444	2.645	831.5	1.533	1.645	0.0627	NOT REJECTED	NO
	Iron	27	0	6259	438.6	3081	560.6	1107	6.301	1.645	1.48E-10	REJECTED	YES
	Lead	27	9	1.284	1.396	1.666	2.064	663	-1.403	1.645	0.92	NOT REJECTED	NO
	Manganese	27	0	3204	291.5	726.1	81.37	1107	6.301	1.645	1.48E-10	REJECTED	YES
	Mercury	27	0	0.00288	0.573	0.00312	0.264	378	-6.315	1.645	1	NOT REJECTED	NO
	Selenium	27	0	12.14	1.564	2.618	0.951	1107	6.298	1.645	1.51E-10	REJECTED	YES
	Thallium	27	16	0.623	0.458	0.624	0.602	722	-0.409	1.645	0.659	NOT REJECTED	NO
	Vanadium	27	6	1.242	2.427	0.76	2.1	638.5	-1.818	1.645	0.965	NOT REJECTED	NO
MW-11D and BG-1D	Arsenic	27	2	3.948	1.504	0.834	1.587	1026	4.991	1.645	3.00E-07	REJECTED	YES
	Barium	27	0	25.7	159.3	16.1	15.67	378	-6.336	1.645	1	NOT REJECTED	NO
	Cadmium	27	24	0.727	0.385	0.616	0.252	521	-4.265	1.645	1	NOT REJECTED	NO
	Chromium	27	6	2.645	13.76	3.27	30.05	529.5	-3.698	1.645	1	NOT REJECTED	NO
	Cobalt	27	1	2.677	7.369	2.504	2.551	454.5	-5.296	1.645	1	NOT REJECTED	NO
	Iron	27	0	5230	3861	7180	5938	889.5	2.535	1.645	0.00562	REJECTED	YES
	Lead	27	11	1.983	4.551	3.238	9.117	702.5	-0.821	1.645	0.794	NOT REJECTED	NO
	Manganese	27	0	209	495.6	132.4	318.2	447	-5.125	1.645	1	NOT REJECTED	YES
	Mercury	27	2	0.00531	0.334	0.019	0.263	384	-6.211	1.645	1	NOT REJECTED	NO
	Selenium	27	0	9.283	0.964	5.364	0.596	1107	6.297	1.645	1.52E-10	REJECTED	YES
	Thallium	27	17	0.611	0.54	0.628	0.722	794	1.146	1.645	0.126	NOT REJECTED	NO
	Vanadium	27	13	1.114	1.448	0.981	1.521	687.5	-1.035	1.645	0.85	NOT REJECTED	NO

Notes:
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TABLE 8
HISTORICAL SUMMARY OF WILCOXON-MANN-WHITNEY TESTING RESULTS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter	2012 Null Hypothesis Result	2013 Null Hypothesis Result	2014 Null Hypothesis Result	2015 Null Hypothesis Result	2016 Null Hypothesis Result	2017 Null Hypothesis Result	2018 Null Hypothesis Result	2019 Null Hypothesis Result	2020 Null Hypothesis Result	2021 Null Hypothesis Result
MW-8 and BG-1S	Arsenic	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Barium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Iron	NA	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Lead	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Manganese	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Mercury	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
MW-20S and BG-1D	Arsenic	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED
	Barium	NA	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Iron	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Lead	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Manganese	NA	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Mercury	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
MW-21S and BG-1S	Arsenic	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Barium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED
	Chromium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Iron	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Lead	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED
	Manganese	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Mercury	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Thallium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
MW-17S and BG-1S	Arsenic	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED
	Barium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Cobalt	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Iron	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
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	Manganese	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Mercury	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Thallium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED
	Vanadium	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED

Notes:
NA - WMW analysis not completed
Reject Null Hypothesis

TABLE 8
HISTORICAL SUMMARY OF WILCOXON-MANN-WHITNEY TESTING RESULTS
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter	2012 Null Hypothesis Result	2013 Null Hypothesis Result	2014 Null Hypothesis Result	2015 Null Hypothesis Result	2016 Null Hypothesis Result	2017 Null Hypothesis Result	2018 Null Hypothesis Result	2019 Null Hypothesis Result	2020 Null Hypothesis Result	2021 Null Hypothesis Result
MW-17D and BG-1D	Arsenic	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Barium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Chromium	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Iron	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Lead	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Manganese	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Mercury	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Thallium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED
	Vanadium	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
MW-19S and BG-1D	Arsenic	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Barium	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED
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	Cobalt	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
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	Lead	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Manganese	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Mercury	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Selenium	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED
	Vanadium	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
MW-6 and BG-1D	Arsenic	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Barium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Iron	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED
	Lead	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Manganese	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Mercury	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED

Notes:
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Reject Null Hypothesis

TABLE 8
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2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter	2012 Null Hypothesis Result	2013 Null Hypothesis Result	2014 Null Hypothesis Result	2015 Null Hypothesis Result	2016 Null Hypothesis Result	2017 Null Hypothesis Result	2018 Null Hypothesis Result	2019 Null Hypothesis Result	2020 Null Hypothesis Result	2021 Null Hypothesis Result
MW-13S and BG-1S	Arsenic	NA	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Barium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Cadmium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Iron	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Lead	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Manganese	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Mercury	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
MW-11S and BG-1S	Arsenic	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Barium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
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	Iron	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
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	Manganese	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Mercury	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
MW-11D and BG-1D	Arsenic	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED
	Barium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cadmium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Chromium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Cobalt	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Iron	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Lead	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Manganese	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Mercury	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Selenium	NA	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED
	Thallium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED
	Vanadium	NA	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED	NOT REJECTED

Notes:
NA - WMW analysis not completed
Reject Null Hypothesis

TABLE 9A

MANN-KENDALL TREND TESTING RESULTS - ANALYTE SUMMARY

2021 Annual Monitored Natural Attenuation Report

Crater Resources Superfund Site

Upper Merion Township, Pennsylvania

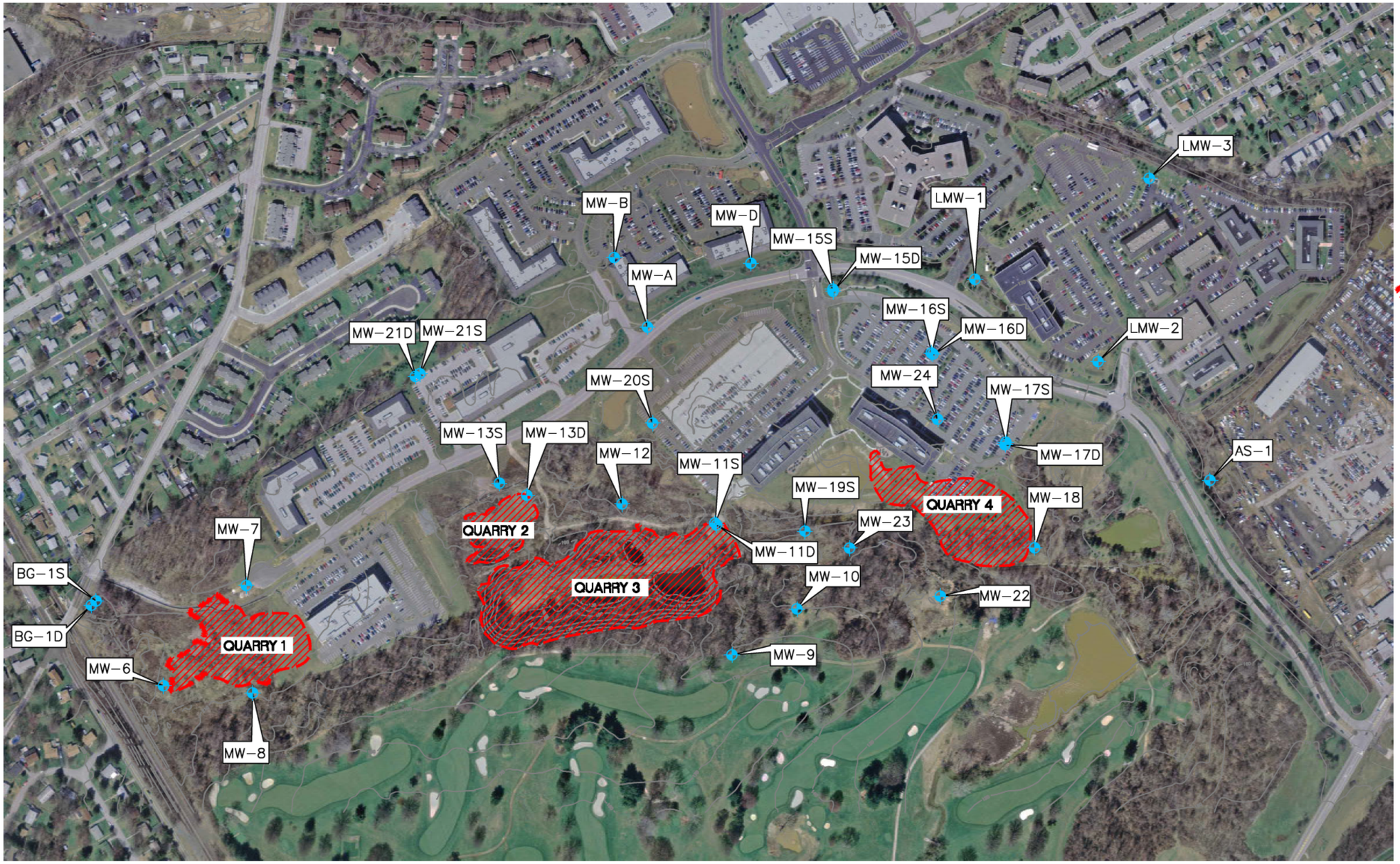
Parameter	Decreasing Trend	No Trend	Increasing Trend
2,4-Dimethyphenol	MW-6, MW-11S, MW-11D, MW-13S		
2-Methylphenol	MW-13S		
4-Methylphenol	MW-13S		
Naphthalene	MW-13S		
Phenol		MW-13S	
Acetone	MW-13S		
Benzene	MW-6, MW-11D, MW-13S		MW-20S
Arsenic	MW-6	MW-11S, MW-11D, MW-13S	BG-1S, BG-1D, MW-17D
Barium	MW-13S	BG-1D	BG-1S
Cadmium		MW-17D	BG-1D
Cobalt		MW-17D	
Chromium			BG-1S
Iron	BG-1D, MW-11D	BG-1S, MW-6, MW-11S, MW-17D, MW-20S, MW-21S	
Lead		MW-17D	BG-1D
Manganese	BG-1S, MW-6, MW-11S, MW-13S	BG-1S, MW-17D, MW-19S	
Mercury	MW-19S	BG-1S	BG-1D
Selenium	MW-6, MW-8, MW-11S, MW-11D, MW-13S, MW-20S	BG-1S, MW-19S	BG-1D
Thallium	BG-1S, MW-19S	MW-17D	
Vanadium		BG-1D, MW-17D	BG-1S
Total Cyanide	MW-6, MW-11S, MW-11D, MW-17D	MW-13S	

TABLE 9B
MANN-KENDALL TREND TESTING RESULTS - WELL SUMMARY
2021 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Well	Parameter	Mean Concentration (ug/L)	Standard Deviation	Coefficient of Variation	Mann-Kendall Test Value (S)	Mann-Kendall Trend (90% Confidence)
BG-1S	Arsenic	1.009	0.878	0.87	189	INCREASE
	Barium	110	15.71	0.211	207	INCREASE
	Chromium	3.2	32.16	1.712	64	INCREASE
	Iron	407	550.5	1.352	10	NO TREND
	Manganese	291.5	81.37	0.279	60	NO TREND
	Mercury	0.573	0.264	0.461	57	NO TREND
	Selenium	1.564	0.951	0.608	-56	NO TREND
	Thallium	0.229	0.467	2.036	-132	DECREASE
	Vanadium	2.111	2.081	0.986	112	INCREASE
BG-1D	Arsenic	1.277	1.506	1.179	144	INCREASE
	Barium	159.3	15.67	0.0984	53	NO TREND
	Cadmium	0.331	0.244	0.739	150	INCREASE
	Iron	3861	5938	1.538	-249	DECREASE
	Lead	3.221	7.868	2.443	176	INCREASE
	Manganese	495.6	318.2	0.642	-289	DECREASE
	Mercury	0.334	0.263	0.787	98	INCREASE
	Selenium	0.964	0.596	0.619	159	INCREASE
	Vanadium	0.967	1.353	1.399	19	NO TREND
MW-6	Benzene	19.07	6.719	0.352	-189	DECREASE
	2,4-Dimethylphenol	8.62	9.562	1.109	-181	DECREASE
	Arsenic	2.392	0.456	0.191	-113	DECREASE
	Iron	2,911	790.5	0.272	58	NO TREND
	Manganese	944.1	144.1	0.153	-162	DECREASE
	Selenium	13.1	3.369	0.257	-181	DECREASE
	Total Cyanide	228.6	101.1	0.442	-86	DECREASE
MW-8	Selenium	25.49	7.854	0.308	-136	DECREASE
MW-11S	2,4-Dimethylphenol	21.41	20.44	0.955	-226	DECREASE
	Arsenic	31.11	16.33	0.525	47	NO TREND
	Iron	6259	3081	0.492	8	NO TREND
	Manganese	3204	726.1	0.227	-243	DECREASE
	Selenium	12.14	2.618	0.216	-91	DECREASE
	Total Cyanide	508.5	119	0.234	-205	DECREASE
MW-11D	Benzene	19.58	8.429	0.431	-257	DECREASE
	2,4-Dimethylphenol	87.67	50.94	0.581	-222	DECREASE
	Arsenic	3.729	1.123	0.301	-7	NO TREND
	Iron	5230	7180	1.373	-244	DECREASE
	Selenium	9.283	5.364	0.578	-267	DECREASE
	Total Cyanide	640.7	247.3	0.386	-189	DECREASE
MW-13S	Benzene	417.4	258.1	0.618	-142	DECREASE
	Naphthalene	193	114	0.591	-177	DECREASE
	Phenol	27222	8354	0.307	-15	NO TREND
	2,4-Dimethylphenol	1391	720.8	0.518	-137	DECREASE
	2-Methylphenol	8048	3055	0.38	-179	DECREASE
	4-Methylphenol	25370	8293	0.327	-193	DECREASE
	Acetone	288	150.8	0.524	-89	DECREASE
	Arsenic	3.607	6.216	1.723	29	NO TREND
	Barium	1822	403.2	0.221	-231	DECREASE
	Manganese	6615	3211	0.485	-271	DECREASE
	Selenium	10.74	4.761	0.443	-191	DECREASE
	Total Cyanide	1692	4289	2.535	11	NO TREND
MW-17D	Arsenic	6.903	7.79	1.128	100	INCREASE
	Cadmium	2.52	4.307	1.71	-14	NO TREND
	Cobalt	59.07	95.53	1.617	-34	NO TREND
	Iron	23749	50440	2.124	-13	NO TREND
	Lead	74.06	127	1.714	4	NO TREND
	Manganese	946.3	791.1	0.836	-21	NO TREND
	Thallium	0.674	0.768	1.138	-10	NO TREND
	Vanadium	13.74	28.04	2.04	-12	NO TREND
	Total Cyanide	50.99	114.1	2.237	-123	DECREASE
MW-19S	Manganese	679.3	366.8	0.54	58	NO TREND
	Mercury	6.421	5.963	0.929	-190	DECREASE
	Selenium	3.786	1.37	0.362	-50	NO TREND
	Thallium	0.547	0.487	0.891	-155	DECREASE
MW-20S	Benzene	2.385	2.005	0.841	98	INCREASE
	Iron	46993	44539	0.948	23	NO TREND
	Selenium	3.845	6.372	1.657	-132	DECREASE
MW-21S	Iron	3083	3187	1.034	22	NO TREND

Notes:
ug/L - micrograms per liter
NA - Not Applicable
Mann Kendall Trend Testing was not completed on well MW-17S due to the second semiannual 2021 organic results being non-detect and the inorganic results either bring non-detect, detected below GWCS, or GWCS exceedances below background concentrations.

FIGURES



N

LEGEND

APPROXIMATE QUARRY BOUNDARIES FROM 1959 AS DEPICTED IN THE RI REPORT

MONITORING WELL LOCATION

NOTE:
MW-22, MW-23, AND MW-24 WERE INSTALLED BY LIBERTY PROPERTY TRUST FOR THEIR QUARRY 4 DEMONSTRATION PROJECT.

0 400 800 FEET

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted] DATE: 03/11/22
DATE: 03/11/22
DATE: 03/11/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

SITE MAP

PROJECT NO: 10-144
FIGURE 1

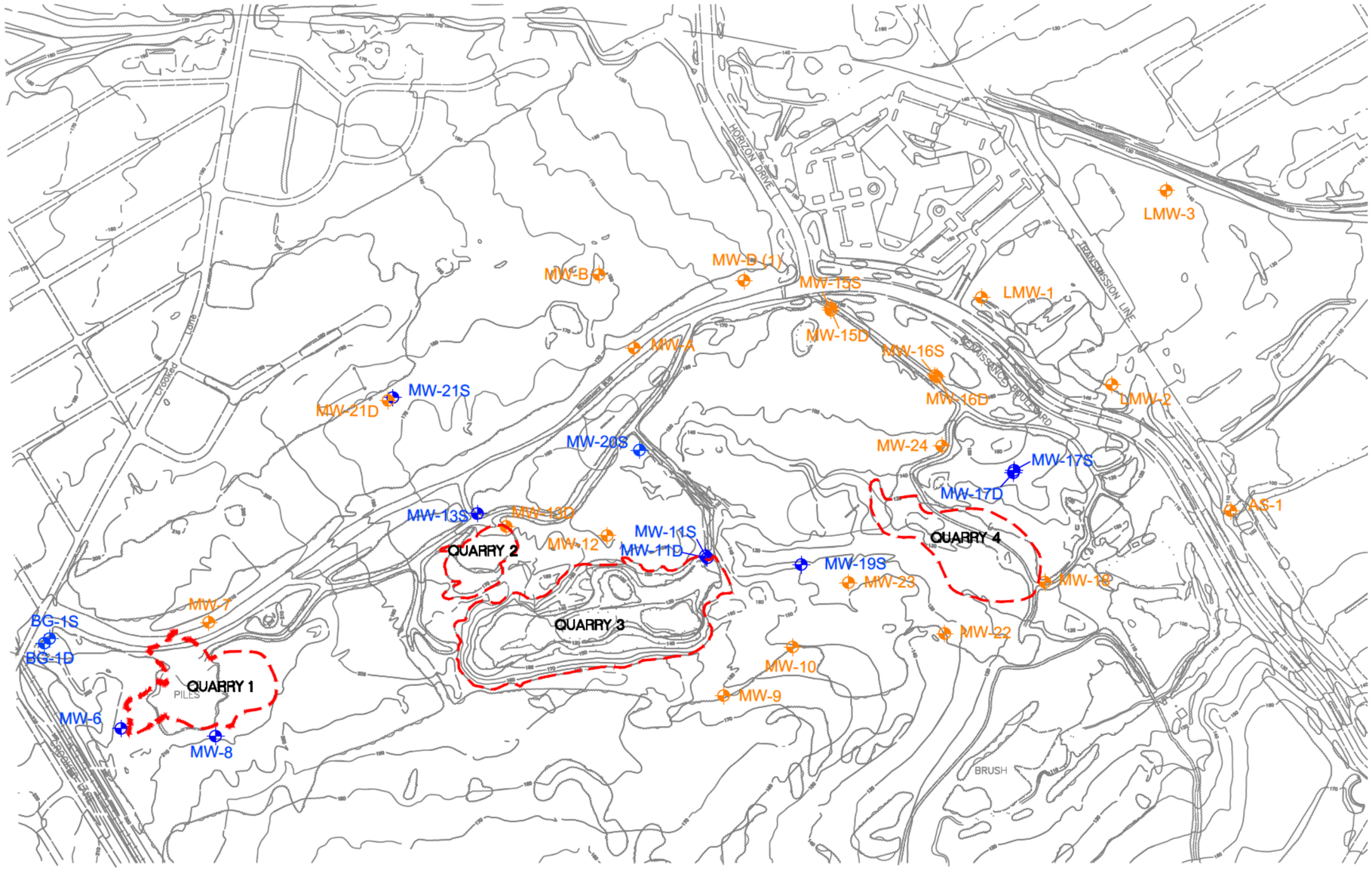
REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE: AERIAL PHOTOGRAPH OBTAINED FROM PASDA (PENNSYLVANIA SPATIAL DATA ACCESS), DATED MARCH 2010.

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 1 site map.dwg Last Saved By: Emaloney 5/10/2021 3:54 PM Plotted By: Shelly Comer 3/11/2022 2:12 PM Scale: 1:1



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LEGEND

- APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO
- NATURAL ATTENUATION GROUNDWATER SAMPLING AND WATER LEVEL MEASUREMENT LOCATION
- WATER LEVEL MEASUREMENT LOCATION

NOTES:

1. SAMPLING OF MONITORING WELLS MW–15S/D AND MW–16S/D WAS DISCONTINUED WITH EPA APPROVAL FOLLOWING THE FEBRUARY 2013 MONITORING EVENT. THESE WELLS WILL CONTINUE TO BE GAUGED FOR WATER LEVEL MEASUREMENTS DURING EACH SAMPLING EVENT.
2. MW–22, MW–23, AND MW–24 WERE INSTALLED BY LIBERTY PROPERTY TRUST FOR THEIR QUARRY 4 DEMONSTRATION PROJECT.

0 400 800 FEET

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted]	DATE: 03/11/22	KEY ENVIRONMENTAL INCORPORATED
	DATE: 03/11/22	
	DATE: 03/11/22	
SCALE:	AS SHOWN	

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

NATURAL ATTENUATION MONITORING LOCATIONS

PROJECT NO: 10–144

FIGURE 2

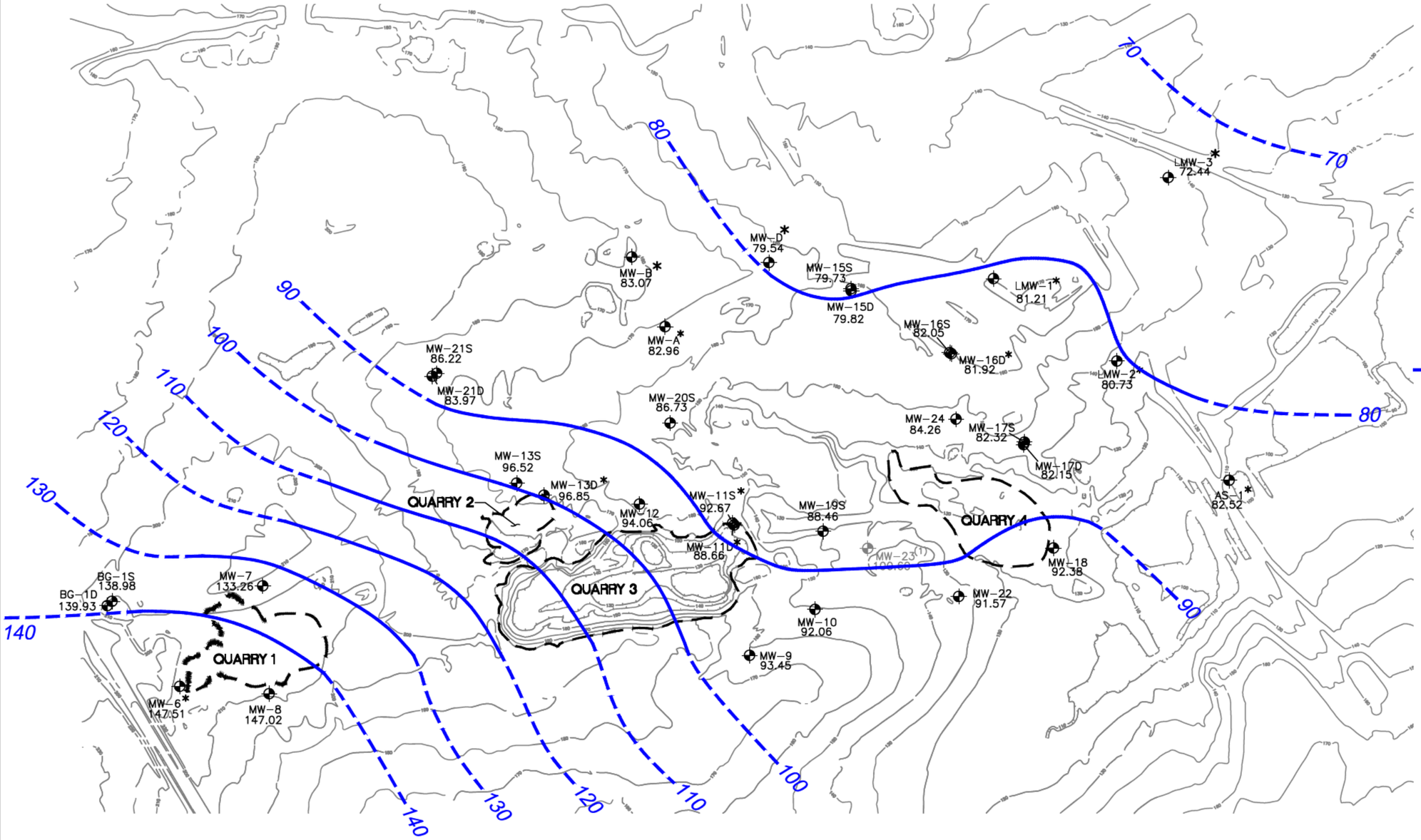
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10–144\mna\2021 annual mna report\figure 2 natural mw locations.dwg Last Saved By: Emaloney 5/10/2021 3:55 PM Plotted By: Shelly Corner 3/11/2022 2:12 PM Scale: 1:1



LEGEND

APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO

80 — POTENTIOMETRIC SURFACE CONTOUR (FT–MSL) (DASHED WHERE INFERRED)

* INDICATES OPEN BOREHOLE

EXISTING MONITORING WELL

80.96 — POTENTIOMETRIC SURFACE ELEVATION (FT–MSL)

0 400 800 FEET

NOTES:
(1) – POTENTOMETRIC SURFACE ELEVATION AT MW–23 NOT USED FOR CONTOURING PURPOSES.
(2) – POTENTOMETRIC SURFACE ELEVATION AT MW–11S NOT USED FOR CONTOURING PURPOSES.
(3) – MW–22, MW–23, AND MW–24 WERE INSTALLED BY LIBERTY PROPERTY TRUST FOR THEIR QUARRY 4 DEMONSTRATION PROJECT.

REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE:

ISSUE DATE:

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

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted] DATE: 05/28/21
DATE: 02/16/22
DATE: 02/16/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

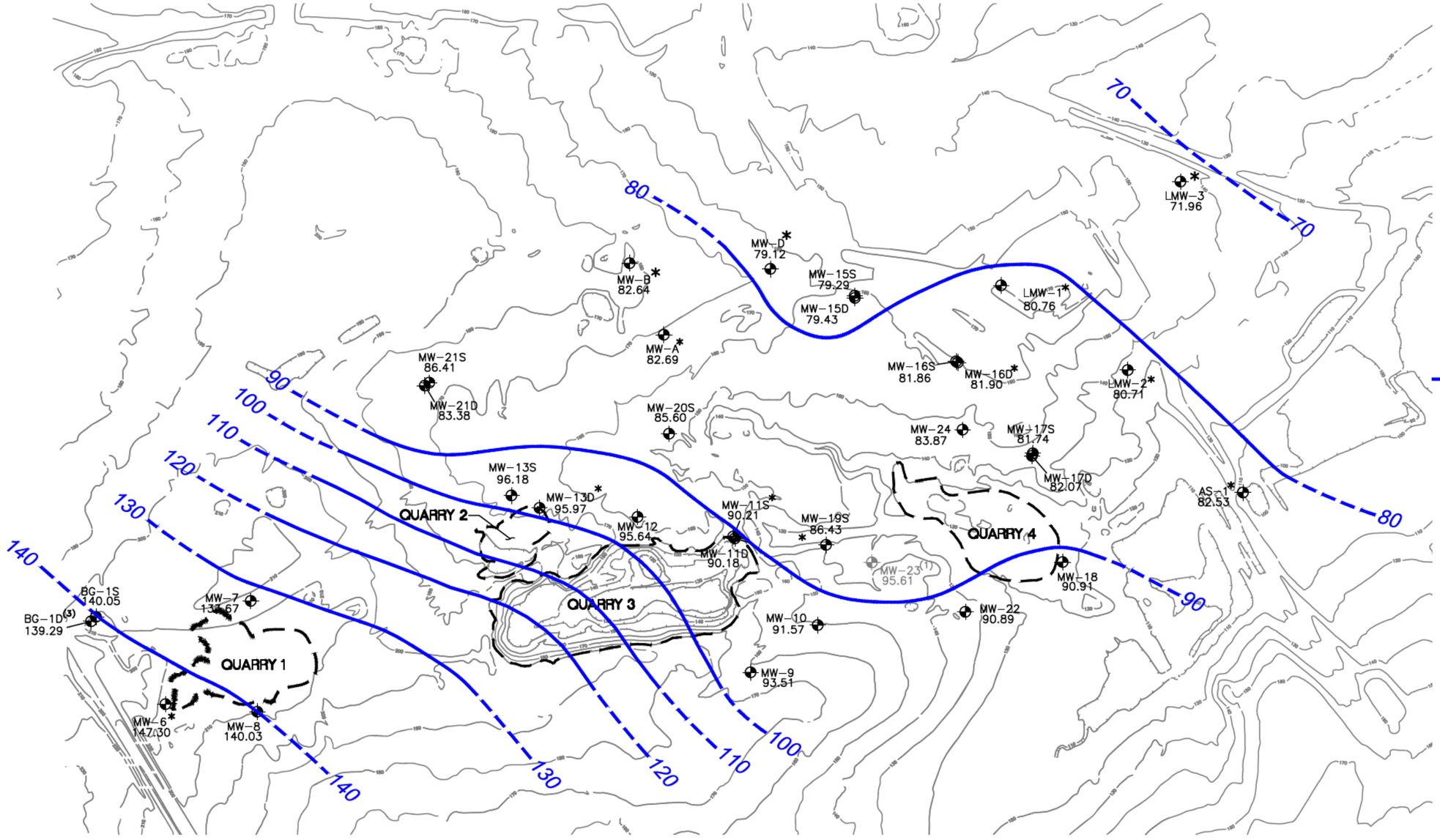
2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP – (03/22/21)

PROJECT NO: 10–144

FIGURE 3A

y:\crater\10–144\mna\2021 annual mna report\figure 3a potent map 03–2021.dwg Last Saved By: Emaloney 5/28/2021 8:49 AM Plotted By: Shelly Corner 4/21/2022 8:33 AM Scale: 1:1



LEGEND

APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO

80 — POTENTIOMETRIC SURFACE CONTOUR (FT–MSL) (DASHED WHERE INFERRED)

* INDICATES OPEN BOREHOLE

EXISTING MONITORING WELL

80.71 — POTENTIOMETRIC SURFACE ELEVATION (FT–MSL)

0 400 800 FEET

NOTES:

(1) – POTENTOMETRIC SURFACE ELEVATION AT MW–23 NOT USED FOR CONTOURING PURPOSES.
(2) – MW–22, MW–23, AND MW–24 WERE INSTALLED BY LIBERTY PROPERTY TRUST FOR THEIR QUARRY 4 DEMONSTRATION PROJECT.
(3) – BG–1D NOT USED FOR CONTOURING PURPOSES

REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE:

ISSUE DATE:

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

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

Non responsive based on revis

DATE: 02/15/22
DATE: 02/15/22
DATE: 02/16/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

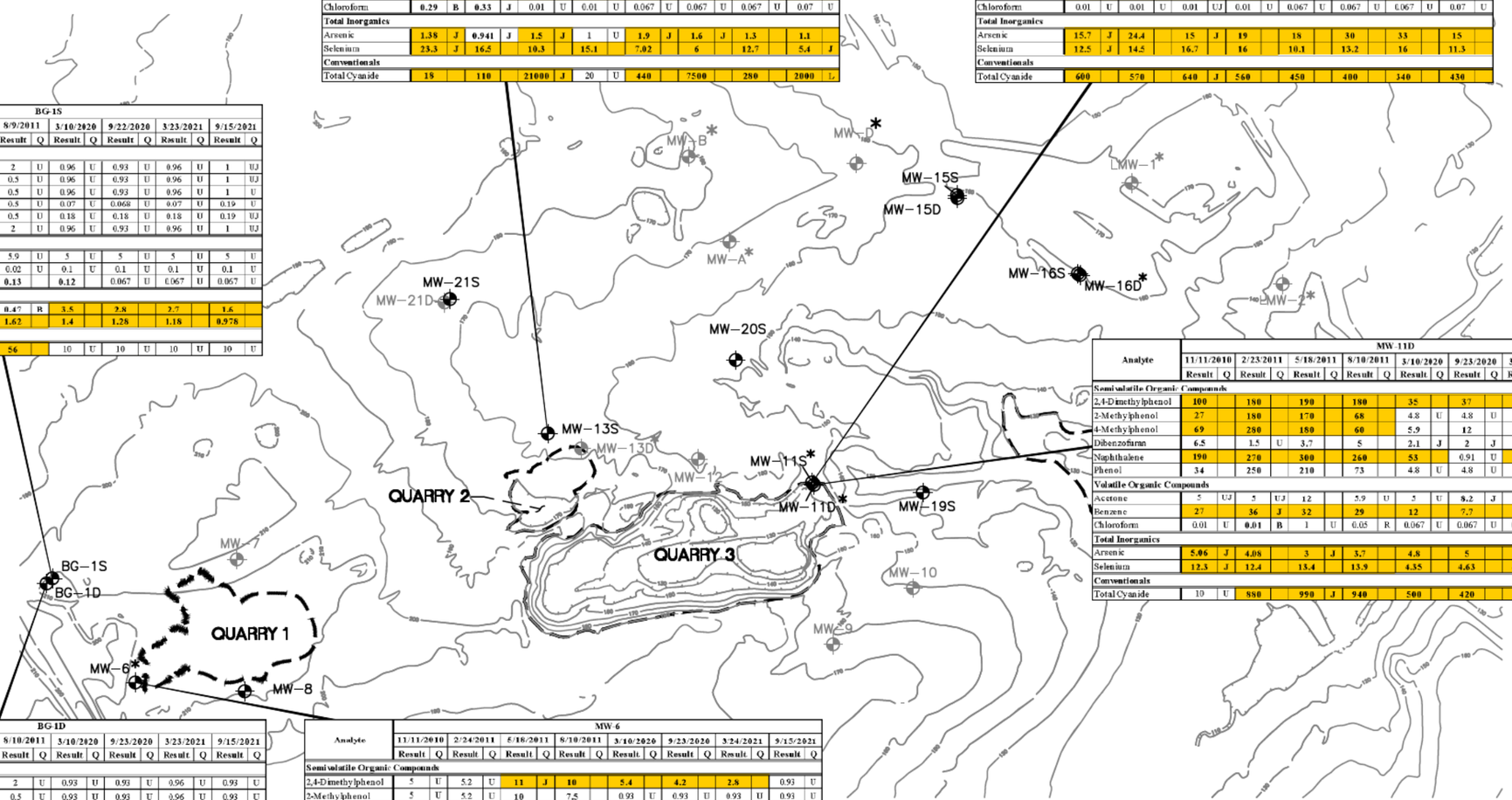
2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP – (09/13/21)

PROJECT NO: 10–144

FIGURE 3B

y:\crater\10-144\mna\2021 annual mna report\figure 3b potent map 09-2021.dwg Last Saved By: Scomer 2/16/2022 1:24 PM Plotted By: Shelly Comer 2/16/2022 1:26 PM Scale: 1:1



Analyte	MW-13S															
	11/11/2010		2/24/2011		5/19/2011		8/11/2011		3/10/2020		9/23/2020		3/24/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	**1700**		100	U	**1,500**		**2500**		**910**	J	**990**		**620**	J	**840**	J
2-Methylphenol	**11000**		**10000**		**9000**		**13000**		**4700**		**6200**		**5100**		**6700**	
4-Methylphenol	**37000**		**32000**		**29000**		**44000**		**15000**		**20000**		**16000**		**19000**	
Dibenzofuran	130	U	100	U	0.51	U	0.51	U	70	U	68	U	68	U	180	U
Naphthalene	**330**		**150**		**190**		**280**		**69**	J	**99**	J	**73**	J	**110**	J
Phenol	**29000**		**25000**		**24000**		**31000**		**20000**		**27000**		**21000**		**27000**	
Volatile Organic Compounds																
Acetone	**230**	J	**180**	J	**200**		**360**		**99**		**210**	J	**190**	J	**69**	
Benzene	**370**		**380**	J	**330**		**640**		**170**		**210**		**280**		**360**	
Chloroform	**0.29**	B	**0.33**	J	0.01	U	0.01	U	0.067	U	0.067	U	0.067	U	0.07	U
Total Inorganics																
Arsenic	**1.38**	J	**0.941**	J	**1.5**	J	1	U	**1.9**	J	**1.6**	J	**1.3**		**1.1**	
Selenium	**23.3**	J	**16.5**		**10.3**		**15.1**		**7.02**		**6**		**12.7**		**5.4**	J
Conventionals																
Total Cyanide	**18**		**110**		**21000**	J	20	U	**440**		**7500**		**280**		**2000**	L

Analyte	MW-11S															
	11/11/2010		2/23/2011		5/18/2011		8/10/2011		3/10/2020		9/23/2020		3/24/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	**62**		**75**		**53**		**35**		**0.89**	J	**7.7**	J	**6.8**		**1**	
2-Methylphenol	1.5	U	0.52	U	**0.76**		**0.65**		0.96	U	**0.51**	J	**0.5**	J	0.96	U
4-Methylphenol	1.5	U	0.52	U	**1**		0.5	U	0.96	U	**0.77**	J	**0.52**	J	0.96	U
Dibenzofuran	**16**		**20**		**19**		**11**		**1.6**	J	**9**		**1.4**		**0.34**	J
Naphthalene	**22**		**13**		**12**		**4.1**		**0.074**	J	**0.65**		0.18	U	**0.079**	JB
Phenol	6	U	**2.1**	U	2	U	2	U	0.96	U	0.96	U	0.93	U	0.96	U
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	UJ	5	UJ	5	U
Benzene	**19**		**20**	J	**15**		**12**		**4.8**		**4.1**		**5.4**		**3.3**	
Chloroform	0.01	U	0.01	U	**0.01**	UJ	0.01	U	0.067	U	0.067	U	0.067	U	0.07	U
Total Inorganics																
Arsenic	**15.7**	J	**24.4**		**15**	J	**19**		**18**		**30**		**33**		**15**	
Selenium	**12.5**	J	**14.5**		**16.7**		**16**		**10.1**		**13.2**		**16**		**11.3**	
Conventionals																
Total Cyanide	**600**		**570**		**640**	J	**560**		**450**		**400**		**340**		**430**	

LEGEND

APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO

INDICATES OPEN BOREHOLE

EXISTING MONITORING WELL

Analyte	Units	GW Cleanup Standards Center of Plume
Semivolatile Organic Compounds		
2,4-Dimethylphenol	µg/L	1.15
2-Methylphenol	µg/L	12.5
4-Methylphenol	µg/L	47.7
Dibenzofuran	µg/L	12
Naphthalene	µg/L	5
Phenol	µg/L	7860
Volatile Organic Compounds		
Acetone	µg/L	95.9
Benzene	µg/L	5
Chloroform	µg/L	1
Total Inorganics		
Arsenic	µg/L	1
Selenium	µg/L	0.4
Conventionals		
Total Cyanide	µg/L	10

Analyte	BG-1S															
	11/9/2010		2/23/2011		5/18/2011		8/9/2011		3/10/2020		9/22/2020		3/23/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.52	U	0.5	U	2	U	2	U	0.96	U	0.93	U	0.96	U	1	UJ
2-Methylphenol	0.52	U	0.5	U	0.5	U	0.5	U	0.96	U	0.93	U	0.96	U	1	UJ
4-Methylphenol	0.52	U	0.5	U	0.5	U	0.5	U	0.96	U	0.93	U	0.96	U	1	U
Dibenzofuran	0.52	U	0.5	U	0.5	U	0.5	U	0.07	U	0.068	U	0.07	U	0.19	U
Naphthalene	0.52	U	0.5	U	0.5	U	0.5	U	0.18	U	0.18	U	0.18	U	0.19	UJ
Phenol	2.1	U	2	U	2	U	2	U	0.96	U	0.93	U	0.96	U	1	UJ
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.02**		0.02	UJ	0.02	U	0.02	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	**0.83**		**0.29**		**0.15**		**0.13**		**0.12**		0.067	U	0.067	U	0.067	U
Total Inorganics																
Arsenic	**0.406**	J	**1.04**		**0.48**	J	**0.47**	B	**3.5**		**2.8**		**2.7**		**1.6**	
Selenium	**1.03**		**1.59**		**1.91**		**1.62**		**1.4**		**1.28**		**1.18**		**0.978**	
Conventionals																
Total Cyanide	10	U	10	U	20	UJ	**56**		10	U	10	U	10	U	10	U

Analyte	MW-11D															
	11/11/2010		2/23/2011		5/18/2011		8/10/2011		3/10/2020		9/23/2020		3/24/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	**100**		**180**		**190**		**180**		**35**		**37**		**30**		**36**	
2-Methylphenol	**27**		**180**		**170**		**68**		4.8	U	4.8	U	4.6	U	4.8	U
4-Methylphenol	**69**		**280**		**180**		**60**		**5.9**		**12**		**5**		**6.7**	
Dibenzofuran	**6.5**		1.5	U	3.7		5		2.1	J	2	J	2	J	2.2	J
Naphthalene	**190**		**270**		**300**		**260**		**53**		0.91	U	**44**		**54**	
Phenol	**34**		**250**		**210**		73		4.8	U	4.8	U	4.6	U	4.8	U
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	12		5.9	U	5	U	**8.2**	J	5.4	JB	5	U
Benzene	**27**		**36**	J	**32**		**29**		**12**		**7.7**		**9.7**		**11**	
Chloroform	0.01	U	**0.01**	B	1	U	0.05	R	0.067	U	0.067	U	0.067	U	0.07	U
Total Inorganics																
Arsenic	**5.06**	J	**4.08**		**3**	J	**3.7**		**4.8**		**5**		**3.5**		**3.7**	
Selenium	**12.3**	J	**12.4**		**13.4**		**13.9**		**4.35**		**4.63**		**4.48**		**3.7**	
Conventionals																
Total Cyanide	10	U	**880**		**990**	J	**940**		**500**		**420**		**480**		**430**	L

Analyte	BG-1D															
	11/9/2010		2/23/2011		5/18/2011		8/10/2011		3/10/2020		9/23/2020		3/23/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.52	U	0.51	U	2.1	U	2	U	0.93	U	0.93	U	0.96	U	0.93	U
2-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.93	U	0.93	U	0.96	U	0.93	U
4-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.93	U	0.93	U	0.96	U	0.93	U
Dibenzofuran	0.52	U	0.51	U	0.52	U	0.5	U	0.068	U	0.068	U	0.07	U	0.18	U
Naphthalene	0.52	U	0.51	U	0.52	U	0.5	U	0.18	U	0.18	U	0.18	U	0.18	U
Phenol	2.1	U	2	U	2.1	U	2	U	0.93	U	0.93	U	0.96	U	0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	UJ	5	U	5	U
Benzene	**0.05**		**0.02**	J	0.02	U	0.02	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	**1.4**		**1.2**		**2.4**		**1**		**1.9**		0.067	U	**0.099**	J	**0.079**	J
Total Inorganics																
Arsenic	**1.36**	J	**1.23**		**0.86**	J	**1**	B	**2.3**		**7.4**		**2.4**		**4.2**	
Selenium	**0.253**	J	**0.365**	J	**0.488**		**0.274**	J	**0.715**		**1.69**		**1.2**		**1.45**	
Conventionals																
Total Cyanide	10	U	10	U	20	UJ	20	U	10	U	10	U	10	U	10	U

Analyte	MW-6															
	11/11/2010		2/24/2011		5/18/2011		8/10/2011		3/10/2020		9/23/2020		3/24/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	5	U	5.2	U	**11**	J	**10**		**5.4**		**4.2**		**2.8**		0.93	U
2-Methylphenol	5	U	5.2	U	**10**		**7.5**		0.93	U	0.93	U	0.93	U	0.93	U
4-Methylphenol	5	U	5.2	U	5.2	U	**2.4**		0.93	U	**0.83**	J	**1.5**		0.93	U
Dibenzofuran	5	U	5.2	U	**2.9**	J	**1.1**		0.068	U	**0.27**	J	**0.29**	J	0.18	U
Naphthalene	**950**		**1200**		**1500**		**900**		**0.51**		**0.47**		**0.54**		**0.27**	
Phenol	20	U	21	U	21	U	2	U	**1.7**		**1.2**		**1.6**		0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	UJ	5	UJ	25	U
Benzene	**23**		**29**	J	**27**		**27**		**17**		**16**		**12**	J	**23**	
Chloroform	**0.01**	B	**0.01**	B	0.01	UJ	0.02	R	0.067	U	0.067	U	0.067	U	0.067	U
Total Inorganics																
Arsenic	**2.59**	J	**3.02**		**2.1**	J	**2.9**		**2.1**		**2**		**2.1**		**2.1**	
Selenium	**8.25**	J	**14.8**		**19**		**15.4**		**7.8**		**12**		**12.3**		**10.3**	
Conventionals																
Total Cyanide	**21**		**210**		**260**	J	**240**		**200**		**220**		**250**		**210**	L

NOTES:
BOLD – INDICATES POSITIVE DETECTION
NA – NOT ANALYZED
U – ANALYTE NON-DETECT AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE
B – RESULT IS QUALITATIVELY INVALID SINCE THE ANALYTE WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION
R – RESULT IS REJECTED
L – RESULT SHOULD BE CONSIDERED TO BE BIASED LOW.
non responsive based on review PERFORMED THE ANALYSES FOR: ARSENIC, MERCURY, AND SELENIUM
– INDICATES EXCEEDENCE OF GW CLEANUP STANDARDS – CENTER OF PLUME

0 400 800 FEET

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

non responsive based on review

DATE: 01/21/22
DATE: 01/21/22
DATE: 01/30/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

CENTER OF PLUME
HISTORICAL ANALYTICAL

PROJECT NO: 10-144
FIGURE 4A

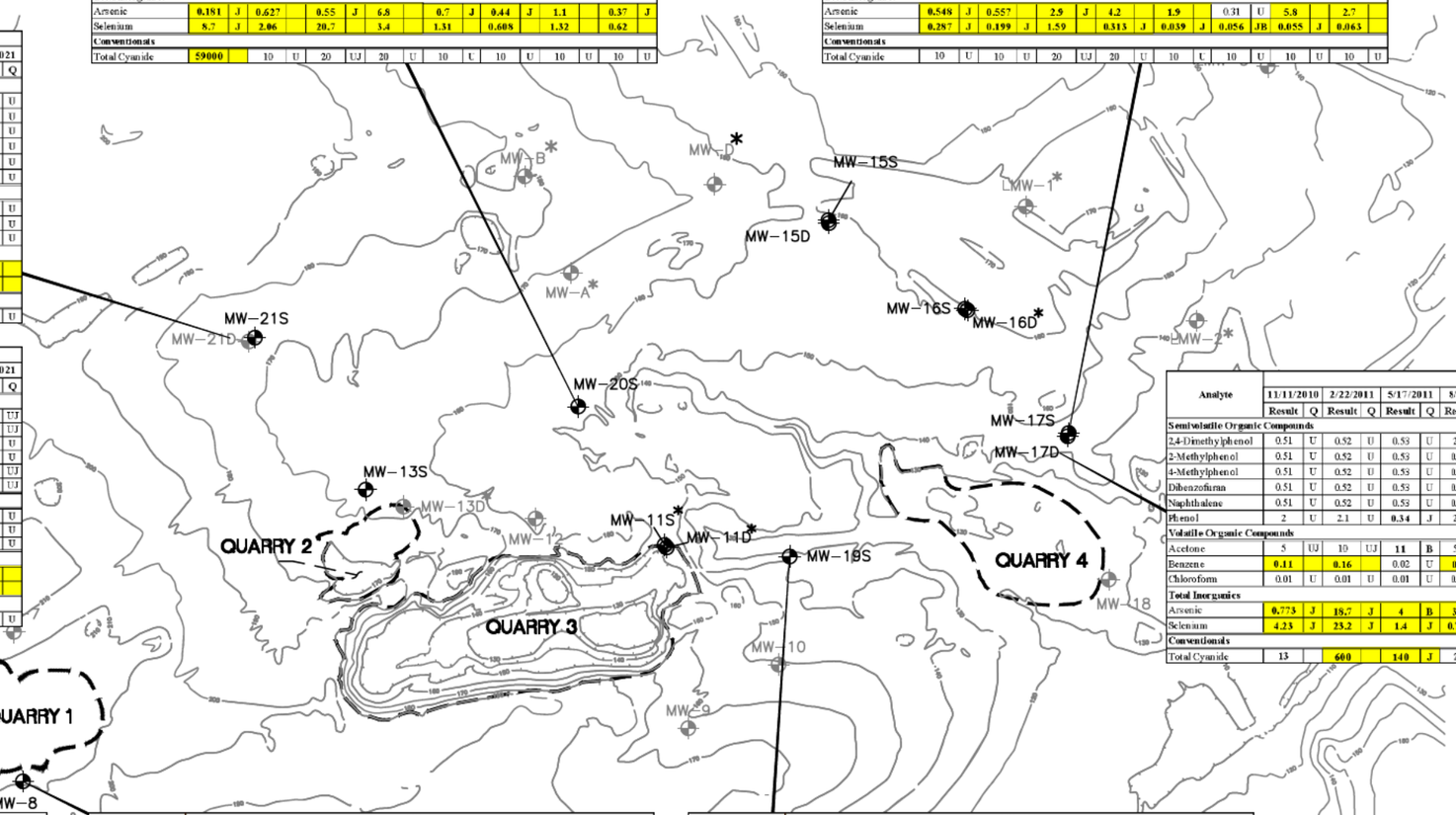
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 4a center of plume.dwg Last Saved By: Kohlntelis 2/9/2022 10:39 AM Plotted By: Shelly Comer 3/25/2022 10:40 AM Scale: 1:1



LEGEND

- APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO
- INDICATES OPEN BOREHOLE
- EXISTING MONITORING WELL

Analyte	Units	GW Cleanup Standards Extent of Plume
Semivolatile Organic Compounds		
2,4-Dimethylphenol	µg/L	1
2-Methylphenol	µg/L	1
4-Methylphenol	µg/L	1
Dibenzofuran	µg/L	0.86
Naphthalene	µg/L	1
Phenol	µg/L	--
Volatile Organic Compounds		
Acetone	µg/L	24
Benzene	µg/L	0.04
Chloroform	µg/L	0.015
Total Inorganics		
Arsenic	µg/L	0.04
Selenium	µg/L	0.006
Conventionals		
Total Cyanide	µg/L	13

MW-20S

Analyte	11/10/2010		2/23/2011		5/18/2011		8/9/2011		3/10/2026		9/22/2020		3/23/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.52	U	0.51	U	**0.65**	J	**6.26**	J	**0.66**	J	0.93	U	**0.36**	J	0.93	UJ
2-Methylphenol	0.52	U	0.51	U	**1.1**		**0.77**		0.93	U	0.93	U	0.93	U	0.93	UJ
4-Methylphenol	0.52	U	0.51	U	0.52	U	0.35	U	0.93	U	0.93	U	0.93	U	0.93	UJ
Dibenzofuran	0.52	U	0.51	U	0.52	U	0.35	U	0.068	U	0.068	U	0.068	U	0.18	U
Naphthalene	0.52	U	**1.5**		**2**		**6.93**		**2.2**		**0.34**		**1.7**		**0.46**	J
Phenol	2.1	U	2	U	2.1	U	1.4	U	0.93	U	0.93	U	0.93	U	0.93	UJ
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	**10**		5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.29**		**3.7**	J	**4.4**		**3.9**		**6.7**		**3.3**		**9.6**		**3.6**	
Chloroform	**0.02**		**0.02**	B	0.01	U	0.01	U	0.067	U	0.067	U	0.067	U	0.07	U
Total Inorganics																
Arsenic	**0.181**	J	**0.627**		**0.55**	J	**6.8**		**0.7**	J	**0.44**	J	**1.1**		**0.37**	J
Selenium	**8.7**	J	**2.06**		**20.7**		**3.4**		**1.31**		**0.608**		**1.32**		**0.62**	
Conventionals																
Total Cyanide	**59000**		10	U	20	UJ	20	U	10	U	10	U	10	U	10	U

MW-17S

Analyte	11/9/2010		2/22/2011		5/17/2011		8/10/2011		3/10/2026		9/22/2020		3/23/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.52	U	0.52	U	0.53	U	2	U	1	U	0.93	U	0.93	U	0.93	U
2-Methylphenol	0.52	U	0.52	U	0.53	U	0.5	U	1	U	0.93	U	0.93	U	0.93	U
4-Methylphenol	0.52	U	0.52	U	0.53	U	0.5	U	1	U	0.93	U	0.93	U	0.93	U
Dibenzofuran	0.52	U	0.52	U	0.53	U	0.5	U	0.073	U	0.068	U	0.068	U	0.18	U
Naphthalene	0.52	U	**0.54**		0.53	U	0.5	U	0.19	U	0.18	U	0.18	U	0.18	U
Phenol	2.1	U	2.1	U	2.1	U	2	U	1	U	0.93	U	0.93	U	0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	10	UJ	10	U	5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.02**		0.02	U	0.02	U	0.02	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	0.01	U	0.01	U	0.01	U	0.01	U	**0.12**		0.1	U	0.067	U	0.07	U
Total Inorganics																
Arsenic	**0.548**	J	**0.557**		**2.9**	J	**4.2**		**1.9**		0.31	U	**5.8**		**2.7**	
Selenium	**0.287**	J	**0.199**	J	**1.59**		**0.313**	J	**0.039**	J	**0.056**	JB	**0.055**	J	**0.063**	
Conventionals																
Total Cyanide	10	U	10	U	20	UJ	20	U	10	U	10	U	10	U	10	U

MW-21S

Analyte	11/10/2010		2/22/2011		5/18/2011		8/10/2011		3/10/2026		9/22/2020		3/23/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.5	U	0.52	U	2.1	U	2.1	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
2-Methylphenol	0.5	U	0.52	U	0.53	U	0.52	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
4-Methylphenol	0.5	U	0.52	U	0.53	U	0.52	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
Dibenzofuran	0.5	U	0.52	U	0.53	U	0.52	U	0.068	U	0.068	UJ	**0.32**	J	0.18	U
Naphthalene	0.5	U	0.52	U	0.53	U	0.52	U	0.18	U	0.18	UJ	**0.094**	J	0.18	U
Phenol	2	U	2.1	U	2.1	U	2.1	U	0.93	U	0.93	UJ	0.96	UJ	0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	10	UJ	10	U	5.9	U	5	U	5	UJ	5	U	5	U
Benzene	0.02	U	0.02	U	0.02	U	0.02	U	0.1	U	0.05	U	0.1	U	0.1	U
Chloroform	**0.05**		**0.13**		0.01	U	**0.052**	B	0.067	U	0.067	U	0.067	U	0.067	U
Total Inorganics																
Arsenic	**1.22**	J	**1.64**		**0.67**	J	**1.8**	B	**0.47**	J	**0.7**	J	**4.3**		**2.7**	
Selenium	**0.709**	J	**0.509**		**2.8**	J	**1.08**		**0.054**	J	**0.049**	JB	**0.164**		**0.125**	
Conventionals																
Total Cyanide	2000	U	10	U	20	UJ	20	U	10	U	10	U	**24**	J	10	U

MW-17D

Analyte	11/11/2010		2/22/2011		5/17/2011		8/9/2011		3/10/2026		9/22/2020		3/23/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.51	U	0.52	U	0.53	U	2.2	U	0.93	U	0.93	U	0.93	U	0.93	U
2-Methylphenol	0.51	U	0.52	U	0.53	U	0.54	U	0.93	U	0.93	U	0.93	U	0.93	U
4-Methylphenol	0.51	U	0.52	U	0.53	U	0.54	U	0.93	U	0.93	U	0.93	U	0.93	U
Dibenzofuran	0.51	U	0.52	U	0.53	U	0.54	U	0.068	U	0.068	U	0.068	U	0.18	U
Naphthalene	0.51	U	0.52	U	0.53	U	0.54	U	0.18	U	0.18	U	0.18	U	0.18	U
Phenol	2	U	2.1	U	**0.34**	J	2.2	U	0.93	U	0.93	U	0.93	U	0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	10	UJ	**11**	B	5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.11**		**0.16**		0.02	U	**0.2**		**0.13**		0.1	U	**0.2**		**0.27**	
Chloroform	0.01	U	0.01	U	0.01	U	0.01	U	**1.1**		**0.49**		**2**		**1.2**	
Total Inorganics																
Arsenic	**0.773**	J	**18.7**	J	**4**	B	**3.4**		**15**		**9.1**		**10**		**24**	
Selenium	**4.23**	J	**23.2**	J	**1.4**	J	**0.722**		**0.265**		**0.443**		**0.645**		**0.295**	
Conventionals																
Total Cyanide	**13**		**600**		**140**	J	20	U	10	U	**17**		**15**		**17**	

BG-1S

Analyte	11/9/2010		2/23/2011		5/18/2011		8/9/2011		3/10/2026		9/22/2020		3/23/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.52	U	0.5	U	2	U	2	U	0.96	U	0.93	U	0.96	U	1	UJ
2-Methylphenol	0.52	U	0.5	U	0.5	U	0.5	U	0.96	U	0.93	U	0.96	U	1	UJ
4-Methylphenol	0.52	U	0.5	U	0.5	U	0.5	U	0.96	U	0.93	U	0.96	U	1	U
Dibenzofuran	0.52	U	0.5	U	0.5	U	0.5	U	0.07	U	0.068	U	0.07	U	0.19	U
Naphthalene	0.52	U	0.5	U	0.5	U	0.5	U	0.18	U	0.18	U	0.18	U	0.19	UJ
Phenol	2.1	U	2	U	2	U	2	U	0.96	U	0.93	U	0.96	U	1	UJ
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.02**		0.02	UJ	0.02	U	0.02	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	**0.03**		**0.29**		**0.15**		**0.13**		**0.12**		0.067	U	0.067	U	0.067	U
Total Inorganics																
Arsenic	**0.406**	J	**1.04**		**0.48**	J	**0.47**	B	**3.5**		**2.8**		**2.7**		**1.6**	
Selenium	**1.03**		**1.59**		**1.91**		**1.62**		**1.4**		**1.28**		**1.18**		**0.978**	
Conventionals																
Total Cyanide	10	U	10	U	20	UJ	**56**		10	U	10	U	10	U	10	U

BG-1D

Analyte	11/9/2010		2/23/2011		5/18/2011		8/10/2011		3/10/2020		9/23/2020		3/23/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.52	U	0.51	U	2.1	U	2	U	0.93	U	0.93	U	0.96	U	0.93	U
2-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.93	U	0.93	U	0.96	U	0.93	U
4-Methylphenol	0.52	U	0.51	U	0.52	U	0.5	U	0.93	U	0.93	U	0.96	U	0.93	U
Dibenzofuran	0.52	U	0.51	U	0.52	U	0.5	U	0.068	U	0.068	U	0.07	U	0.18	U
Naphthalene	0.52	U	0.51	U	0.52	U	0.5	U	0.18	U	0.18	U	0.18	U	0.18	U
Phenol	2.1	U	2	U	2.1	U	2	U	0.93	U	0.93	U	0.96	U	0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	UJ	5	U	5	U
Benzene	**0.05**		**0.02**	J	0.02	U	0.02	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	**1.4**		**1.2**		**2.4**		**1**		**1.9**		0.067	U	**0.099**	J	**0.079**	J
Total Inorganics																
Arsenic	**1.36**	J	**1.23**		**0.86**	J	**1**	B	**2.3**		**7.4**		**2.4**		**4.2**	
Selenium	**0.253**	J	**0.365**	J	**0.488**		**0.274**	J	**0.715**		**1.69**		**1.2**		**1.45**	
Conventionals																
Total Cyanide	10	U	10	U	20	UJ	20	U	10	U	10	U	10	U	10	U

MW-8

Analyte	11/10/2010		2/23/2011		5/17/2011		8/10/2011		3/10/2026		9/22/2020		3/24/2021		9/14/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.51	U	0.52	U	0.53	U	2	U	**0.13**	J	0.93	U	0.93	U	1	U
2-Methylphenol	0.51	U	0.52	U	0.53	U	0.51	U	0.96	U	0.93	U	**0.33**	J	**0.32**	J
4-Methylphenol	0.51	U	0.52	U	0.53	U	0.51	U	**0.74**	J	**0.7**	J	**0.59**	J	**1**	
Dibenzofuran	0.51	U	0.52	U	0.53	U	0.51	U	0.07	U	**0.081**	J	0.068	U	0.19	U
Naphthalene	**10**		0.52	U	**3.2**		**2.3**		**1.5**		**0.61**		0.18	U	**2**	
Phenol	2	U	2.1	U	2.1	U	2	U	0.96	U	0.93	U	0.93	U	**0.61**	JB
Volatile Organic Compounds																
Acetone	5	UJ	5	UJ	10	U	5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.09**		**0.04**	J	0.02	U	**0.062**		0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	0.01	U	0.01	U	0.01	U	0.01	U	0.067	U	0.067	U	0.067	U	0.07	U
Total Inorganics																
Arsenic	**0.515**	J	**0.444**		**0.41**	B	**1.2**	B	**0.63**	J	**1.6**		**1.2**		0.31	U
Selenium	**16.6**	J	**22.7**		**27.5**		**25.5**		**17.4**		**22.9**		**23.6**		**13**	J
Conventionals																
Total Cyanide	2000	U	10	U	20	UJ	20	U	**6.9**	JB	**7.4**	J	**8**	J	10	U

MW-19S

Analyte	11/10/2010		2/22/2011		5/17/2011		8/9/2011		3/10/2026		9/22/2020		3/23/2021		9/15/2021	
	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																
2,4-Dimethylphenol	0.5	U	0.51	U	0.54	U	2	U	0.93	UJ	0.93	U	0.93	U	0.93	U
2-Methylphenol	0.5	U	0.51	U	0.54	U	0.51	U	0.93	UJ	0.93	U	0.93	U	0.93	U
4-Methylphenol	0.5	U	0.51	U	0.54	U	0.51	U	0.93	UJ	0.93	U	0.93	U	0.93	U
Dibenzofuran	0.5	U	0.51	U	0.54	U	0.51	U	0.068	UJ	0.068	U	**0.13**	J	0.18	U
Naphthalene	0.5	U	0.51	U	0.54	U	0.51	U	0.18	UJ	0.18	U	0.18	U	0.18	U
Phenol	2	U	2	U	2.2	U	2	U	0.93	UJ	0.93	U	0.93	U	0.93	U
Volatile Organic Compounds																
Acetone	5	UJ	10	UJ	10	U	5.9	U	5	U	5	U	5	U	5	U
Benzene	**0.02**		**0.02**		**0.024**		**0.068**		0.1	U	0.1	U	0.1	U	0.1	U
Chloroform	0.01	U	0.01	U	0.01	U	0.01	U	0.067	U	0.067	U	0.067	U	0.067	U
Total Inorganics																
Arsenic	**0.097**	J	**0.094**	J	**0.6**	B	**6.39**	B	**0.46**	J	**0.32**	J	0.31	U	0.31	U
Selenium	**3.55**	J	**3.75**		**4.14**		**3.52**		**3.08**		**5.26**		**1.22**		**4.49**	
Conventionals																
Total Cyanide	2000	U	10	U	20	UJ	20	U	10	U	10	U	10	U	10	R

NOTES:
BOLD – INDICATES POSITIVE DETECTION
NA – NOT ANALYZED
U – ANALYTE NON-DETECT AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE
B – RESULT IS QUALITATIVELY INVALID SINCE THE ANALYTE WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION
R – RESULT IS REJECTED
J – RESULT SHOULD BE CONSIDERED TO BE BIASED LOW.
Non Responsive based on PERFORMED THE ANALYSES FOR: ARSENIC, MERCURY, AND SELENIUM
– INDICATES EXCEEDENCE OF GW CLEANUP STANDARD – EXTENT OF PLUME

0 400 800 FEET

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

Non Responsive based on
DATE: 01/21/22
DATE: 01/21/22
DATE: 01/30/22
SC-__: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

EXTENT OF PLUME
HISTORICAL ANALYTICAL

PROJECT NO: 10-144
FIGURE 4B

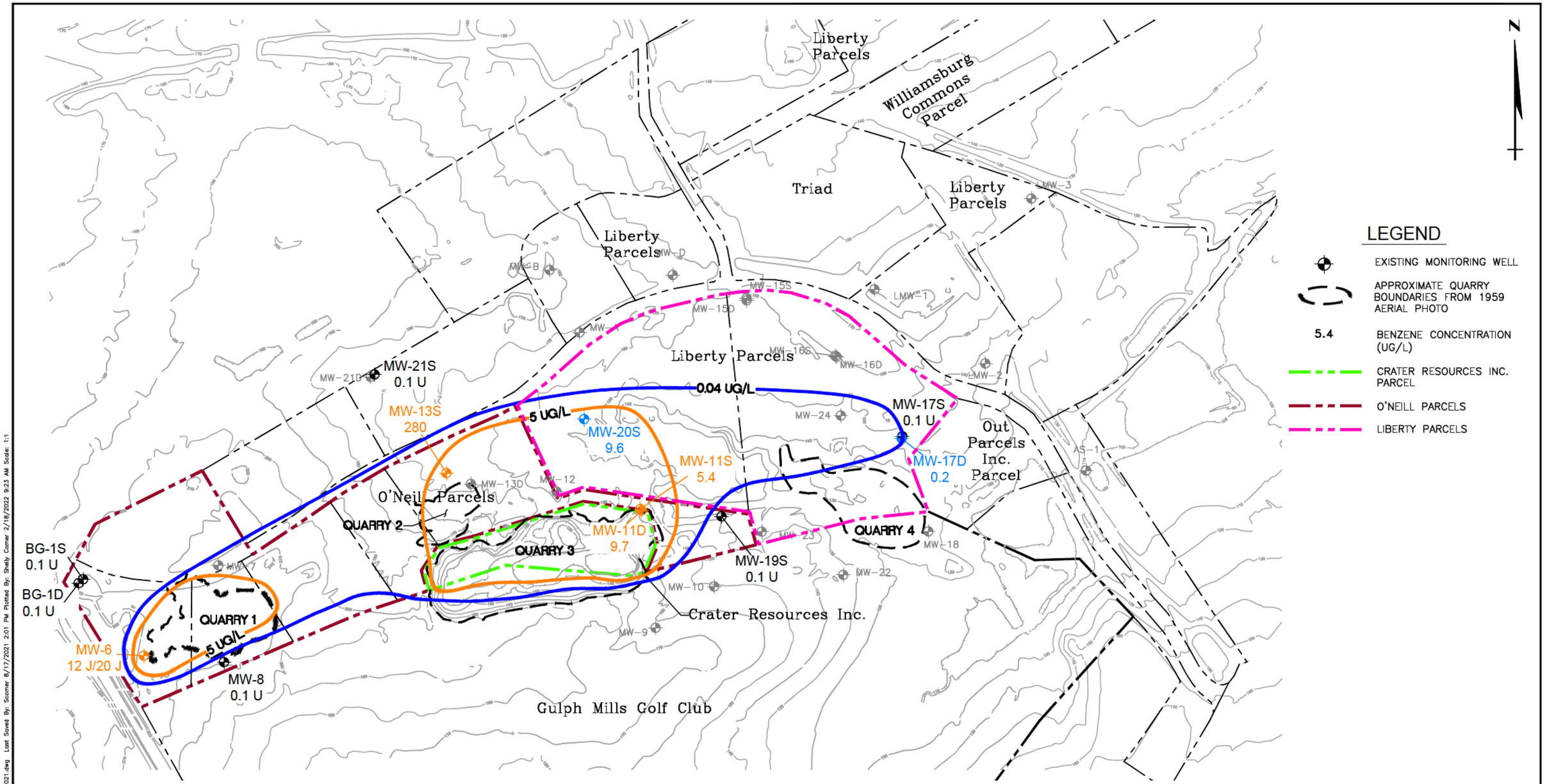
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 4b extent of plume.dwg Last Saved By: Kchiarella 2/9/2022 10:40 AM Plotted By: Shelly Corner 3/25/2022 10:40 AM Scale: 1:1



NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME (5 UG/L)
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME (0.04 UG/L)

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted] DATE: 02/18/22
DATE: 02/18/22
DATE: 02/22/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

BENZENE CONCENTRATIONS IN GROUNDWATER – (03/23–24/21)

PROJECT NO: 10–144
FIGURE 5A

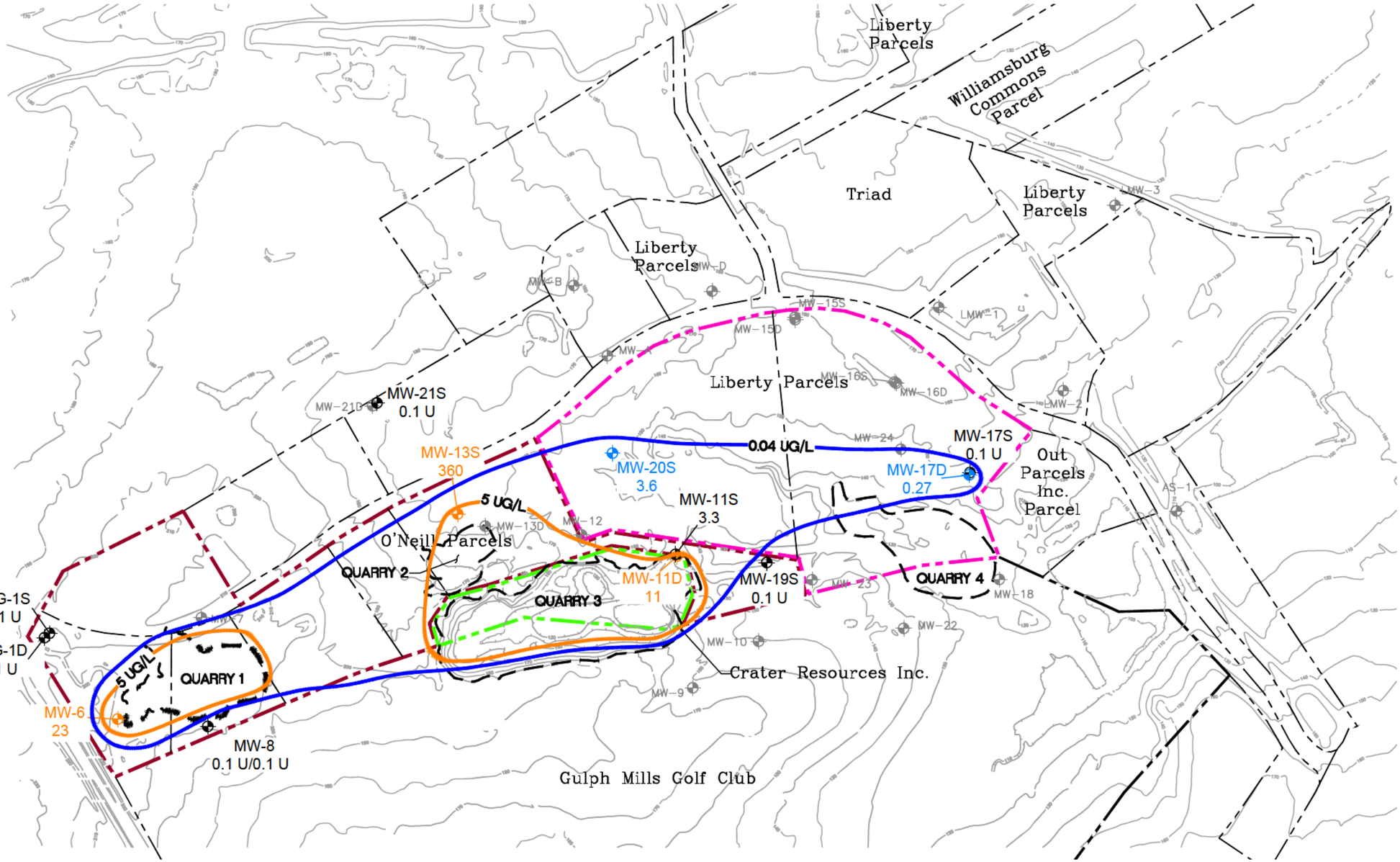
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 5a benzene 03-2021.dwg Last Saved By: Scomer 8/17/2021 2:01 PM Plotted By: Shelly Comer 2/18/2022 9:23 AM Scale: 1:1



LEGEND

- EXISTING MONITORING WELL
- APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO
- 3.6 — BENZENE CONCENTRATION (UG/L)
- CRATER RESOURCES INC. PARCEL
- O'NEILL PARCELS
- LIBERTY PARCELS

0 400 800 FEET

NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME (5 UG/L)
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME (0.04 UG/L)

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted]	DATE: 02/18/22
	DATE: 02/18/22
	DATE: 02/22/22
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

BENZENE CONCENTRATIONS IN GROUNDWATER – (09/14–15/21)

PROJECT NO: 10–144
FIGURE 5B

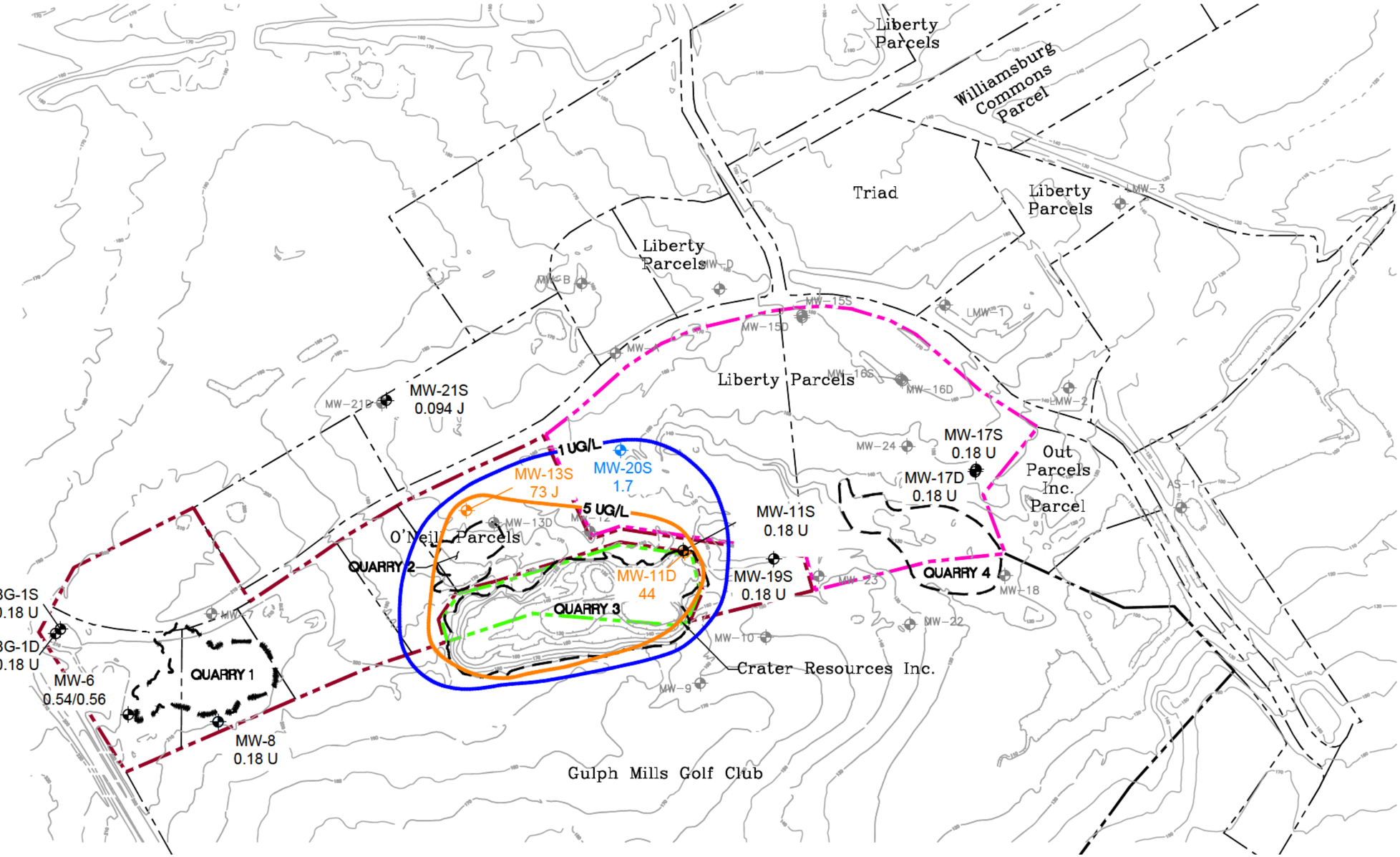
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 5b benzene 09-2021.dwg Last Saved By: Scorner 3/15/2022 8:18 AM Plotted By: Shelly Corner 3/15/2022 8:31 AM Scale: 1:1



LEGEND

- EXISTING MONITORING WELL
- APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO
- 1.7 NAPHTHALENE CONCENTRATION (UG/L)
- CRATER RESOURCES INC. PARCEL
- O'NEILL PARCELS
- LIBERTY PARCELS

0 400 800 FEET

NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME (5 UG/L)
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME (1 UG/L)

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

non responsive based on	DATE: 02/18/22
	DATE: 02/18/22
	DATE: 02/22/22
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE:

ISSUE DATE:

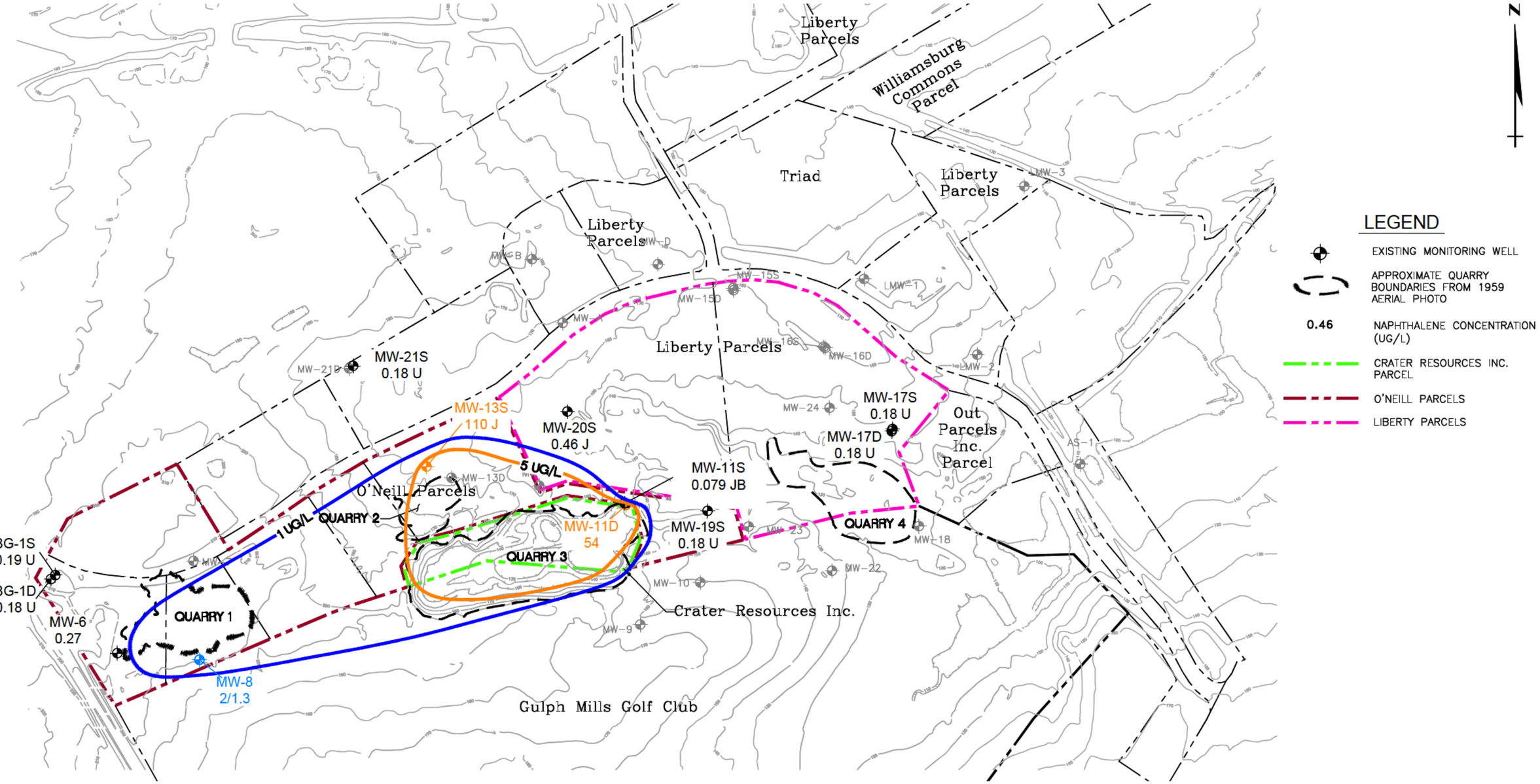
KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

NAPHTHALENE CONCENTRATIONS IN GROUNDWATER – (03/23–24/21)

PROJECT NO: 10–144

FIGURE 6A

y:\crater\10-144\mna\2021 annual mna report\figure 6a naphthalene 03-2021.dwg Last Saved By: Scomer 2/18/2022 9:41 AM Plotted By: Shelly Comer 2/18/2022 9:43 AM Scale: 1:1



NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE
B – CONSTITUENT DETECTED IN BLANK

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME (5 UG/L)
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME (1 UG/L)

REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE:

ISSUE DATE:

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

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

Non responsive based on re

DATE: 02/18/22
DATE: 02/18/22
DATE: 02/22/22

KEY ENVIRONMENTAL INCORPORATED

SCALE: AS SHOWN

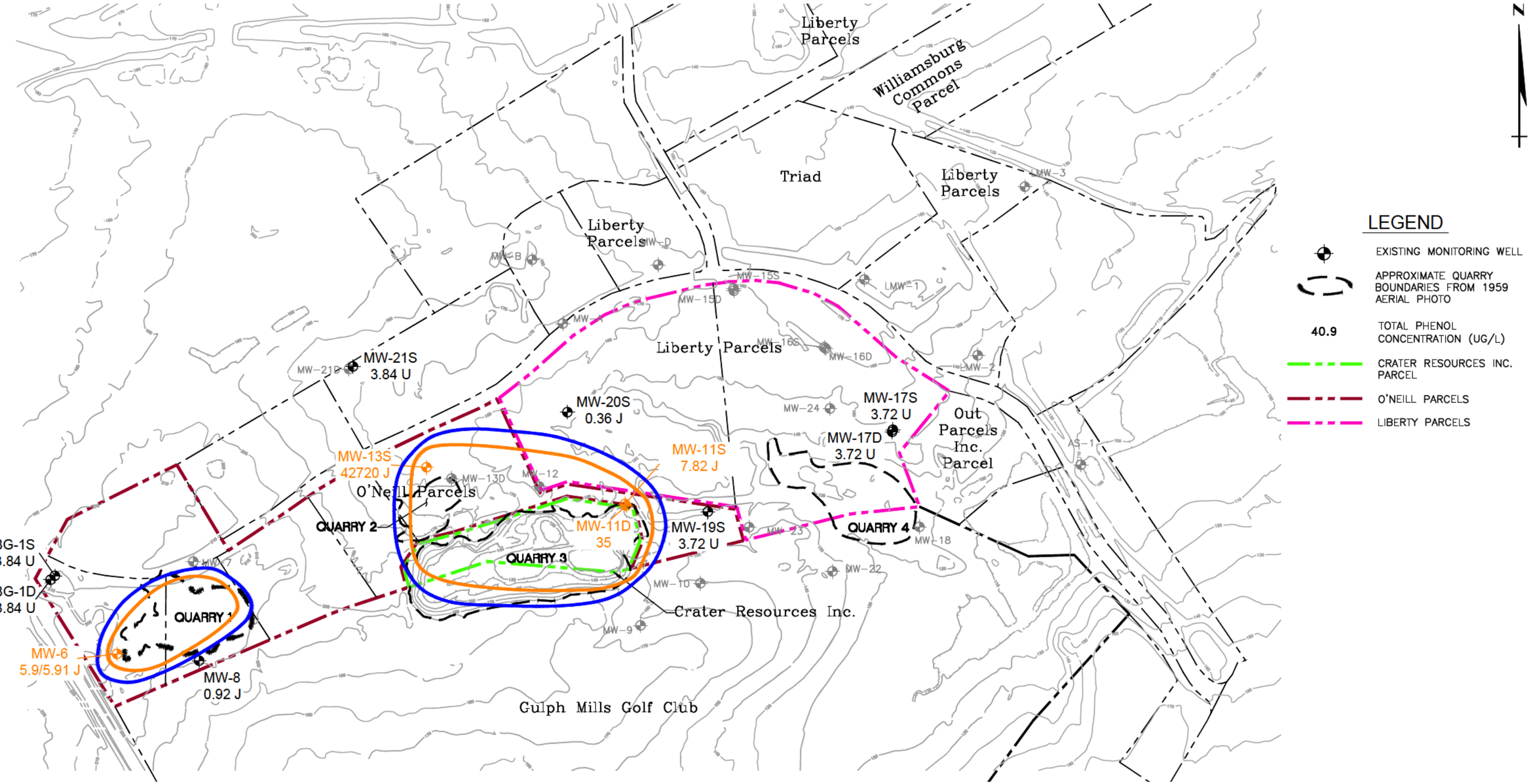
2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

NAPHTHALENE CONCENTRATIONS IN GROUNDWATER – (09/14–15/21)

PROJECT NO: 10–144

FIGURE 6B

y:\crater\10-144\mna\2021 annual mna report\figure 6b naphthalene 09-2021.dwg Last Saved By: Scomer 2/21/2022 10:36 AM Plotted By: Shelly Comer 2/21/2022 10:36 AM Scale: 1:1



NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME

CONSTITUENT (ug/L)	CENTER OF PLUME CLEANUP STANDARD	EXTENT OF PLUME CLEANUP STANDARD
Phenol	7,860	–
2,4–Dimethylphenol	1.15	1
2–Methylphenol	12.5	1
4–Methylphenol	47.7	1

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

Non responsive based on re

DATE: 02/18/22
DATE: 02/18/22
DATE: 02/22/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

TOTAL PHENOLIC COMPOUND CONCENTRATIONS IN GROUNDWATER – (03/23–24/21)

PROJECT NO: 10–144

FIGURE 7A

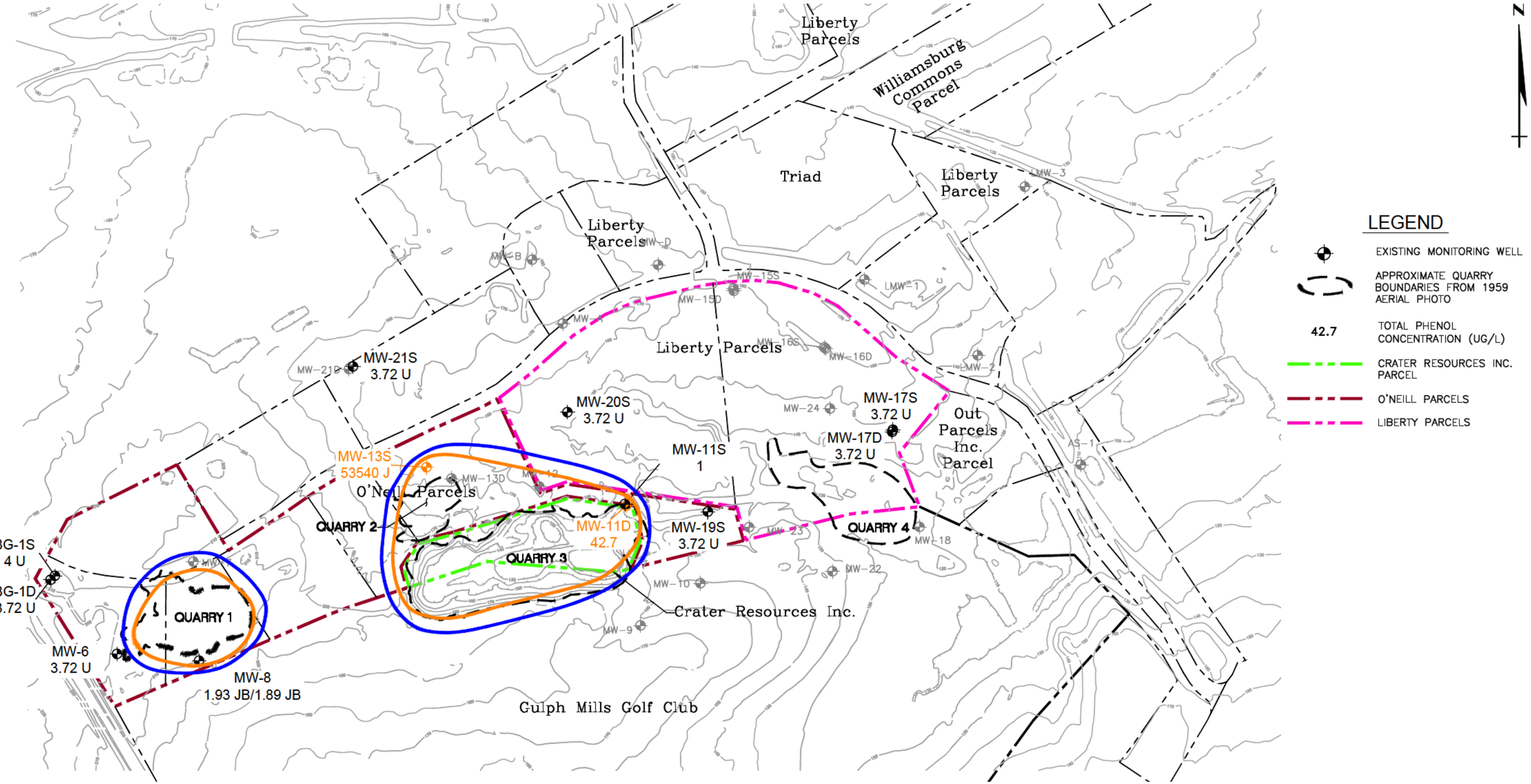
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10–144\mna\2021 annual mna report\figure 7a phenolic compound 03–2021.dwg Last Saved By: Scomer 2/18/2022 10:25 AM Plotted By: Shelly Comer 3/15/2022 7:15 AM Scale: 1:1



NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE
B – CONSTITUENT DETECTED IN BLANK

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME

CONSTITUENT (ug/L)	CENTER OF PLUME CLEANUP STANDARD	EXTENT OF PLUME CLEANUP STANDARD
Phenol	7,860	–
2,4–Dimethylphenol	1.15	1
2–Methylphenol	12.5	1
4–Methylphenol	47.7	1

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted] DATE: 02/18/22
DATE: 02/18/22
DATE: 02/22/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

TOTAL PHENOLIC COMPOUND CONCENTRATIONS IN GROUNDWATER – (09/14–15/21)

PROJECT NO: 10–144

FIGURE 7B

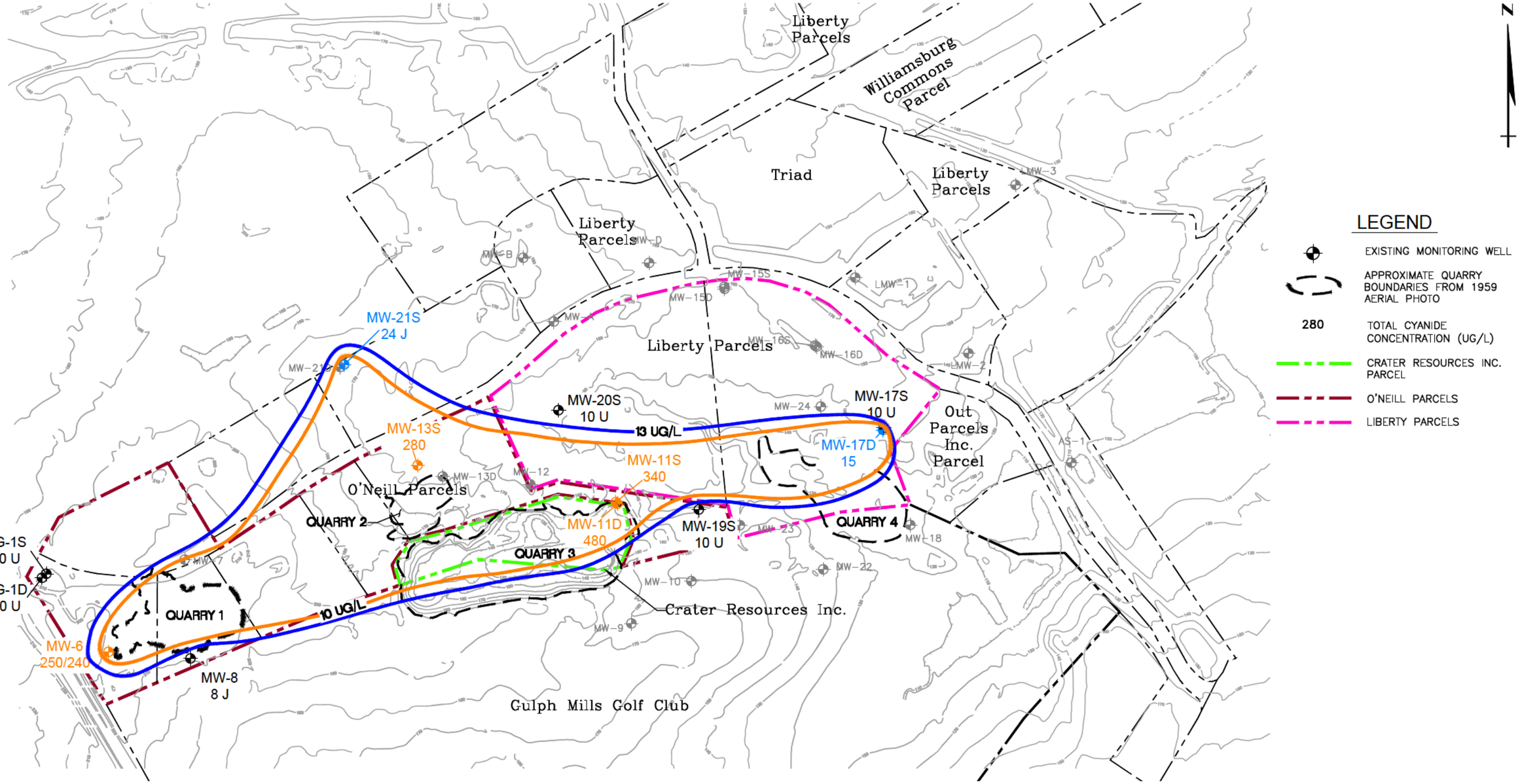
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10–144\mna\2021 annual mna report\figure 7b phenolic compound 08–2021.dwg Last Saved By: Scomer 3/15/2022 7:09 AM Plotted By: Shelly Comer 3/15/2022 7:15 AM Scale: 1:1



NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE
B – CONSTITUENT DETECTED IN BLANK

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME (10 UG/L)
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME (13 UG/L)

REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

DRWN: SCC	DATE: 02/18/22
CHKD: AAM	DATE: 02/18/22
APPD: JSZ	DATE: 02/22/22
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

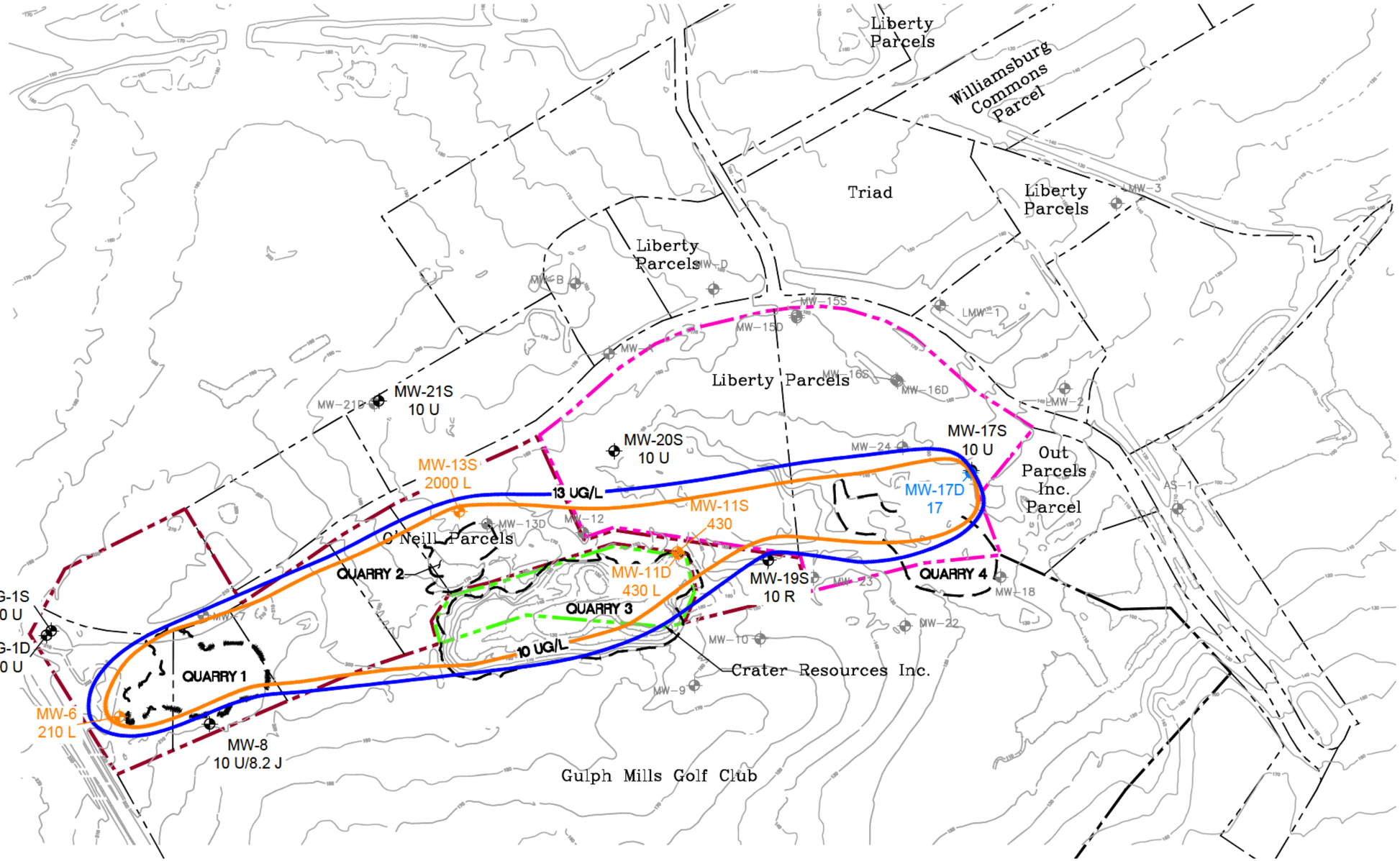
2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

TOTAL CYANIDE CONCENTRATIONS IN GROUNDWATER – (03/23–24/21)

PROJECT NO: 10–144

FIGURE 8A

y:\crater\10-144\mna\2021 annual mna report\figure 8a total cyanide 03-2021.dwg Last Saved By: Scomer 3/15/2022 7:09 AM Plotted By: Shelly Comer 3/15/2022 7:12 AM Scale: 1:1



LEGEND

- EXISTING MONITORING WELL
- APPROXIMATE QUARRY BOUNDARIES FROM 1959 AERIAL PHOTO
- 430 — TOTAL CYANIDE CONCENTRATION (UG/L)
- CRATER RESOURCES INC. PARCEL
- O'NEILL PARCELS
- LIBERTY PARCELS

NOTE:
U – ANALYTE NOT DETECTED AT THE INDICATED CONCENTRATION
J – RESULT SHOULD BE CONSIDERED A QUANTITATIVE ESTIMATE
L – RESULT BIASED LOW
R – RESULT IS REJECTED

– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – CENTER OF PLUME (10 UG/L)
– INDICATES EXCEEDANCE OF GW CLEANUP STANDARD – EXTENT OF PLUME (13 UG/L)

0 400 800 FEET

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

Non responsive based on

DATE: 02/18/22
DATE: 02/18/22
DATE: 02/22/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

TOTAL CYANIDE CONCENTRATIONS IN GROUNDWATER – (09/14–15/21)

PROJECT NO: 10–144
FIGURE 8B

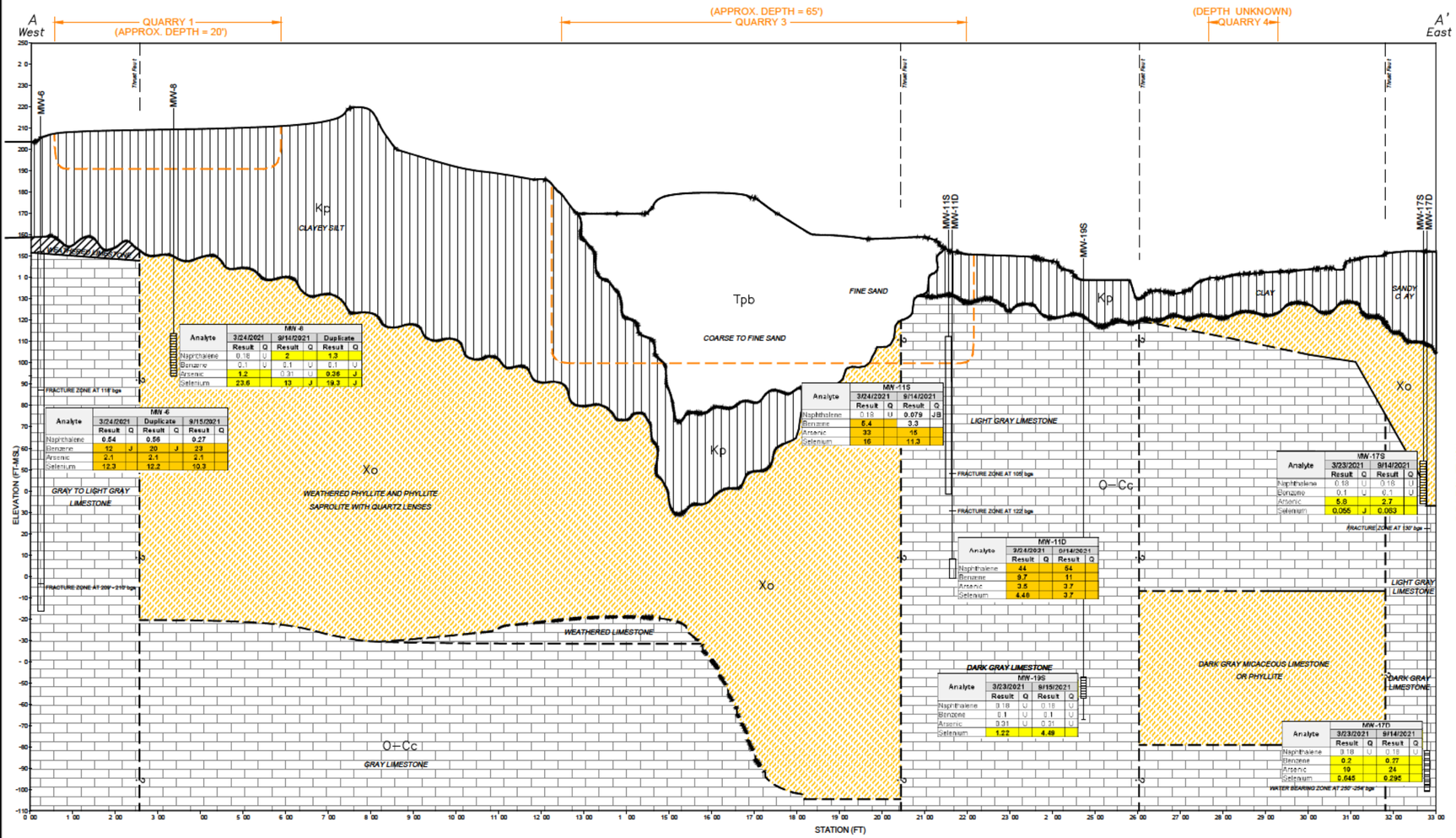
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 8b total cyanide 09-2021.dwg Last Saved By: Scamer 3/15/2022 7:08 AM Plotted By: Shelly Comer 3/15/2022 7:12 AM Scale: 1:1



MW-6						
Analyte	3/24/2021		9/15/2021		Duplicate	
	Result	Q	Result	Q	Result	Q
Naphthalene	0.18	U	2		1.3	
Benzene	0.1	U	0.1	U	0.1	U
Arsenic	1.2		0.31	U	0.26	J
Selenium	23.6		13	J	19.3	J

MW-6						
Analyte	3/24/2021		Duplicate		9/15/2021	
	Result	Q	Result	Q	Result	Q
Naphthalene	0.54		0.56		0.27	
Benzene	12	J	20	J	23	
Arsenic	2.1		2.1		2.1	
Selenium	12.3		12.2		10.3	

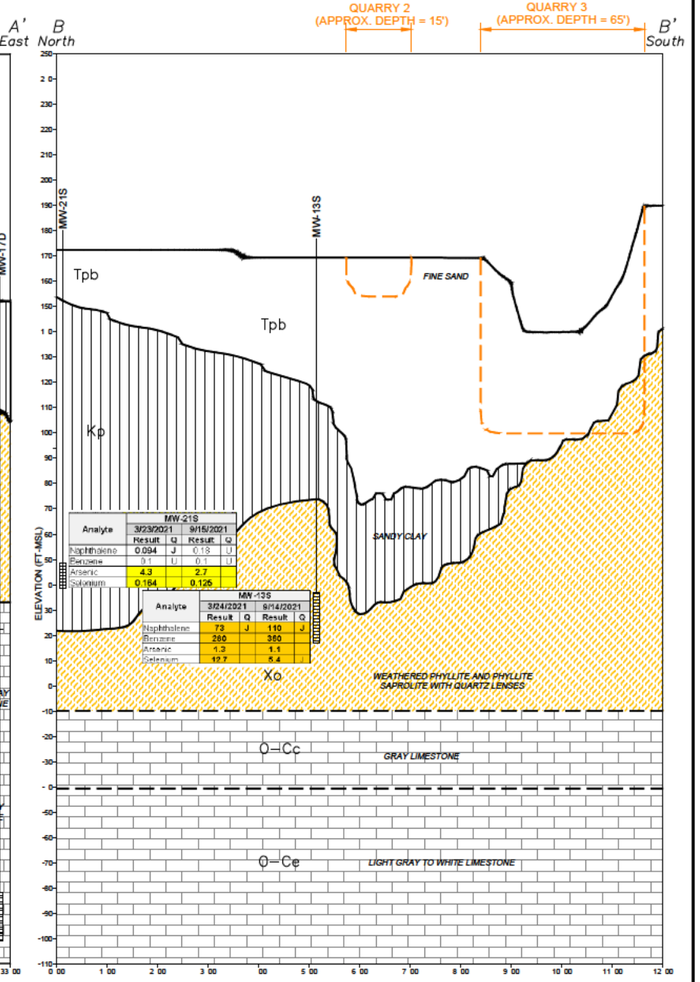
MW-11S				
Analyte	3/24/2021		9/14/2021	
	Result	Q	Result	Q
Naphthalene	0.18	U	0.079	JB
Benzene	5.4		3.3	
Arsenic	33		16	
Selenium	16		11.3	

MW-11D				
Analyte	3/24/2021		9/14/2021	
	Result	Q	Result	Q
Naphthalene	44		54	
Benzene	9.7		11	
Arsenic	3.5		3.7	
Selenium	4.46		3.7	

MW-19S				
Analyte	3/23/2021		9/15/2021	
	Result	Q	Result	Q
Naphthalene	0.18	U	0.18	U
Benzene	0.1	U	0.1	U
Arsenic	0.31	U	0.31	U
Selenium	1.22		4.49	

MW-17S				
Analyte	3/23/2021		9/14/2021	
	Result	Q	Result	Q
Naphthalene	0.18	U	0.18	U
Benzene	0.1	U	0.1	U
Arsenic	5.8		2.7	
Selenium	0.055	J	0.063	

MW-17D				
Analyte	3/23/2021		9/14/2021	
	Result	Q	Result	Q
Naphthalene	0.18	U	0.18	U
Benzene	0.2		0.27	
Arsenic	19		24	
Selenium	0.045		0.295	



MW-21S				
Analyte	3/23/2021		9/15/2021	
	Result	Q	Result	Q
Naphthalene	0.094	J	0.18	U
Benzene	0.1	U	0.1	U
Arsenic	4.3		2.7	
Selenium	0.184		0.125	

MW-13S				
Analyte	3/24/2021		9/14/2021	
	Result	Q	Result	Q
Naphthalene	73	J	110	J
Benzene	280		380	
Arsenic	1.3		1.1	
Selenium	12.7		5.4	

LEGEND

MW-18 — WELL DESIGNATION

GEOLOGIC CONTACT (DASHED WHERE INFERRED)

SCREENED INTERVAL

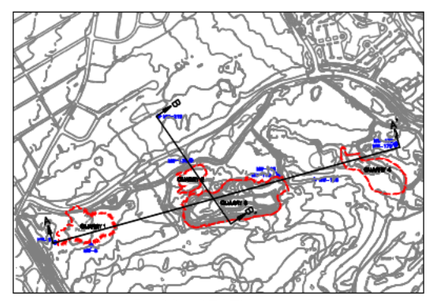
Tpb	PENSAUKEN/BRIDGETON FORMATION
Kp	PATAPSCO FORMATION
Xo	OCTORARO PHYLLITE
O-Cc	CONESTOGA LIMESTONE
O-Ce	ELBROOK FORMATION

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume
Naphthalene	ug/L	5	1
Benzene	ug/L	5	0.04
Arsenic	ug/L	1	0.04
Selenium	ug/L	0.4	0.006

– INDICATES EXCEEDENCE OF GW CLEANUP STANDARDS – CENTER OF PLUME

– INDICATES EXCEEDENCE OF GW CLEANUP STANDARD – EXTENT OF PLUME

(ND = NON-DETECT)
(J = ESTIMATED VALUE)
(B = BLANK)



CROSS-SECTION MAP

NOTES:
1. ALL RESULTS ARE REPORTED IN ug/L.
2. QUARRY 3 REMEDIATION WAS COMPLETED IN 2010. ALL CONTAMINATED SOILS WERE REMOVED AND CLEAN BACKFILL WAS PLACED.

V: 0 30 60 FEET
H: 0 150 300 FEET

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

Non responsive based on
DATE: 01/21/22
DATE: 01/21/22
DATE: 01/30/22
SCALE: AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

COI CONCENTRATION CROSS-SECTIONS

PROJECT NO: 10-144
FIGURE 9

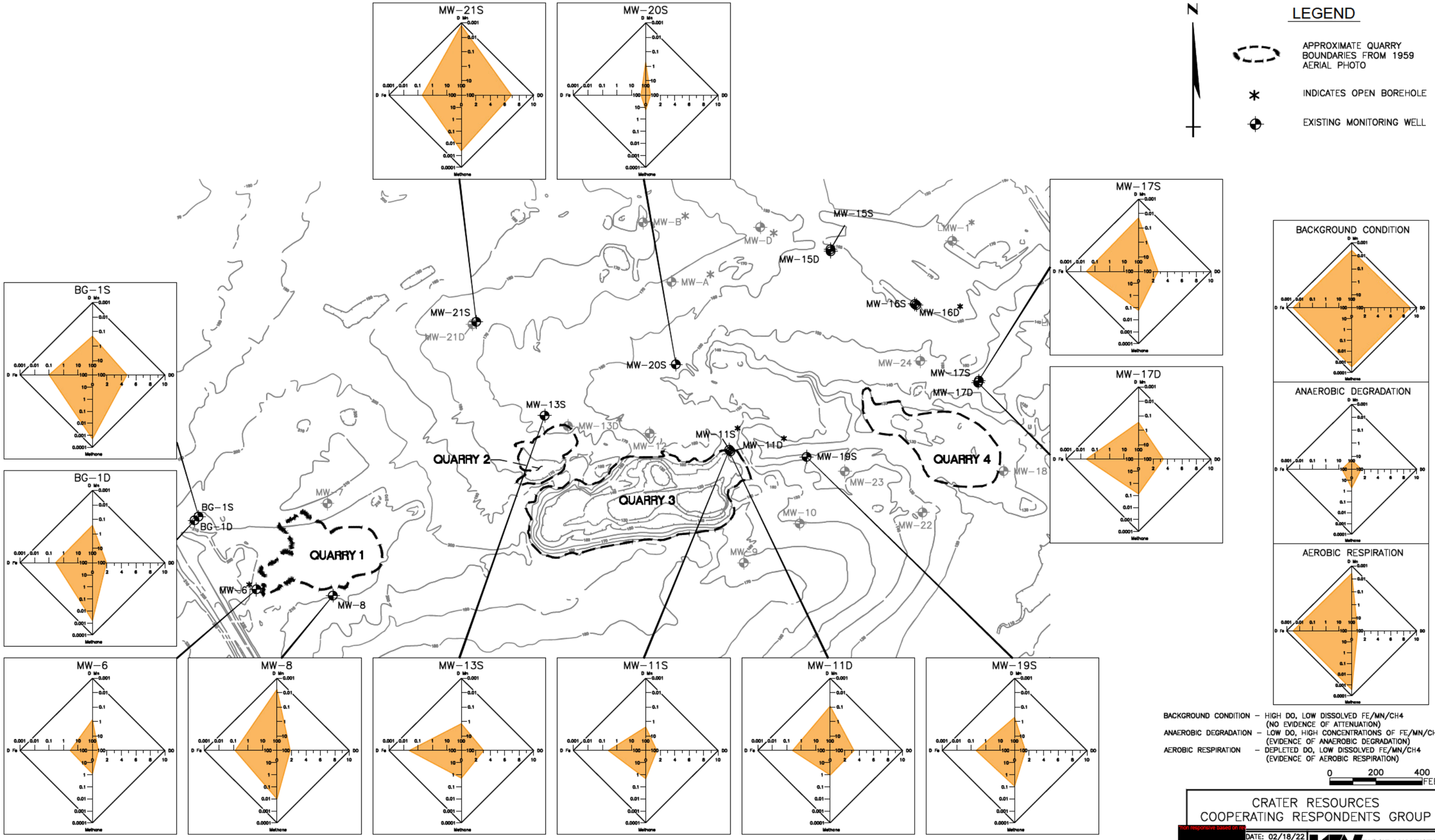
REV #	DATE	DESCRIPTION	APPD

REFERENCE:

ISSUE DATE:

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

y:\crater\10-144\mna\2021 annual mna report\figure 9 coi x-sections.dwg Last Saved By: Kchintello 1/20/2022 11:50 AM Plotted By: Kendra L. Chintello 1/20/2022 11:50 AM Scale: 1:2



BACKGROUND CONDITION – HIGH DO, LOW DISSOLVED FE/MN/CH4 (NO EVIDENCE OF ATTENUATION)

ANAEROBIC DEGRADATION – LOW DO, HIGH CONCENTRATIONS OF FE/MN/CH4 (EVIDENCE OF ANAEROBIC DEGRADATION)

AEROBIC RESPIRATION – DEPLETED DO, LOW DISSOLVED FE/MN/CH4 (EVIDENCE OF AEROBIC RESPIRATION)

0 200 400 FEET

NOTES:
1. ALL CONCENTRATION DATA REPORTED IN PARTS PER MILLION (mg/L.)
2. DISSOLVED Fe, DISSOLVED Mn, AND METHANE PRESENTED IN LOGARITHMIC SCALE FORMAT.
3. SCALE FOR DISSOLVED Fe, DISSOLVED Mn, AND METHANE INCREASE TOWARDS CENTER. SCALE FOR DO INCREASES TOWARD OUTER EDGE OF PLOT.
4. METHANE MINIMUM LIMIT SET AT 0.0001 mg/L AND Mn LIMIT SET AT 0.001 mg/L.
5. ALL NON-DETECTED ANALYTES ARE PRESENTED AT CONCENTRATIONS OF 1/2 THE REPORTING LIMIT.

REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE:

ISSUE DATE:

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

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

[redacted]	DATE: 02/18/22	KEY ENVIRONMENTAL INCORPORATED
	DATE: 02/18/22	
	DATE: 02/18/22	
SCALE: AS SHOWN		

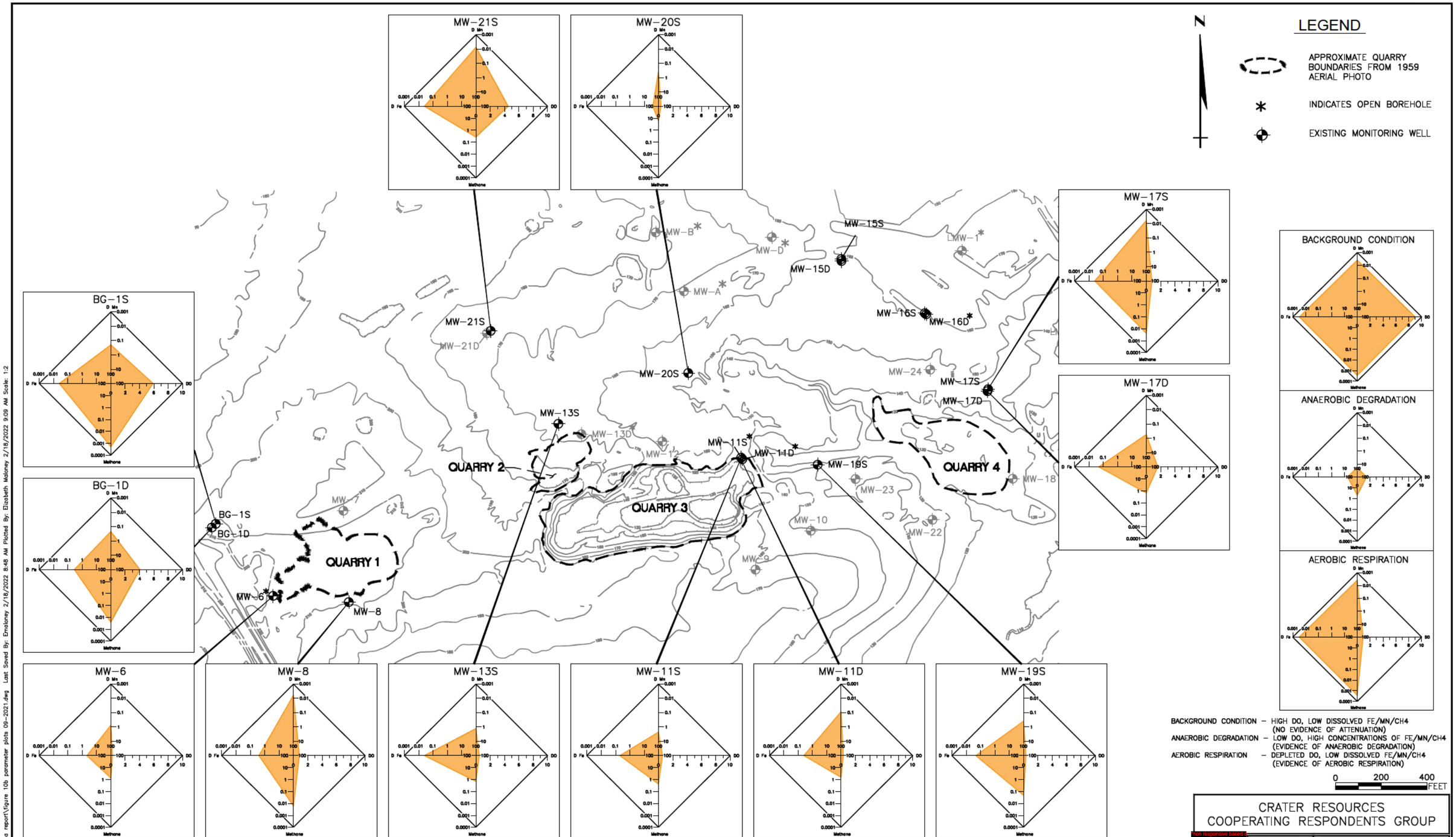
2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

MNA PARAMETER PLOTS
MARCH 2021

PROJECT NO: 10-144

FIGURE 10A

y:\crater\10-144\mna\2021 annual mna report\figure 10a parameter plots 03-2021.dwg Last Saved By: Emaloney 2/18/2022 8:38 AM Plotted By: Elizabeth Maloney 2/18/2022 8:42 AM Scale: 1:2



BACKGROUND CONDITION – HIGH DO, LOW DISSOLVED FE/MN/CH4 (NO EVIDENCE OF ATTENUATION)
ANAEROBIC DEGRADATION – LOW DO, HIGH CONCENTRATIONS OF FE/MN/CH4 (EVIDENCE OF ANAEROBIC DEGRADATION)
AEROBIC RESPIRATION – DEPLETED DO, LOW DISSOLVED FE/MN/CH4 (EVIDENCE OF AEROBIC RESPIRATION)

0 200 400 FEET

NOTES:
1. ALL CONCENTRATION DATA REPORTED IN PARTS PER MILLION (mg/L.)
2. DISSOLVED Fe, DISSOLVED Mn, AND METHANE PRESENTED IN LOGARITHMIC SCALE FORMAT.
3. SCALE FOR DISSOLVED Fe, DISSOLVED Mn, AND METHANE INCREASE TOWARDS CENTER. SCALE FOR DO INCREASES TOWARD OUTER EDGE OF PLOT.
4. METHANE MINIMUM LIMIT SET AT 0.0001 mg/L AND Mn LIMIT SET AT 0.001 mg/L.
5. ALL NON-DETECTED ANALYTES ARE PRESENTED AT CONCENTRATIONS OF 1/2 THE REPORTING LIMIT.

REV #	DATE	DESCRIPTION	APPD
1			

REFERENCE:

ISSUE DATE:

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

CRATER RESOURCES
COOPERATING RESPONDENTS GROUP

non responsive based	DATE: 02/18/22
	DATE: 02/18/22
	DATE: 02/18/22
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

2021 ANNUAL MNA REPORT
CRATER RESOURCES SITE
UPPER MERION TWP., PENNSYLVANIA

MNA PARAMETER PLOTS
SEPTEMBER 2021

PROJECT NO: 10-144

FIGURE 10B

y:\crater\10-144\mna\2021 annual mna report\figure 10b parameter plots 09-2021.dwg Last Saved By: Emaloney 2/18/2022 8:48 AM Plotted By: Elizabeth Maloney 2/18/2022 9:09 AM Scale: 1:2