THIRD FIVE-YEAR REVIEW REPORT FOR CRATER RESOURCES, INC./KEYSTONE COKE CO./ALAN WOOD STEEL CO. SUPERFUND SITE UPPER MERION TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA

September 2016

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SEP 12 2016
Date

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LIST OF ACRONYMS

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIC	Community Involvement Coordinator
COC	Contaminant of Concern
CSFA	Cinder/Slag Fill Area
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
ESPC	Erosion and Sediment Pollution Control
FFS	Focused Feasibility Study
FRA	Focused Risk Assessment
FYR	Five-Year Review
GPR	Ground-Penetrating Radar
GPRA	Government Performance and Results Act
HI	Hazard Index
HQ	Hazard Quotients
IC	Institutional Control
ICR	Increased Carcinogenic Risk
IRDR	Interim Remedial Design Report
LDP	Land Development Plan
LPT	Liberty Property Trust
MCCD	Montgomery County Conservation District
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/kg	Milligram per Kilogram
µg/L	Microgram per Liter
MIPP	Municipal Industrial Pretreatment Program
MNA	Monitored Natural Attenuation
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PADEP	Pennsylvania Department of Environmental Protection
PADOH	Pennsylvania Department of Health
PAH	Polycyclic Aromatic Hydro
PDI	Pre-Design Investigation
Penn E&R	Penn Environmental & Remediation, Inc.
PID	Photoionization Detector
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RD	Remedial Design
RDR	Remedial Design Report
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

RPM	Remedial Project Manager
RSL	Regional Screening Level
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
UAO	Unilateral Order
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
WAL	Waste Ammonia Liquor

EXECUTIVE SUMMARY

The Crater Resources, Inc./Keystone Coke Co./Alan Wood Steel Co. Superfund site (the Site) is located about 1 mile southeast of King of Prussia in Upper Merion Township, Montgomery County, Pennsylvania. From 1918 until 1981, Alan Wood Steel Co. and its successors operated a coke and coke byproduct manufacturing facility about 1 mile northeast of the Site in Swedeland, Pennsylvania. Facility operations included pumping waste ammonia liquor (WAL) through a pipeline from the Alan Wood facility to on-site quarries. The discharge of coke plant wastes to several site areas, waste overflow from on-site quarries where waste was disposed of, and releases and leaks from the WAL transport pipeline contaminated soil, sediment and groundwater with cyanide, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and metals.

The United States Environmental Protection Agency (EPA) placed the Site on the Superfund program's National Priorities List (NPL) on October 14, 1992. EPA selected a remedy in a 2000 Record of Decision (ROD). The ROD addressed contaminated groundwater, soil, sediment and the WAL pipeline. EPA revised the remedial components for the Quarry 3 area of the Site in a 2009 Explanation of Significant Differences (ESD). The current remedy, as described in the 2000 ROD and modified by the 2009 ESD, includes dewatering and on-site treatment of contaminated water within Quarry 3 ponds; excavation, and off-site disposal of Quarry 3 soil and sediment; backfilling and regrading of Quarry 3; construction of permanent caps over Quarries 1, 2 and 4; and monitored natural attenuation (MNA) of contaminated groundwater. The selected remedy also included further investigation of the former WAL pipeline, performance of any remedial actions (RAs) deemed necessary based on those investigations, and implementation of institutional controls (ICs). In the years following the 2000 ROD, EPA divided the Site into 10 separate operable units (OUs) to facilitate cleanup of the different parts of the Site, which are as follows:

OU1	Quarry 1 soil
OU2	Quarry 2 soil
OU3	Quarry 3 soil and sediment
OU4	Quarry 4 soil and sediment
OU5	WAL pipeline soil and sediment
OU6	MNA of groundwater
OU7	Cinder/Slag Fill Area (CSFA) soil
OU8	Area 6 soil
OU9	Southeast Disposal Area soil
OU10	Lot 7 and nearby daycare soil

Site potentially responsible parties (PRPs) have completed remedy construction for OU3, OU5, OU6, OU7, OU8, OU9 and OU10. Permanent caps have not yet been constructed at OU1, OU2 or OU4. Temporary caps installed at OU1 and OU2 provide protectiveness by preventing direct contact with contaminated soils. The triggering action for this five-year review (FYR) was the signing of the previous FYR on September 15, 2011.

The remedies for OU1 and OU2 will be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled by limited exposure to unsafe soils by placement of temporary caps (OU1 and OU2). The remedy for OU4 is protective in the short-term and implementation of ICs will

control exposure to unacceptable risk. However, in order for the remedy at OU1, OU2 and OU4 to be protective in the long term, several actions described within this FYR are needed.

The remedy for OU3 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks have been addressed through the removal of contaminated soils and sediment and through the implementation of ICs.

The remedy for OU5 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks have been addressed by excavation of contaminated soils and by the implementation of land use restrictions for the OU property parcels.

The remedy for OU6 currently protects human health and the environment by the implementation of ICs to prevent the use of groundwater. A vapor intrusion evaluation also determined that current indoor air exposure to groundwater contaminants does not present an unacceptable risk; however, any future construction over or within 100 feet of the groundwater plume should consider the potential for vapor intrusion during design and construction.

The remedies for OU7, OU8, OU9 and OU10 are protective of human health and the environment. Exposure pathways that could result in unacceptable risks have been addressed through the removal of contaminated soils and through the implementation of ICs.

Government Performance and Results Act (GPRA) Measure Review

As part of this FYR, the GPRA Measures have also been reviewed. The GPRA Measures and their status are provided as follows:

Environmental Indicators
Human Health: Human Exposure Controlled
Groundwater Migration: Groundwater Migration under Control

Sitewide Ready for Anticipated Use
The Site has not achieved Sitewide Ready for Anticipated Use.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Crater Resources, Inc./Keystone Coke Co./Alan Wood Steel Co.		
EPA ID: PAD980419097		
Region: 3	**State:** PA	**City/County:** Upper Merion Township/Montgomery County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" selected above, enter Agency name:** Click here to enter text.
Author name: Joseph McDowell, with additional support provided by Skeo Solutions
Author affiliation: EPA Region 3
Review period: November 2015 – September 2016
Date of site inspection: 11/10/2015
Type of review: Statutory
Review number: 3
Triggering action date: 9/15/2011
Due date *(five years after triggering action date)*: 9/15/2016

FIVE-YEAR REVIEW SUMMARY FORM (CONTINUED)

Issues/Recommendations

Issues and Recommendations Identified in the Five-Year Review:

OU(s): OU6	Issue Category: Monitoring			
	Issue: Vapor intrusion modeling indicates the potential for exposure for new construction over portions or within 100 feet of the groundwater plume, particularly in the vicinity of Quarries 1 and 2. Modeling and investigations do not indicate a current unacceptable risk to existing buildings.			
	Recommendation: New buildings constructed over or within 100 feet of the groundwater plume should assess the requirements for vapor intrusion mitigation technology in their design and construction. These requirements will be added in a future decision document.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	TBD

Protectiveness Statement(s)

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU1, Quarry 1	Will be Protective	

Protectiveness Statement:

The remedy at OU1 is expected to be protective of human health and the environment upon completion. A temporary cover currently prevents human exposure to soils in the short term. In the long term, this OU is expected to be capped, permanently in accordance with the 2000 ROD. However, under that ROD, the restriction of residential use was also expected. A change in anticipated land use has been proposed for OU1, from commercial to residential and EPA is in the process of considering whether this land use change would affect the cap design, specifically in terms of cap extent. As part of this effort, an updated risk assessment is being prepared under separate cover, at which time the protectiveness of the proposed modification to the remedy will be evaluated. If the change is adopted, a new decision document will be prepared.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU2, Quarry 2	Will be Protective	

Protectiveness Statement:
The remedy at OU2 is expected to be protective of human health and the environment upon completion. A temporary cap over Quarry 2 currently prevents human exposure to unsafe concentrations of soil contamination in the short term. In the long term, this OU is expected to be capped permanently, in accordance with the 2000 ROD. However, under that ROD, the restriction of residential use was also expected. A change in anticipated land use has been proposed for OU2, from commercial to residential. EPA is in the process of evaluating the proposed modification to the remedy, specifically in terms of cap extent. As part of this effort, an updated risk assessment is being prepared under separate cover, at which time the protectiveness will be evaluated. If the change is adopted, a new decision document will be prepared.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU3, Quarry 3	Protective	

Protectiveness Statement:
The remedy for OU3 is protective of human health and the environment because exposure pathways that could result in unacceptable risks have been addressed by excavating and properly disposing of Quarry 3 contaminated soil and sediment. This OU contained an open quarry (the former site of three ponds) and is otherwise expected to be used as open space, with land use controls. Residential use is prohibited. The post-removal samples underwent a screening process and are protective for commercial/industrial workers.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU4, Quarry 4	Short-term Protective	

Protectiveness Statement:
The remedy is protective of human health and the environment in the short-term. The land is used as an office park, and residential use is not permitted under the terms of the 2000 ROD. EPA anticipates modifying the cap performance standards for this quarry, following an investigation and assessment of the risks via direct contact, and an assessment that found a lack of Quarry 4 impacts on groundwater. The current soil cover underwent a screening process for commercial/industrial use, and were found to be protective for workers. If the change is adopted, a new decision document will be prepared.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU5, WAL Pipeline	Protective	

Protectiveness Statement:
The remedy for OU5 is protective of human health and the environment because exposure pathways that could result in unacceptable risks have been addressed by the soil removal and proper offsite disposal completed at the properties located along the former WAL pipeline. Land use restrictions that prohibit residential land use and disturbance of the land surface are in place for several areas where residual soil does not allow for unrestricted land use. The remaining soil underwent a screening process and were found to be protective for workers. The Liberty and Williamsburg properties were also evaluated using site-specific risk assessment and were found to be protective for residents.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU6, groundwater	Short-term Protective	

Protectiveness Statement:
The remedy is currently protective in the short term since groundwater contaminated by the Site is not used as a source of drinking water. The groundwater cleanup is still underway, and the exposure and toxicity factors for these chemicals have evolved since the 2000 ROD, and may continue to change in the future. Therefore, a reevaluation of the risk should be performed to determine the protectiveness of the groundwater goals at the point when it is believed that the groundwater has been successfully remediated. A review of the data indicates the current area of groundwater contamination has not been mapped; therefore, a plume map should be prepared with future annual reports. The remediation needs to continue, in order to reduce future risks. As noted previously, vapor intrusion is also a potential consideration for future construction, but current conditions are protective of workers at nearby buildings.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU7, OU8, OU9 and OU10 soil	Protective	

Protectiveness Statement:
The remedy for OU7, OU8, OU9 and OU10 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks have been addressed through the removal of contaminated soil and implementation of ICs. The existing soil samples from each of these OUs were found to be protective for workers. The February 2006 Restrictive Covenant and February 2008 Notice of Superfund Site and Use Restrictions prevent the installation of new groundwater wells or use of existing wells other than to implement the remedy, prohibit residential land use, and prohibit disturbance of the surface of the land, without prior EPA approval.

Third Five-Year Review Report
for
Crater Resources, Inc./Keystone Coke Co./Alan Wood Steel Co.
Superfund Site

1.0 Introduction

The purpose of a FYR is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. FYR reports document FYR methods, findings and conclusions. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

EPA prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121 states:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each 5 years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

EPA interpreted this requirement further in the NCP, 40 Code of Federal Regulations Section 300.430(f)(4)(ii), which states:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the selected remedial action.

EPA Region 3, with contractor support from Skeo Solutions, conducted the FYR and prepared this report regarding the remedy implemented and being implemented at the Crater Resources, Inc./Keystone Coke Co./Alan Wood Steel Co. Superfund site (the Site) in Upper Merion Township, Montgomery County, Pennsylvania. EPA conducted this FYR from November 2015 to September 2016. EPA is the lead agency for selecting, developing, and implementing the remedy for the PRP-financed cleanup at the Site. The Pennsylvania Department of Environmental Protection (PADEP), as the support agency representing the Commonwealth of Pennsylvania, has reviewed all supporting documentation and provided input to EPA during the FYR process.

This is the third FYR for the Site. The triggering action for this statutory review is the previous FYR. The FYR is required because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. The Site consists of 10 OUs. This FYR report addresses all site OUs that were established after the selection of the remedy. The OUs are described in section 4.2.

2.0 Site Chronology

Table 1 lists the dates of important events for the Site.

Table 1: Chronology of Site Events

Event	Date
Different parties mined the on-site quarries for sand, gravel, limestone and marble	1800s-early 1900s
Alan Wood Steel Company (Alan Wood) and its successors operated a coke and coke byproduct manufacturing facility in nearby Swedeland, Pennsylvania and discharged waste ammonia liquor (WAL) to three quarries on site	1918-1977
The Pennsylvania Department of Health (PADOH) initiated an environmental investigation at the Site	January 6, 1969
Alan Wood installed a prototype treatment plant to treat its industrial wastes and discharge them to the Schuylkill River	1975
Alan Wood filed for bankruptcy. The facility and property were first leased and subsequently sold to the Keystone Coke Company (Keystone Coke)	1977
EPA conducted a groundwater monitoring survey	May 16, 1979
Operations ceased at the Keystone Coke facility	April 1, 1981
EPA conducted a preliminary site assessment	April 8, 1983
EPA performed a site inspection	May 9, 1983
EPA proposed the Site for inclusion on the Superfund program's National Priorities List (NPL)	February 7, 1992
EPA added the Site to the NPL	October 14, 1992
Beazer East, Inc., Keystone Coke and Vesper Corporation (collectively referred to as the Crater PRP Group) initiated a remedial investigation and feasibility study (RI/FS)	September 7, 1994
Crater PRP Group entered into an Administrative Order on Consent with EPA to perform the RI/FS	September 17, 1994
EPA approved RI	June 23, 1999
EPA completed a Human Health Risk Assessment	December 14, 1999
EPA approved FS	June 16, 2000
Crater PRP Group completed RI/FS; EPA selected the site remedy in a Record of Decision (ROD)	September 27, 2000
Unilateral Administrative Order issued to Beazer East, Inc., Keystone Coke, Crater Resources, Inc., Each As Is, Inc., Gulph Mills Golf Club, Inc., Liberty Property Limited Partnership, Liberty Property Trust (LPT), R-T Option Corporation and Vesper Corporation (PRP Group) to conduct Remedial Design (RD) and Remedial Action (RA)	April 30, 2001
PRPs initiated RD for: Quarry 1 cap (OU1), Quarry 2 cap (OU2), phase 1 of the Quarry 3 removal (OU3), Quarry 4 cap (OU4), WAL Pipeline (OU5 – initial RD), groundwater monitored natural attenuation (MNA) (OU6), Cinder/Slag Fill Area (CSFA) (OU7), Area 6 (OU8), Southeast Disposal Area (OU9), and Lot 7 and nearby daycare center (OU10)	June 1, 2001
Pre-Design Work Plan for OU1 and OU2 approved by EPA	July 3, 2001

Event	Date
PRPs completed RD and initiated RA for OU7	September 17, 2001
Remedial Design/RA Work Plan for OU7 approved by EPA	October 29, 2001
Pre-Design Investigation (PDI) Report for OU1 and OU2 approved by EPA	December 3, 2001
Remedial Design Work Plan for OU3 approved by EPA	April 14, 2003
Remedial Design Work Plan for OU8 approved by EPA	August 20, 2003
OU3 PDI conducted by the PRP Group	June 16, 2003 to September 15, 2003
Remedial Action Report for OU7 approved by EPA	September 30, 2003
OU8 PDI Work Plan Addendum approved by EPA	April 20, 2004
Remedial Design Work Plan for OU4 Demonstration Project approved by EPA	June 29, 2004
Remedial Design Work Plan for OU5 at 3000 Horizon Drive approved by EPA	March 1, 2005
Remedial Design Work Plan for OU1 and OU2 approved by EPA	May 24, 2005
Remedial Design Work Plan OU5 at Quarry 2 approved by EPA	July 21, 2005
Remedial Action Work Plan for OU5 Removal at 3000 Horizon Drive approved by EPA	February 8, 2006
RAGM Holding Company, Crater Resources, Inc. and the Crater PRP Group recorded a restrictive covenant with Montgomery County establishing institutional controls (ICs) at OU3, OU4, OU5, OU8, OU9, and OU10	February 9, 2006
PDI Work Plan for OU6 approved by EPA	April 13, 2006
IC Work Plan submitted	July 16, 2006
EPA completed the Site's first FYR	September 15, 2006
Report of Investigations and Risk Assessments for Four Areas of Concern (AOCs) at OU1 and OU2 approved by EPA	December 19, 2006
Remedial Action Report for OU5 Removal at 3000 Horizon Drive approved by EPA	January 12, 2007
Remedial Action Construction Start at OU1 and OU2	April 23, 2007
Soil Management Plan for Non-Impacted Areas at OU1 and OU2 approved by EPA	July 5, 2007
Report of Results and Human Health Risk Assessment for Pennsylvania Department of Environmental Protection (PADEP) AOC and Former WAL Pipeline at OU2 approved by EPA	September 17, 2007
Remedial Design Work Plan for OU8 and OU9 approved by EPA	September 20, 2007
Report of Results for Additional Remedial Action at PADEP AOC at OU2 approved by EPA	December 17, 2007
Remediation Plan for Relocation of Soils from OU1 Boring 141/203 AOC to OU2 approved by EPA	January 7, 2008
ICs implemented for OU4 and OU7 by Liberty	February 26, 2008
OU6 PDI Report approved by EPA	March 19, 2008
RD for OU 1 and OU2 approved by EPA	March 27, 2008
Supplemental PDI for OU6 approved by EPA	April 9, 2008
Focused FS for surface water treatment and discharge of Quarry 3 pond water approved by EPA	July 24, 2008
PRPs initiated phase 2 of the RD for OU3	July 9, 2008
Report of Results for Boring 141/203 AOC at OU1 approved by EPA	December 4, 2008
Report of Results for Relocation of Soils from OU1 to OU2 approved by EPA	January 23, 2009
PRP Group completed phase 1 of the RD for OU3	February 6, 2009
Remedial Action Work Plan for OU3 Phase 1A; Appendix E (Water Treatment and Discharge) approved by EPA	February 18, 2009

Event	Date
RA at OU3 initiated	February 24, 2009
Indoor Air Sampling Plan for Kindercare Learning Center (OU10) approved by EPA	March 6, 2009
Health Risk Assessment for Area 6 OU8 approved by EPA	March 31, 2009
Technical Memorandum for Statistical Analysis of Quarry 3 Soils and Development of Naphthalene Concentration in Soils approved by EPA	April 6, 2009
OU3 Phase 1A Remedial Action Work Plan approved by EPA	April 13, 2009
OU3 Phase 1B Remedial Action Work Plan approved by EPA	April 21, 2009
ESD issued for OU3 to revise the cleanup goal for naphthalene in soil and sediment at Quarry 3 and allow for on-site treatment of surface water in the three Quarry 3 ponds	April 29, 2009
Phase 2 RD for OU3 approved by EPA	July 21, 2009
Health Risk Assessment for OU5 approved by EPA	September 16, 2009
OU5 Investigation Report approved by EPA	September 21, 2009
Remedial Design and Remedial Action Work Plan for OU5 approved by EPA	October 7, 2009
RA Construction at OU5 initiated	October 14, 2009
PRP Group completed RD for OU10	November 24, 2009
PRP Group performed RA for OU10	December 5, 2009 to January 9, 2010
PRP Group completed RD for OU8 and OU9	December 10, 2009
PRP Group performed RA for OU8	December 18, 2009 to January 22, 2010
PRP Group performed RA for OU9	December 22, 2009 to January 21, 2010
Post Excavation Risk Evaluation for Soil, OU5 at Williamsburg Commons Property approved by EPA	March 19, 2010
Post Excavation Risk Evaluations for OU8 and OU9 approved by EPA	June 1, 2010
Health Risk Assessment for OU10 Post-Excavation Soil approved by EPA	June 2, 2010
Air Quality Report for Kindercare Learning Center approved by EPA	June 3, 2010
EPA provided conditional approval of Interim Remedial Design Report for Quarry 4 (OU4) Demonstration Project	July 22, 2010
PRP Group submitted RA Report for Former WAL Pipeline (OU5)	August 10, 2010
OU6 Work Plan approved by EPA	August 17, 2010
PRP Group completed both phases of the OU3 RA	August 19, 2010
OU4 Demonstration Project activities (well drilling) initiated	August 23, 2010
OU4 Demonstration Project sampling initiated	September 14, 2010
PRP Group initiated OU6 sampling	November 9, 2010
RA Reports for OU8 and OU9 approved by EPA	December 14, 2010
RA Report for OU3 submitted	December 15, 2010
PRPs entered into a Consent Decree with EPA for site-related cost reimbursement	May 9, 2011
EPA approved the OU10 RA report	August 2, 2011
EPA completed the Site's second FYR	September 15, 2011
Revised ICs Work Plan submitted	November 22, 2011
RA Report for OU5 approved by EPA	January 17, 2012
Report of Results for Relocation of Soils from OU1 to OU2 approved by EPA	January 26, 2012
Work Plan for Vapor Intrusion Investigation at 2701 Renaissance Boulevard approved by EPA	February 13, 2012
OU6 Annual Monitoring Report for 2011	February 23, 2012
RA for OU3 approved by EPA	March 29, 2012

Event	Date
Amendment to the OU4 Demonstration Project Work Plan to include analysis for available cyanide approved by EPA	June 19, 2012
O'Neill conducted a vapor intrusion evaluation for 2701 Renaissance Boulevard	January 25, 2013
OU6 Annual Monitoring Report for 2012	April 30, 2013
Revised Final RD Report for the OU4 Demonstration Project Submitted	January 13, 2014
OU6 Annual Monitoring Report for 2013	March 6, 2014
PADEP concurred on a request for waiver of cap requirements at OU4	March 18, 2014
OU6 Annual Monitoring Report for 2014	March 25, 2015
O'Neill submitted an update to EPA's 1999 Human Health Risk Assessment for the Quarry 1 and Quarry 2 areas	August 10, 2015
EPA comments on the 2014 OU6 Annual Monitoring Report provided to PRP Group	November 30, 2015
Vapor Intrusion Summary Report for 2701 Renaissance Boulevard approved by EPA	February 1, 2016
Request to change land use at 2501 and 2901 Residential Boulevard properties submitted to EPA	February 24, 2016
Environmental Work Plan for Geotechnical Investigations at OU1 and OU2 submitted to EPA	March 22, 2016
Environmental Work Plan for Parking Lot Partial Cap Construction Over Quarry 1	May 11, 2016

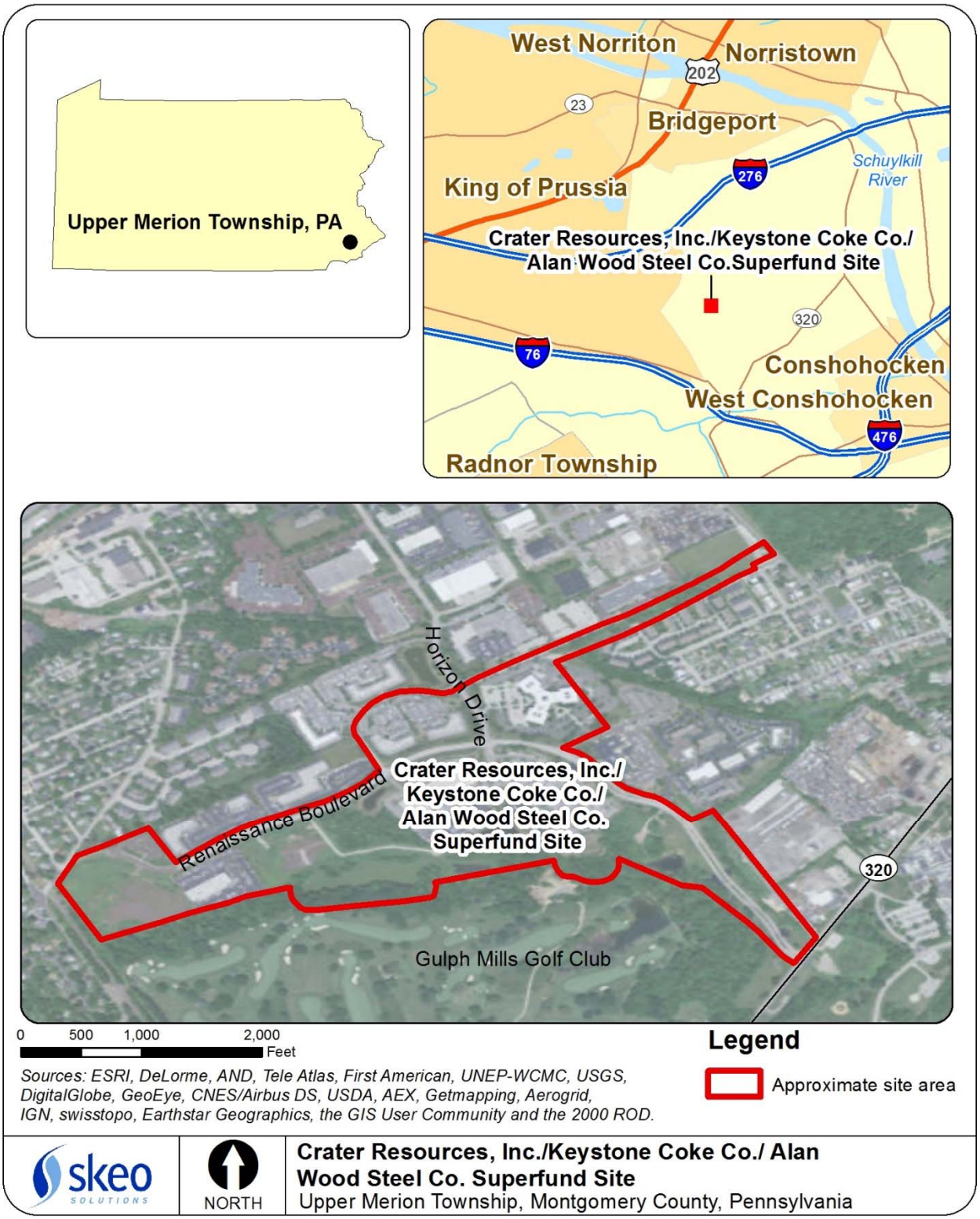
3.0 Background

3.1 Physical Characteristics

The Site is located about 1 mile southeast of King of Prussia in a developed area of Upper Merion Township, Montgomery County, Pennsylvania (Figure 1). A former nearby coke plant previously disposed of facility wastes at several different locations throughout the Site. The 50-acre Site consists of multiple subdivided parcels, owned by different private entities. Current site features include commercial businesses, partially developed properties and four former quarries (Quarries 1, 2, 3 and 4) (Figure 2). All four quarries occupy about 14 acres of the Site. Quarries 1, 2 and 4 are backfilled to match surrounding grade. Quarries 1 and 2 have a temporary cover consisting 8 inches of modified 2A stone placed over a geotextile layer. Quarry 3 is about 65 feet deep and occupies about 8 acres. It remains open and is vegetated with grass. Quarry 4 is covered by a paved parking area, the corner of an office building, grass, and a stormwater collection basin. The Site includes several former waste disposal areas and areas surrounding those areas that were impacted by site-related contamination.

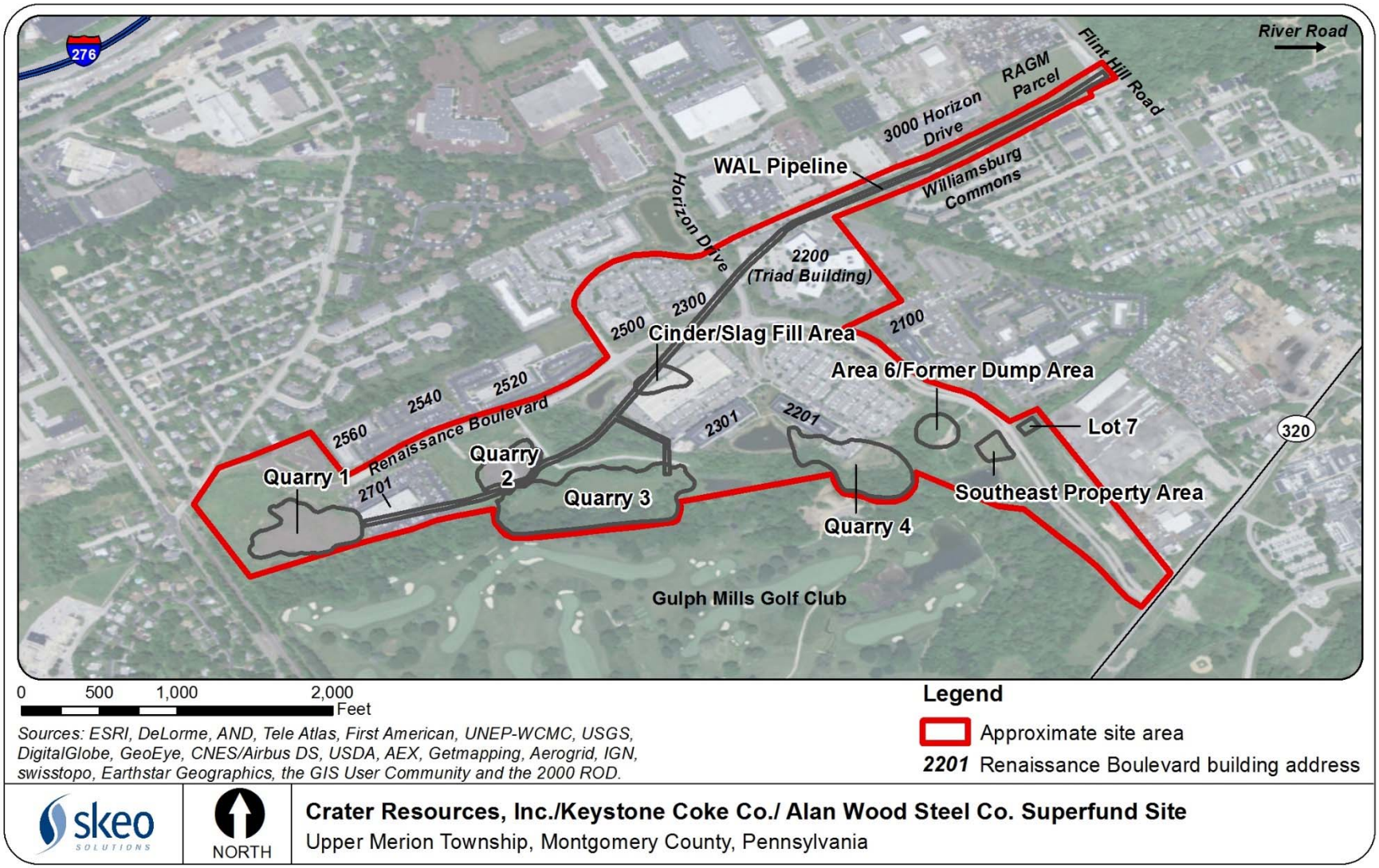
Renaissance Boulevard divides the Site, running east to west. Horizon Drive runs from south to north through the northern half of the Site. The Site is surrounded by commercial and light industrial development to the north, east and west; scattered residential development to the northeast and northwest; and the Gulph Mills Golf Club to the south.

Figure 1: Site Location Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Surface water in the vicinity of the Site generally flows east toward the Schuylkill River, which is located 1 mile east of the Site (Figure 1). Matsunk Creek drains the area southeast of the Site and discharges to the Schuylkill River. Groundwater in the site vicinity predominantly flows toward the east/northeast, toward the Schuylkill River and parallel to the bedrock strike (Figure 5). Pumping of large volumes of groundwater for the municipal water supply to the north of the Site further influences the northeastern flow of groundwater near the Site.

The Site is located in the eastern portion of the Piedmont Physiographic province and underlain by the Conestoga Formation. The Conestoga Formation, previously mined for limestone and marble, is up to 500 feet thick in the Upper Merion Township area. It consists primarily of thinly-bedded limestone and marble. Regionally, the Site lies in the eastern end of an east/northeastward trending geologic province known as the Chester Valley. The bedrock in the site vicinity is extensively fractured and jointed. The bedrock at the Site is overlain by unconsolidated sand and gravel deposits. Surficial evidence within the region indicates the presence of extensive subsurface karst dissolution features. Groundwater is present in the site vicinity within the Chester Valley carbonate aquifers.

3.2 Land and Resource Use

Historical accounts indicate that different parties mined the on-site quarries for sand and gravel (Quarries 1, 2 and 4), and limestone and marble (Quarry 3) from sometime in the 1800s until the early 1900s. From 1918 until 1981, a nearby coke and coke byproduct manufacturing facility disposed of facility wastes at several locations across the Site, including the four quarries. Much of the site ground surface is currently occupied by commercial development, consistent with the expected future land use mentioned in the Site's 2000 ROD. Several businesses operate within Renaissance Park, the on-site commercial office park. Renaissance Park includes the property and development along Renaissance Boulevard, within the Site boundaries (Figure 2). Planning is underway for additional commercial and residential development within the park. Residential developments occupy the northeastern portion of the Site. A small part of the Gulph Mills Golf Club is located on the far southern part of the Site.

The Site's 1999 remedial investigation (RI) determined that private wells are not used to supply potable water within the area potentially affected by site contamination. Upper Merion Township requires that all residential, commercial and industrial potable water users connect to public water if available. The township allows the use of water wells for non-potable uses. The RI identified Matsunk Creek as a warm water fishery.

3.3 History of Contamination

From 1918 until 1977, Alan Wood and its successors operated a coke and coke byproduct manufacturing facility about 1 mile northeast of the Site in Swedeland, Pennsylvania. After the company declared bankruptcy in 1977, Keystone Coke Company, Inc. (Keystone Coke) first leased, then purchased the facility and property. Keystone Coke produced and sold coke at the facility from 1978 until the spring of 1981 when all operations at the facility ceased.

The coking process typically generated coal gas, light oils, tars containing phenolic compounds, naphthalene, ammonia and WAL. Facility operations included pumping WAL through a pipeline from the Alan Wood facility to Quarries 1, 2 and 3 (Figure 2). Site investigations did not find evidence Quarry 4 was used directly for WAL disposal, but determined that it may have received contaminated water from Quarry 3 overflows and WAL pipeline releases. Sometime after 1969, property owners filled in Quarries 1, 2 and 4 with demolition debris and soil.

The Pennsylvania Department of Health (PADOH) and the Pennsylvania Department of Environmental Resources, now PADEP, conducted investigations at the Site between 1969 and the late 1970s. These investigations discovered elevated concentrations of cyanide and ammonia in the WAL discharge and area groundwater. EPA sampling between 1970 and 1990 found elevated concentrations of benzene, toluene, naphthalene, cyanide, zinc, arsenic, lead, phenolic compounds and PAHs in Quarry 3 soil and sediment, and elevated metals concentrations in groundwater.

EPA placed the Site on the Superfund program's NPL on October 14, 1992.

3.4 Initial Response

In September 1994, Beazer East, Inc., Keystone Coke and Vesper Corporation, collectively referred to as the Crater PRP Group, entered into an Administrative Order on Consent with EPA. Under the Administrative Order on Consent, the Crater PRP Group agreed to perform a remedial investigation and feasibility study (RI/FS) to fully determine the nature and extent of site contamination and explore cleanup options.

EPA approved the RI in June 1999 and completed a Human Health Risk Assessment in December 1999. EPA approved the FS in June 2000.

3.5 Basis for Taking Action

The RI concluded that site-related contaminants present increased carcinogenic and non-carcinogenic risks to human health. EPA's sitewide 1999 Human Health Risk Assessment determined that the receptors at greatest risk include future potential residential receptors, future industrial workers exposed to surface soils, and future construction workers exposed to surface and subsurface soil.

Groundwater sampling performed as part of the RI between 1996 and 1998 determined that a plume of contaminated groundwater extended from Quarry 1, toward the northeast. In general, sampling found elevated concentrations of metals, VOCs, semi-volatile organic compounds (SVOCs) and cyanide near the quarries. Surface water found in the three ponds in Quarry 3 contained cyanide above EPA's maximum contaminant level (MCL) and traces of iron, mercury and selenium.

RI sampling at several different site areas (quarries and other impacted areas) identified contamination in site soil. Contaminants of concern (COCs) associated with Quarry 3 surface

and subsurface soils were PAHs and metals. COCs in Quarry 3 sediment were PAHs. COCs in surface soils outside the quarries were aluminum, arsenic, iron, manganese, and benz(a)pyrene. The COCs in Yellow Parcel Pipeline soil (OU5) were PAHs and metals. Contaminant concentrations in sediment sample SS-3, collected from a drainage swale located between Quarry 3 and Quarry 4, contained elevated concentrations of phenols, PAHs and several metals. Groundwater COCs were VOCs, SVOCs, cyanide, and metals. Groundwater was divided into Center of Plume, where COC concentrations were notable higher, and Extent of Plume to represent the entire horizontal extent of the plume where concentrations were lower in concentration in wells located farther downgradient. The risk assessment calculated increased non-carcinogenic effects for industrial workers and adult and child residents.

The ecological risk assessment, performed as part of the RI, concluded that some exposure to ephemeral aquatic insects, amphibians and migratory species would likely occur. However, the small areal extent of the contaminated parts of the Site would limit such exposure. The ecological risk assessment identified terrestrial invertebrates that come into contact with soil as the most susceptible terrestrial receptors.

4.0 Remedial Actions

In accordance with CERCLA and the NCP, the overriding goals for any RA are protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). A number of remedial alternatives were considered for the Site, and final selection was made based on an evaluation of each alternative against nine evaluation criteria that are specified in Section 300.430(e)(9)(iii) of the NCP.

4.1 Remedy Selection

EPA selected a remedy to address sitewide groundwater, soil and sediment contamination in the September 2000 ROD. The ROD listed the following remedial action objectives (RAOs):

<u>Groundwater</u>

- Prevent future potential exposure to contamination via ingestion of site-related groundwater so that the exposure risk level is between 1×10^{-4} and 1×10^{-6} excess cancer risk and the hazard index (HI) is less than 1.
- Restoration of the aquifer to a beneficial use.

<u>Soil/Sediment</u>

- Eliminate exposure to soil/sediment that presents an unacceptable risk to human health or the environment.
- Prevent contact of soil/sediment constituents with other media that may transport the contamination (such as groundwater and surface water) so that the transport does not create an unacceptable risk to human health or the environment.

<u>Surface Water</u>

- Limit exposure of ecological receptors to contaminated surface water.

The ROD's remedy for soil, sediment, groundwater and surface water consisted of the following:

- Removal of all contaminated soil and sediment in Quarry 3. Remedial components include:
    - Dewatering and off-site disposal of water within Ponds 1, 2 and 3 within Quarry 3.
    - Excavation of pond sediments down to the bedrock layer or to the level where contaminant concentrations are at levels protective of groundwater, human health or ecological risk-based concentrations.
    - Dewatering and off-site disposal or recycling of excavated sediment.
    - Excavation of all Quarry 3 soil containing contaminant concentrations at levels above human health or ecological risk-based concentrations.
    - Off-site disposal or recycling of excavated contaminated soil.
    - Backfill Quarry 3 with clean fill and regrade the area.
- Construction of a cap to prevent infiltration of surface water into the contaminated soils at Quarries 1, 2 and 4 and other contaminated soil areas. The multi-media caps will consist of a series of low permeability clays, geotextile liners, sand drainage layers and soil or other appropriate covers.
- MNA of groundwater.
- Further investigation of the former WAL pipeline. Remedial components include:
    - Full investigation and characterization of the route of the former WAL pipeline where previous RAs have not been taken.
    - Removal and off-site disposal or recycling of any pipeline soil found to contain contaminant levels above human health or ecological risk-based concentrations.
    - Excavation and off-site disposal of any hardened tar material from past pipeline leaks.
- Institutional controls (ICs) to restrict on-site soil, sediment, surface water and groundwater use and/or disturbance at the Site in order to reduce the potential for human exposure to contamination.

The 2000 ROD estimated that it would take 15 years for MNA to meet groundwater cleanup goals. It also indicated that a contingent groundwater remedy would be required if, at any point during that 15-year timeframe, it was evident that MNA was not capable of meeting groundwater cleanup goals. The MNA remedy relied on the completion of remedial action at all OUs with impacted soils. The remedy at OU1 and OU2 has not been completed and are continuing sources of contaminants to groundwater. The contingent groundwater remedy included extraction and on-site treatment of contaminated groundwater, with discharge to Schuylkill River or Matsunk Creek.

Table 2 shows cleanup goals established in the 2000 ROD for the Site's groundwater COCs. The ROD based groundwater cleanup goals on health risk, assuming a risk of 1×10^{-6} for the extent of the plume, 3×10^{-5} for the center of the plume, and a HI of 1. At the time of the ROD, all risk-based cleanup goals were equal to or lower than MCLs.

Table 2: Groundwater COCs and Cleanup Goals

Groundwater COC	Cleanup Goal at Center of Plume (µg/L)	Cleanup Goal at Extent of Plume (µg/L)
Acetone	95.9	24
Benzene	5	0.04
Chloroform	1	0.015
Dibenzofuran	12	0.86
2,4-Dimethylphenol	1.15	1
2-Methylphenol	12.5	1
4-Methylphenol	47.7	1
Naphthalene	5	1
Phenol	7,860	—
Cyanide (Total)	10	13
Arsenic	1	0.04
Barium	40	450
Beryllium	4	4
Cadmium	—	0.62
Chromium	8	12
Cobalt	—	22
Iron	250	2,300
Lead	15	15
Manganese	66.8	310
Mercury	—	0.004
Nickel	—	260
Selenium	0.4	0.006
Thallium	—	0.17
Vanadium	—	0.41
Zinc	—	170

Notes:
a. Groundwater COCs as defined in the 2000 ROD.
µg/L: micrograms per liter
— : This symbol indicates that the ROD did not establish a cleanup goal for that COC at that specific plume location.

In April 2009, EPA modified the ROD with an ESD to revise remedial components for the Quarry 3 portion of the Site. The initial remedy included off-site disposal of surface water in the Quarry 3 ponds. Water level measurements collected in February 2008 indicated that the three Quarry 3 ponds contained an estimated 3.6 million gallons of water, a much greater volume than what was present at the time of the 2003 pre-design investigation (PDI). Under those circumstances, EPA and the Crater PRP Group determined that the transportation and off-site disposal of that large amount of impacted surface water would be cost-prohibitive, time-consuming and extremely difficult. The ESD revised the OU3 remedy to allow for on-site treatment of surface water in the three Quarry 3 ponds and subsequent discharge of the treated water to Matsunk Creek.

Following the selection of the remedy and establishment of Quarry 3 cleanup goals in the ROD, the Crater PRP Group used two EPA models, VLEACH and CHEMFLO2000, to evaluate naphthalene transport from peripheral Quarry 3 soil to groundwater, and to develop acceptable average residual soil concentrations of naphthalene in the peripheral soils that would be

protective of groundwater. Both models yielded similar naphthalene concentrations, greater than the ROD cleanup standards. EPA reviewed the modeling results and approved the revision of the naphthalene cleanup goal for Quarry 3 soil and sediment. The 2009 ESD revised the cleanup goal for naphthalene in soil and sediment at Quarry 3 from 0.2 milligrams per kilogram (mg/kg) to 48 mg/kg.

Table 5 shows soil and sediment cleanup goals established in the 2000 ROD, and amended in the 2009 ESD for naphthalene, for the Site's soil and sediment COCs. The ROD based soil and sediment cleanup goals on human health risk of 1×10^{-5} and a HI of 1.

4.2 Remedy Implementation

The Site consists of ten OUs. Table 3 provides the definition, RAOs, and status of each OU. Figure 3 provides a map showing the locations of the OUs.

Three of the OUs listed above were more fully characterized after the issuance of the ROD for the Site. As part of Liberty's due diligence survey prior to purchasing the parcel for development, an area of fill material was identified in the north-central portion of their 2301 Renaissance Boulevard property. This fill area was named the Cinder/Slag Fill Area (CSFA) and designated OU7. Based on the results of these previous site characterization activities, the material in the CSFA was determined to consist primarily of glass, ash, coal dust, cinders, and slag. As part of Liberty's due diligence survey of Lot 44 (which was not purchased by Liberty), an area of fill material was identified located south of OU8 (Area 6). This area was divided into OU9 (Southeast Property Area) and OU10 (Lot 7). The fill was determined to consist primarily of ash, coal dust, cinders, and slag.

EPA sent Special Notice Letters on November 17, 2000 to the Respondents requesting that they enter into another Consent Decree pursuant to which they would agree to perform the RD/RA called for in the ROD. EPA subsequently issued an Administrative Order for Remedial Design and Remedial Action, (Unilateral Order or UAO) Docket No. 3-2001-0009, on April 30, 2001 to nine PRPs. Those nine PRPs agreed to comply with the UAO, by letter dated June 1, 2001, and undertook performance of the UAO obligations. Appendix A provides a summary of the RAs which have been implemented at the Site.

Results of Implemented Actions

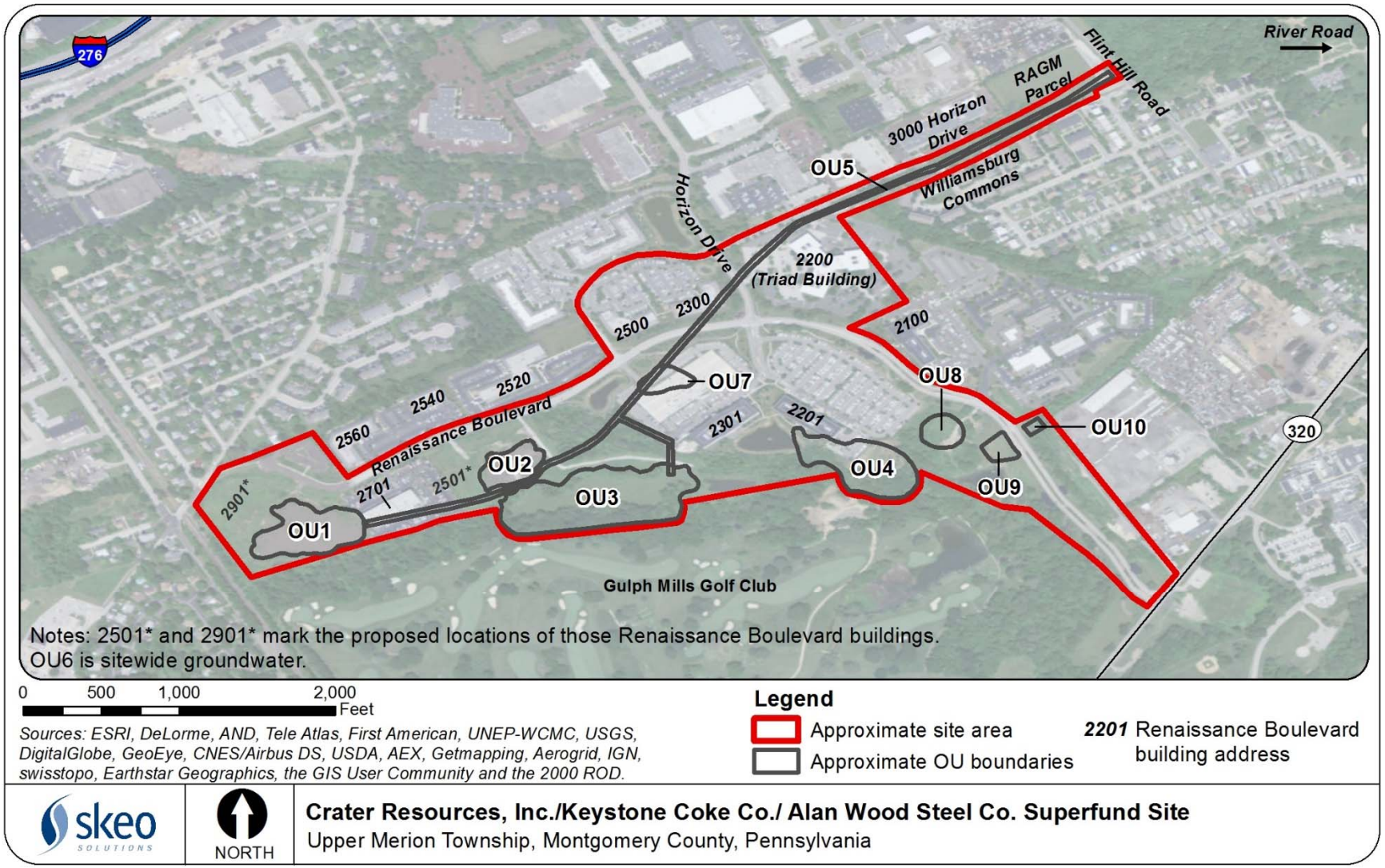
Actions at OU1 and OU2 have consolidated all impacted materials which have been covered by temporary caps preventing direct exposure to contamination. These temporary measures have met the intended purpose of mitigating direct contact with contaminated materials. Construction of the permanent caps in conjunction with the planned redevelopment which includes OU1 and OU2 will prevent further migration of contaminants to groundwater which will achieve the RAOs for these OUs.

The RAs which have been completed at OU3, OU5, OU7, OU8, OU9 and OU10 have met the established performance standards by removing contamination that could present adverse impacts to human health or the environment. The RAOs for each of these OUs have been met.

Table 3: Description of Site Operable Units

Operable Unit	Remedial Action Objectives	Current Status
OU1 – Quarry 1	Preventing contact of soil/sediment constituents with other media such as groundwater and surface water which may transport the contamination.	Remedial Design complete. Remedial Action underway. Soil cut/fill complete and temporary cover installed. All contaminated materials placed under temporary cap and fencing erected to restrict access.
OU2 – Quarry 2	Preventing contact of soil/sediment constituents with other media such as groundwater and surface water which may transport the contamination.	Remedial Design complete. Remedial Action underway. Soil cut/fill complete and temporary cover installed. All contaminated materials placed under temporary cap and fencing erected to restrict access.
OU3 – Quarry 3	Eliminating exposure to soil/sediment which presents an unacceptable risk to human health. Limiting exposure of ecological receptors to affected surface water in the Quarry 3 pond water.	Remedial Action Complete
OU4 – Quarry 4	Preventing contact of soil/sediment constituents with other media such as groundwater and surface water which may transport the contamination.	Demonstration project completed to show that leaching from the quarry to groundwater is not occurring.
OU5 – WAL Pipeline	Eliminating exposure to soil/sediment which presents an unacceptable risk to human health.	Remedial Action Complete
OU6 – Groundwater MNA	Restoring groundwater to its beneficial use (as drinking water)	MNA monitoring ongoing
OU7 – Cinder/Slag Fill Area	Eliminating exposure to soil/sediment which presents an unacceptable risk to human health.	Remedial Action Complete
OU8 – Area 6	Eliminating exposure to soil which presents an unacceptable risk to human health. Preventing contact of soil/sediment constituents with other media such as groundwater and surface water which may transport the contamination.	Remedial Action Complete
OU9 – Southeast Property Area	Eliminating exposure to soil which presents an unacceptable risk to human health. Preventing contact of soil/sediment constituents with other media such as groundwater and surface water which may transport the contamination.	Remedial Action Complete
OU10 – Lot 7	Eliminating exposure to soil which presents an unacceptable risk to human health. Preventing contact of soil/sediment constituents with other media such as groundwater and surface water which may transport the contamination.	Remedial Action Complete

Figure 3: Map of Site OUs



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

The Quarry 4 (OU4) Demonstration Project has been completed and results show no impacts to groundwater as a result of materials contained in the quarry. PADEP has concurred with the request for a modification in the cap performance standards. An ESD to document the modification is currently being prepared.

Groundwater monitoring for OU6 is being performed. MNA monitoring indicates that degradation of contaminants in the center of the plume is occurring. Reductions of contaminants in groundwater may also be attributable to source removal activities at OU3.

4.3 Operation and Maintenance (O&M)

The 2000 ROD requires routine maintenance and repair of the quarry caps, once constructed, to ensure their long-term effectiveness. In 2011, the Crater PRP Group performed quarterly inspections of Quarry 3. The first three of the 2011 quarterly inspections included inspections of OU10 and a small section of OU5. In 2012 and 2013, the Crater PRP Group performed semi-annual inspections of Quarry 3. The Crater PRP Group currently performs annual inspections of Quarry 3 and associated stormwater outlet structures. The annual inspections check for vegetation health, overgrowth of vegetation near stormwater intake and outlet structures, and potential issues with erosion and sediment control. In June 2014, the Crater PRP Group observed woody brush growing in front of the stormwater intake and noted that it would be removed in the near future. Inspection reports from 2011 through 2015 did not note any significant O&M issues.

O&M activities are not currently performed for any of the other OUs. Based on the nature of the selected remedy, long-term O&M is not needed for OUs 5, 7, 8, 9 or 10.

The 2000 ROD requires implementation of a long-term groundwater monitoring program (OU6) to evaluate the effectiveness of MNA and the maintenance of monitoring wells. The Crater PRP Group performs groundwater monitoring twice a year, as approved by EPA. The Crater PRP Group inspects monitoring wells during sampling events and documents inspection findings in annual MNA reports

The ROD estimated an annual O&M cost of $11,900 for Quarry 3 and all quarry caps (caps for OU1, OU2 and OU4), and $26,600 for groundwater monitoring and related maintenance activities.

5.0 Progress Since the Last Five-Year Review

The protectiveness statement from the 2011 FYR for the Site stated the following:

> *As noted above, the remedy is being implemented in accordance with the ROD. Remedial Action has been completed at several OUs (OU3, OU5, OU7, OU8, OU9, and OU10) and work is underway at OU1 and OU2. A demonstration project is underway to evaluate the need for a cap on Quarry 4 (OU4), and sampling has been initiated to evaluate the MNA groundwater remedy (OU6). While no one is currently using groundwater in the vicinity of the site as a source of drinking water, a determination regarding the short-term*

protectiveness of the groundwater remedy is being deferred until further information is obtained regarding the potential for vapor intrusion at the commercial office buildings that currently exist or are proposed to be constructed adjacent to Quarries 1 and 2 or above the groundwater plume. The time required to collect the air quality data, evaluate the information, and submit a report to EPA and PADEP will be about eighteen months for the existing buildings. After EPA and PADEP have reviewed the data and report, EPA will make a protectiveness determination regarding the vapor intrusion pathway. EPA expects the site will be fully protective of human health and the environment when the groundwater cleanup goals are met, all institutional controls are in place, and all the contaminated soils are either capped or removed for off-site disposal.

During the period since completion of the 2011 FYR, an evaluation of the groundwater plume was performed using EPA's Vapor Intrusion Screening Level (VISL) calculator. A vapor intrusion assessment was conducted for all existing buildings which have the potential to be impacted by vapor intrusion, as summarized in Table 4. EPA will also issue an ESD to require ICs in which vapor intrusion assessments be performed for any future buildings to be constructed in the impacted area.

The 2011 FYR included two issues and recommendations. Table 4 summarizes each recommendation and its current status below.

6.0 Five-Year Review Process

6.1 Administrative Components

EPA Region 3 initiated the FYR in November 2015 and scheduled its completion for September 2016. EPA remedial project manager (RPM) Joseph McDowell led the EPA site review team, which also included EPA site attorney Bonnie Pugh, EPA community involvement coordinator (CIC) Gina Soscia and contractor support provided to EPA by Skeo Solutions. The review schedule established consisted of the following activities:

- Community notification
- Document review
- Data collection and review
- Site inspection
- Local interviews
- FYR Report development and review

Table 4: Progress on Recommendations from the 2011 FYR

Recommendations	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Complete vapor intrusion assessment at potentially impacted buildings	EPA and PRPs	3/30/13	Ongoing. In January 2013, O'Neill conducted a vapor intrusion evaluation for 2701 Renaissance Boulevard (Figure 2), titled Vapor Intrusion Summary Report, Crater Resources Building 2701. In a letter dated 2/1/2016, EPA approved the report's findings that vapor intrusion does not pose an unacceptable risk to people working at this building. In that letter, EPA stated that there is a potential for vapor intrusion into future buildings constructed on the Site where VOC concentrations exceed their respective MCLs in shallow groundwater. EPA recommends that all new habitable structures constructed over or within 100 feet of groundwater contamination should include, at a minimum, a foundation vapor barrier and subsurface piping for a sub-slab depressurization system. Indoor air testing will be required prior to occupancy of any new buildings. If indoor air concentrations are equal to or exceed EPA risk-based criteria, the sub-slab system shall be activated and operated until EPA determines that groundwater contamination no longer poses a vapor intrusion risk. A vapor intrusion evaluation using EPA's vapor intrusion model indicated that there is no unacceptable vapor intrusion risk to buildings currently constructed at the site. Construction of any new buildings over or within 100 feet of the most highly contaminated areas of the plume (i.e., area encompassed by MW-6 to MW-11S) should consider vapor intrusion evaluation or mitigation technology during planning, construction, and prior to occupancy.	1/25/2013
Finalize ICs	EPA and PRPs	12/30/16	Ongoing. The final ICs Work Plan was submitted on November 22, 2011. ICs have been established in accordance with the work plan at all OUs. The vapor intrusion evaluation indicated that any future construction over or within 100 feet of the groundwater plume with contaminants above MCLs may be subject to vapor intrusion risks. ICs may be needed for future buildings to prevent or assess exposure via vapor intrusion.	6/30/16

6.2 Community Involvement

In June 2016, EPA published a public notice in the Times Herald announcing the commencement of the FYR process for the Site, providing contact information for Darriel Swatts (EPA) and inviting community participation. The press notice is available in Appendix B. No one contacted EPA as a result of the advertisement.

This FYR Report will be available to the public. EPA will place copies of the document in the designated site repository: Upper Merion Township Building at 175 W. Valley Forge Road in King of Prussia.

6.3 Document Review

This FYR included a review of relevant site-related documents, including the ROD, 2009 ESD, RI/FS, RA reports and recent monitoring data. Appendix C provides a complete list of the documents reviewed.

ARARs Review

CERCLA Section 121(d)(1) requires that Superfund cleanups attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The cleanup must achieve a level that at least attains those requirements that are legally applicable or relevant and appropriate.

Groundwater ARARs

Note that the ROD established MCLs and risk-based levels as groundwater cleanup standards. According to the 2000 ROD, the groundwater ARARs are the federal Safe Drinking Water Act MCLs and non-zero Maximum Contaminant Level Goals (MCLGs). This FYR compares current federal MCLs and non-zero MCLGs to the 2000 ARARs for groundwater COCs. The current MCL for arsenic is more stringent than at the time of the ROD, however the change does not affect the protectiveness of the remedy since the groundwater cleanup goals (Table 2) for arsenic [1.0 microgram per liter (µg/L) for the plume center and 0.04 µg/L for the plume extent] are risk-based and significantly lower than the current arsenic MCL of 10 µg/L. The ARAR for chloroform has become less stringent since EPA issued the ROD in 2000. At the time of the ROD, the MCL for nickel was 100 µg/L. There is no current MCL or MCLG for nickel. These changes do not affect the protectiveness of the remedy because the Site's groundwater cleanup standards for chloroform and nickel are more stringent than the current ARARs. The ARARs associated with the Site's remaining groundwater COCs have not changed since 2000.

Soil ARARs

The 2000 ROD identified the PADEP Act 2 program's Statewide Health Standards for Soil as ARARs for the Site's soil cleanup. Where the PADEP Act 2 Standards provide more stringent requirements than the Site's risk-based soil cleanup standards, EPA incorporated the Act 2 standards as cleanup goals.

Table 5 compares the Site's soil and sediment cleanup standards against the current Pennsylvania Statewide Health Standards for Soil. All of the Site's soil and sediment cleanup standards are at least as stringent as the current state standards. The Site's 2009 ESD changed the subsurface soil and sediment cleanup standard for naphthalene to 48 mg/kg, based on site-specific modeling results that included the effects of biodegradation. This standard is below the current state standard for soils at depth and for the soil to groundwater pathway.

See Section 7.2 for a discussion of soil cleanup goals and any changes in toxicity levels for COCs.

Institutional Control (IC) Review

On November 9, 2015, Skeo staff conducted research at the Montgomery County Recorder of Deeds Office and found the IC information pertaining to the Site.

The ROD requires the implementation of ICs to restrict on-site soil, sediment, surface water and groundwater use and/or disturbance at the Site in order to reduce the potential for human exposure to contamination. The ROD specifically requires that ICs prevent disturbance of the caps, once installed, and prohibit the installation of any potable wells in the contaminated aquifer.

In November 2011, the Crater PRP Group completed the Crater Resources Superfund Site ICs Implementation and Assurance Plan. The plan identified necessary ICs for the different site areas, provided a schedule of implementation and reviewed the adequacy of existing ICs.

The sections below describe the current status of ICs at each OU. See Appendix D for additional detailed, parcel-specific IC information.

OU1 and OU2 (Quarries 1 and 2 and associated impacted areas)

The remedy requires ICs to prevent exposure to soil and groundwater contamination at OU1 and OU2. These controls must include, but may not be limited to, prohibiting residential use at Quarries 1 and 2 and their respective buffer zones, prohibiting any activities that could potentially disrupt contaminated soil, and notifying future property owners of the Site. Development and RA activities at OU1 and OU2 left soil contamination in place at areas outside of the quarry boundaries and quarry buffer zones, including under the 2701 Renaissance Boulevard parking lot. Excavations were performed at other areas outside of Quarries 1, 2 and associated buffer zones. Risk assessments to determine if residual contamination presented unacceptable risks to commercial/industrial workers was performed and additional excavation was conducted, if needed, until acceptable risk levels were achieved. O'Neill recorded a deed notice with the Montgomery County Recorder of Deeds office on September 22, 2008 which provides notice of restrictions for the parcels containing OU1 and OU2. The notice prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the land surface, other than to

Table 5: Review of ARARs for Soil and Sediment COCs

Soil and Sediment COCs[a]	Cleanup Standards from ROD and ESD (mg/kg)				Current ARARs[b] (mg/kg)			Is Current ARAR More Stringent Than Site's Cleanup Standard?
	Quarry 3 Surface Soil	Quarry 3 Sediment	Quarry 3 Subsurface Soil	Yellow Parcel Pipeline (OU5)	Non-residential Soil 0-2 feet	Non-residential Soil 2-15 feet	Protection of Groundwater[f]	
Benzo(a)anthracene	3.59	110[c]	—	4.48	110	190,000	320	No
Benzo(a)fluoranthene	5.65	110[c]	—	8.55	110	190,000	170	No
Benzo(a)pyrene	4.13	11[c]	11[c]	5.23	11	190,000	46	No
Dibenz(a,h)anthracene	0.897	—	4.48	0.177	11	190,000	160	No
Dibenzofuran	—	0.66	—	3.180	2,800	190,000	260	No
Indeno(1,2,3-c,d)pyrene	2.96	—	—	1.26	110	190,000	28,000	No
2-Methylnaphthalene	—	—	16	—	11,000	190,000	1,600	No
Naphthalene	48[e]	48[e]	48[e]	—	56,000	190,000	48[e,g]	No
Aluminum	13,800	—	—	14,800	190,000	190,000	—	No
Arsenic	0.2[d]	—	0.2[d]	0.586	53	190,000	29	No
Chromium	—	—	—	0.525	190,000	190,000	190,000	No
Iron	40[d]	—	—	190,000[c]	190,000	190,000	—	No
Manganese	—	—	200	—	130,000	190,000	2,000	No
Mercury	11.6	—	13	—	450	190,000	10	No

Notes:

a. Soil COCs as defined in the 2000 ROD.

b. Current Pennsylvania Statewide Health Standards (accessed 2/25/16 at http://www.dep.pa.gov/Business/Land/LandRecycling/Standards-Guidance-Procedures/Pages/Statewide-Health-Standards.aspx#.Vs9E0KMo6Uk).

c. Based on PADEP's Act 2 Standards.

d. Based on soil screening level.

e. Value established by the 2009 ESD.

f. Value for used non-residential aquifers with total dissolved solids less than or equal to 2,500 mg/L. Protection of groundwater standard applies only to Quarry 3 sediment.

g. Site-Specific number developed

implement the remedy, without prior written approval from EPA. The Upper Merion Zoning Ordinance indicates that the entire Site is zoned as SM-1 Suburban Metropolitan District, which does not permit residential use. Limited portions of the site may be permitted to request a residential land usage from Upper Merion Township in accordance with Township Ordinance 2014-832. Upon completion of remedy implementation at OU1 and OU2, additional ICs will be implemented.

The potential exists for vapor intrusion at current and future structures in the vicinity of OU1 and OU2. ICs are needed for future OU1 and OU2 structures to prevent exposure to harmful concentrations of vapors.

OU3 (Quarry 3)

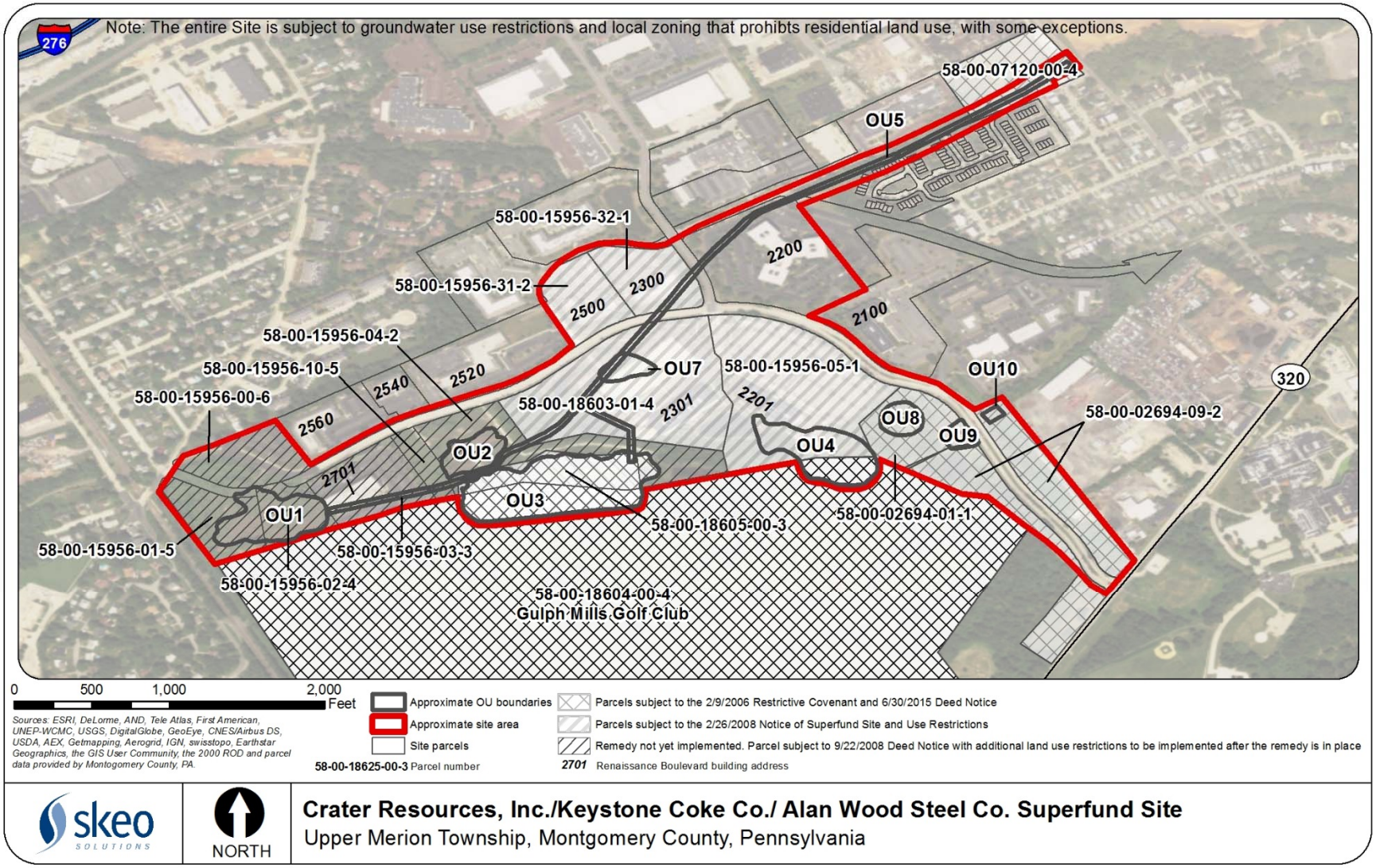
The remedial activities performed within Quarry 3 eliminated exposure risks to all non-residential receptors, except future construction workers performing intrusive activities. RAGM, Crater Resources, Inc. and the Crater PRP Group recorded a restrictive covenant with Montgomery County on February 9, 2006, identifying parcel 58-00-18605-00-3 as part of the Site (Figure 4). That parcel covers most of the Quarry 3 footprint. The restrictive covenant prohibits residential use of the property, prohibits the installation or use of groundwater wells and requires prior notification of, and approval by, the PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work.

The southern part of Quarry 3 is located on the Golf Club parcel. Gulph Mills Golf Club recorded a deed notice with the Montgomery County Recorder of Deeds office on July 30, 2015 which prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the land surface, other than to implement the remedy, without prior written approval from EPA, for the Gulph Mills Golf Club parcel 58-00-18604-00-4 (Figure 4). A small part of the far eastern end of Quarry 3 is located on parcel 58-00-15956-04-2 (Figure 4). O'Neill recorded a deed notice with the Montgomery County Recorder of Deeds office on September 22, 2008 which prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the land surface, other than to implement the remedy, without prior written approval from EPA for this parcel.

OU4 (Quarry 4)

Liberty recorded a Notice of Superfund Site and Use Restrictions at the Montgomery County Recorder of Deeds Office on February 26, 2008, for the 2201 Renaissance Boulevard property (parcel 58-00-15956-05-1) (Figure 4). The parcel contains most of Quarry 4 and a stormwater retention basin. The notice prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the land surface, other than to implement the remedy, without prior written approval from EPA.

Figure 4: Institutional Controls Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Small parts of Quarry 4 are located on parcels 58-00-02694-01-1 (owned by Out Parcels, Inc.) and 58-00-18604-00-4 (owned by Gulph Mills Golf Club) (Figure 4). The February 9, 2006 Restrictive Covenant applies to parcel 58-00-02694-01-1 (Figure 4). The restrictive covenant identifies the property as part of the Site, prohibits residential use of the property and requires notification of, and approval by, the PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work. Gulph Mills Golf Club recorded a deed notice with the Montgomery County Recorder of Deeds office on July 30, 2015 which prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the land surface, other than to implement the remedy, without prior written approval from EPA at the Gulph Mills Golf Club parcel 58-00-18604-00-4 as mentioned under OU3.

OU5 (WAL pipeline)

The properties associated with the required ICs are shown in Figure 4 and include:

- 2300 Renaissance Boulevard (parcel 58-00-15956-32-1)
- 2301 Renaissance Boulevard (parcel 58-00-18603-01-4)
- 2500 Renaissance Boulevard (parcel 58-00-15956-31-2)
- 2501 Renaissance Boulevard (parcel 58-00-15956-10-5)
- 2701 Renaissance Boulevard (parcels 58-00-15956-04-2 and 58-00- 15956-03-3)
- 2901 Renaissance Boulevard (parcels 58-00-15956-02-4, 58-00-15956-01-5 and 58-00-15956-00-6) (Table C-1).

Parcel 58-00-07120-00-4, located along Flint Hill Road, at the far northeastern corner of the Site, is subject to the February 9, 2006 Restrictive Covenant (Figure 4).

Following remediation at the 2300, 2301 and 2500 Renaissance Boulevard properties, remaining soil met risk-based criteria, permitting use of the properties for non-residential purposes. Liberty recorded deed notices at the Montgomery County Recorder of Deeds Office on February 26, 2008, for the 2300, 2500 and 2301 Renaissance Boulevard properties, identifying them as part of the Site. The deed notices prohibit the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibit residential land use; and prohibit disturbance of the land surface, other than to implement the remedy, without prior written approval from EPA.

Remedial activities along the pipeline run have been completed to meet EPA risk-based standards for non-residential use, with the exception of the parcel adjacent to Williamsburg Commons and the 3000 Horizon Drive property which were cleaned to residential criteria. There is an overlap of the parcels that make up OU5, OU1 and OU2. O'Neill recorded a deed notice with the Montgomery County Recorder of Deeds office on September 22, 2008 which prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the land surface, other than to implement the remedy, without prior written approval from EPA for these parcels which include 2501, 2701 and 2901 Renaissance Boulevard.

OU6 (Groundwater)

There are overlapping types of ICs in place to prevent exposure to contaminated groundwater at the Site. Upper Merion Township's zoning and land development ordinances prohibit the installation of groundwater wells for potable use when the property is serviced by a water main. The entire Site and the areas surrounding the Site are serviced by water mains.

On February 1, 1997, the Montgomery County Health Department's Division of Water Quality Management adopted Chapter XVII, Individual Water Supply Regulations and amended these regulations on August 1, 2003. Section 17-5.2 of the Individual Water Supply Regulations makes it unlawful to install or modify an individual water supply well without first obtaining a permit from the Montgomery County Health Department. If someone installs or modifies an individual water supply well without a permit, Chapter XXI of the Regulations sets forth an enforcement scheme that provides for the notification of violations of the Public Health Code, issuance of emergency orders to protect public health and the imposition of penalties for violations of any part of the Public Health Code.

The February 26, 2008 Notice of Superfund Site and Use Restrictions for the properties located at 2201, 2300, 2301 and 2500 Renaissance Boulevard properties prohibit the installation of new groundwater supply wells and potable use of groundwater from existing wells.

The February 9, 2006 Restrictive Covenant between RAGM, Crater Resources, Inc. and the Crater PRP Group, prohibits the installation or use of groundwater wells at Quarry 3 (parcel 58-00-18605-00-3), the parcel previously referred to at the RAGM parcel located at the very far northeastern corner of the Site (parcel 58-00-07120-00-4) and at OU10 (parcel 58-00-02694-09-2).

As required by the ROD, groundwater ICs have been implemented to prevent exposure to groundwater through ingestion. Based on recent groundwater monitoring results, EPA has determined that the potential exists for vapor intrusion into future buildings constructed on the Site where VOC concentrations exceed their respective MCLs in shallow groundwater. This is primarily in the vicinity of Quarries 1 and 2. Land use restrictions are needed to notify current and future site property owners of the requirement to assess vapor intrusion into all future structures built directly above or within 100 feet of the groundwater plume.

OU7 (Cinder/Slag Fill Area)

OU7 is located at 2301 Renaissance Boulevard (parcel 58-00-18603-01-4) beneath a parking structure/lot (Figure 4). The remedial activities at OU7 eliminated the exposure risks to all non-residential receptors, except future construction workers performing intrusive activities. Liberty recorded a Notice of Superfund Site and Use Restrictions for the 2301 Renaissance Boulevard OU7 property at the Montgomery County Recorder of Deeds Office on February 26, 2008. The notice prohibits the installation of new groundwater wells, or use of existing wells, other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the surface of the land, other than to implement the remedy, without written prior approval from EPA. The notice meets the IC requirement for OU7.

OU8 (Area 6), OU9 (Southeast Property Area) and OU10 (Lot 7)

OU8 consists of a small irregularly shaped area in the center of Lot 44 (parcel 58-00-02694-01-1) (Figure 4). OU9 covers a small trapezoidal area in the southeast corner of Lot 44 (parcel 58-00-02694-01-1). OU10 is located at the northern end of parcel 58-00-02694-09-2 (Figure 4). Remedial activities at OU8, OU9 and OU10 eliminated unacceptable risks to non-residential receptors. The February 9, 2006 Restrictive Covenant identifies the properties that make up those OUs as part of the Site, prohibits residential use of the properties and requires notification of, and approval by, the Crater PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work. The restrictive covenant meets the IC requirement for OU8, OU9 and OU10.

6.4 Data Review

Groundwater

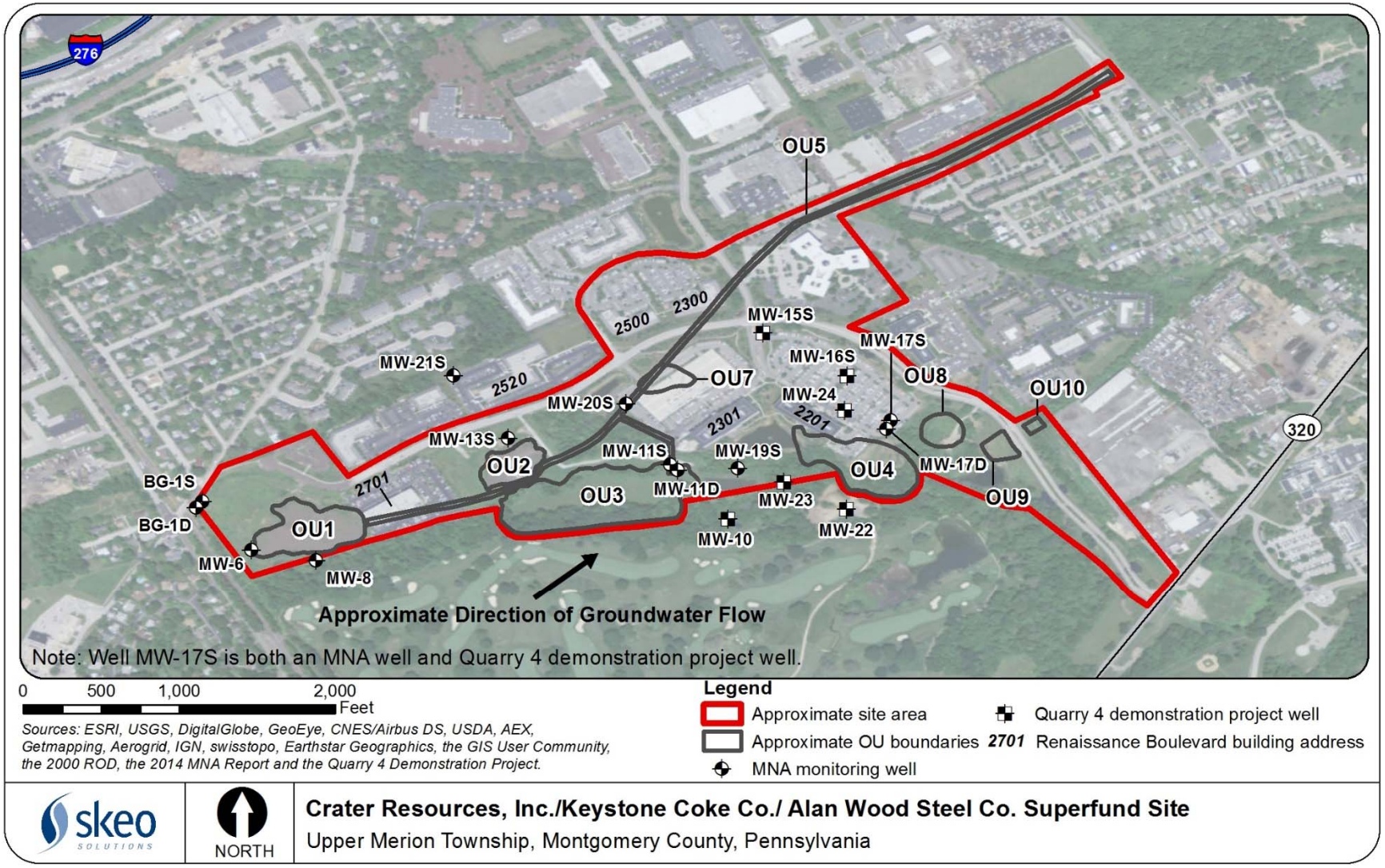
The Crater PRP Group began MNA groundwater monitoring at 16 groundwater monitoring wells (Figure 5) for VOCs, SVOCs, target analyte list (TAL) metals, total and available cyanide, and natural attenuation parameters in November 2010. Groundwater monitoring was performed quarterly between November 2010 and November 2012. EPA granted the Crater PRP Group permission to reduce the monitoring frequency to 12 wells on a semi-annual basis in April 2013.

In general, concentrations of organic and inorganic COCs sitewide remain relatively stable, with no significant trends observed with the exception of wells immediately downgradient of Quarry 3 (MW-11 cluster) which have shown a reduction of contamination after completion of the Quarry 3 RA. The spatial trends for most MNA parameters are consistent with the continuing occurrence of natural biodegradation. However, until permanent caps over remaining areas of source contamination (Quarries 1 and 2) are installed, MNA will likely not effectively address groundwater contamination.

The ROD established two sets of groundwater cleanup goals, one for the center of the plume (MW-11S, MW-11D, MW-13S) and one for the extent, or outer areas, of the plume (MW-11S, MW-11D, MW-13S, and MW-8, MW17S, MW-17D, MW-19S, MW-20S, MW-21S). The Final Baseline Risk Assessment identified the wells specific to each category; however, the PRPs compare all MNA monitoring data to both sets of cleanup goals. Following review of the 2014 MNA report, EPA submitted a letter to the Crater PRP Group, dated November 30, 2015, clarifying that analytical results should only be compared to the groundwater cleanup level that is appropriate to that well.

This FYR examined all monitoring data collected from July 2008 through August 2014 (Appendix E). The data for organic constituents (VOCs and SVOCs) show that concentrations greater than the groundwater cleanup goals are primarily limited to the immediate vicinity of Quarries 1, 2 and 3. Wells showing the highest VOC and SVOC concentrations include monitoring well MW-6 (west side of Quarry 1), wells MW-11S and MW-11D (northeast corner

Figure 5: Groundwater Monitoring Well Locations



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

of Quarry 3) and MW-13S (immediately north of Quarry 2), with MW-13S showing the highest COC concentrations of any wells (Figure 5). Elevated COC concentrations are expected at MW-6 and MW-13S as Quarries 1 and 2 have not yet been capped and continue to serve as a source of groundwater contamination.

As remedial activities have been completed at Quarry 3, it would be expected that MNA monitoring would detect decreasing COC concentrations at downgradient wells, MW-11S and MW-11D, over time. While concentrations of SVOCs have decreased significantly at wells MW-11S and MW-11D, and benzene shows a decreasing trend over time, concentrations of cyanide and inorganic COCs have remained relatively stable at those wells since 2008.

The results for inorganic COCs are inconclusive and a complete evaluation of the effectiveness of MNA as a remedy for these constituents may not be determined until full implementation of the remedy across the site including Quarries 1 and 2.

At 10 of the 12 wells routinely monitored, total cyanide is consistently present at concentrations above the center of the plume cleanup goal of 10 µg/L and above the plume extent cleanup goal of 13 µg/L. MW-6, MW-11S, MW-11D and MW-13S consistently show the highest cyanide concentrations, with the highest concentrations observed at MW-13S (Table 6). Between July 2008 and August 2014, cyanide concentrations at MW-13S have ranged from non-detectable results in July 2008 and August 2011, to a high of 21,000 µg/L in May 2011. Elevated concentrations of cyanide are expected at MW-6 or MW-13S, as those wells are located near Quarries 1 and 2, which have not yet been remediated. MW-11S and MW-11-D are located on the downgradient edge of Quarry 3 and routinely exhibit the second highest cyanide concentrations sitewide. As remedial activities have been completed at Quarry 3, decreases in cyanide concentrations at that location would be expected. Between July 2008 and August 2014, overall, cyanide concentrations at MW-11S and MW-11D have remained relatively stable (Table 6).

Table 6: Total Cyanide Exceedances in Select Wells, 2008-2014

	Sampling Date (MM/YY)													
Well ID	**7/08**	**11/10**	**2/11**	**5/11**	**8/11**	**12/11**	**3/12**	**5/12**	**9/12**	**11/12**	**2/13**	**8/13**	**3/14**	**8/14**
MW-6	198 J	21	210	260 J	240	240	250[a]	230	260	230	220	230	680	190
MW-11S	691	600	570	640 J	560	620[b]	630	630[c]	730	690	570	590[c]	39	570
MW-11D	973	ND	880	990 J	940	1,200	730	860	880	760	890	760	220	600
MW-13S	ND	18	110	21,000 J	ND	7.7	2,200	6,200	1,600	610	270	2,800	570	24 J

Notes:
a. Well sampled twice on 3/21/2012. The higher of the two results is presented in this table.
b. Well sampled twice on 12/7/2011. The higher of the two results is presented in this table.
c. Well sampled twice on 8/28/2013. The higher of the two results is presented in this table.
J Result should be considered a quantitative estimate.
All results presented in µg/L.
ND – Not Detected
Total cyanide cleanup goal for the plume center: 10 µg/L
Total cyanide cleanup goal for the plume extent: 13 µg/L

In several instances prior to the most recent sampling events, the detection limit used to analyze groundwater samples were not low enough and exceeded the cleanup goals. For example, the 2014 MNA report lists a detection limit of 20 µg/L for total cyanide for several samples and 10 µg/L for others; cyanide cleanup goals are 10 µg/L for the plume center and

13 µg/L for the plume extent. The detection limit used in those instances where the detection limits are greater than 10 µg/L would not be able to accurately detect total cyanide at concentrations at or below the cleanup goals. The approved MNA Work Plan requires a minimum detection limit of 10 µg/L; the PRP Group has worked with their laboratories to assure these requirements are attained. Required detection limits were met for 2015 sampling events. Among others, arsenic, selenium, thallium and vanadium also have cleanup goals that are lower than the detection limits achieved for some samples in the past. In order to compare groundwater COC concentrations to cleanup goals, analytical detection limits must be at least as low, or lower than, the established cleanup goals; however, revised laboratory methodology has indicated the required detection limits will be met and this does not appear to be an issue moving forward. In addition, the PRP Group will be requested to include plume delineation maps in the annual MNA reports to better depict the exceedances of the center of plume and extent of plume performance standards.

Background Wells

Wells BG-1D and BG-1S are background wells. Typically, any contamination present in those wells would be considered not related to the Site. These background wells contain cyanide and VOCs at concentrations higher than their respective cleanup goals but at significantly lower levels than the most impacted wells downgradient of source areas (Appendix E).

Cyanide cleanup goals were established for total cyanide; however, at the PRPs request, available cyanide analysis was also performed, although all comparisons to cleanup criteria are based on total cyanide. At BG-1S, total cyanide exceeded the center of the plume cleanup goal of 10 µg/L in August (56 µg/L) and December 2011 (21 µg/L), Chloroform concentrations routinely exceed the plume extent cleanup goal of 0.015 µg/L, but do not exceed the center of the plume cleanup goal of 1 µg/L. Total cyanide has not been detected above cleanup goals since the December 2011 sampling and reliable results above the cleanup goals for chloroform have not been detected since September 2012.

At BG-1D, results for total cyanide have been below cleanup goals for all samples collected; however, these results are unexpected as available cyanide is present at levels greater than total cyanide. Chloroform concentrations at BG-1D routinely exceed the plume extent cleanup goal of 0.015 µg/L, and exceeded the plume center cleanup goal of 1 µg/L during sampling events in 2010 and 2011. The low levels of chloroform detected in the background wells are significantly below the most highly impacted wells downgradient of source areas at the site.

The levels present in these wells should be indicative of site background conditions.

Vapor Intrusion

VOC, SVOC, and cyanide concentrations at MW-6, MW-13S and MW-11S could potentially pose a vapor intrusion risk to people working in buildings in the vicinity of those wells. Benzene concentrations at MW-6, MW-13S, and MW-11S consistently exceed the 5 µg/L cleanup goal with the highest concentrations at MW-13S. Between July 2008 and August 2014,

benzene concentrations at MW-13S have ranged from a low of 1.1 µg/L in July 2008, to a high of 1,200 µg/L in September 2012; the most recent benzene result was 420 µg/L in August 2014. Benzene concentrations at MW-11S range from a low of 4.3 µg/L in September 2012 to a high of 21 µg/L in July 2008. Note that an unusual pattern was observed in the 3/26/2014 data for wells MW-13S and MW-11S. The concentrations in MW-11S showed a sharp increase in chemical concentrations, of 3-5 orders of magnitude. The 8/27/2014 concentrations were back down at the much lower concentrations typical of previous rounds. The 3/26/2014 concentrations in MW-13S showed a sharp decrease of several orders of magnitude, and the 8/26/2014 data were back up in the historical range. EPA strongly suspects that the 3/26/2014 samples for MW-11S and MW-13S were inadvertently switched. Data reported in the text above reflects this probable error.

Benzene at MW-6 has ranged from 16 µg/L to 29 µg/L with a most recent result of 20 µg/L. SVOC concentrations at the MW-11 well cluster also routinely exceed cleanup goals. For example, naphthalene is a SVOC of particular importance to the vapor intrusion pathway; results at all three wells have exceeded cleanup goals during each sampling event, with a maximum naphthalene concentration of 450 µg/L detected at MW-13S. Total cyanide exceeded the cleanup goal of 10 µg/L at these three wells with a maximum concentration of 21,000 µg/L at MW-13S.

In June 2016, EPA conducted a vapor intrusion evaluation utilizing EPA's VISL calculator for the groundwater to indoor air pathway. Results were calculated for all wells sampled during MNA monitoring. Two wells, MW-6 and MW-11S showed increased potential carcinogenic risks but still within EPA's acceptable risk range of 1.0E-04 to 1.0E-06. MW-6 and MW-11S also showed a HI greater than 0.1. MW-6 is approximately 600 feet from the closest downgradient building (2701 Renaissance Boulevard) and MW-11S is approximately 150 feet from the closest building. The calculated increased carcinogenic risk at MW-13S (1.83E-04) exceeded EPAs acceptable risk range and showed a HI (2.4) greater than 1. These results indicate that buildings constructed in the future over or within 100 feet of the plume in the area where the VISL results showed an increased carcinogenic risk greater than 1.0E-06 or an HI of 0.1 (i.e., MW-6, MW-11S, MW-13S) could pose a potential risk. Therefore, an indoor air evaluation after the building is constructed will be performed to ensure protectiveness. Pre-emptive mitigation could also be considered.

In February 2012, O'Neill conducted a vapor intrusion investigation at their office building located at 2701 Renaissance Boulevard. This building is located immediately adjacent to the Quarry 1 and the Boring 141/203 AOC and upgradient of monitoring wells MW-13S and MW-11S. Results showed low levels of naphthalene, acetone and benzene; however, a risk evaluation indicated there was no unacceptable risk associated with exposure to indoor air to site workers. The final report was approved by EPA on February 1, 2016.

Quarry 4 Demonstration Project

Liberty performed a demonstration project to determine if contamination in Quarry 4 will impact groundwater quality if not capped in accordance with 25 PA Code 288.234(b). The Quarry 4 Demonstration Project included quarterly sampling of seven monitoring wells between October 2010 and July 2012. The project included sampling of upgradient wells MW-10,

MW-22 and MW-23, and downgradient wells MW-15S, MW-16S, MW-17S and MW-24 (Figure 5). Of those wells, only MW-17S is still routinely monitored during MNA sampling events. Results for VOCs and SVOCs were generally non-detected in both upgradient and downgradient wells. Where detected, contaminants were at levels below cleanup goals in both upgradient and downgradient wells. Results for inorganics did show contaminants above cleanup goals in upgradient and downgradient wells; however, the data evaluation indicated no statistical difference in groundwater contaminant concentrations between downgradient and upgradient wells. The data suggests there is no evidence of contaminant leaching from Quarry 4 into groundwater. Based on the results of the Demonstration Project, Liberty submitted a request to PADEP in January 2014 for a modification of the performance standards pursuant to 25 PA Code 288.234(b). PADEP provided concurrence with the request on March 18, 2014. EPA is working to incorporate this change into the remedy through an ESD.

Soil

As part of the Quarry 4 Demonstration Project, in July 2010, Liberty collected three soil samples from the Quarry 4 fill. The purpose of the sampling was to determine if soil contaminants could potentially impact groundwater if the area is not capped. Sampling did not identify contamination above screening levels. The deepest sample analyzed was collected from 8 feet below ground surface. No other soil sampling was conducted during this FYR period.

6.5 Site Inspection

A site inspection took place on November 10, 2015. The inspection team included Joseph McDowell (EPA Region 3 RPM), Gina Soscia (EPA Region 3 CIC) and Bonnie Pugh (EPA Region 3), Tim Cherry and Lena Harper (PADEP), Andy Frebowitz (Tetra Tech), and Sabrina Foster and Melissa Oakley (Skeo Solutions). PRP representatives present at the site inspection included Tom Legel (AGC), Mike Christie (Penn E&R), and Kevin Kyle (O'Neill Properties Group).

The site inspection began at OU1. A temporary, permeable cap consisting of geotextile fabric and modified 2A stone covers the Quarry 1 area. Some revegetation has occurred through the geotextile fabric layer. A temporary fence surrounds the area.

The team then inspected OU2 and OU3. The two areas are surrounded by the same temporary fencing. The main gate entrance of Quarry 2 was secured with a lock. A temporary, permeable cap consisting of geotextile fabric and modified 2A stone covers Quarry 2. Some revegetation through the geotextile fabric has occurred. Access roads adjacent to and over Quarry 2 are constructed with 8-inch stone. No evidence of trespassing in the area was observed.

Quarry 3 is a large, low-lying area, covered with vegetation. The vegetation appeared to be healthy. The Quarry 3 stormwater discharge point and stormwater retention basin are located behind the building at 2301 Renaissance Boulevard. Both stormwater features appeared to be in good condition. No evidence of trespassing in the area was observed.

The team then inspected the OU4 area. A corner of the building at 2201 Renaissance Boulevard is on top of the quarry. Subsidence of that part of the quarry resulted in structural impacts to the building. Grout was injected under the corner of the building to compensate for the subsidence. A parking lot, stormwater drainage area and wooded areas cover the remaining parts of Quarry 4 and appear to be functioning as designed. The stormwater drainage area is a low-lying area that channels surface water runoff from nearby parking lots.

OU7 was observed and is a small area covered by a parking deck in front on 2301 Renaissance Boulevard.

The team then inspected OUs 8, 9 and 10. OU8 is a small area covered with dense vegetation. Renaissance Boulevard separates OUs 9 and 10. OU9 consists of a large, open grassy field. OU10 includes a long, bermed area along Renaissance Road that is covered with trees, shrubs and grass. Vegetation at all areas appeared healthy.

The site inspection team walked along part of the former WAL pipeline (OU5) area, viewing the Williamsburg Commons residential development (immediately adjacent to the former pipeline route), and the location where the pipeline previously crossed the creek (at 3000 Horizon Boulevard). The site tour ended at the RAGM parcel at the far northeastern corner of the Site. The RAGM parcel consists of a large stormwater retention basin. The area is vacant and covered with grass.

Following the site inspection, Skeo Solutions staff visited the Site's local information repository, the Upper Merion Township Building at 175 W Valley Forge Road in King of Prussia. A collection of printed site-related documents and a CD of site documents from 2009 are available for public viewing.

Appendix F includes a completed Site Inspection Checklist.

6.6 Interviews

The FYR process included interviews with parties affected by the Site, including the current landowners and regulatory agencies involved in site activities. The purpose was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. The interviews are summarized below. Appendix G provides the complete interviews.

On December 21, 2015, EPA CIC Gina Soscia conducted a telephone interview with the Upper Merion Township Administrator of the Municipal Industrial Pretreatment Program (MIPP). The Administrator also serves as the Staff Liaison to the Upper Merion Township Environmental Advisory Council. The Administrator stated she felt as though the Site has been handled very well. She was initially involved with permitting the water that was pumped, treated and discharged at the Site, and felt as though everyone did an exceptional job with these efforts. The Administrator also stated she felt the site has had a positive effect on the surrounding community, especially because of the development taking place for mixed industrial use. The

Administrator was not aware of any community concerns related to the Site and requested that EPA continue to update her regarding the Site status.

7.0 Technical Assessment

7.1 Question A: Is the remedy functioning as intended by the decision documents?

A review of site monitoring data, site documents, ARARs and site inspection findings indicate that the remedy is functioning as intended by site decision documents for the OUs where the remedy has been fully implemented (OUs 3, 5, 7, 8, 9 and 10). Contaminated soil and sediment at those areas have been excavated and disposed of off-site. Post-excavation sampling results indicated that residual contaminant concentrations are protective for non-residential land uses at those areas. Some areas of OU5 have been cleaned to standards allowing for unlimited land use. The remedy has not yet been fully implemented at OU1, OU2 or OU4, but is expected to function as intended upon remedy completion at those areas. MNA sampling is ongoing for OU6; performance standards have not been achieved. Groundwater quality would be expected to improve with implementation of the remedy at OU1 and OU2.

OUs Where Remedy Construction Is Complete

Land and groundwater use restrictions are in place for OUs 3, 5, 7, 8, 9 and 10. The February 2006 Restrictive Covenant and February 2008 deed notices, signed and recorded with Montgomery County by various PRPs, meet the IC requirements for those OUs. The Upper Merion Zoning Ordinance indicates that the entire Site is zoned as SM-1 Suburban Metropolitan District, which does not permit residential use. Limited portions of the site may be permitted to request a residential land usage from Upper Merion Township in accordance with Township Ordinance 2014-832; however, the Restrictive Covenant and deed notices in place restrict residential use at these parcels.

Overlapping ICs are in place to prevent exposure to contaminated groundwater (OU6) through ingestion at the Site. Together, ICs and the RAs completed for OUs 3, 5, 6, 7, 8, 9 and 10 removed the potential for human exposure to unsafe concentrations of site-related contamination at those areas.

OUs Where Remedy Construction Is Not Complete

The remedy has not yet been fully implemented at OU1, OU2 or OU4. Soil contamination is currently present, and will remain in place at OU1, OU2 and OU4 that will not allow for unlimited land use. Permanent caps have not yet been constructed over Quarry 1, 2 or 4. The ROD currently prohibits residential land use at OU1, OU2 and OU4 and requires ICs to prevent such use. The Upper Merion Zoning Ordinance indicates that the entire Site is zoned as SM-1 Suburban Metropolitan District, which does not permit residential use. Limited portions of the site may be permitted to request a residential land usage from Upper Merion Township in accordance with Township Ordinance 2014-832. ICs preventing residential use at OU1, OU2 and OU4 are in place. If changes are made to the existing land use, the ROD and covenants would require modification.

Quarry 4 (OU4)

As discussed earlier, EPA is preparing a modification to the remedy for OU4. This modification will allow a change in the cap performance standards required by 25 PA Code 288.234(b). The impermeable cap and drainage layer requirements are unnecessary on this quarry.

Groundwater (OU6)

The groundwater data review performed as part of this FYR identified several issues. Between 2008 and 2014, some COCs at each monitoring well exceeded cleanup goals for both the center of the plume and extent of the plume. An updated plume map showing the current extent of groundwater contamination has been requested. The spatial trends for most of the natural attenuation indicator parameters are consistent with the continuing occurrence of natural biodegradation. However, until remaining areas of source contamination (Quarries 1 and 2) are capped, MNA will likely not effectively address groundwater contamination.

COC concentrations immediately downgradient of Quarry 3, especially total cyanide concentrations, have not decreased significantly since completion of the OU3 RA, and remain at concentrations orders of magnitude greater than cleanup goals while other Quarry 3 COCs have shown significant decreases in groundwater. All impacted soils, sediment and surface water were removed from Quarry 3 and restored with backfill that met cleanup criteria. These findings suggest that a complete evaluation of the effectiveness of the remedy on cyanide in groundwater may not be determined until complete implementation of the remedy across the site including Quarries 1 and 2.

In several instances, the detection limits used prior to the 2015 sampling for total cyanide, arsenic, selenium, thallium, vanadium and other COCs were higher than their respective COC cleanup goals. Those COCs were sometimes detected at several wells at concentrations above their respective cleanup goals. In order to effectively compare groundwater COC concentrations to cleanup goals, analytical detection limits must be at least as low as, or lower than, the established cleanup goals. Future monitoring should achieve the detection limits as required in the approved MNA Work Plan. The PRP Group has worked with their laboratories to assure these requirements are attained. Detection limits from the 2015 sampling event indicated this is no longer an issue.

7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of remedy selection still valid?

Changes in Standards and TBCs

Have standards identified in the ROD been revised, and does this call into question the protectiveness of the remedy? Do newly promulgated standards call into question the protectiveness of the remedy? Have TBCs used in selecting cleanup levels at the site changed, and could this affect the protectiveness of the remedy?

The groundwater performance standards listed in Table 13 of the 2000 ROD and summarized in Table 2 of this FYR are still more stringent than federal MCLs and non-zero MCLGs.

To examine whether the groundwater performance standards would attain current TBCs and levels of protectiveness, a more detailed assessment is provided under the "Changes in Toxicity and Other Contaminant Characteristics" discussion for OU6, below.

Changes in Exposure Pathways

Has land use or expected land use on or near the site changed? Have human health or ecological routes of exposure or receptors been newly identified or changed in a way that could affect the protectiveness of the remedy? Are there newly identified contaminants or contaminant sources? Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? Have physical site conditions or the understanding of these conditions changed in a way that could affect the protectiveness of the remedy?

The anticipated land uses were largely commercial (e.g., office space), and existing development is consistent with that expected use. One area adjacent to the property contains a golf course. A day-care center located near the Site was sampled to rule out site-related vapor intrusion. Evaluations of these various OUs have used the appropriate receptors for each parcel.

A change in anticipated land use has been proposed for OU1 and OU2, from commercial to residential. EPA is in the process of considering that possibility. An updated risk assessment is being prepared under separate cover. If the change is adopted, a new decision document will be prepared if necessary.

Because buildings have been built or are proposed for this site, which has subsurface contamination, vapor intrusion is a consideration. The chemicals of concern at this site are largely semivolatile chemicals and metals, although some of the chemicals (most notably acetone, benzene, chloroform, and naphthalene) do display characteristics of volatility. The 2011 FYR also recommended assessment of vapor intrusion. A vapor intrusion assessment of Building 2701 was performed, and is discussed above. A vapor intrusion assessment of a nearby day-care center was performed, and is discussed above. A comprehensive review of vapor intrusion at the site has been conducted. Results indicate that there is no unacceptable risk by vapor intrusion to existing buildings; however, new construction over or within 100 feet of the plume, particularly in the areas of Quarries 1 and 2, will consider the requirements for assessment and/or pre-emptive mitigation of vapor intrusion during planning and construction and prior to occupancy as required through a future ESD.

Changes in Toxicity and Other Contaminant Characteristics

Have toxicity factors for contaminants of concern at the site changed in a way that could affect the protectiveness of the remedy?

The original risk assessment for the site was completed in 1999. Toxicity factors have changed since then for several chemicals. However, as the parcels have undergone remediation, they have also been subjected to risk assessments incorporating updated toxicity factors and risk assessment methodology using confirmation sampling data.

As part of this FYR, the EPA toxicologist examined the post-remediation data to verify that existing concentrations remain protective. For most OUs, a screening risk assessment was performed as follows:

> The maximum concentrations of existing post-remediation data were evaluated using the Fall 2015 Regional Screening Levels (RSLs) at cancer risks of 1E-6 and Hazard Quotients (HQs) of 0.1. The following equation was used: (site maximum concentration) / (site risk) = (RSL) / (RSL target risk), solving for site risk. If the total cancer risk was at or below 5E-5, and the total HI was at or below 0.5, the concentrations were considered protective. These total risk levels, which were within rather than at the upper end of the acceptable risk range, were used to allow for the uncertainties of using screening-level RSLs instead of a detailed risk assessment. Lead was assessed using the residential screening concentration of 400 mg/kg, the Adult Lead Model for non-residential soils, and the drinking water Action Level of 15 µg/L. Chemicals that significantly contributed to a total cancer risk above 5E-5 or an HI of 0.5 were assessed further and in more detail, considering the Upper Confidence Limits on the mean of the concentrations; separation of target organs; and background attribution. The ultimate goal of this more specific assessment was to ascertain whether the cancer risks exceeded 1E-4 or the Hazard Indices exceeded 1, and whether the risk-driving chemicals exceeded background concentrations.

This risk assessment process is referred to below as the “FYR screening.” The various OUs are discussed individually.

OU1 and OU2

These OUs, which represent Quarries 1 and 2, are expected to be capped, in accordance with the 2000 ROD. However, under that ROD, the prevention of residential use was also expected. As noted above, a change in anticipated land use has been proposed for OU1 and OU2, from commercial to residential. EPA is in the process of considering that possibility and whether it would affect the cap design (especially in terms of cap extent). An updated risk assessment and vapor intrusion assessment is being prepared under separate cover. The protectiveness will be evaluated, and if the change is adopted, a new decision document will be prepared if necessary.

OU3

Eleven sets of soil data associated with OU3 (Quarry 3) were available in the December 2010 Remedial Action Report. These data sets consisted of Pond 1, Pond 2, Pond 3, Plateau, Periphery north of Pond 3, Periphery SB8, Periphery SB17, Periphery SB7, Periphery SB1, Stone Haul road, and the Renaissance Blvd. lot. This OU contained an open quarry (the former site of three ponds) and is otherwise expected to be used as an office park, with land use controls. Residential use is prohibited. The existing samples underwent the FYR screening process described above, for commercial/industrial use, and were found to be protective for workers.

OU4

Soil samples from the cover material in the vicinity of OU4 (Quarry 4) were available in the September 2010 Data Validation Reports for SDGs 1007182 and 1007183. This cover soil is the only exposed material. The land is used as an office park, and residential use is not allowed under the terms of the 2000 ROD. EPA anticipates modifying the cap performance standards, following an investigation of the risks via direct contact, and an assessment that found a lack of Quarry 4 impacts on groundwater. Assuming that remedy change is formalized in a decision document, then the current soil cover would remain available for worker exposure.
The cover material samples underwent the FYR screening process described above, for commercial/industrial use, and were found to be protective for workers.

OU5

Soil samples were available from three parcels associated with the WAL Pipeline: Liberty[1], Williamsburg Commons[2], and O'Neill[3]. The Williamsburg property is in an area zoned for residential use, while the Liberty 3000 Horizon property is part of an office park; both were evaluated for unrestricted use. The O'Neill property is part of an office park that has land-use controls applicable to the office park as a whole. O'Neill's ICs include a deed restriction prohibiting disturbance of impacted areas without EPA approval, and a deed notice identifying the presence of the pipeline and associated soil contamination that was not removed from below buildings and paved areas. The existing soil samples underwent the FYR screening process described above, and were found to be protective for workers. The Liberty and Williamsburg properties were also evaluated for residents. The simplified FYR screening of maximum concentrations described above indicated that this scenario required further, more refined site-specific assessment that concluded that these areas do not appear to have unacceptable site risks and were remediated to standards permitting unlimited use and unrestricted exposure.

OU6

OU6 is the operable unit for groundwater. Groundwater goals were set in Table 13 of the 2000 ROD, with the acknowledgment that background concentrations could supersede Table 13. As stated above, the groundwater cleanup goals (see Table 2) are more stringent than current federal MCLs and non-zero MCLGs. In this FYR, they were also screened to indicate whether they would still be protective in combination; i.e., whether total cancer risks would fall between (or below) 1E-6 to 1E-4, and whether the HI would be 1 or less, if all of these goals were met. Chromium, dibenzofuran, and phenol in the center of the plume exceeded the levels of potential concern, as did cobalt, cyanide, and chromium in the extent of the plume. This means that the groundwater goals may not be fully protective. However, the groundwater cleanup is still underway, and the groundwater is not currently being consumed. The exposure and toxicity factors for these chemicals have evolved since 2000, and may continue to change in the future. Therefore, it would appear logical to reevaluate the protectiveness of the groundwater goals at

[1] Summary of Analytical Results for Post-Excavation Samples from 3000 Horizon Drive, Samples PE-6 through PE-19, PE21 through PE-26, PE-1A/B/C, PE-3A/B/C, PE-4B/C/D/E/F, PE-20A/B/B-1/C/D/E
[2] December 2009 Post-Excavation Risk Evaluation for Soil, Former WAL Pipeline Area (OU5), Williamsburg Commons Property
[3] June 2007 Report of Results and Streamlined Human Risk Assessment, PADEP AOC and Former WAL Pipeline Remediation, Table 1, W-PE- samples

the point when it is believed that the groundwater has been successfully remediated using the actual groundwater concentrations at that time. In addition to the evaluation of the groundwater goals, the actual groundwater data were screened using the most recent year for which data were available, 2014, from the 2014 Annual Monitored Natural Attenuation Report (dated March 2015).[4]

OU7

The intended use of this parcel is for offices and parking. ICs are in place preventing residential land use. Cinder slag fill was once excavated from this area, and post-excavation samples were collected in 2001. The existing soil samples (summarized in Summary of Analytical Results for Post-Excavation Soil Samples Collected from the Cinder Slag Fill Area) underwent the FYR screening process described above, and were found to be protective for workers.

OU8

This parcel is a vacant field zoned for commercial use; it is in the same parcel with the same land-use controls as OU9. The intended use of this parcel has yet to be determined. The parcel was evaluated in 2010 and found not to be acceptable for unrestricted (e.g., residential) use. The parcel has land-use controls prohibiting residential use. The data for existing soils range from 1999 to 2009 and were summarized in the January 2010 Post-Excavation Risk Evaluation for Lot 44, Former Dump Area (Area 6 – OU8). The simplified FYR screening of maximum concentrations indicated that the worker scenario required further, more refined site-specific assessment. The soil samples underwent the FYR screening process described above, and were found to be protective for workers.

OU9

This parcel is a vacant field zoned for commercial use; it is in the same parcel with the same land-use controls as OU8. The parcel was evaluated in 2010 and found not to be acceptable for unrestricted (e.g., residential) use. The parcel has land-use controls prohibiting residential use. Cinder slag fill was excavated from this area. The data for remaining soils range from 2003 to 2010 and were summarized in the January 2010 Post-Excavation Risk Evaluation for Soil, Southeastern Property Area (Area 6 – OU9). The soil samples underwent the FYR screening process described above, and were found to be protective for workers.

OU10

This parcel was a steeply sloping grassy area underlain by naphthalene contamination. Soil was excavated, and the remaining soil was sampled. The parcel was evaluated in 2010 and found not to be acceptable for unrestricted (e.g., residential) use. The parcel has land-use controls prohibiting residential use. The data for remaining soils were collected from 2003 to 2009 and

[4] An unusual pattern was noted in the 3/26/2014 data for wells MW-13S and MW-11S. The concentrations in MW-11S showed a sharp increase in chemical concentrations, of 3-5 orders of magnitude. The 8/27/2014 concentrations were back down at the much lower concentrations typical of previous rounds. The 3/26/2014 concentrations in MW-13S showed a sharp decrease of several orders of magnitude, and the 8/26/2014 data were back up in the historical range. EPA strongly suspects that the 3/26/2014 samples for MW-11S and MW-13S were inadvertently switched, and these data should be flagged as questionable.

were summarized in the January 2010 Post-Excavation Risk Evaluation for Soil for Lot 7. The existing soil samples underwent the FYR screening process described above, and were found to be protective for workers.

Day Care Vapor Intrusion

A day-care center near OU10 was sampled to ensure that the site-related subsurface contamination was not posing a threat to workers or children. The results were reported in a 2009 air quality report. No site-related vapor intrusion or vapor accumulation beneath the slab was detected above screening levels. Benzene and naphthalene were detected slightly above screening levels in indoor air. The HI (0.01 to 0.02) from the reported concentrations were below the level of concern (0.1) and the child increased carcinogenic risk (ICR) (2.0E-07) and worker ICR (7.0E-07) were below EPA's acceptable risk range.

As part of this FYR, the data were revisited and rescreened. The air RSLs have changed only negligibly since the previous assessment. Therefore, the conclusions have not changed.

Building 2701 Vapor Intrusion

In 2012, following the last FYR and its recommendations for vapor intrusion investigation, Building 2701 was sampled. This building is adjacent to Quarry 1 (OU1).

The results were reported in the January 2013 Vapor Intrusion Summary Report: Crater Resources Building 2701. Subslab, indoor, and outdoor air were collected via sorbent tubes (semivolatiles) and Summa canisters (VOCs). Naphthalene, acetone, and benzene were detected at low concentrations. EPA concluded that "neither significant vapor intrusion, nor significant accumulation of vapors associated with the sampled chemicals of concern, appears to be occurring in this building at this time." The air RSLs have changed only negligibly since the previous assessment. Therefore, the conclusions would not change.

Other Vapor Intrusion

A comprehensive look at the subsurface contamination—both soil and groundwater—with respect to the placement of current and future buildings has been performed, to ensure that the vapor intrusion scenario has been sufficiently addressed for all parcels associated with the site. Results indicate that there is no unacceptable risk by vapor intrusion to existing buildings; As specified in an ESD currently in preparation, new construction over or within 100 feet of the plume, particularly in the area of Quarries 1 and 2, will include the requirements for assessment and/or pre-emptive mitigation of vapor intrusion during planning and construction and prior to occupancy.

Have other contaminant characteristics changed in a way that could affect the protectiveness of the remedy?

No. Any changes in risk inputs associated with the contaminants have been incorporated into the FYR screening process discussed above.

Changes in Risk Assessment Methods

Have standardized risk assessment methodologies changed in a way that could affect the protectiveness of the remedy?

There have been some changes in EPA's risk assessment guidance since 1999, involving changes in dermal and inhalation risk methodology, as well as an increase in the estimated carcinogenicity of chemicals that act as mutagens (such as chromium and PAHs). Default exposure factors also changed in 2014. Current methodology, toxicity factors, and exposure factors have been used in the FYR screening process described above, to update the evaluation of protectiveness. There have also been refinements in ecological risk assessment methodology; however, none of the changes affect the protectiveness of the remedy.

Expected Progress Toward Meeting Remedial Action Objectives

Is the remedy progressing as expected?

The RAO of restoring groundwater to its beneficial use as drinking water has yet to be achieved, but the MNA sampling program is now underway. The RAO of preventing exposure to Site-related groundwater is currently being met through a combination of ICs, which restrict the installation or use of groundwater wells. The RAO of eliminating exposure to soil/sediment that presented an unacceptable risk to human health has been met with the removal of contaminated soils and sediments. A comprehensive assessment of the vapor intrusion in future buildings will ensure that potential future unacceptable exposures will not occur. The RAO of preventing or reducing further migration to groundwater has been partially addressed by the removal of soil, sediment, and surface water contaminants, and will be met once the Quarry 1 and 2 caps are constructed. Quarry 1 and 2 are also being reassessed for potential residential use.

7.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

A review of site documents, ARARs, risk assumptions and site inspection findings indicate that the remedy is mostly functioning as intended by site decision documents for OUs where the remedy has been fully implemented (OUs 3, 5, 7, 8, 9 and 10). The remedy is expected to function as intended for OUs where the remedy has not yet been fully implemented (OUs 1, 2 and 4), following remedy completion at those areas. Overlapping ICs are in place to prevent exposure to contaminated groundwater (OU6) through ingestion at the Site. The MNA remedy for OU6 is ongoing and data show biodegradation of contaminants; however, until remaining source areas are capped, MNA will likely not be able to effectively achieve groundwater cleanup goals.

A review of groundwater data indicates that the current area of the groundwater plume has not been mapped. As there are two sets of cleanup criteria (center of plume and extent of plume), current groundwater conditions should be delineated. An updated plume map has been requested. COC concentrations exceed cleanup goals in upgradient background groundwater monitoring wells.

In addition, some of the analyte detection limits used for groundwater analysis exceed the cleanup goals for those contaminants. It is therefore not possible to accurately determine if those groundwater COCs are present at concentrations below the detection limits, but above cleanup goals. When monitoring to show compliance with performance standards is conducted, the detection limits must meet the minimum detection limit of 10 µg/L as required in the approved MNA Work Plan. The PRP Group has worked with their laboratories to assure these requirements are attained. Required detection limits were achieved for the 2015 sampling event. In addition, the PRP Group should provide details accounting for the discrepancy between the available cyanide and total cyanide results.

No one is currently using groundwater in the vicinity of the Site as a source of drinking water, so the groundwater does not pose a current risk through ingestion. However, VOC concentrations in shallow site groundwater routinely exceed MCLs. Potential vapor intrusion risks were evaluated using EPA's VISL calculator. Results indicate that there is no unacceptable risk by vapor intrusion to existing buildings; however, new construction over or within 100 feet of the plume, particularly in the area of Quarries 1 and 2, should consider the requirements for assessment and/or mitigation of vapor intrusion during planning and construction and prior to occupancy.

EPA is currently evaluating the protectiveness of the proposed change in land use for OU1 and OU2 to residential.

8.0 Issues

Table 7 summarizes the current site issues.

Table 7: Current Site Issues

Issue	Affects Current Protectiveness?	Affects Future Protectiveness?
The potential exists for vapor intrusion into future buildings constructed on the Site within 100 feet of contaminated groundwater.	No	Yes

9.0 Recommendations and Follow-up Actions

Table 8 provides recommendations to address the current site issues.

To Be Determined Issue and Recommendation

The remedy has not yet been fully implemented for OU1, OU2 or OU4. In order for MNA to function more effectively and to prevent potential human exposure to unacceptable

levels of site-related contamination, it is recommended that remedy implementation at those areas be completed.

The following items, though not expected to affect protectiveness, warrant additional follow up:

- O&M activities are not performed for Quarries 1 and 2. In order to monitor conditions at those areas, it is suggested that routine inspections of the areas (fencing and condition of temporary cover) be performed and documented.

Table 8: Recommendations to Address Current Site Issues

Issue	Recommendation / Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
					Current	Future
The potential exists for vapor intrusion into future buildings constructed on the Site within 100 feet of contaminated groundwater, particularly in the area of Quarries 1 and 2.	Results indicate that currently there is no unacceptable risk by vapor intrusion to existing buildings; however, new construction over or within 100 feet of the plume, particularly in the area of Quarry 2. The requirements for assessment and/or mitigation of vapor intrusion during planning and construction and prior to occupancy will be added to future site decision documents.	PRPs	EPA	09/15/2017	No	Yes

10.0 Protectiveness Statements

OU1

The remedy at OU1 is expected to be protective of human health and the environment upon completion. Installation of the temporary cover prevents human exposure to soils. This OU is expected to be capped, in accordance with the 2000 ROD. However, under that ROD, the restriction of residential use was also expected. As noted above, a change in anticipated land use has been proposed for OU1, from commercial to residential. EPA is in the process of considering that possibility and whether it would affect the cap design (especially in terms of cap extent). An updated risk assessment is being prepared under separate cover. The protectiveness of the proposed modification will be evaluated. If the change is adopted, a new decision document will be prepared if necessary.

OU2

The remedy at OU2 is expected to be protective of human health and the environment upon completion. Installation of a temporary cap over Quarry 2 prevents human exposure to unsafe concentrations of soil contamination. This OU is expected to be capped, in accordance with the 2000 ROD. However, under that ROD, the restriction of residential use was also expected. As noted above, a change in anticipated land use has been proposed for OU2, from commercial to residential. EPA is in the process of considering that possibility and whether it

would affect the cap design (especially in terms of cap extent). An updated risk assessment is being prepared under separate cover. The protectiveness of this proposed change will be evaluated. If the change is adopted, a new decision document will be prepared if necessary.

OU3

The selected remedy for OU3 is protective of human health and the environment because exposure pathways that could result in unacceptable risks have been addressed. This OU contained an open quarry (the former site of three ponds) and is otherwise expected to be used as open space, with land use controls. Residential use is prohibited. The post-removal samples underwent the FYR screening process described above, for commercial/industrial use, and were found to be protective for workers.

OU4

The remedy currently protects human health and the environment. The land is used as an office park, and residential use is not permitted under the terms of the 2000 ROD. EPA is evaluating the modification of the cap performance standards. The current soil cover material samples underwent the FYR screening process described earlier in this FYR, for commercial/industrial use, and were found to be protective for workers.

OU5

The selected remedy for OU5 is protective of human health and the environment because exposure pathways that could result in unacceptable risks have been addressed by the RAs completed at the properties located along the former WAL pipeline. Land use restrictions that prohibit residential land use and disturbance of the land surface are in place for several areas where residual soil does not allow for unrestricted land use. The existing soil samples underwent the FYR screening process described above, and were found to be protective for workers. The Liberty and Williamsburg properties were also evaluated for residents. The site-specific assessment concluded that these areas do not have unacceptable site risks.

OU6

In the short-term the remedy is protective since groundwater in the site vicinity is not used as a source of drinking water. The OU1 and OU2 source cleanup and the groundwater cleanup is still underway, and the groundwater is not currently being consumed. The exposure and toxicity factors for the COCs have evolved since 2000, and may continue to change in the future. Therefore, the protectiveness of the groundwater goals will be evaluated at the point when it is believed that the groundwater has been successfully remediated. In addition to the evaluation of the groundwater goals, the actual groundwater data were screened using the most recent year for which data were available, 2014, from the 2014 Annual Monitored Natural Attenuation Report (dated March 2015). As expected, chromium, dibenzofuran, and phenol in the center of the plume exceeded the cleanup goals, as did cobalt, cyanide, and chromium in the extent of the plume. This only affects the future protectiveness of the groundwater remedy. The remediation needs to continue, in order to reduce future risks. As noted, vapor intrusion is also a potential consideration for future construction, but current conditions are protective of workers at nearby buildings.

OU7, OU8, OU9 and OU10

The selected remedy for OU7, OU8, OU9 and OU10 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks have been addressed through the removal of contaminated soil and implementation of ICs. The existing soil samples from each of these OUs underwent the FYR screening process described above, and were found to be protective for workers. The February 2006 Restrictive Covenant and February 2008 Notice of Superfund Site and Use Restrictions prevent the installation of new groundwater wells or use of existing wells other than to implement the remedy, prohibit residential land use, and prohibit disturbance of the surface of the land, without prior EPA approval.

11.0 Next Review

The next FYR will be due within five years of the signature date of this FYR.

Appendix A: Remedial Actions Implemented to Date

Operable Unit 1 – Quarry 1

The ROD specifies that a multi-media cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers, and soil or other appropriate covers to prevent unacceptable leaching of contaminants from the soils and sediment into the groundwater shall be constructed at Quarry 1. The cap will be constructed in accordance with the Commonwealth's Residual Waste Management Regulations, for final cover of Class 1 residual waste landfills, set forth at 25 Pa. Code Sections 288.234 and 288.236-237.

O'Neill Properties LLP (O'Neill) is planning the development of the parcel adjacent to and including Quarry 1 (2901 Renaissance Boulevard parcel). O'Neill has completed development of the 2701 Renaissance Boulevard office building located on a parcel between Quarries 1 and 2. OU1 includes Quarry 1 and areas outside Quarry 1 impacted by WAL. These areas, identified during various stages of site development and investigations, include the western side of Quarry 1, the Boring 141/203 Area of Concern located on the eastern side of Quarry 1, the Golf Course Area of Concern located on the southern side of the quarry, and the Upper Retention Basin. These areas will be discussed individually below.

A PDI Work Plan for Quarries 1 and 2 was submitted by O'Neill and approved by EPA on July 3, 2001. The PDI included a geophysical study and soil boring program to determine the limits of each quarry. The results were presented in a PDI report approved by EPA on December 3, 2001. A geotechnical investigation was performed from December 2003 through January 2004 to acquire data applicable to the cap design at Quarries 1 and 2. O'Neill submitted a RD work plan for capping Quarries 1 and 2 which was approved by EPA on May 24, 2005.

EPA approved the 100% RD on March 27, 2008. The design included remediation of the impacted soils outside the Quarry limits, consolidation of materials in Quarry 1 to Quarry 2, and capping of the quarries in accordance with PADEP Residual Waste Management Regulations for Class 1 Landfills set forth in PA Code Sections 288.234 and 288.236-237. The design included a flexible membrane hydraulic barrier layer with an overlying drainage composite layer.

RA activities were planned to coordinate with O'Neill's Land Development Plan (LDP) which was approved by Upper Merion Township for the property. The LDP required cutting the elevation of Quarry 1. As this phase of the development was to proceed prior to cap construction, O'Neill submitted a document titled "Remediation Plan for Relocation of Soils From Quarry 1 and Boring 141/203 to Quarry 2" which was approved by EPA on January 8, 2007. This plan provided details on clearing vegetation from the quarries; excavation, loading, and transport of materials from Quarry 1 to Quarry 2 including a pedestrian and traffic control plan; placement and compaction of materials in Quarry 2; surface water management; and construction of a temporary cover on both quarries.

As part of the land development, EPA required O'Neill to provide a contingency plan if WAL or impacted soils was encountered during conventional construction activities. O'Neill submitted a "Soil Management Plan for Non-Impacted Areas", which was approved by EPA on

July 5, 2007. This plan included the contingency that all work would stop if an impacted area was encountered and included provisions for excavation and relocation of the materials to Quarry 2 and post-excavation sampling. Further development of the area would not proceed until performance standards were met.

The LDP called for two retention basins to be constructed at the O'Neill parcels. The lower basin is located east of Quarry 3 and the upper basin is located adjacent to the southwestern corner of Quarry 1. A soils investigation was performed at the basins and other potentially impacted areas outside the quarry limits in 2006 in accordance with the "Revised Retention Basin Sampling and Analysis Plan" approved by EPA on January 11, 2005. Results from the investigation at the basins showed no unacceptable risks for any exposure scenarios at the lower basin; however, arsenic results at two sample locations taken from the upper basin were above PADEP Non-Regulated Clean Fill standards. EPA and PADEP agreed that these soils could be placed beneath the building pad for the 2901 Renaissance Boulevard building to be constructed which would mitigate the potential for surface water runoff to come into contact with these materials for transfer to surface water or groundwater. Remediation of these locations in the upper basin was conducted in accordance with the "Soil Management Plan for Non-Impacted Areas – Crater Resources Superfund Site" approved by EPA on July 5, 2007. Excavation of impacted soils at the upper basin and relocation and compaction of these soils at the 2901 Renaissance Boulevard building pad was performed in April 2008. Approximately 1,175 cubic yards of impacted soil were relocated to the building footprint and placed approximately 5 feet below the top of the final grade of the pad. These activities were documented in a letter report of results on August 29, 2008.

The boring 141/203 area includes the area adjacent to the eastern side of Quarry 1, part of which was designed as the Quarry 1 cap buffer zone, and extends eastward to a portion under the parking lot for the building at 2701 Renaissance Boulevard. Subsurface investigations of this area were performed in 2006 and 2007 and included soil borings which showed the presence of WAL in several locations. O'Neill prepared the document titled "Remediation Plan for Relocation of Soils From Quarry 1 and Boring 141/203 Area of Concern to Quarry 2" approved by EPA on January 8, 2008. A portion of the buffer zone is adjacent to a retaining wall and the 2701 Renaissance building; excavation in this area would potentially impact the stability of these structures. O'Neill obtained approval from PADEP with EPA's concurrence to permit WAL-impacted materials in the buffer zone to remain as this was to be left under the cap. EPA also approved O'Neill's request to leave impacted soils under the parking lot provided the area was maintained as a paved parking lot. The remediation work plan specified that only WAL-impacted materials either outside the buffer zone, but not under the parking lot, or within the buffer zone that required a cut as per the LDP, were to be removed and placed within Quarry 2. ICs preventing disturbance of areas with contamination left under the cap in the buffer zone or under the parking lot without EPA approval have been implemented.

Excavation of the boring 141/203 Area of Concern was conducted in June and July 2008. WAL and visually impacted soils were removed from the areas outside the buffer zone and from areas within the buffer zone which required a cut in accordance with the LDP. The initial excavation was approximately 25 feet wide by 35 feet long and 8 feet deep. Post-excavation samples were collected and two samples collected from outside the cap buffer zone showed

arsenic and chromium above performance standards. Additional excavation and post-excavation sampling was conducted between the cap and paved area to remove the soils exceeding standards. Sampling indicated that performance standards were achieved and the area was backfilled. A total of approximately 260 cubic yards of impacted soils and WAL was removed from this area. The RAs are documented in the "Boring 142/203 Area of Concern- Final Remedial Action Report" approved by EPA on December 4, 2008.

WAL-impacted soils were discovered during conventional construction activities on the western side of Quarry 1 in several areas outside the quarry and the 15-foot buffer zone required in the RD. EPA determined that these areas could be addressed using the remediation plans and standards developed for relocating soils from Quarry 1 and the Boring 141/203 area to Quarry 2. These areas were addressed at various stages of land development as they were encountered. The first areas were visually stained surface soils which were excavated on February 11, 2008. These areas were located approximately 60 feet outside the northwest corner of the quarry and approximately 40 feet west of the quarry, respectively. The first excavation was approximately 94 feet by 17 feet and 1 foot in depth; the second area was approximately 5 feet by 3 feet and 1 foot in depth. Excavated materials were placed in Quarry 1 for later transfer to Quarry 2. Post-excavation samples were collected and several samples showed that SVOCs exceeded performance standards and additional excavation would be required in both areas.

On February 28, 2008, prior to re-excavation of these areas, test pits were dug to determine the visual extent of contamination. On February 28 and 29, 2008, an additional 170 cubic yards of material were removed from these areas and resampled. Results again showed two locations from the bottom of the excavations exceeding SVOC standards. It was agreed that additional excavation would be required. Additional excavation and sampling occurred on March 25, 2008; two samples adjacent to a required cut at the buffer zone exceeded standards; however, this excavation was scheduled, with EPA approval, to coincide with the cut work scheduled for the buffer zone in May 2008.

On April 17, 2008 WAL stained soils from three small areas on the southern side of Quarry 1 were excavated and samples were collected. Two of the samples exceeded the SVOC standards and resulted in additional excavation. This additional work was performed on April 23, 2008 and the post-excavation samples indicated that performance standards were met. On April 29, 2008, three small areas with WAL-stained soils were excavated from the southwestern side of Quarry 1. Post-excavation samples showed one location on the excavation floor exceeding performance standards. Additional excavation from this area was completed on May 5, 2008. All excavated materials were placed in Quarry 1 for later transfer to Quarry 2. Post-excavation samples showed that performance standards were met.

WAL-stained soils and boulders were excavated from an area on the southwest corner of the quarry on May 13 and 14, 2008. Post-excavation samples showed levels above performance standards for chromium and arsenic. On May 22, 2008, additional excavation in this area was conducted; post-excavation samples showed that performance standards were met. Excavated materials were placed in Quarry 1 for later transfer to Quarry 2. Results of the excavation and confirmation sampling were presented in the "Report of Results for WAL Removal –Outside of Quarry 1" dated August 2008.

The Golf Course Area of Concern was identified during grading for land development of the area south of the quarry. This area was observed to be a deposit of WAL-impacted materials around a tree growing along the property line of the O'Neill parcel and Gulph Mills Golf Club. Similar to the WAL-impacted soils discovered west of the quarry, EPA determined that the Golf Course AOC could be addressed using the remediation plans and standards developed for relocating soils from Quarry 1 and the Boring 141/203 area to Quarry 2. Initially, on April 17, 2008, O'Neill removed visually impacted materials from around the tree on their portion of the property and collected post-excavation samples. As additional land clearing for conventional construction occurred in the area, more impacted soils were observed. O'Neill, the Group, and Gulph Mills Golf Club reached an agreement for O'Neill to access the golf course property to remove the tree where WAL was initially observed and perform removal of WAL impacted soils.

In May 2008, the tree root ball, and visually impacted soil were removed and placed in Quarry 1 for later transfer to Quarry 2. Post-excavation samples indicated that SVOCs and chromium remained at concentrations above performance standards; therefore, additional excavation was required. On July 14, 2008, additional soils were excavated and post-excavation samples were collected. Results showed remaining soils met performance standards and no additional excavation in the area was required. A description of the RAs and results were presented in the document titled "Report of Results – Golf Course Area of Concern" submitted in September 2008.

The transfer of materials from Quarry 1 to Quarry 2 occurred between May 2008 and July 2008. After clearing of both quarries and preparation of Quarry 2 to accept new materials, Quarry 1 was cut to the elevation specified in the LDP. A total of 1,593 truckloads (estimated 17,523 cubic yards) of material from Quarry 1 were transferred to Quarry 2 where it was placed and compacted. After relocation of materials from Quarry 1 was completed, a temporary cover was placed on the quarry and a 15-foot buffer zone outside the quarry limits. The temporary cover consisted of 16-ounce non-woven geotextile fabric placed directly on the prepared quarry subgrade. The fabric was covered with a minimum 8-inch continuous layer of 2A stone. A fence was erected around the quarry to restrict access. O'Neill submitted a document on January 23, 2009 titled "Report of Results for Relocation of Soils – Quarry 1 to Quarry 2" providing a description of these activities.

In February 2012, O'Neill conducted a vapor intrusion investigation at their office building located at 2701 Renaissance Boulevard. This building is located immediately adjacent to the Quarry 1 and the Boring 141/203 AOC. Results showed low levels of naphthalene, acetone, and benzene; however, a risk evaluation indicated there was no unacceptable risk associated with exposure to indoor air to site workers. The final report was approved by EPA on February 1, 2016.

In 2014, O'Neill met with EPA to discuss the requirements for a potential land use change from commercial/light industrial to residential. O'Neill formally submitted a request for this change on February 24, 2016 in a document titled "Request for Change in Land Use for 2901 and 2501 Renaissance Boulevard Properties". On March 26, 2015, EPA provided comments requesting additional information including an evaluation of risks on residual

contamination from removal areas outside the cap (since these areas were cleaned to industrial standards) and how this impacts ICs. On August 10, 2015, O'Neill submitted an update to the Human Health Risk Assessment; which is currently in EPA review. On March 22, 2016, O'Neill submitted a preliminary document titled "Environmental Work Plan for Geotechnical Investigation Over Quarry 1 and Quarry 2". This document included a work plan for geotechnical studies to support building design and a plan to install a portion (approximately 1/3) of the permanent cap at Quarry 1 for the purpose of constructing a parking lot for the 2701 Renaissance Boulevard office building. On May 11, 2016, O'Neill submitted an Environmental Work Plan for Parking Lot Partial Cap Construction over Quarry 1. This plan provided additional design details for the construction of the portion of the permanent cap. Construction of the entire cap as designed would be delayed until construction of the proposed residential complex.

Operable Unit 2 – Quarry 2

The ROD specifies that a multi-media cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers, and soil or other appropriate covers to prevent unacceptable leaching of contaminants from the soils and sediment into the groundwater shall be constructed at Quarry 2. The cap will be constructed in accordance with the Commonwealth's Residual Waste Management Regulations, for final cover of Class 1 residual waste landfills, set forth at 25 Pa. Code Sections 288.234 and 288.236-237.

O'Neill is planning for development of the parcel adjacent to and including Quarry 2 (2501 Renaissance Boulevard). OU2 includes Quarry 2 and areas outside the quarry impacted by WAL. These areas include the PADEP Area of Concern, located to the north and northwest of the quarry. A section of the remnants of the former WAL pipeline was also located adjacent to Quarry 2. Impacted soils and the pipeline remnants were placed in Quarry 2; however, details of the RD and RA activities for the pipeline are presented in the OU5 narrative.

Quarry 2 RD activities and the transfer of Quarry 1 soils to Quarry 2 are detailed in the OU1 narrative. The area north and northwest of the quarry outside the cap limits specified in the OU1/OU2 RD is referred to as the PADEP AOC. O'Neill reached agreement with EPA that the cap would not be extended over this area and O'Neill would investigate, delineate, and remediate impacted soils for comparison to the ROD's performance standards or perform a risk assessment to justify that no adverse risk to human health or leaching to groundwater would occur.

In August 2005, investigation of the PADEP AOC was performed to delineate the extent of WAL-impacted soils in the area. This area was identified by PADEP personnel who observed deposits of WAL on the ground surface. A series of test pits/trenches were dug in the area. A total of 13 trenches were excavated to lengths from approximately 35 feet to 165 feet and to depths of 3 to 10 feet below ground surface. The length and depth of the excavations were based on observations of WAL material, stained soils, or elevated photoionization detector (PID) readings in the trench and continued until evidence of contamination was no longer present. Approximately 345 cubic yards of material was excavated and placed in Quarry 2 for later compaction and placement under the cap. Samples were then collected at intervals along the sidewalls, headwalls, and floor of each trench. Sample results showed exceedances of soil

standards for SVOCs. A risk assessment was performed, and based on the sample results, it was estimated that additional remediation of 285 cubic yards of impacted soils was required. The results of the investigation and risk assessment were approved by EPA on December 19, 2006.

O'Neill prepared a remediation plan for the additional soil removal which EPA approved on March 15, 2007. The proposed area of additional excavation was approximately 85 by 10 feet wide and 10 feet deep and included a provision to continue excavation until no visual or olfactory evidence of contamination was present. Excavation commenced on April 23, 2007. The excavation area increased in size to approximately 120 feet by 25 feet by 10 feet in depth due to the observation of contamination. The excavation was halted on the western side when it approached the embankment for a storm water retention basin to prevent undermining of the basin. It was decided that post-excavation samples would be collected at this point as well as the other headwalls, sidewalls, and floor of the excavation. Three of the eight samples collected showed SVOCs above site-specific screening levels and a risk assessment was prepared. The risk assessment indicated that there was no adverse risk to a future industrial worker; however, the potential for naphthalene to leach to groundwater had not been mitigated by the remediation. The risk assessment indicated the proposed LDP included an asphalt parking lot over the soils containing elevated naphthalene which would mitigate infiltration and leaching of contamination to groundwater. EPA approved the report of results and risk assessment on September 17, 2007.

In September 2007, additional WAL-impacted soils were uncovered on the surface during land development construction activities at a location approximately 50 feet from the southwestern corner of the PADEP AOC. Action was taken in accordance with procedures detailed in the contingency plan in the soil management plan for non-impacted soils. In October 2007, a 30 by 25 foot wide area was excavated to a depth of 1 foot to remove the surface contamination and the material was placed in Quarry 2. Post-excavation samples showed that chromium exceeded performance standards on a section of the floor of the excavation and additional excavation was required. Approximately one additional foot of soil was removed from a 20 by 20 foot area of the initial excavation on November 5, 2007 and placed in Quarry 2. Post-excavation samples were collected and results met performance standards. Results are documented in the "Letter Report of Results – Additional Remedial Actions at PADEP AOC West Side of Quarry 2" approved by EPA on December 17, 2007.

The stockpiles of materials from the PADEP AOC and WAL Pipeline section on the O'Neill parcel along with soils cut from Quarry 1 were placed in Quarry 2 in lifts and compacted. Density and moisture testing were performed to assure proper compaction for future cap construction. A temporary cover was placed on the quarry and a 15-foot buffer zone outside the quarry limits. The temporary cover consisted of 16-ounce non-woven geotextile fabric placed directly on the prepared quarry subgrade. The fabric was covered with a minimum 8-inch continuous layer of 2A stone. The quarry is enclosed by fencing to restrict access. O'Neill submitted a document on January 23, 2009 titled "Report of Results for Relocation of Soils – Quarry 1 to Quarry 2" providing a description of these activities.

In 2014, O'Neill met with EPA to discuss the requirements for a potential land use change from commercial/light industrial to residential. O'Neill formally submitted a request for this change on February 24, 2016 in a document titled "Request for Change in Land Use for

2901 and 2501 Renaissance Boulevard Properties". On March 26, 2015, EPA provided requesting additional information including an evaluation of risks on residual contamination from removal areas outside the cap (since these areas were cleaned to industrial standards) and how this impacts ICs. On August 10, 2015, O'Neill submitted an update to the Human Health Risk Assessment; which is currently in EPA review. On March 22, 2016, O'Neill submitted a document titled "Environmental Work Plan for Geotechnical Investigation Over Quarry 1 and Quarry 2". This document included a work plan for geotechnical studies to support building design. Construction of the entire cap as designed would be delayed until construction of the residential complex.

Operable Unit 3 – Quarry 3

Quarry 3 is located south of the 2501 Renaissance Boulevard parcel which is also occupied by Quarry 2. Quarry 3 is approximately 480 feet south of Renaissance Boulevard and bordered to the south by Gulph Mills Golf Club. Quarry 3 is approximately 7.6 acres. Prior to start of the RA, OU3 was heavily vegetated and contained three ponds with contaminated sediments, a sediment/sludge disposal area on the western side referred to as the plateau area, and contaminated soils in other areas of the quarry.

The ROD called for removal of all contaminated soils and sediment in Quarry 3 including dewatering of the ponds with the water transported to an off-site treatment and disposal facility. Sediment in the ponds and plateau area were to be excavated to bedrock or to the level where contaminant concentrations are protective of human health and ecological risk-based concentrations. Contaminated soils outside the ponds and plateau area, identified as peripheral soils, were to be excavated until contaminant concentrations are at levels protective of human health and ecological risk-based concentrations. All excavated soils and sediment were to be taken off-site for proper disposal. The ROD also called for the site to be backfilled to a uniform grade for proper drainage.

During pre-design planning, the PRP Group proposed to EPA the construction of an on-site water treatment system with discharge of treated pond water to Matsunk Creek in lieu of containerizing and shipping pond water to an off-site location. A focused feasibility study (FFS) to evaluate this proposed alternative was submitted on May 23, 2008. On June 25, 2008, PADEP approved the concept of on-site treatment with discharge to the creek. EPA approved the FFS on July 24, 2008.

The PRP Group and EPA also discussed evaluation of soil cleanup goals. The Group submitted a "Technical Memorandum for the Statistical Analysis of Quarry 3 Soils" and a "Technical Memorandum for Development of Target Naphthalene Concentrations in Quarry 3" which were approved by EPA on April 6, 2009. The first memorandum presented a statistical analysis to determine when soil performance standards were met and the second provided modeling to develop an alternate naphthalene standard that would be protective of human health, the environment, and prevent leaching to groundwater.

On April 30, 2009, EPA issued an ESD to revise the naphthalene performance standard and allow on-site treatment of pond water with discharge to Matsunk Creek.

The RD was divided into two separate phases. The Phase 1 RD, addressing pond dewatering and treatment and excavation and disposal of pond sediment, was approved by EPA on February 6, 2009. During RAWP planning, Phase 1 was divided further. Phase 1A included mobilization and construction of support areas, water treatment system construction, and pond dewatering. Phase 1B included excavation of pond sediments, stabilization of pond sediment, offsite transportation and disposal of pond sediment, and backfill of ponds. The Phase 1A RAWP was approved by EPA on April 13, 2009 and the Phase 1B RAWP was approved by EPA on April 21, 2009. The Phase 2 RD and RAWP, addressing removal and disposal of plateau area sediment/sludge and impacted peripheral soils and backfilling, grading, and restoration of the quarry, were approved by EPA on July 21, 2009.

The remediation commenced on February 24, 2009 with mobilization of equipment, preparation of support zones and staging areas, site improvements for security and access, clearing, and establishment of haul roads followed by construction of the on-site water treatment system. The water treatment system included solids removal and treatment using granular activated carbon and ion exchange. Pond water was also pre-treated with aeration and caustic injection to control pH and alum to aid settling of solids. Initial trials of the treatment system were conducted where treated water was discharged back into the ponds. Samples were collected to assure that treated water met PADEP temporary permit discharge limits. Upon confirmation that the system met performance standards, pond dewatering commenced on April 20, 2009. The plant typically operated on a 24-hour per day basis with the effluent sent via five-inch pipe approximately 2,000 feet to the discharge point at Matsunk Creek. A total of 2,293,913 gallons of treated water was discharged to the creek through May 15, 2009. At that time, sample results indicated that discharge limits were exceeded for phenanthrene, benzo(a)anthracene, ammonia, and mercury; therefore, the plant was shut down and additional treatment process options were evaluated. Sufficient water had been removed from Pond 3 during the initial operation of the system to allow conditioning and excavation of sediments to proceed.

On April 27, 2009, excavation and stabilization of sediments from Pond 3 began. Sediment was too wet for transportation and disposal and required conditioning/stabilization prior to shipment. Sediments from all ponds were stabilized using either lime kiln dust, pelletized lime, shredded corn cobs, or, during later stages of the work, mixed with peripheral soils. Stabilization agents were mixed in-situ and tested using the paint filter test to confirm materials were suitable for transportation. Excavation of Pond 3 sediments continued through June 2009 until bedrock was encountered on the bottom and north, west, and east sidewalls. The southern sidewall was excavated until no visually impacted soils were observed and post-excavation samples were collected. Sample results were evaluated and EPA agreed on July 11, 2009 that performance standards were attained. A total of approximately 11,293 tons of sediment were removed and disposed off site.

In July 2009 the Group contacted Upper Merion Township Public Works Department to request a discharge permit for treated water to the sanitary sewer as a substitute for discharge to Matsunk Creek. Upper Merion Township issued an Industrial Waste Discharge Permit on July 23, 2009. The treatment system was restarted and discharge to the sanitary sewer commenced on

July 28, 2009 and ran on and off throughout the remainder of the project. A total of 1,972,172 gallons of treated water was discharged to the sewer.

Excavation of the Plateau Area began on July 23, 2009 and continued through August 21, 2009 when the first round of post-excavation samples were collected at various locations and depths throughout the area. The Group and EPA discussed results and determined that additional excavation in several areas was required. Proposed excavation areas and depths and a request to compare arsenic results to background levels vs. a statistical evaluation was presented by the Group in a letter report dated October 15, 2009 and approved by EPA on November 6, 2009. Excavation and sampling activities continued from October 22, 2009 through December 5, 2009 until performance standards were achieved. A total of 19,539 tons of excavated material from the Plateau Area was disposed off-site.

Excavation, stabilization, and transport and offsite disposal of Pond 1 sediments occurred from August 22, 2009 through November 17, 2009. Bedrock was exposed on the bottom, south, west, and east walls; however, some visually non-impacted soil was left in place on the northern side. These soils were sampled with additional excavation occurring until remaining soils met performance standards. Approximately 29,880 tons of sediment including 540 tons of stabilization agents were removed and disposed off-site.

Pond 2 sediments were excavated, stabilized and disposed offsite from November 19, 2009 through December 4, 2009. The excavation exposed bedrock on all but the west sidewall and a portion of the northwest and southwest walls. These areas were sampled and re-excavated until post-excavation samples showed performance standards had been met or the limits of the peripheral soil excavation area were encountered. A total of 5,570 tons of sediment were excavated and transported off-site for disposal.

Peripheral soils were excavated intermittently from August 25, 2009 to February 23, 2010. Excavation was primarily from five areas of impacted soils between the ponds and the eastern end of the quarry. Excavation continued in each area until post-excavation sample results showed performance standards were achieved. A total of 21,097 tons of peripheral soils were excavated and disposed off-site.

Backfill operations occurred from July 13, 2009 through March 10, 2010 as each area met performance its standards. Clean fill was sampled prior to placement to determine suitability for use and had to pass PADEP Clean Fill Standards and Quarry 3 performance standards. Fill was placed in lifts, compacted with a vibratory roller, and density tested to meet project specifications. The site was graded to allow drainage as per project specifications. A total of 120,300 tons of imported backfill was placed at the site.

Restoration activities included installation of a storm water control system to drain the surface of the backfilled quarry and discharge storm water to a drainage channel adjacent to the site. The system includes an inlet structure with skimmer and an 18-inch diameter pipe discharging through an end-wall into riprap and the drainage channel. The site was covered with a minimum 6-inch layer of topsoil, fertilized and seeded with annual and perennial ryegrass. Support areas including staging areas, decontamination pad, stone entrances, and the stone

access roads within the quarry were removed. Samples collected from below the haul roads and decontamination pad verified that no contamination resulted from construction activities. The haul road from Renaissance Boulevard to Quarry 3 was left in place, although the stone was replaced after construction was completed.

A pre-certification inspection was conducted by EPA on August 19, 2010. Based on results of the post-excavation soil samples, the RA implemented at OU3 was successful in removing all impacted soil. The remaining soils do not present an unacceptable risk based upon leaching of potential contaminants to the groundwater. On December 15, 2010, the PRP Group submitted a report to the EPA entitled "Remedial Action Report for Operable Unit 3 – Quarry 3" which documented the results of the remedial activities that were completed at OU3. A revised report was submitted on October 20, 2011 and approved by EPA on March 29, 2012.

Ongoing operation and maintenance (O&M) activities included quarterly inspections during the first year followed by annual inspections. Repairs for erosion and vegetation growth are made as necessary.

Operable Unit 4 – Quarry 4

The ROD specifies that a multi-media cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers, and soil or other appropriate covers to prevent unacceptable leaching of contaminants from the soils and sediment into the groundwater shall be constructed at Quarry 4. The cap was to be constructed in accordance with the Commonwealth's Residual Waste Management Regulations, for final cover of Class 1 residual waste landfills, set forth at 25 Pa. Code Sections 288.234 and 288.236-237. Prior to issuance of the ROD, Liberty performed a due diligence investigation and remediation of the 2201 and 2301 Renaissance Boulevard properties and commenced development of the site for use as an office park. A portion of Quarry 4 was developed and includes a portion of an office building, parking areas, and a lined storm water retention basin. In 2001, Liberty requested a waiver of the capping and drainage layer requirements; however, PADEP and EPA determined additional information and data would be needed to demonstrate that there would be no impact to groundwater if infiltration of surface water into the quarry was not limited.

Penn Environmental & Remediation, Inc. (Penn E&R), on behalf of Liberty, submitted an RD Work Plan for the Quarry 4 Demonstration Project which was approved by EPA on June 29, 2004. The work plan provided a summary of available data and proposed additional data collection activities including soil borings to collect samples at various intervals throughout the quarry and additional sampling of nearby monitoring wells. These activities were conducted between 2004 and 2008. The results of the additional data collection activities were presented in the "Interim Remedial Design Report (IRDR) for the Quarry No. 4 Demonstration Project" approved by EPA on July 22, 2010. The IRDR summarized the data and provided a work plan to finalize requirements needed to complete the Demonstration Project. The IRDR included identification of all wells needed for sampling, including installation of three new wells to provide adequate coverage of the groundwater regime at Quarry 4, duration and frequency of sampling, analytical requirements, and data evaluation procedures.

In July 2010, three soil borings were advanced in the fill material placed on Quarry 4 as part of development of Liberty Property Trust's (LPT) 2201 Renaissance Boulevard property. Samples were collected to evaluate if contaminants were present in the fill which could potentially impact groundwater. No contamination above screening levels was detected. In August 2010, three new monitoring wells were installed.

The Demonstration Project included sampling seven monitoring wells on a quarterly basis over a two year period and a statistical analysis of the data to determine if constituents in Quarry 4 are impacting groundwater. Sample analysis was for volatiles, semi-volatiles, and metals. Investigation activities commenced in August 2010 in accordance with the IRDR and included sampling of soils placed in the quarry as fill and installation and sampling of monitoring wells. Soil sample results were all below site-specific soil screening levels for workers. Eight consecutive quarterly groundwater monitoring events were performed from October 2010 through August 2012. Statistical analysis of results comparing monitoring well results upgradient of Quarry 4 to wells downgradient of Quarry 4 were completed and presented in the Remedial Design Report (RDR). Results indicate that there is no statistical difference in groundwater concentrations in downgradient wells from the upgradient wells; therefore, there is no evidence of leaching of contaminants from Quarry 4 into groundwater. The final RDR was submitted in January 2014. Based on the results of the Demonstration Project, LPT submitted a request for Waiver Pursuant to 25 PA Code 288.234(b) to PADEP in January 2014. PADEP has provided its response in a letter dated March 18, 2014 which informed EPA that an elimination of the capping requirements in this case appears warranted, is allowable pursuant to the requirements found in 25 PA Code Section 288.234 (b) relating to final cover and grading requirements for residual waste landfills, and would, if granted, satisfy PADEP's ARAR for final cover at Quarry 4.

Operable Unit 5 – WAL Pipeline

Liberty owns the properties located at 2201 and 2301 Renaissance Boulevard. The 2201 Renaissance Boulevard property was developed by Liberty and is currently occupied by an office building, associated parking lots and a storm water detention basin. Liberty has also completed development of the adjacent 2301 Renaissance Boulevard property with a second office building, associated parking lots, and two storm water detention basins.

As part of Liberty's due diligence survey for the 2201 and 2301 Renaissance Boulevard properties, Liberty retained Penn E&R to complete due diligence and a site characterization of the property. During this site characterization, Penn E&R encountered two buried pipelines located one on top of the other on the west side of the property. The pipelines entered the site near Renaissance Boulevard and ran south/southwest along a dirt access road to a point where they exited the property in the southwest corner of the parcel. The buried pipelines appear to have followed the course of, and to have been located directly beneath, an aboveground pipeline which was also reportedly located in this area. The pipelines transported WAL from the former Alan Wood Coke facility, which was located about one mile east of the site, to Quarry 1, 2, and 3 located on the Site. No portions of the reported aboveground pipeline were ever identified on these properties.

Penn E&R implemented a program of pipeline removal and additional sampling. The activities implemented were outlined in a work plan developed by Penn E&R entitled "Work Plan to Complete Additional Site Characterization Activities and To Remove a Buried Pipeline at the Yellow Parcel (2201 and 2301 Renaissance Boulevard properties) in the Renaissance Park Commercial Development," dated June 25, 1998. The activities outlined in the Work Plan and which were implemented included the following: 1) collection and analysis of surface and subsurface soil samples along the length of the former pipeline; 2) the collection and analysis of sediment samples from an adjacent drainage swale; 3) the removal of the buried pipeline; 4) the excavation of potentially impacted soil located beneath the buried pipeline; 5) the collection of post-excavation soil samples from the remediated areas; and 6) the implementation of a focused risk assessment.

The pipeline was removed in two separate phases. The first phase was implemented in September 1999 and included the removal of the northern half of the pipeline. The southern half of the former pipeline ran through a portion of an area designated as a wetland. Prior to removing the pipeline from this wetland area, Chester Valley Engineers, on behalf of Liberty, submitted a General Permit No. 5 Application to PADEP to remove the pipeline from the wetland area. PADEP approved this request and in April of 1999 issued a general permit to complete this work. The PADEP permit number for this work was GP No. 054699324. On January 18, 2000, a Revised Erosion and Sediment Pollution Control (ESPC) Plan developed by Chester Valley Engineers was submitted to the Montgomery County Conservation District (MCCD). This revised ESPC plan incorporated the activities associated with the removal of the pipeline from the wetland area. On January 20, 2000, the MCCD approved the revised plan and issued a general permit (General permit #PAR10T555) to complete the removal of the pipeline from the wetland area. After obtaining all appropriate permits, the southern half of the pipeline was removed in March 2000.

As part of the site characterization, surface and subsurface soil samples were collected along the length of the former pipelines and sediment samples were collected from a swale that drained the western end of the 2301 Renaissance Boulevard parcel. The results of this sampling indicated that soils at five specific locations along the pipelines had been impacted by the pipeline; however, no impact to the swale was documented. These five areas along the former pipes were remediated, and all potentially impacted soil (approximately 220 cubic yards) was excavated from these areas. Upon completion of the remedial activities, post-excavation soil samples were collected and each area was backfilled with clean soil.

The results of the analysis of the post-excavation samples and other samples collected during the site characterization indicate that remaining soils and sediments do not present a human health concern. Several of the analytical results included PAH compounds and the metals arsenic, iron and lead at concentrations that exceeded their EPA Risk Based Concentrations (RBCs). To ensure that these exceedances did not represent an unacceptable risk, a site-specific risk assessment was completed. The results of the risk assessment indicated that the future use of the 2301 Renaissance Boulevard property for commercial purposes would not result in an unacceptable risk to industrial workers, construction workers, or adolescent trespassers.

Other sections of the WAL pipeline that were not addressed in these prior actions required investigation and remediation as specified in the ROD. These include the portion of pipeline on the O'Neill parcel, a section of pipeline on Liberty's 3000 Horizon Drive property, and the continuation of that section of pipeline that leaves the 3000 Horizon property and runs through and adjacent to the Williamsburg Commons property and through the 2201 Renaissance Boulevard property.

The section of the pipeline which traversed the 2200 Renaissance Boulevard property was investigated as part of a Phase II Environmental Assessment conducted by URS Corporation for the property owners in 2002. This property contains the building referred to as the Triad Building. The investigation included a ground-penetrating radar (GPR) survey at the location of the pipeline run to evaluate if the pipeline had been removed during land development or remained at the property. The GPR survey showed anomalies suggestive of buried metallic debris, storm and sanitary sewer lines and a linear anomaly potentially indicating the presence of the former pipeline in the northern portion of the property. This anomaly was not continuous through the property. Based on the results of the GPR survey, a total of 19 soil borings were advanced at approximately 50-foot intervals along the length of the pipeline run. Borings were advanced to depths of 12 feet below ground surface and screened at 2-foot intervals for evidence of visual or olfactory contamination. Samples were also screened using a PID. No evidence of contamination was observed; however, samples were collected from 9 borings at depths where the pipeline would be expected to be encountered. All results for metals, VOCs, and PAHs were either non-detect or below PADEP Act 2 MSCs. Based on the results, no soil contamination associated with the pipeline was present at this parcel.

Liberty submitted the "Remedial Design Work Plan for Investigation of the Former WAL Pipeline at 3000 Horizon Drive" which was approved by EPA on March 1, 2005. The investigation commenced on March 7, 2005 with an electromagnetic survey to identify the approximate location of the pipeline on the Liberty property. The sections of the pipeline remaining on the property were identified, and test pits were installed to confirm the geophysical survey and ensure no other sections of pipeline were present on the site.

Liberty submitted the "Remedial Action Work Plan for the WAL Pipeline Removal at 3000 Horizon Drive" which was approved by EPA on February 8, 2006. The RAWP detailed procedures for excavating the pipeline and pipeline route, post-excavation soil sampling, and site restoration activities. Remedial construction started on November 15, 2005; approximately 70 feet of pipeline and impacted soils were removed and post-excavation soil samples were collected. Post-excavation soil results showed that PAHs remained at levels above ROD performance standards. Liberty submitted a RAWP Addendum to address the remaining contamination. The RAWP Addendum was approved by EPA on May 25, 2006. In June 2006, additional RA including further excavation and off-site disposal of impacted soils was completed. Post-excavation sample results showed only slight exceedances of screening criteria; therefore, a focused risk assessment was conducted. Results showed no unacceptable risks to human health based on the most conservative (residential) exposure scenarios and no unacceptable leaching potential to groundwater; therefore, the remaining soils met risk-based cleanup criteria permitting unrestricted future use of the site.

The remediation included removal of the pipeline and impacted soils to the property line bordering Williamsburg Commons. A total of 155 cubic yards (230 tons) of impacted soils were removed and disposed off-site. The site was restored to as near as original conditions as possible. Excavations were stabilized with modified 2A stone, backfilled with clean soils and topsoil, reseeded and mulched. The area has been allowed to become naturally revegetated as this portion of the property was unused and not maintained or landscaped. Remedial activities were documented in a report titled "Final Report for the WAL Pipeline Removal at 3000 Horizon Drive" which was approved by EPA on January 12, 2007. There are no ongoing O&M activities as the parcel was remediated to standards permitting unrestricted use.

O'Neill submitted a RD Work Plan for the pipeline section adjacent to the southern side of Quarry 2. EPA approved the work plan on July 21, 2005. On March 15, 2007, EPA approved the "Remediation Plan for the PADEP Area of Concern and Former WAL Pipeline". RAs were performed in accordance with the Remediation Plan which called for excavation of a 160 foot by 15 foot wide area (approximately 150 cubic yards) of impacted soils and slag materials. Remedial construction was performed on April 20, 2007 and April 23, 2007. Deposits of slag material were visible throughout the excavation area and were removed. Small sections of pipeline were also present and removed. These materials were transported to Quarry 2 and placed in a stockpile in the quarry. The OU2 discussion presents details on waste handling from AOCs outside Quarry 2 and the relocation of these materials to Quarry 2. Post-excavation samples were collected from the sidewalls and floor of the excavation and a risk evaluation was performed. Results were compared to the performance standards used for the ROD's pipeline cleanup standards and all results were below these levels. A summary of the RA and risk evaluation was presented in a report titled "Report of Results and Streamlined Human Risk Assessment for the PADEP AOC and Former WAL Pipeline Remediation" approved by EPA on September 17, 2007.

From April to June 2006, the Group performed investigations of the remaining areas where the WAL pipeline had not been investigated or remediated. These areas include west of Flint Hill Road to Liberty's 3000 Horizon Drive property (RAGM parcel) and from the southwestern corner of the 3000 Horizon property west-southwest to Horizon Drive. The investigation included electromagnetic surveys, including radio-tracing of the pipeline from the terminus at the corner of the 3000 Horizon Drive and Williamsburg Commons property, and test pit and soil boring investigations and sampling. The investigation showed approximately 190 feet of pipeline remaining and elevated levels of SVOCs in soils in the area of undisturbed pipeline sections in the area of Williamsburg Commons. No pipeline remnants were identified in the area from Flint Hill Road to Liberty's 3000 Horizon Drive property. Results were provided in an investigation report approved by EPA on September 21, 2009. A risk assessment was also performed which identified four areas for soil remediation at the Williamsburg Commons area where PAHs and arsenic were at levels that presented unacceptable risks for residential exposure.

The Group prepared a Remedial Design and Remedial Action Work Plan for remediation of these remaining areas of the pipeline and impacted soils. The RD/RAWP was approved by EPA on October 7, 2009. Remedial construction was implemented from October 14, 2009 through November 19, 2009. The four areas with pipeline remnants and soil contamination were excavated; approximately 190 feet of 4-inch diameter pipeline and 190 cubic yards (365 tons) of

soil were removed and disposed off-site. Post-excavation samples were collected from the excavation sidewalls and floor for use in a risk evaluation to determine if risk-based performance standards were achieved. The excavation was backfilled with imported clean fill and topsoil and the disturbed areas were raked, seeded and mulched. Trees that were removed or damaged during the RA were also replaced. A pre-certification inspection was conducted by EPA on May 5, 2010 to verify that onsite construction and restoration activities were completed.

The Group prepared a risk evaluation based on the post-excavation sample results which concluded there were no unacceptable risks to adult or child residential receptors or leaching to groundwater; therefore, the remediation was considered complete. EPA approved the risk evaluation on March 19, 2010. On August 10, 2010, the Group submitted the "Remedial Action Report for the Former WAL Pipeline (Operable Unit 5)".

Since no permanent or semi-permanent structures were constructed and contaminated soils were remediated to levels for unrestricted use at the Williamsburg Commons property, no long-term O&M is required. As per the warranty, the site was monitored for a one-year period to assure that grass has been re-established.

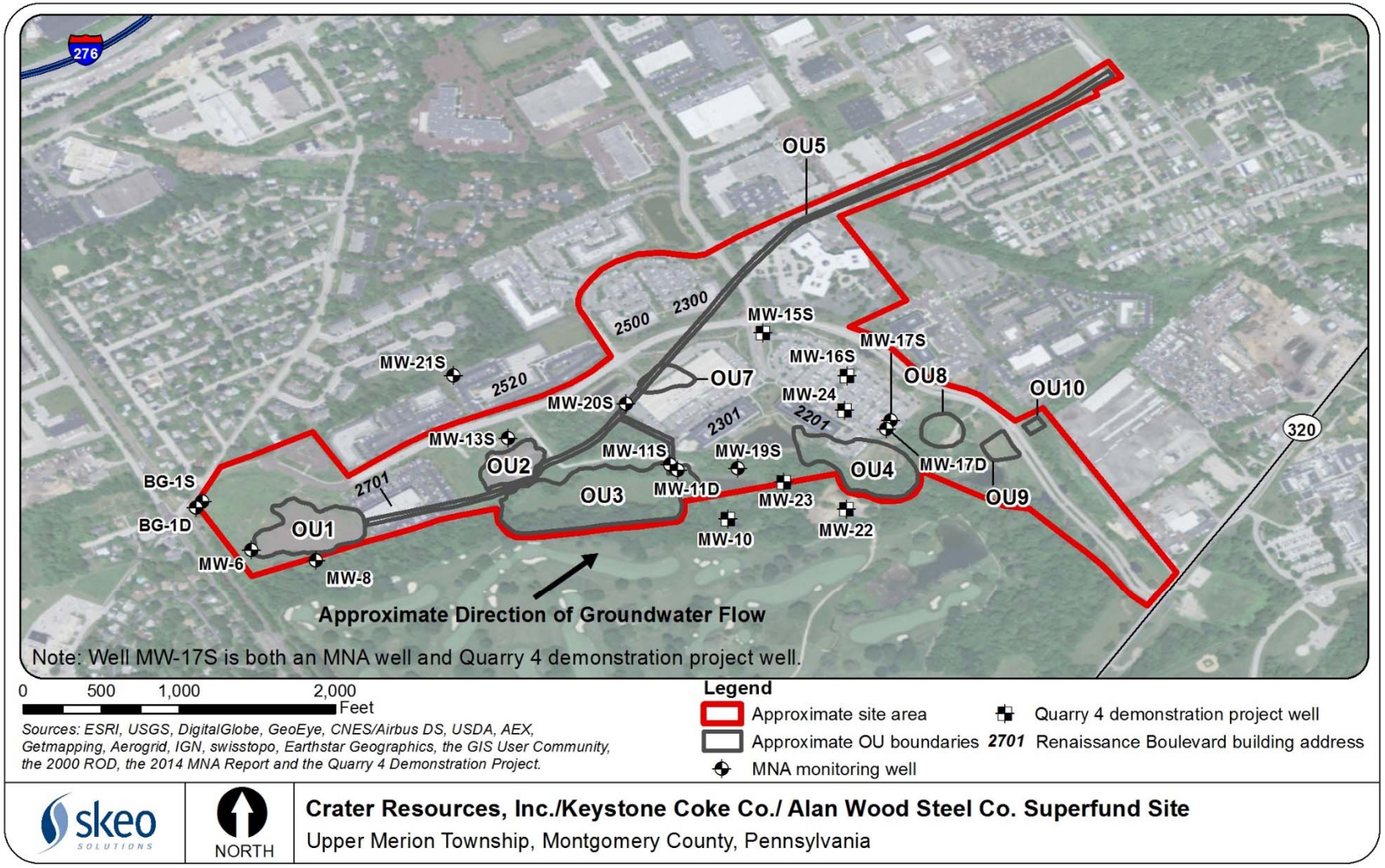
Operable Unit 6 – Groundwater Monitored Natural Attenuation

As specified in the ROD, groundwater monitoring is being conducted at on-site and off-site locations for selected Site-related SVOCs, metals, cyanide, and VOCs that presently exceed preliminary remediation goals. Additional parameters representative of the natural attenuation process are included in the monitoring program. This monitoring provides a basis to determine the rate at which natural attenuation is taking place.

The Group prepared a PDI Work Plan for MNA which was approved by EPA on April 13, 2006. The work plan detailed the data collection requirements to evaluate groundwater conditions and update the conceptual site model. Field activities, including monitoring well sampling and water level measurements, were conducted in 2006 and the MNA Pre-Design Investigation Report was submitted, revised, and approved by EPA on March 19, 2008. The PDI report also provided a plan for additional field activities required to fill data gaps and prepare the MNA RD. The PDI report recommended test borings and sampling, packer testing and geophysical logging of the borings, construction of monitoring wells in the borings, and a complete round of site-wide sampling and water level measurements. A Supplemental PDI Work Plan for this additional work was submitted and approved by EPA on April 9, 2008. Field activities were conducted from May through July 2008 and the Supplemental Pre-Design Investigation Results report was submitted on December 5, 2008. The results from this report served as the basis for developing the MNA sampling strategy.

The MNA Work Plan, submitted by the Group, was approved by EPA on August 17, 2010 and provides the sampling and data evaluation requirements for the MNA remedy. Sampling is performed at 12 monitoring wells for volatiles, semi-volatiles, metals, cyanide, and other MNA parameters. Well locations are shown on Figure A-1. The initial monitoring program frequency was quarterly for three years, with an evaluation regarding future frequency performed

Figure A-1: Groundwater Monitoring Well Locations



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

after completion of the second year of monitoring. A request to conduct monitoring on a semi-annual basis was approved by EPA on April 30, 2013. Semi-annual monitoring is occurring and annual reports are provided to EPA. After performance standards are achieved, monitoring will be quarterly until results for all wells are below performance standards for four consecutive quarters.

MNA sampling commenced in November 2010. Results show the highest levels of contamination in the vicinity of Quarry 1 (MW-6; benzene and naphthalene), Quarry 2 (MW-13S; SVOCs, benzene, acetone, cyanide), and Quarry 3 (MW-11S and MW-11D; SVOCs, benzene, arsenic). Wells further away from these sources show significantly lower levels of contamination although performance standards for inorganics (arsenic, cyanide, selenium) are exceeded at most wells included in the MNA monitoring. Wells further downgradient of those included in the MNA monitoring program (MW-A, MW-B, LMW-1, LMW-2, and LMW-3 as detailed in the RI) do not show site-related contamination. Of the MNA wells, those located north-northeast of Quarries 2 and 3 showed exceedances of extent of plume standards for naphthalene (MW-20S), benzene (MW-20S), and chloroform (MW-15S, MW-15D, MW-20S). These results generally show the same contaminant patterns as historical results; however, the wells near Quarry 3 (particularly in MW-11D) have shown declining concentrations of SVOCs in the samples after completion of the RA at Quarry 3. Results for MNA parameters from most wells, including those in the center of the plume, show favorable conditions for anaerobic degradation (low dissolved oxygen, and high levels of methane, dissolved iron, and dissolved manganese).

Operable Unit 7 – Cinder/Slag Fill Area

Liberty owns the properties located at 2201 and 2301 Renaissance Boulevard. The 2201 Renaissance Boulevard property was developed by Liberty and is currently occupied by an office building, associated parking lots and a storm water detention basin. Liberty has also completed development of the adjacent 2301 Renaissance Boulevard property with a second office building, associated parking lots, and two storm water detention basins.

As part of Liberty's due diligence survey, an area of fill material was identified in the north-central portion of their 2301 Renaissance Boulevard property. This fill area was designated the CSFA. The CSFA was characterized through the installation of test pits and soil borings and the submittal of samples for laboratory analysis. Based on the results of these previous site characterization activities, the material in the CSFA was determined to consist primarily of glass, ash, coal dust, cinders, and slag, and encompassed an area 250 feet long by 150 feet wide. The thickness of the fill ranged from 1-foot along the perimeter of the area, to up to 20 feet in the central portion of the CSFA. However, the fill material was, on average, from 3 to 4 feet thick. The source of the fill is not known; however, based on historical aerial photographs, it was placed in this area prior to 1959.

The ROD selected capping, in accordance with 25 PA Code Sections 288.234 and 288.236-237, as the appropriate remedy for Quarries 1, 2 and 4 and other contaminated soil areas, and the excavation and off-site disposal of impacted soils/sediments located in Quarry 3. Although not investigated as part of the Crater RI/FS or identified as an area of concern in the

ROD, EPA considered the CSFA to be a contaminated soil area related to the Crater Resources site and designated this area OU 7.

Liberty discussed with EPA the remediation of the CSFA via capping and/or the excavation and off-site disposal of the contents of this area. Based on these discussions, the RA implemented at the CSFA included the excavation and off-site disposal of all potentially impacted materials and soils. The implementation of this remedy enabled the planned development to proceed on schedule, and without any impacts on the planned use of the property (which included the construction of an office building and parking garage). This remedy meets the RAOs and Performance Standards of Section VIII and XII, respectively, of the ROD, and satisfies the Statutory Determinations of Section XIII of the ROD. In addition, EPA in the ROD's Responsiveness Summary acknowledged that flexibility during the RD for land development considerations was allowed.

The RAs implemented in the CSFA were completed in accordance with the document developed by Penn E&R on behalf of Liberty entitled "Remedial Design/Remedial Action Work Plan for the Cinder/Slag Fill Area Located at 2301 Renaissance Boulevard in Upper Merion Township, Montgomery County, PA", dated October 10, 2001 (Final). This work plan was approved by the EPA on October 29, 2001.

The remediation of the CSFA was implemented between September and November 2001 and included the excavation and off-site disposal of approximately 5,500 cubic yards or 7,100 tons of potentially impacted fill and soil. Upon completion of the remedial activities, forty nine post-excavation soil samples were collected from the CSFA. No site-specific cleanup standards for the CSFA were included in the ROD. However, based upon discussions with and approval of EPA, a Focused Risk Assessment (FRA) was implemented using the results of the post-excavation sampling to evaluate the effectiveness of the remedial activities implemented in the CSFA. Potential risks to industrial and on-site adult construction workers were evaluated, as were potential impacts to groundwater.

Based on results of the post-excavation soil samples and the FRA, the RA implemented in the CSFA was successful in removing all potentially impacted soil. The soils remaining in the CSFA do not present an unacceptable risk to construction or industrial/office workers at the site, and leaching of potential contaminants to the groundwater at unacceptable levels will not occur. On September 22, 2003, Liberty submitted a report to the EPA entitled "Remedial Action Report for the former Cinder/Slag Fill Area Operational Unit 7" which documented the results of the remedial activities that were completed in the former CSFA, which EPA approved in a letter dated September 30, 2003.

Liberty has developed the 2301 Renaissance Boulevard property for commercial office use only, consistent with the commercial use zoning of this property, and does not intend to use the 2301 Renaissance Boulevard property for any residential or child care purposes. Given that no residential assessments have been performed, Liberty implemented an IC for the CSFA at the 2301 Renaissance Boulevard property to notify any future owners of the need for additional assessment in the event of residential use or development of the CSFA. The notification was

included in the deed to the 2301 Renaissance Boulevard property upon any future transfer of this property by Liberty to a new owner.

Operable Unit 8 – Area 6 – Former Dump Area

Area 6 is located south-southwest of Renaissance Boulevard and north-northeast of Quarry 4. The unused parcel is vegetated with grass, brush and trees. Area 6 was identified during a 1997 geophysical investigation to determine subsurface conditions for future development. Due to the contamination encountered during the geotechnical investigation, a remedial investigation was performed in 1999 for the PRP Group. In addition, Liberty performed an additional investigation in October 2000 leading to the discovery of another disposal area east of the area where the 1999 remedial investigation occurred. This area has been designated the Southeast Property Area (OU9) as discussed below. The portion of Area 6 identified during the geophysical investigation has been designated the Former Dump Area (OU8).

EPA considered the Former Dump Area to be a contaminated soil area related to the Crater Resources site and designated this area OU8. The ROD selected capping, in accordance with 25 PA Code Sections 288.234 and 288.236-237, as the appropriate remedy for Quarries 1, 2 and 4 and other contaminated soil areas, and the excavation and off-site disposal of impacted soils/sediments located in Quarry 3. The Responsiveness Summary in the ROD noted that other contaminated soil areas would be more fully evaluated during RD activities and allowed for flexibility during the RD to reflect land development considerations. The ROD did not provide cleanup standards for this area, but indicated that cleanup standards for soil and sediment at the Crater Resources Site are based on health risks.

On August 20, 2003 EPA approved a PDI Work Plan for Area 6 submitted by the PRP Group. The investigation was performed in September and October 2003 to determine the extent of fill material at OU8 and OU9. Subsurface investigation was performed using test pits and direct-push methods and the results were provided in the "Area 6 Operable Unit 8 Pre-Design Investigation Summary Report", which contained data for OU8 and OU9, dated May 2004.

Based on the results of the PDI, the "Health Risk Assessment for Former Dump Area (Area 6 - Operable Unit 8)" was submitted on December 2, 2008 and approved by EPA on March 31, 2009. The risk evaluation identified unacceptable future risks to receptor populations if the impacted materials were encountered. The risk assessment also identified that removal of impacted materials at one location at a depth of 5 feet would eliminate the adverse risk.

After discussions with EPA, the implemented remedy was excavation of the impacted soils identified in the risk assessment because of the small area and impracticality of capping this area. Removal of impacted soils from this area would also allow reuse of that portion of the parcel. This remedy meets the RAOs and Performance Standards of Section VIII and XII, respectively, of the ROD, and satisfies the Statutory Determinations of Section XIII of the ROD. A Remedial Design/Remedial Action Work Plan for excavation of impacted soils was submitted by the PRP Group on September 25, 2009 and approved by EPA on December 10, 2009.

The RD specified an initial removal of a 20-foot by 20-foot area to a depth of 6 feet at which point post-excavation samples would be collected to determine if performance standards were met. This excavation was conducted on December 22, 2009. Approximately 90 cubic yards (120 tons) of impacted soil was removed and disposed off-site. Results from post-excavation samples indicated that performance standards had been met, and the excavation was backfilled and restored on January 21 and 22, 2010. A pre-certification inspection was conducted by EPA on May 5, 2010 to verify that onsite construction and restoration activities were completed. A risk assessment providing an evaluation that the remediation had attained performance standards was submitted and approved by EPA on June 1, 2010.

Based on results of the post-excavation soil samples, the RA implemented at OU8 was successful in removing all potentially impacted soil. The soils remaining at OU8 do not present an unacceptable risk to outdoor, indoor, and future construction workers, and leaching of potential contaminants to the groundwater at unacceptable levels will not occur. On July 20, 2010 the PRP Group submitted a report to the EPA entitled "Remedial Action Report for Area 6/Lot 44 Former Dump Area – Operable Unit 8" which documented the results of the remedial activities that were completed at OU8. EPA approved the RA Report in a letter dated December 14, 2010.

Since no permanent or semi-permanent structures were constructed, no long-term O&M is required. As per the warranty, the site was monitored for a one-year period to assure that grass had been re-established.

Operable Unit 9 – Southeast Property Area

The Southeast Property Area consists of a portion of Area 6/Lot 44 which also contains OU8. This area is primarily an open, maintained lawn east of OU8 and adjacent to Renaissance Boulevard across from Lot 7. Area 6 was identified during a 1997 geophysical investigation to determine subsurface conditions for future development. Due to the contamination encountered during the geotechnical investigation, a remedial investigation was performed in 1999 for the PRP Group. In addition, Liberty performed an additional investigation in October 2000 and discovered the fill material in the area that later was named the Southeast Property Area or Southeast Property Area (OU9).

EPA considered the Southeast Property Area to be a contaminated soil area related to the Crater Resources site and designated this area OU9. The ROD selected capping, in accordance with 25 PA Code Sections 288.234 and 288.236-237, as the appropriate remedy for Quarries 1, 2 and 4 and other contaminated soil areas, and the excavation and off-site disposal of impacted soils/sediments located in Quarry 3. The Responsiveness Summary in the ROD noted that other contaminated soil areas would be more fully evaluated during RD activities and allowed for flexibility during the RD to reflect land development considerations. The ROD did not provide cleanup standards for this area, but indicated that cleanup standards for soil and sediment at the Crater Resources Site are based on health risks.

On August 20, 2003 EPA approved a PDI Work Plan for Area 6 submitted by the PRP Group. The investigation was performed to determine the extent of fill material at OU8 and

OU9. Subsurface investigation was performed using test pits and direct-push methods and the results were provided in the "Area 6 Operable Unit 8 Pre-Design Investigation Summary Report", which contained data for OU8 and OU9, dated May 2004.

Based on the results of the prior investigations, the "Health Risk Assessment for Southeastern Property Area (Area 6- Operable Unit 9)" was submitted on August 15, 2008. The risk evaluation identified unacceptable future risks to receptor populations if the impacted materials were encountered. The risk assessment also identified that removal of impacted materials at one location at a depth of nine feet would eliminate the adverse risk.

In May 2009, additional investigations were conducted by the PRP Group to determine the extent of cinder/slag fill material relative to the location of underground utilities on the property. After utility mark-out, direct-push and test pit samples were collected when cinders/slag were encountered. This work was performed to supplement the RD for OU9.

After discussions with EPA, the implemented remedy was excavation of the impacted soils identified in the risk assessment because of the small area and impracticality of capping this area. A cap at this area would have potentially required relocation of utilities including water, electrical, and sewer lines. Removal of impacted soils from this area would also allow reuse of that portion of the parcel. This remedy meets the RAOs and Performance Standards of Section VIII and XII, respectively, of the ROD, and satisfies the Statutory Determinations of Section XIII of the ROD. A Remedial Design/Remedial Action Work Plan for excavation of impacted soils was submitted by the PRP Group on September 25, 2009 and approved by EPA on December 10, 2009.

Remedial construction started at OU9 on December 22, 2009 and was conducted in stages to allow for sidewall sample collection at specific depths until the target depth of 10 feet was reached on January 8, 2010. Post-excavation sample results were evaluated and it was determined that additional excavation would be required to meet the risk-based performance standards. Additional excavation was conducted on January 11, 2010; however, performance standards were still not attained. On January 19, 2010, excavation was continued resulting in a final excavation area of 33 feet by 29 feet by 10 feet deep. Post-excavation samples indicated that the performance standards were met. An estimated total of 350 cubic yards (545 tons) of impacted soils were disposed off-site. On January 21, 2010, the excavation area was backfilled and restored. A pre-certification inspection was conducted by EPA on May 5, 2010 to verify that onsite construction and restoration activities were completed.

Based on results of the post-excavation soil samples, the RA implemented at OU9 was successful in removing all potentially impacted soil. The soils remaining at OU9 do not present an unacceptable risk to outdoor, indoor, and future construction workers, and leaching of potential contaminants to the groundwater at unacceptable levels will not occur. On July 15, 2010 the PRP Group submitted a report to the EPA entitled "Remedial Action Report for Area 6/Lot 44 Southeast Property Area – Operable Unit 9" which documented the results of the remedial activities that were completed at OU9. EPA approved the RA Report in a letter dated December 14, 2010.

Since no permanent or semi-permanent structures were constructed, no long-term O&M is required. As per the warranty, the site was monitored for a one-year period to assure that grass had been re-established.

Operable Unit 10 – Lot 7

As part of Liberty's due diligence survey of Lot 44 (which was not purchased by Liberty), an area of fill material was identified located south of OU8 (Area 6). This area was divided into OU9 (Southeast Property Area) and OU10 (Lot 7). The fill was determined to consist primarily of ash, coal dust, cinders, and slag. Lot 7 is on the opposite side of Renaissance Boulevard from OU8 and OU9 and extends approximately 1,100 feet north from Swedeland Road. The 130 feet wide lot contains open grass areas mixed with areas of trees and brush. The northern section of the lot is a landscaped berm that slopes steeply from Renaissance Boulevard east-northeast. Lot 7 is deed restricted as permanent green space and cannot be developed. East-northeast of the berm at Lot 7 are office buildings including a day care facility.

EPA considered Lot 7 to be a contaminated soil area related to the Crater Resources site Area 6 and designated this area OU10. The ROD selected capping, in accordance with 25 PA Code Sections 288.234 and 288.236-237, as the appropriate remedy for Quarries 1, 2 and 4 and other contaminated soil areas, and the excavation and off-site disposal of impacted soils/sediments located in Quarry 3. The Responsiveness Summary in the ROD noted that other contaminated soil areas would be more fully evaluated during RD activities and allowed for flexibility during the RD to reflect land development considerations. The ROD did not provide cleanup standards for this area, but indicated that cleanup standards for soil and sediment at the Crater Resources Site are based on health risks.

The PRP Group conducted an investigation of Lot 7 in October 2003. The investigation was performed in accordance with a Remedial Design Work Plan for Area 6, approved by EPA on August 20, 2003, and included test pits, direct-push borings, and hand-auger samples to determine the extent of cinder slag impacted soils. One boring showed elevated levels of SVOCs, including naphthalene; therefore additional investigation was required to further delineate the extent of contamination in this area. Additional investigation was performed in April 2004 in accordance with a work plan amendment submitted on April 13, 2004. Results of the investigation are presented in the Pre-Design Investigation Summary Report for Lot 7 submitted on February 16, 2006.

Although the ROD did not address Lot 7 specifically, the ROD required capping of other contaminated areas to prevent leaching of contaminants to groundwater; but allowed for flexibility during the RD based on LDPs and evaluation of other data. The ROD did not specify cleanup standards for Lot 7, but indicates that soil cleanup standards are based on health risk. A risk assessment was performed in 2007 and indicated that after removal of soils in two areas at Lot 7 residual levels of COCs would not present adverse risks to human health and the environment, including leaching of contaminants to groundwater. Based on the results of the investigations and risk assessment, the PRP Group prepared an RD for removal of impacted soils to a depth of 8 feet and a subsequent risk evaluation based on results from post-excavation sampling. After discussions with EPA, excavation was implemented due to limited quantities of

impacted soils and impracticability of capping this area. This remedy meets the RAOs and Performance Standards of Section VIII and XII, respectively, of the ROD, and satisfies the Statutory Determinations of Section XIII of the ROD. EPA approved the Remedial Design/Remedial Action Work Plan for excavation of impacted soils on November 24, 2009.

The RA at Lot 7 was conducted from December 2009 to January 2010. Impacted soils were excavated on December 5 and 6, 2009 and post-excavation samples were collected. Results of a preliminary risk assessment based on the post-excavation results indicated that additional excavation was required; and excavation resumed on December 12, 2009. An estimated 290 cubic yards (430 tons) of impacted material was removed during the two excavation events and disposed off-site. The risk calculations based on post-excavation samples collected on December 12, 2009 indicated that the risk-based performance standard had been achieved, and the excavation area was partially backfilled. Weather delays prevented restoration of the excavation area with clean fill, topsoil and seed mixture until January 9, 2010. A pre-certification inspection was conducted by EPA on May 5, 2010 in order to assess the re-establishment of vegetation growth. The formal risk evaluation was submitted and approved by EPA on June 2, 2010.

Based on results of the post-excavation soil samples, the RA implemented at Lot 7 was successful in removing all potentially impacted soil. The soils remaining at Lot 7 do not present an unacceptable risk to outdoor, indoor, and future construction workers, and leaching of potential contaminants to the groundwater at unacceptable levels will not occur. On August 3, 2010, the PRP Group submitted a report to the EPA entitled “Remedial Action Report for Lot 7 Operable Unit 7” which documented the results of the remedial activities that were completed at Lot 7. EPA approved the RA Report in a letter dated August 2, 2011.

Since no permanent or semi-permanent structures were constructed, no long-term O&M is required. As per the warranty, the site was monitored for a one-year period to assure that grass had been re-established.

Kindercare Learning Center – Vapor Intrusion Investigation

The Kindercare Learning Center is located at 2001 Renaissance Boulevard. Due to the proximity of the day care to Lot 7 an indoor air quality sampling program was conducted to evaluate the potential for contaminants present at Lot 7 to be introduced into indoor air via vapor intrusion. The Group prepared the “Indoor Air Quality Sampling Plan for the Kindercare Learning Center” which was approved by EPA on March 6, 2009. Field activities were conducted between March 25, 2009 and April 11, 2009 and included collection of subslab, indoor air, and outdoor ambient air samples. Results did not show the presence of contaminants above EPA’s screening levels with the exception of benzene which was detected in both indoor and outdoor air samples at levels slightly above EPA screening levels. Further evaluation of the benzene results including results from PADEP air monitoring stations in the area, showed the benzene levels were comparable to ambient air background levels. EPA also conducted additional risk analysis and concluded that the results did not present an unacceptable risk. Results of the investigation are documented in a report titled “Air Quality Report for Kindercare Learning Center” approved by EPA on June 3, 2010.

Appendix B: Press Notice

EPA REVIEWS CLEANUP

Crater Resources Superfund Site

The U.S. Environmental Protection Agency (EPA) is conducting a Five-Year Review of the Crater Resources, Inc./Keystone Coke Co./Alan Wood Steel Co. Superfund Site located in Upper Merion Township. EPA inspects sites regularly to ensure that cleanups conducted remain protective of public health and the environment. EPA's last review of the site determined more testing was needed to make a long-term protectiveness determination. Since then, additional tests have confirmed that the remedy will be fully protective of public health and environment when groundwater cleanup goals are met and all contaminated soil is capped or removed. Test results and a protectiveness determination will be made available September 2016.

To access results of the review (starting Sept. 2016):
http://epa.gov/5yr

To read detailed site and contact information:
http://go.usa.gov/cutwj

To ask questions or provide site information:
Contact: Darriel Swatts **Phone**: 215-814-5536
Email: swatts.darriel@epa.gov

Protecting public health and the environment

Appendix C: List of Documents Reviewed

Approval of the Vapor Intrusion Summary Report Crater Resources Building 2701 Report, EPA Region 3, dated February 1, 2016.

Approval of MNA Sampling Frequency Change to Semi-Annual and Removal of Select Wells from Sampling Routine, EPA Region 3, dated April 30, 2013.

Crater Resources Superfund Site, 2013 Annual Monitored Natural Attenuation Report, Key Environmental, dated March 6, 2014.

Crater Resources Superfund Site, 2014 Annual Monitored Natural Attenuation Report, Key Environmental, Inc., dated November 30, 2015.

Crater Resources Superfund Site Institutional Controls Implementation and Assurance Plan, Advanced GeoServices Corp., dated November 22, 2011.

Daily Field Report – O&M Inspection, Advanced GeoServices, February 16, 2011.

Daily Field Report – O&M Inspection, Advanced GeoServices, May 20, 2011.

Daily Field Report – O&M Inspection, Advanced GeoServices, September 13, 2011.

Daily Field Report – O&M Inspection, Advanced GeoServices, December 6, 2011.

Daily Field Report – O&M Inspection, Advanced GeoServices, March 21, 2012.

Daily Field Report – O&M Inspection, Advanced GeoServices, June 22, 2012.

Daily Field Report – O&M Inspection, Advanced GeoServices, April 26, 2013.

Daily Field Report – O&M Inspection, Advanced GeoServices, October 31, 2013.

Daily Field Report – O&M Inspection, Advanced GeoServices, June 5, 2014.

Daily Field Report – O&M Inspection, Advanced GeoServices, May 8, 2015.

Environmental Work Plan for Geotechnical Investigation at 2901 Renaissance Boulevard, dated March 22, 2016.

Explanation of Significant Differences, EPA Region 3, dated April 30 2009.

Health Risk Assessment for Lot 7 (OU10) and 2001 Commons Associates L.P. Property, dated February 12, 2010.

Indoor Air Quality Report for the Kindercare Learning Center (OU10), dated December 4, 2009.

Institutional Controls Work Plan (revised) for Crater Resources Site, dated November 22, 2011.

Notice of Superfund Site and Use Restrictions for 2201, 2300, 2301 and 2500 Renaissance Blvd., Recorded February 26, 2008.

Post-Excavation Risk Evaluation for Former WAL Pipeline (OU5), dated December 3, 2009.

Post-Excavation Risk Evaluation for Lot 44/Former Dump Area-Area 6 (OU8) dated January 25, 2010.

Post-Excavation Risk Evaluation for Soil for Southeastern Property Area (OU9) dated January 25, 2010.

Post-Excavation Risk Evaluation for Soil for Lot 7 (OU10), dated February 12, 2010.

Preliminary Assessment and Site Inspection, NUS Corporation, dated May 14, 1983.

Record of Decision, EPA, dated September 27, 2000.

Remedial Action Completion Report for the Removal of Buried Pipes Located at Yellow Parcel in the Renaissance Park Commercial Development, Penn Environmental & Remediation, Inc., dated May 5, 2000.

Remedial Action Report for the Former Cinder/Slag Fill Area Operable Unit 7, dated September 22, 2003.

Remedial Action Report for the WAL Pipeline (OU5) Removal at 3000 Horizon Drive, dated October 20, 2006.

Remedial Action Report for the Former WAL Pipeline (OU5), dated May 26, 2010.

Remedial Action Report for Area 6/Lot 44 (OU8), dated July 20, 2010.

Remedial Action Report for Southeast Property Area (OU9), dated July 15, 2010.

Remedial Action Report for Lot 7, dated August 2, 2011.

Remedial Action Report for Quarry 3 (OU3), dated December 15, 2010.

Remedial Design Report for the Quarry 4 Demonstration Project, dated January 14, 2014.

Remedial Investigation Report, Environmental Resources Management, dated June 4, 1999.

Report of Investigations for 4 Areas of Concern (OU1 and OU2), dated July 5, 2006.

Report of Results and Streamlined Human Health Risk Assessment for PADEP AOC and Former WAL Pipeline (OU2), dated August 13, 2007.

Report of Results for Additional Remedial Actions for PADEP AOC (OU2), dated December 5, 2007.

Report of Results for Boring 141/203 Area of Concern (OU1) Final Remedial Action, dated November 4, 2008.

Report of Results for WAL Removal Outside of Quarry 1 (OU1), dated August 2008.

Report of Results for Remedial Actions – Upper Retention Basin, dated August 29, 2008.

Report of Results for Golf Course Area of Concern, dated September 2008.

Report of Results for Relocation of Soils – Quarry 1 to Quarry 2, dated January 23, 2009.

Restrictive Covenant Between RAGM Holding Company and Crater Resources, Inc., and Beazer East, Inc., Keystone Coke Company and Vesper Corporation, Recorded February 9, 2006.

Risk Assessments for 4 Areas of Concern (OU1 and OU2), dated November 13, 2006.

Risk Assessment for Operable Unit 8, dated December 2, 2008.

Risk Assessment for Former WAL Pipeline (OU5), dated August 4, 2009.

Second Five-Year Review Report, EPA, dated September 15, 2011.

Technical Memorandum, Vapor Intrusion Evaluation, Crater Resources Superfund Site, June 2016.

Vapor Intrusion Summary Report Crater Resources Building 2701, Synergy Environmental, Inc., dated February 1, 2016.

Appendix D: Institutional Controls

Table D-1: Institutional Control Summary Table

OU	Impacted Parcel(s)	Parcel Address	Parcel Owner	IC Objective	Instrument in Place	Notes
OU1 and OU2	58-00-15956-03-3	2701 Renaissance Boulevard	Renaissance Land Associates II	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb contamination without prior approval from EPA.	The Upper Merion Zoning Ordinance (local zoning) indicates that the entire Site is zoned as SM-1 Suburban Metropolitan District, which does not permit residential use. Limited portions of the site may be permitted to request a residential land usage from Upper Merion Township in accordance with Township Ordinance 2014-832. Deed notice recorded September 22, 2008 to prevent the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the surface of the land, other than to implement the remedy, without written prior approval from EPA. Additional institutional controls will be implemented following completion of remedy implementation at OU1 and OU2.	Parcel located between Quarry 1 and Quarry 2
	58-00-15956-04-2	Renaissance Boulevard	Renaissance Land Associates II			Parcel located at Quarry 2. A small part of the far eastern end of Quarry 3 is also located on a small part of this parcel.
	58-00-15956-10-5	Renaissance Boulevard	Renaissance Land Associates II			Parcel located between 2701 Renaissance Boulevard and Quarry 2
	58-00-15956-00-6	2901 Renaissance Boulevard	Renaissance Land Associates II			Parcel located at Quarry 1. The far northern extent of OU1 is located on a small part of this parcel.
	58-00-15956-01-5	Renaissance Boulevard	Renaissance Land Associates II			Parcel located at Quarry 1
	58-00-15956-02-4	Renaissance Boulevard	Renaissance Land Associates II			Parcel located at Quarry 1

OU	Impacted Parcel(s)	Parcel Address	Parcel Owner	IC Objective	Instrument in Place	Notes
OU3	58-00-18605-00-3	Renaissance Boulevard (Quarry 3 footprint)	Crater Resources, Inc.		February 9, 2006 Restrictive Covenant Local zoning does not permit residential use at the Site.	The restrictive covenant identifies the property as part of the Site, prohibits residential use of the property, prohibits the installation or use of groundwater wells and requires notification of, and approval by, the Crater PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work.
	58-00-18604-00-4	200 Swedeland Road	Gulph Mills Golf Club	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	Local zoning does not permit residential use at the Site.	Golf course property, located south of the quarries. Part of Quarry 3 is located within this parcel.
	58-00-15956-04-2	Renaissance Boulevard	Renaissance Land Associates II	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb contamination without prior approval from EPA.	Local zoning does not permit residential use at the Site.	A small part of the far eastern end of Quarry 3 is located on a small part of this parcel.
OU4	58-00-15956-05-1	2201 Renaissance Boulevard, includes the stormwater basin	Liberty Property LP	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	February 26, 2008 Notice of Superfund Site and Use Restrictions Local zoning does not permit residential use at the Site.	Both the Notice of Superfund Site and Use Restrictions and restrictive covenant prevent the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the surface of the land, other than to implement the remedy, without written prior approval from EPA.
	58-00-02694-01-1	Tract 1 of the Lot 44 property	Out Parcels, Inc.		February 9, 2006 Restrictive Covenant	

OU	Impacted Parcel(s)	Parcel Address	Parcel Owner	IC Objective	Instrument in Place	Notes
					Local zoning does not permit residential use at the Site.	
	58-00-18604-00-4	200 Swedeland Road	Gulph Mills Golf Club	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	July 30, 2015 Deed Notice Local zoning does not permit residential use at the Site. Additional institutional controls will be implemented following completion of remedy implementation at OU4.	Deed notice to prevent the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the surface of the land, other than to implement the remedy, without written prior approval from EPA. Golf course property, located south of the quarries. Part of Quarry 4 is located within this parcel.
OU5	58-00-18603-01-4	2301 Renaissance Boulevard	Liberty Property LP	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	February 26, 2008 Notice of Superfund Site and Use Restrictions Local zoning does not permit residential use at the Site.	The Notice of Superfund Site and Use Restrictions prevents the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the surface of the land, other than to implement the remedy, without written prior approval from EPA.
	58-00-15956-32-1	2300 Renaissance Boulevard	Liberty Property LP		February 26, 2008 Notice of Superfund Site and Use Restrictions Local zoning does not permit residential use at the Site.	
	58-00-15956-31-2	2500 Renaissance Boulevard	Liberty Property LP		February 26, 2008 Notice of Superfund Site and Use Restrictions Local zoning does not permit residential use at the Site.	

OU	Impacted Parcel(s)	Parcel Address	Parcel Owner	IC Objective	Instrument in Place	Notes
OU5 (continued)	58-00-15956-00-6	2901 Renaissance Boulevard	Renaissance Land Associates II		Local zoning does not permit residential use at the Site. Following completion of remedy implementation at OU1 and OU2, appropriate institutional controls will be implemented at the parcels impacted by the WAL pipeline that are located within OU1 and OU2.	These OU5 property parcels overlap with the parcels that make up OU1 and OU2.
	58-00-15956-01-5	Renaissance Boulevard	Renaissance Land Associates II			
	58-00-15956-02-4	Renaissance Boulevard	Renaissance Land Associates II			
	58-00-15956-03-3	2701 Renaissance Boulevard	Renaissance Land Associates II			
	58-00-15956-04-2	Renaissance Boulevard	Renaissance Land Associates II			
	58-00-15956-10-5	Renaissance Boulevard	Renaissance Land Associates II			
	58-00-07120-00-4	Flint Hill Road (located at the far northeastern corner of the Site)	Renaissance at Gulph Mills Holding Co.	IC not needed but in place.	February 9, 2006 Restrictive Covenant Local zoning does not permit residential use at the Site.	The restrictive covenant identifies the property as part of the Site, prohibits residential use of the property and requires notification of, and approval by, the Crater PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work.
OU6[a]	Entire Site	Entire Site	Entire Site	Prohibit installation of new groundwater supply wells and potable use of groundwater from existing wells.	Upper Merion Township Zoning Ordinance Chapter 165	Upper Merion Township's zoning ordinance requires all new commercial developments to be serviced by public water. The entire area surrounding the Site is serviced by public water mains.
				Prohibit installation of new groundwater supply wells and potable use of groundwater from existing wells.	Montgomery County Health Department's Division of Water Quality Management adopted Chapter XVII, Individual Water Supply Regulations	Section 17-5.2 of the Individual Water Supply Regulations makes it unlawful to install or modify an individual water supply well without first obtaining a permit from MCDH.

OU	Impacted Parcel(s)	Parcel Address	Parcel Owner	IC Objective	Instrument in Place	Notes
	Not yet determined	Not yet determined	Not yet determined	Notify current and future site property owners of the requirement to install vapor mitigation components into all future structures to be built above the groundwater plume where VOC concentrations exceed MCLs.	None	The potential exists for vapor intrusion into future buildings constructed on the Site where VOC concentrations exceed their respective MCLs in shallow groundwater.
OU7	58-00-18603-01-4	2301 Renaissance Boulevard, specifically under a parking structure	Liberty Property LP	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	February 26, 2008 Notice of Superfund Site and Use Restrictions Local zoning does not permit residential use at the Site.	The Notice of Superfund Site and Use Restrictions prohibits the installation of new groundwater wells or use of existing wells other than to implement the remedy; prohibits residential land use; and prohibits disturbance of the surface of the land, other than to implement the remedy, without written prior approval from EPA.
OU8	58-00-02694-01-1	Lot 44, Renaissance Boulevard	Out Parcels, Inc.	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	February 9, 2006 Restrictive Covenant Local zoning does not permit residential use at the Site.	The restrictive covenant identifies the property as part of the Site, prohibits residential use of the property and requires notification of, and approval by, the Crater PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work.
OU9	58-00-02694-01-1	Lot 44, Renaissance Boulevard	Out Parcels, Inc.	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	February 9, 2006 Restrictive Covenant Local zoning does not permit residential use at the Site.	The restrictive covenant identifies the property as part of the Site, prohibits residential use of the property and requires notification of, and approval by, the Crater PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work.

OU	Impacted Parcel(s)	Parcel Address	Parcel Owner	IC Objective	Instrument in Place	Notes
OU10	58-00-02694-09-2	Lot 7 (Tract 2 of the Lot 44 property)	Each Parcel As Is, Inc.	Notify future property owners of the Site; prohibit residential use; prohibit activities that could potentially disturb residual contamination without prior approval from EPA.	February 9, 2006 Restrictive Covenant Local zoning does not permit residential use at the Site.	The restrictive covenant identifies the property as part of the Site, prohibits residential use of the property and requires notification of, and approval by, the Crater PRP Group and EPA if disturbance of the final grade and drainage features is to occur, including repair and intrusive maintenance work.
Notes: a. Additional groundwater use restrictions are imposed by specific restrictions and deed notices for several specific site parcels. Details are included throughout the table.						

Appendix E: Groundwater Monitoring Results and Assessment

Appendix E1: MNA Groundwater Monitoring Results: 2008-2014

TABLE 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	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	
				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
Semivolatile Organic Compounds																															
2,4-Dimethylphenol	µg/L	1.15	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
2-Methylphenol	µg/L	12.5	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
4-Methylphenol	µg/L	47.7	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
Dibenzofuran	µg/L	12	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
Naphthalene	µg/L	5	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
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
Volatile Organic Compounds																															
Acetone	µg/L	95.9	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
Benzene	µg/L	5	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
Chloroform	µg/L	1	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
Total Inorganics																															
Arsenic	µg/L	1	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
Barium	µg/L	40	450	**52**		**79**		**66**		**68**		**62**		**53**		**55**		**57**		**66**		**67**		**78**		**69**		**65**	J	**64**	J
Beryllium	µg/L	4	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
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
Chromium	µg/L	8	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
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
Iron	µg/L	250	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
Lead	µg/L	15	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
Manganese	µg/L	66.8	310	**200**		**330**		**280**	B	**320**		**230**		**180**		**190**		**230**		**260**		**260**		**290**		**260**		**260**	J	**260**	J
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**	
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
Selenium	µg/L	0.4	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
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
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
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
Dissolved Inorganics																															
Arsenic	µg/L	1	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
Barium	µg/L	40	450	**48**		**61**		**59**		**65**		**60**		**50**		**54**		--	NA	**62**		--	NA	**72**		--	NA	--	NA	--	NA
Beryllium	µg/L	4	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
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
Chromium	µg/L	8	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
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
Iron	µg/L	250	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
Lead	µg/L	15	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
Manganese	µg/L	66.8	310	**200**		**300**		**290**	B	**310**		**230**		**180**		**210**		**220**		**250**		**260**		**290**		**250**	J	**250**	J	**260**	J
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
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
Selenium	µg/L	0.4	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
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
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
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
Conventionals																															
Available Cyanide	µg/L	10	13	**2**	U	**3.9**		5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	2	U	2	U	2	U
Total Cyanide	µg/L	10	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

Notes:

MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

- Indicates exceedence of GW Cleanup Standards - Center of plume
- indicates exceedence of GW Cleanup Standard - Extent of plume
- Indicates exceedence of both GW Cleanup Standards

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

L - Result should be considered to be biased low

K - Result should be considered to be 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 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	BG-1D																									
				11/9/2010		2/23/2011		5/18/2011		8/10/2011		12/8/2011		3/20/2012		5/31/2012		9/6/2012		11/28/2012		2/26/2013		8/27/2013		3/25/2014		8/26/2014	
				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	1	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	µg/L	12.5	1	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	µg/L	47.7	1	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	µg/L	12	0.86	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	µg/L	5	1	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	µg/L	7860	--	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	µg/L	95.9	24	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	µg/L	5	0.04	**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	µg/L	1	0.015	**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	µg/L	1	0.04	**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	µg/L	40	450	**140**		**160**		**120**		**150**		**150**		**150**		**160**		**170**		**180**		**170**		**170**	B	**170**		**160**	J
Beryllium	µg/L	4	4	`	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	µg/L	--	0.62	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	µg/L	8	12	**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	µg/L	--	22	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	µg/L	250	2300	**21000**	J	**21000**		**13000**	B	**12000**		**4400**		**5300**		**6400**		**3000**		**3100**		**1500**		**1800**		**630**		**1500**	J
Lead	µg/L	15	15	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	µg/L	66.8	310	**1400**		**1300**		**890**	B	**940**		**770**		**600**		**570**		**600**		**520**		**550**		**560**		**310**		**290**	J
Mercury	µg/L	--	0.004	**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	µg/L	--	260	37		96	J	16		13		21		20		19		25		23	J	26		29	J	25		21	J
Selenium	µg/L	0.4	0.006	**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	µg/L	--	0.17	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	µg/L	--	0.41	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	µg/L	--	170	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	µg/L	1	0.04	**0.761**	J	**1.26**		**0.72**	J	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Barium	µg/L	40	450	**170**		**20**	J	**130**		--	NA	**150**		--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Beryllium	µg/L	4	4	0.75	U	0.75	U	0.75	U	--	NA	**0.18**	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Cadmium	µg/L	--	0.62	1	U	1	U	1	U	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Chromium	µg/L	8	12	**3.5**	J	1	U	**1.2**	B	--	NA	1	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Cobalt	µg/L	--	22	10	U	**1.5**	J	**2.5**	J	--	NA	**5.2**	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Iron	µg/L	250	2300	**22000**	J	**3800**		**13000**	B	**14000**		**3700**		**6300**		**6200**		**3100**		**2300**		**800**		**1700**		**520**		**1600**	J
Lead	µg/L	15	15	5	U	**1.6**	J	**1.7**	J	--	NA	5	U	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Manganese	µg/L	66.8	310	**1600**		**150**		**940**	B	**930**		**760**		**670**		**560**		**610**		**510**		**520**		**540**		**290**	J	**290**	J
Mercury	µg/L	--	0.004	**0.00308**		**0.016**		**0.00394**		--	NA		NA	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Nickel	µg/L	--	260	10	U	10	UJ	**6.5**	J	--	NA	**20**		--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Selenium	µg/L	0.4	0.006	**0.231**	J	**0.331**	J	**0.411**		--	NA		NA	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Thallium	µg/L	--	0.17	1.5	U	**1.5**	B	**0.2**	B	--	NA	**1.5**	B	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Vanadium	µg/L	--	0.41	**0.81**	J	1	U	**1**	B	--	NA	**1**	B	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Zinc	µg/L	--	170	25	U	25	U	25	U	--	NA	**19**	J	--	NA	--	NA	--		--	NA	--	NA	--	NA	--	NA	--	NA
Conventionals																													
Available Cyanide	µg/L	10	13	**81**		**68**		**56**	K	5	U	**61**		**27**		5	UJ	5	U	5	U	5	U	**22**		2	U	2	U
Total Cyanide	µg/L	10	13	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-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

■ - Indicates exceedence of GW Cleanup Standards - Center of plume

■ - indicates exceedence of GW Cleanup Standard - Extent of plume

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NA - Not Analyzed

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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

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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 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-6																													
				7/17/2008		11/11/2010		2/24/2011		5/18/2011		8/10/2011		12/8/2011		3/21/2012		3/21/2012		5/31/2012		9/6/2012		11/29/2012		2/27/2013		8/28/2013		3/26/2014		8/26/2014	
				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	1	100	U	5	U	5.2	U	11	J	10		12		11		11		9.4		12		9.6		9.3		9.4		54		4.3	
2-Methylphenol	µg/L	12.5	1	8.2	J	5	U	5.2	U	10		7.5		8.9		7.5		7.2		0.51	U	8.2		7.6		5.1	J	0.54	U	3.6		1	
4-Methylphenol	µg/L	47.7	1	100	U	5	U	5.2	U	5.2	U	2.4		2.6	U	1.2	B	1.2	B	0.51	U	1.8		4.6		1.7	J	0.54	U	6		0.76	J
Dibenzofuran	µg/L	12	0.86	2.4	J	5	U	5.2	U	2.9	J	1.1		2.6	U	0.75		0.73		0.74		0.87		0.6		0.84		0.78		2.8		0.17	J
Naphthalene	µg/L	5	1	1000		880		1200		1500		900		710		630	D	640	D	670	D	600		650		700	D	840		56		91	
Phenol	µg/L	7860	--	100	U	20	U	21	U	21	U	2	U	10	U	2.1	U	2	U	2	U	0.87	J	2.1	U	0.44	J	2.2	U	1		0.96	U
Volatile Organic Compounds																																	
Acetone	µg/L	95.9	24	25	R	5	UJ	5	UJ	10	U	5.9	U	20	U	10	U	10	U	10	U	10	U	50	U	50	U	10	U	10	U	7	JB
Benzene	µg/L	5	0.04	21		23		29	J	27		27		27		25		24		25		24		19		23		23	J	16		20	
Chloroform	µg/L	1	0.015	25	U	0.01	B	0.01	B	0.01	UJ	0.02	R	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	0.017	JB
Total Inorganics																																	
Arsenic	µg/L	1	0.04	2.2	U	2.58	J	3.02		2.1	J	2.9		2.4		2		1.5		2.5		2.68		2.2		2.3		2.7		5.4		2.4	J
Barium	µg/L	40	450	0.1	U	120	J	120		130		130		120		140		130		130		130		140	J	130		140		33		110	J
Beryllium	µg/L	4	4	0.32	U	0.75	U	0.45	J	0.43	J	0.94		0.72	J	0.49	J	0.2	J	0.57	J	0.46	J	0.44	J	0.52	J	0.75	UJ	0.062	J	0.49	J
Cadmium	µg/L	--	0.62	0.23	U	1	U	1	U	0.24	B	0.18	J	0.11	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.19	J
Chromium	µg/L	8	12	1.2	U	13		2.1		5	B	2.9		4.1		1.9		1.8		1.8		2.3		1	B	1.5		4.1		3.5	B	4.1	J
Cobalt	µg/L	--	22	0.7	U	10	U	3.6	J	3.7	J	4.7	J	3.7	J	10	B	10	B	3.7	J	3.3	J	2.6	J	1.5	J	3.2	J	2		2	J
Iron	µg/L	250	2300	1930	J	4400		2300		2000	B	3300		3200		2500		2500		4700		2400		2200		2200		2600		6700		2600	J
Lead	µg/L	15	15	2.4	U	5	U	4.9	J	3.5	J	4.8	J	2.3	J	3.2	J	3.1	J	4.2	J	2.9	J	5	U	2.6	J	8.9		0.13	J	0.54	JB
Manganese	µg/L	66.8	310	1680		790		880		1300	B	1000		870		1100		1100		1100		1200		1100		1100		1100		260		850	J
Mercury	µg/L	--	0.004	0.055	U	0.0034		0.00799		0.0137		0.0142		0.049		0.0116		0.0125		0.00362		0.00464	J	0.00095		0.00269		0.00182	J	0.00104		0.00195	
Nickel	µg/L	--	260	1.1	U	15		7.6	J	9.6	J	10		10		9.9	J	9.7	J	11		8.9	J	6.3	J	6.4	J	8.1	J	3.8		5.8	J
Selenium	µg/L	0.4	0.006	19.6		8.25	J	14.8		19		15.4		19.1		18.2		19		16.6		15.1		14.8		15.1		16.5		9.65		14.3	
Thallium	µg/L	--	0.17	3.1	U	1.5	U	1.5	B	0.21	B	1.5	U	1.5	B	1.5	U	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	0.026	JB	0.019	JB
Vanadium	µg/L	--	0.41	1	U	5		5.2		5.9	B	6.4		5.6		5.5		5.3		5.6		5.8		6.2		5.8		6		0.082	JB	4.2	J
Zinc	µg/L	--	170	1.3	U	25	U	31		31		60	B	58		29		29		30	J	22	J	11	J	10	J	25	U	2.4	JB	10	JB
Dissolved Inorganics																																	
Arsenic	µg/L	1	0.04	--	NA	2.39	J	2.78		2.2		2.4	B	2.1		1.5		1.6		2.3		2.49		2		2.3		2.4		4.6		--	NA
Barium	µg/L	40	450	--	NA	120	J	120		130		130		110		130		130		130		130		140	J	140		140		30		--	NA
Beryllium	µg/L	4	4	--	NA	0.75	U	0.19	J	0.29	J	0.4	J	0.25	J	0.28	J	0.35	J	0.22	J	0.39	J	0.23	J	0.31	J	0.75	UJ	1	U	--	NA
Cadmium	µg/L	--	0.62	--	NA	1	U	1	U	0.16	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	--	NA
Chromium	µg/L	8	12	--	NA	1	U	1	U	0.73	B	0.46	J	0.34	J	1	U	1	U	1	U	0.59	J	1	B	0.31	J	1	U	1.8	JB	--	NA
Cobalt	µg/L	--	22	--	NA	10	U	2.7	J	2.9	J	3.5	J	2.5	J	10	B	10	B	2.7	J	3.2	J	2.4	J	1.4	J	2.8	J	1.7		--	NA
Iron	µg/L	250	2300	479		1300		1400		1300	B	1600		1600		1800		1700		1700		1800		1900		1900		1900		2200		2100	J
Lead	µg/L	15	15	--	NA	5	U	1.9	J	1.5	J	1.3	J	5	U	1.2	J	1.6	J	1.3	J	1.9	J	5	U	5	U	7		0.047	J	--	NA
Manganese	µg/L	66.8	310	1620		780		890		1300	B	1100		820		1000		1000		1100		1100		1100		1100		1100		230		840	J
Mercury	µg/L	--	0.004	--	NA	0.0009		0.00204		0.00416		0.00204		0.00778		0.00369		0.00345		0.001		0.00042	B	0.00039	J	0.00139		0.00058	JB	0.00079		--	NA
Nickel	µg/L	--	260	--	NA	10	U	4	J	4.9	J	5	J	5.3	J	6.9	J	6.7	J	6	J	6.7	J	5	J	5	J	4.4	J	1.4		--	NA
Selenium	µg/L	0.4	0.006	--	NA	10.7	J	13.8		18.3		15.7		19.7		18.3		18.3		16.7		15		14.5		15		16.2		9.22		--	NA
Thallium	µg/L	--	0.17	--	NA	1.5	U	1.5	B	0.19	B	1.5	UL	1.5	B	1.5	U	1.5	U	1.5	B	1.5	U	1.5	U	1.5	U	1.5	U	1	U	--	NA
Vanadium	µg/L	--	0.41	--	NA	4.6		5.2		5.7	B	5.4		5.2		5.1		5		5.5		5.2		5.9		5.9		5.4		0.44	JB	--	NA
Zinc	µg/L	--	170	--	NA	25	U	8	J	25	U	14	B	25	B	25	B	25	B	25	JB	25	B	25	U	25	U	25	U	2.4	JB	--	NA
Conventionals																																	
Available Cyanide	µg/L	10	13	1.5	U	6		3.5	B	15	K	21	B	9.2		19		21		5	UJ	5	U	5	UJ	5.2		5	UJ	9		21	
Total Cyanide	µg/L	10	13	198	J	21		210		260	J	240		240		250		230		230		260		230		220		230		680		190	

Notes:
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Upper Merion Township, Pennsylvania

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				7/17/2008		7/17/2008		11/10/2010		2/23/2011		5/17/2011		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	
				Result	Q	Duplicate	Q	Result	Q	Result	Q	Result	Q	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
Semivolatile Organic Compounds																																					
2,4-Dimethylphenol	µg/L	1.15	1	10	U	10	U	0.51	U	0.52	U	0.53	U	0.52	U	0.51	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
2-Methylphenol	µg/L	12.5	1	10	U	10	U	0.51	U	0.52	U	0.53	U	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
4-Methylphenol	µg/L	47.7	1	0.6	J	0.8	J	0.51	U	0.52	U	0.53	U	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
Dibenzofuran	µg/L	12	0.86	10	U	10	U	0.51	U	0.52	U	0.53	U	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
Naphthalene	µg/L	5	1	8.6	J	9.7	J	10		0.52	U	3.2		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	
Phenol	µg/L	7860	--	10	U	10	U	2	U	2.1	U	2.1	U	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
Volatile Organic Compounds																																					
Acetone	µg/L	95.9	24	5	R	5	R	5	UJ	5	UJ	10	U	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
Benzene	µg/L	5	0.04	1	U	1	U	0.09		0.04	J	0.02	U	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
Chloroform	µg/L	1	0.015	5	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	0.01	U	0.01	U	0.01	U	0.0093	JB	0.02	U
Total Inorganics																																					
Arsenic	µg/L	1	0.04	2.2	U	2.2	U	0.515	J	0.444		0.41	B	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
Barium	µg/L	40	450	0.1	U	0.1	U	25	U	24	J	20	J	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
Beryllium	µg/L	4	4	0.32	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	UJ	0.75	UJ	0.75	UJ	0.75	U	0.75	U	0.75	UJ	0.038	J	1	UJ
Cadmium	µg/L	--	0.62	0.23	U	0.23	U	1	U	1	U	0.46	B	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
Chromium	µg/L	8	12	1.2	U	1.2	U	1	U	1	U	1.4	B	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
Cobalt	µg/L	--	22	0.7	U	0.7	U	10	U	0.37	J	0.36	J	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
Iron	µg/L	250	2300	1150	J	1230	J	1000		560		450	B	480	B	570		830		1200		750		560		420		380		480		470		560		300		520	J
Lead	µg/L	15	15	2.4	U	2.4	U	5	U	5	U	1.9	J	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
Manganese	µg/L	66.8	310	0.32	U	0.32	U	25	U	33		25	J	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
Mercury	µg/L	--	0.004	0.055	U	0.055	U	0.00096		0.00332		0.00181		0.00193		0.00084		0.0014		0.0136		0.00293		0.00388		0.00306		0.00278		0.00101		0.00096		0.00071	B	0.00342		0.00338	
Nickel	µg/L	--	260	1.1	U	1.1	U	10	U	10	UJ	10	U	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
Selenium	µg/L	0.4	0.006	53.5		55.1		16.6	J	22.7		27.5		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	
Thallium	µg/L	--	0.17	3.1	U	3.1	U	1.5	B	1.5	B	0.31	B	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
Vanadium	µg/L	--	0.41	1	U	1	U	0.63	J	0.58	J	0.51	B	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
Zinc	µg/L	--	170	1.3	U	1.3	U	25	U	16	J	10	J	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
Dissolved Inorganics																																					
Arsenic	µg/L	1	0.04	--	NA	--	NA	0.31	J	0.244	J	1.4	B	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
Barium	µg/L	40	450	--	NA	--	NA	--	NA	24	J	19	J	19	J	18	J	19	J	20	J	16	J	18	J	17	J	18	J	--	NA	--	NA	--	NA	--	NA	--	NA
Beryllium	µg/L	4	4	--	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	0.75	UJ	0.75	UJ	--	NA	--	NA	--	NA	--	NA	--	NA
Cadmium	µg/L	--	0.62	--	NA	--	NA	--	NA	1	U	0.45	B	0.47	B	1	U	1	U	1	U	1	U	1	U	1	U	1	U	--	NA	--	NA	--	NA	--	NA	--	NA
Chromium	µg/L	8	12	--	NA	--	NA	--	NA	1	U	0.89	B	0.85	B	0.47	J	0.25	J	1	U	1	U	1	B	1	B	1	B	--	NA	--	NA	--	NA	--	NA	--	NA
Cobalt	µg/L	--	22	--	NA	--	NA	--	NA	0.71	J	10	U	10	U	0.71	B	10	U	10	B	10	U	10	U	10	U	10	U	--	NA	--	NA	--	NA	--	NA	--	NA
Iron	µg/L	250	2300	816		807		470		150	J	140	B	70	B	120	J	160	B	190		380		290		160		160		260		280		330		67		380	J
Lead	µg/L	15	15	--	NA	--	NA	--	NA	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	--	NA	--	NA	--	NA	--	NA	--	NA
Manganese	µg/L	66.8	310	0.32	U	0.32	U	25	U	34		23	J	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
Mercury	µg/L	--	0.004	--	NA	--	NA	0.00034	J	0.00095		0.00069		0.00078		0.00042	U	0.00054		0.00286		0.00037	J	0.00118		0.00108		0.00099		--	NA	--	NA	--	NA	--	NA	--	NA
Nickel	µg/L	--	260	--	NA	--	NA	--	NA	10	UJ	10	U	10	U	10	U	0.61	J	0.96	J	10	U	10	U	10	U	10	U	--	NA	--	NA	--	NA	--	NA	--	NA
Selenium	µg/L	0.4	0.006	--	NA	--	NA	13.6	J	19.6		23.9		24.6		23.8		40.7		33.4		31.9		71.6	U	20.2		18		--	NA	--	NA	--	NA	--	NA	--	NA
Thallium	µg/L	--	0.17	--	NA	--	NA	--	NA	1.5	B	0.31	B	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
Vanadium	µg/L	--	0.41	--	NA	--	NA	--	NA	1	U	0.15	B	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
Zinc	µg/L	--	170	--	NA	--	NA	--	NA	12	J	9.7	B	9.6	B	12	B	12	J	25	B	25	JB	16	J	5.4	J	5.3	J	--	NA	--	NA	--	NA	--	NA	--	NA
Conventionals																																					
Available Cyanide	µg/L	10	13	1.5	U	1.5	U	0.01	U	2	U	5	U	5	U	7	B	5	U	7.4		5	UJ	5	U	5	UJ	5	UJ	5	U	5	U	6.7		2	U	2	U
Total Cyanide	µg/L	10	13	11.8	J	1.7	UJ	2000	U	10	U	20	UJ	27	J	20	U	20	U	20	U	20	U	21		20	U	20	U	20	U	20	U	20	U	11		10	

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

- Indicates exceedence of GW Cleanup Standards - Center of plume
- indicates exceedence of GW Cleanup Standard - Extent of plume
- Indicates exceedence of both GW Cleanup Standards

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

L - Result should be considered to be biased low

K - Result should be considered to be 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 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-11S																															
				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		8/28/2013		8/28/2013		3/26/2014		8/27/2014	
				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	Result	Q	Duplicate	Q	Result	Q	Result	Q
Semivolatile Organic Compounds																																					
2,4-Dimethylphenol	µg/L	1.15	1	83		62		75		53		35		40		34		21		41		37		2.7	J	11	J	49		39		25		25		1200		11	
2-Methylphenol	µg/L	12.5	1	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	0.51	U	3.2		7900		0.96	U
4-Methylphenol	µg/L	47.7	1	20	J	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	1		10	J	29000		0.96	U
Dibenzofuran	µg/L	12	0.86	10	J	16		20		19		11		21		19		8.2		15		12		3.5	J	7.8	J	19		18		20		20		380	U	9	
Naphthalene	µg/L	5	1	1	J	22		13		12		4.1		9.9		11		2		6		4.9		0.29	J	0.81		6.4		8		5.8		5.8		200		1.4	
Phenol	µg/L	7860	--	1.2	U	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	2	U	5.3		40000		0.48	J
Volatile Organic Compounds																																					
Acetone	µg/L	95.9	24	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	10	U	10	U	200		2.5	J
Benzene	µg/L	5	0.04	21		19		20	J	15		12		10		10		9.5		12		12		4.3		5.8		13		14		8.2	J	8.7	J	640		5.6	
Chloroform	µg/L	1	0.015	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	0.01	U	0.01	U	0.012	JB	0.02	U
Total Inorganics																																					
Arsenic	µg/L	1	0.04	31.2		15.7	J	24.4		15	J	19		18		18		48		20		21		14		16.6		28		31		40		41		24	L	47	J
Barium	µg/L	40	450	0.1	U	60	J	52		53		47		35		34		46		45		48		38		42		52	J	46		40		40		1500	L	35	J
Beryllium	µg/L	4	4	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	0.75	UJ	0.75	UJ	0.11	L	0.88	J
Cadmium	µg/L	--	0.62	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	1	U	1	U	5.4	L	1	UJ
Chromium	µg/L	8	12	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		1	U	1	U	19	L	5.1	J
Cobalt	µg/L	--	22	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	2.9	J	3	J	210	L	2.6	J
Iron	µg/L	250	2300	4570		3700		6000		3300	B	4400		3500		3500		10000		4800		5700		2800		3200		7500		7000		8300		8300		5800	L	10000	J
Lead	µg/L	15	15	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	6.7		8.5		0.51	L	0.086	JB
Manganese	µg/L	66.8	310	3320		4800		4300		3900	B	4200		3300		3300		3700		3700		3900		3300		3600		4200		3700		3500		3500		7900	L	3100	J
Mercury	µg/L	--	0.004	0.2	U	0.00314		0.00649		0.00646		0.0029		0.00203	J	0.00135	J	0.0029		0.00349		0.00319		0.00199		0.00161		0.00029	J	0.00059		0.00445	J	0.00385	J	0.00245		0.0128	
Nickel	µg/L	--	260	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	7	J	7.1	J	29	L	10	J
Selenium	µg/L	0.4	0.006	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		10.7		11		12.3		13.8	
Thallium	µg/L	--	0.17	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	1.5	U	1.5	U	0.25	LB	0.03	J
Vanadium	µg/L	--	0.41	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		1.4		1.4		4.6	LB	0.87	J
Zinc	µg/L	--	170	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	25	U	25	U	9.5	L	3.7	JB
Dissolved Inorganics																																					
Arsenic	µg/L	1	0.04	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		18		19		20	L	13	J
Barium	µg/L	40	450	0.1	U	58	J	--	NA	48		47		37	B	37	B	38		50		51		43	J	44	J	49	J	45		36		36		1800	L	29	J
Beryllium	µg/L	4	4	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	0.75	UJ	0.75	UJ	0.054	L	0.16	J
Cadmium	µg/L	--	0.62	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	1	U	1	U	1.1	L	1	UJ
Chromium	µg/L	8	12	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	1	U	1	U	3	L	0.67	J
Cobalt	µg/L	--	22	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	2.6	J	2.4	J	7.3	L	1.9	J
Iron	µg/L	250	2300	286		880		5000		1500	B	1700		6500		6400		2100		3000		3100		2100		2200		5400		4200		3700		3700		290	L	2500	J
Lead	µg/L	15	15	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	6.9		8.1		0.031	L	1	UJ
Manganese	µg/L	66.8	310	3430		4800		4400		3600	B	4300		3400		3400		3700		3800		3900		3600		3700		4100		3800		3400		3400		7900	L	2900	J
Mercury	µg/L	--	0.004	0.2	U	0.00079		--	NA	0.00283		0.00079			NA		NA	0.00054		0.00068		0.00066		0.00046		0.00055		0.00015	U	0.00031	J	0.00041	UJ	0.00044	U	0.0006		0.00088	
Nickel	µg/L	--	260	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	2	J	2.2	J	3.5	L	2.5	J
Selenium	µg/L	0.4	0.006	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		8.11		7.9		8.15		7.59	
Thallium	µg/L	--	0.17	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	1.5	U	1.5	U	0.038	LB	0.037	J
Vanadium	µg/L	--	0.41	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	1	U	1	U	4	LB	1	UJ
Zinc	µg/L	--	170	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	25	U	25	U	4.4	LB	2.6	JB
Conventionals																																					
Available Cyanide	µg/L	10	13	3.8	J	4.9		6.8		5	U	7.5	B	5	U	5	U	5	U	5	UJ	5	UJ	5	U	5	U	5	UJ	5	U	5	UJ	5	UJ	2.4		9.3	
Total Cyanide	µg/L	10	13	691		600		570		640	J	560		620		610		630		600		630		720		730		690		570		590		580		39		570	

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

- Indicates exceedence of GW Cleanup Standards - Center of plume
- indicates exceedence of GW Cleanup Standard - Extent of plume
- Indicates exceedence of both GW Cleanup Standards

NA - Not Analyzed

U - Analyte non-detect at the indicated concentration

J - Result should be considered a quantitative estimate

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

TABLE 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-11D																											
				7/18/2008		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	
				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	1	320		100		180		190		180		140		95		130		110		150		120		130		10	J	50	
2-Methylphenol	µg/L	12.5	1	780		27		180		170		68		11		1.5	B	0.5	U	6.8		11		2.7	J	9		40		0.96	U
4-Methylphenol	µg/L	47.7	1	1300		69		280		180		60		16		11	J	0.5	U	8.7		15		6.7	J	8.5		110		5.8	
Dibenzofuran	µg/L	12	0.86	12	J	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
Naphthalene	µg/L	5	1	1200		190		270		300		260		200		130		170		120		180		160		180		260		63	
Phenol	µg/L	7860	--	1000		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
Volatile Organic Compounds																															
Acetone	µg/L	95.9	24	15	R	5	UJ	5	UJ	12		5.9	U	10	U	10	U	18		17		10	U	10	U	10	U	25	U	10	U
Benzene	µg/L	5	0.04	39		27		36	J	32		29		29		27		31		25		25		29		26	J	15		17	
Chloroform	µg/L	1	0.015	10	U	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
Total Inorganics																															
Arsenic	µg/L	1	0.04	2.2	U	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
Barium	µg/L	40	450	0.1	U	33	J	20	J	19	J	26		31		35		26		29		24	J	28		27		130		26	J
Beryllium	µg/L	4	4	0.32	U	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
Cadmium	µg/L	--	0.62	0.23	U	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
Chromium	µg/L	8	12	1.2	U	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
Cobalt	µg/L	--	22	0.7	U	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
Iron	µg/L	250	2300	5450		39000		7700		8900	B	5700		4100		7700		6300		4700		4400		5200		8600		2500		4200	J
Lead	µg/L	15	15	3	U	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
Manganese	µg/L	66.8	310	213		590		190		210	B	230		260		300		210		220		180		210		260		1000		220	J
Mercury	µg/L	--	0.004	0.2	U	0.0964		0.00179		0.00164		0.0022		0.00319		0.00185	B	0.00113		0.00044	U	0.00016	U	0.00111		0.0059	J	0.00289		0.00208	
Nickel	µg/L	--	260	1.1	U	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
Selenium	µg/L	0.4	0.006	13.9		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	
Thallium	µg/L	--	0.17	3.1	U	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
Vanadium	µg/L	--	0.41	1	U	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
Zinc	µg/L	--	170	1.3	U	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
Dissolved Inorganics																															
Arsenic	µg/L	1	0.04	--	NA	1.98	J	1.93		2.6		3.4		3.6		2.6		--	NA	2.36		2.3		--	NA	--	NA	1.8		--	NA
Barium	µg/L	40	450	--	NA	29	J	180		19	J	25		31		35		--	NA	28		23	J	--	NA	--	NA	130		--	NA
Beryllium	µg/L	4	4	--	NA	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
Cadmium	µg/L	--	0.62	--	NA	1	U	1	U	1	U	1	U	1	U	1	U	--	NA	1	U	1	U	--	NA	--	NA	0.28	J	--	NA
Chromium	µg/L	8	12	--	NA	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
Cobalt	µg/L	--	22	--	NA	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
Iron	µg/L	250	2300	2850		5800		21000		3300	B	3700		6800		4500		4100		3700		2700		3400		3200		2100		2400	J
Lead	µg/L	15	15	--	NA	5	U	5	U	2	J	5	U	5	U	5	U	--	NA	1.4	J	5	U	--	NA	--	NA	0.28	J	--	NA
Manganese	µg/L	66.8	310	185		220		1400		160	B	210		290		270		180		200		180		200		180		980		200	J
Mercury	µg/L	--	0.004	--	NA	0.00048		0.00029	J	0.00031	J	0.00042	U	0.00026	J	0.00034	J	--	NA	0.00042	U	0.00016	U	--	NA	--	NA	0.00032	J	--	NA
Nickel	µg/L	--	260	--	NA	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
Selenium	µg/L	0.4	0.006	--	NA	8.86	J	11.2		12.9		13.7		20.9		19.7		--	NA	16.3		11.9		--	NA	--	NA	8.42		--	NA
Thallium	µg/L	--	0.17	--	NA	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
Vanadium	µg/L	--	0.41	--	NA	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
Zinc	µg/L	--	170	--	NA	25	U	5.6	J	25	U	15	B	25	B	25	B	--	NA	25	B	25	U	--	NA	--	NA	9.1		--	NA
Conventionals																															
Available Cyanide	µg/L	10	13	12	J	24		13		6.8	K	11	B	6.3		5	U	5	UJ	5	U	5	UJ	5	U	5	UJ	2	U	19	
Total Cyanide	µg/L	10	13	973		10	U	880		990	J	940		1200		730		860		880		760		890		760		220		600	

Notes:
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2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-13S																											
				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	
				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	1	**2.8**	J	**1700**		100	U	**1,500**		**2500**		**2400**		**1900**	D	**2200**		**1900**		**2000**		**1900**		**2500**		**9.7**		**1100**	
2-Methylphenol	µg/L	12.5	1	**29**		**11000**		**10000**		**9000**		**13000**		**12000**		**8500**	D	**10000**		**9800**		**10000**		**8600**		**11000**		**0.87**	J	**6300**	
4-Methylphenol	µg/L	47.7	1	**67**		**37000**		**32000**		**29000**		**44000**		**38000**		**28000**	D	**31000**		**30000**		**34000**		**23000**	D	**32000**	D	**1.1**		**22000**	
Dibenzofuran	µg/L	12	0.86	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	**8.4**		50	U
Naphthalene	µg/L	5	1	10	U	**330**		**150**		**190**		**280**		**310**		**220**		**290**		**250**		**260**		**310**		**450**		**2.5**		**120**	
Phenol	µg/L	7860	--	**26**		**29000**		**25000**		**24000**		**31000**		**30000**		**20000**	D	**23000**		**25000**		**31000**		**18000**		**20000**		**0.64**	J	**29000**	
Volatile Organic Compounds																															
Acetone	µg/L	95.9	24	5	R	**230**	J	**180**	J	**200**		**360**		**280**		**240**		**610**		**630**		**290**		**310**		**340**		5	U	**270**	K
Benzene	µg/L	5	0.04	**1.1**		**370**		**380**	J	**330**		**640**		**590**		**520**		**1100**		**1200**		**430**		**480**		**560**	J	**5.6**		**420**	
Chloroform	µg/L	1	0.015	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	0.02	U	**0.016**	JB
Total Inorganics																															
Arsenic	µg/L	1	0.04	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	**44**		**24**	J
Barium	µg/L	40	450	0.1	U	**2500**	J	**2400**		**2400**	B	**2400**		**2100**		**2300**		**2100**		**2100**		**2300**	J	**2200**		**2100**		**37**		**1700**	J
Beryllium	µg/L	4	4	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	**0.81**	J	1	UJ
Cadmium	µg/L	--	0.62	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	**0.11**	J	**0.63**	J
Chromium	µg/L	8	12	1.2	U	**12**		**19**		**2.4**	B	**2.3**		1	U	**0.9**	J	**2.8**		**2.1**		**6.2**		**4.9**		**2**		**3.8**	B	**2**	J
Cobalt	µg/L	--	22	0.7	U	**120**		**120**		**20**	B	**41**		**3.5**	J	**52**		**30**		**39**		**68**		**35**		**15**		**2.5**		**11**	J
Iron	µg/L	250	2300	**119**		**3900**		**3500**		**1700**	B	**2200**		**1400**		**2300**		**1600**		**2400**		**2500**		**1800**		**750**		**8100**		**460**	J
Lead	µg/L	15	15	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	**0.11**	J	**0.1**	JB
Manganese	µg/L	66.8	310	**475**		**9900**		**9700**		**10000**	B	**10000**		**9500**		**9900**		**9000**		**9300**		**9300**		**9300**		**9400**		**2900**		**8500**	J
Mercury	µg/L	--	0.004	0.2	U	**0.0623**		0.00047	UJ	**0.00827**		**0.00211**		0.00727	U	**0.027**		**0.00467**	J	0.00133	U	**0.00273**	L	0.00093	U	0.00133	UJ	**0.0109**		0.00022	U
Nickel	µg/L	--	260	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	**8.5**		10	UJ
Selenium	µg/L	0.4	0.006	**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**		**13**		**9.48**	
Thallium	µg/L	--	0.17	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	**0.019**	JB	1	UJ
Vanadium	µg/L	--	0.41	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	**2.9**	B	**0.29**	J
Zinc	µg/L	--	170	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	**3.2**	JB	**7.6**	JB
Dissolved Inorganics																															
Arsenic	µg/L	1	0.04	--	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**		**13**		--	NA
Barium	µg/L	40	450	--	NA	**2500**	J	**2400**		**2300**		**2400**		**2100**		**2300**		**2100**		**2100**		**2300**	J	**2200**		**2100**		32		--	NA
Beryllium	µg/L	4	4	--	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	**0.33**	J	--	NA
Cadmium	µg/L	--	0.62	--	NA	**0.71**	J	**0.44**	J	**1**	B	**0.38**	J	**0.64**	J	**0.31**	J	**0.9**	J	1	U	1	U	1	U	1	U	**1**	J	--	NA
Chromium	µg/L	8	12	--	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**		**1.6**	JB	--	NA
Cobalt	µg/L	--	22	--	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	**2.2**		--	NA
Iron	µg/L	250	2300	15.8	U	**1600**		**1300**		**1300**	B	**1500**		**2100**		**1200**		**860**		**650**		**870**		**610**		**150**	J	**2600**		**28**	J
Lead	µg/L	15	15	--	NA	20	U	20	U	**16**	B	25	U	20	U	20	U	20	U	20	U	**6.2**	J	20	U	20	U	**0.025**	J	--	NA
Manganese	µg/L	66.8	310	**472**		**9800**		**9300**		**9500**	B	**10000**		**9300**		**9900**		**9100**		**9300**		**9400**		**9600**		**9600**		**2800**		**8500**	J
Mercury	µg/L	--	0.004	--	NA	0.00047	U	0.00047	UJ	0.00047	U	0.00046	U		NA	0.016	U	0.00802	U	0.00133	U	0.001	UL	0.00089	U	0.00133	UJ	**0.00065**		--	NA
Nickel	µg/L	--	260	--	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	**2.2**		--	NA
Selenium	µg/L	0.4	0.006	--	NA	**7.55**	J	**8.45**		**7.37**		**11.8**			NA	**9.77**		**6.7**		**8.79**		**7.53**		**8.23**		**8.14**		**10.4**		--	NA
Thallium	µg/L	--	0.17	--	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	1	U	--	NA
Vanadium	µg/L	--	0.41	--	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	**2.1**	B	--	NA
Zinc	µg/L	--	170	--	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**	JB	--	NA
Conventionals																															
Available Cyanide	µg/L	10	13	1.5	UJ	**43**		**220**		**340**		**85**		**19**		**200**		5	UJ	8.7		**5.8**	J	**13**		**5.5**	J	2	U	**1700**	J
Total Cyanide	µg/L	10	13	1.7	U	**18**		**110**		**21000**	J	20	U	**7.7**		**2200**		**6200**		**1600**		**610**		**270**		**2800**		**570**		**24**	J

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection
■ - Indicates exceedence of GW Cleanup Standards - Center of plume
■ - indicates exceedence of GW Cleanup Standard - Extent of plume
■ - Indicates exceedence of both GW Cleanup Standards

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
L - Result should be considered to be biased low
K - Result should be considered to be 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 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-17S																													
				7/17/2008		11/9/2010		2/22/2011		5/17/2011		8/10/2011		12/8/2011		3/21/2012		5/30/2012		9/5/2012		11/29/2012		2/27/2013		8/28/2013		3/25/2014		8/26/2014			
				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	1	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	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U		
2-Methylphenol	µg/L	12.5	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	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U		
4-Methylphenol	µg/L	47.7	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	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U		
Dibenzofuran	µg/L	12	0.86	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	0.5	U	0.51	U	0.52	U	0.96	U	0.96	U		
Naphthalene	µg/L	5	1	10	U	0.52	U	**0.54**		0.53	U	0.5	U	**1.9**		0.52	U	0.53	U	0.51	UJ	0.5	U	0.51	U	0.52	U	0.19	U	0.19	U		
Phenol	µg/L	7860	--	10	U	2.1	U	2.1	U	2.1	U	2	U	2.1	U	2.1	U	2.1	U	2	UJ	2	U	2	U	2.1	U	0.96	U	0.96	U		
Volatile Organic Compounds																																	
Acetone	µg/L	95.9	24	5	R	5	UJ	10	UJ	10	U	5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U	5	U	**3.1**	**JB**		
Benzene	µg/L	5	0.04	1	U	**0.02**		0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	**0.022**		0.02	U	0.02	U	0.02	UJ	0.02	U	0.02	U		
Chloroform	µg/L	1	0.015	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	**0.076**		0.01	U	0.01	U	0.02	U	0.02	U		
Total Inorganics																																	
Arsenic	µg/L	1	0.04	2.2	U	**0.548**	**J**	**0.557**		**2.9**	**J**	**4.2**		**0.76**	**J**	1	U	**2.1**		**2.21**		**0.4**	**J**	**0.82**	**J**	**2.4**		**0.57**	**J**	**0.44**	**JB**		
Barium	µg/L	40	450	0.1	U	25	U	**14**	**J**	**37**		**46**		**8.5**	**J**	**13**	**J**	**9**	**J**	**72**		**9.6**	**J**	**9.1**	**J**	**23**	**J**	**11**		**12**	**J**		
Beryllium	µg/L	4	4	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**	0.75	UJ	0.75	U	0.75	UJ	**0.29**	**J**	**0.14**	**J**		
Cadmium	µg/L	--	0.62	0.23	U	1	U	1	U	**0.67**	**B**	**0.42**	**J**	1	U	1	U	**1**	**B**	**0.36**	**J**	1	U	1	U	1	U	1	U	1	UJ		
Chromium	µg/L	8	12	1.2	U	**9.9**	**J**	**35**		**180**	**B**	**180**		**4.5**		**4.7**		**30**		**160**		**12**		**88**		**51**		**96**		**33**	**J**		
Cobalt	µg/L	--	22	0.7	U	10	U	**1.5**	**J**	**18**		**27**		**0.43**	**J**	**10**	**B**	**4.1**	**J**	**39**		10	U	10	U	**11**		**3.1**		**1.6**	**J**		
Iron	µg/L	250	2300	**1210**		**2700**	**J**	**1200**		**15000**	**B**	**30000**		**640**		**510**		**3100**		**25000**		**270**		**1600**		**6900**		**2500**		**1100**	**J**		
Lead	µg/L	15	15	2.4	U	**6.2**		**1.9**	**J**	**34**		**58**		5	U	**2.6**	**J**	**7.1**		**61**		5	U	**1.9**	**J**	**22**		**3.8**		**2.3**	**J**		
Manganese	µg/L	66.8	310	**28.8**		**110**		**89**		**490**		**610**		**29**		**63**		**83**		**1200**		**28**		**41**		**300**		**71**		**89**	**J**		
Mercury	µg/L	--	0.004	0.055	U	**0.041**		**0.00986**	**B**	**0.066**		**0.0486**		**0.0142**		**0.00831**		**0.0489**		**0.144**		**0.00688**		**0.00544**		**0.0116**		**0.0196**		**0.00834**			
Nickel	µg/L	--	260	1.1	U	10	U	20		**130**		**140**		**1.5**	**J**	**5.1**	**J**	**21**		**120**		**7.1**	**J**	**59**		**37**		**52**		**17**	**J**		
Selenium	µg/L	0.4	0.006	2.5	U	**0.287**	**J**	**0.199**	**J**	**1.59**		**0.313**	**J**	**0.222**		**0.132**		**0.549**		**1.12**		0.242	U	**0.278**	**J**	**0.392**		**0.224**	**J**	**0.135**	**J**		
Thallium	µg/L	--	0.17	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**	**1.5**	**B**	1.5	U	1.5	U	**0.2**	**J**	**0.31**	**JB**		
Vanadium	µg/L	--	0.41	1	U	**1.8**		1	U	**5.2**	**B**	**10**		**3.1**		**0.37**	**J**	**7**		**16**		**1**		**4.4**		**2.7**		**7.2**	**J**	1	UJ		
Zinc	µg/L	--	170	**28.2**		**49**		**19**	**J**	**280**		**420**	**J**	**14**	**J**	**25**	**B**	**53**		**360**		**25**	**B**	**22**	**J**	**81**		**36**		**15**	**JB**		
Dissolved Inorganics																																	
Arsenic	µg/L	1	0.04	2.2	U	**0.784**	**J**	**0.4**		**0.73**	**B**	**0.84**	**B**	**0.38**	**J**	--	NA	**1.4**		**0.456**		**0.3**	**J**	**0.36**	**J**	1	U	1	U	**0.33**	**JB**		
Barium	µg/L	40	450	0.1	U	25	U	**13**	**J**	**13**	**J**	**12**	**J**	7.9	**J**	--	NA	**25**	**B**	**9**	**J**	**8.8**	**J**	25	U	**14**	**J**	**7.3**	**J**	**10**	**J**		
Beryllium	µg/L	4	4	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	0.75	UJ	0.75	U	0.75	UJ	1	U	1	UJ		
Cadmium	µg/L	--	0.62	0.23	U	1	U	1	U	**0.46**	**B**	1	U	1	U	--	NA	**1**	**B**	1	U	1	U	1	U	1	U	1	U	1	UJ		
Chromium	µg/L	8	12	1.2	U	1	UJ	1	U	**3.7**	**B**	**1.5**		1	U	--	NA	**4.6**		**1**	**B**	**1**	**B**	**5.4**		1	U	**5.6**	**B**	**2.5**	**J**		
Cobalt	µg/L	--	22	0.7	U	10	U	10	U	**0.64**	**J**	**0.83**	**B**	10	U	--	NA	**0.36**	**J**	10	U	10	U	10	U	10	U	**0.32**	**J**	**0.54**	**J**		
Iron	µg/L	250	2300	15.8	U	150	UJ	150	U	150	U	**110**	**J**	150	U	150	U	**130**	**J**	**150**	**B**	150	U	**52**	**J**	150	U	**16**	**J**	50	UJ		
Lead	µg/L	15	15	2.4	U	5	U	5	U	5	U	5	U	5	U	--	NA	**1.3**	**J**	5	U	5	U	5	U	**4.1**	**J**	**0.034**	**J**	**0.037**	**JB**		
Manganese	µg/L	66.8	310	0.32	U	**65**		**68**		**98**		**67**		**21**	**J**	**51**		**11**	**J**	**56**		**20**	**J**	**5.6**	**J**	**25**		**12**	**J**	**63**	**J**		
Mercury	µg/L	--	0.004	0.055	U	**0.0142**		**0.00262**		**0.00139**		**0.0022**		**0.00557**		--	NA	**0.00952**		**0.00246**		**0.00265**		**0.00296**		**0.00174**	**J**	**0.00314**		**0.00095**			
Nickel	µg/L	--	260	1.1	U	10	U	**2.6**	**J**	**4.5**	**J**	**1.8**	**J**	10	U	--	NA	**3.1**	**J**	**1.9**	**J**	10	U	**2.6**	**J**	10	U	**3.6**		**2.5**	**J**		
Selenium	µg/L	0.4	0.006	2.5	U	**0.153**	**J**	0.474	U	**0.099**		0.716	U	**0.2**		--	NA	**0.105**	**B**	0.716	U	0.242	U	**0.277**	**J**	**0.125**	**J**	0.101	U	0.105	U		
Thallium	µg/L	--	0.17	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**	**1.5**	**B**	1.5	U	1.5	U	**0.16**	**J**	**0.3**	**JB**		
Vanadium	µg/L	--	0.41	1	U	**0.52**	**J**	**1**	**B**	**0.38**	**B**	**0.49**	**J**	**1.1**		--	NA	**4.7**		**0.95**	**J**	**1**	**B**	**1.4**		1	U	**8.2**	**J**	**1.1**	**J**		
Zinc	µg/L	--	170	1.3	U	25	U	25	U	25	U	**11**	**B**	**25**	**B**	--	NA	**3.5**	**J**	**25**	**B**	25	U	25	U	25	U	**3**	**JB**	**2.2**	**JB**		
Conventionals																																	
Available Cyanide	µg/L	10	13	1.5	U	2	U	2	U	5	U	**6.7**	**B**	5	U	5	U	5	U	5	U	5	UJ	5	U	5	UJ	2	U	2	U		
Total Cyanide	µg/L	10	13	1.7	UJ	10	U	10	U	20	UJ	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	**2.9**	**J**	10	U		

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

■ - Indicates exceedence of GW Cleanup Standards - Center of plume

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■ - Indicates exceedence of both GW Cleanup Standards

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J - Result should be considered a quantitative estimate

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K - Result should be considered to be 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.

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2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-17D																									
				7/16/2008		11/11/2010		2/22/2011		5/17/2011		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	
				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	1	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
2-Methylphenol	µg/L	12.5	1	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
4-Methylphenol	µg/L	47.7	1	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
Dibenzofuran	µg/L	12	0.86	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
Naphthalene	µg/L	5	1	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
Phenol	µg/L	7860	--	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
Volatile Organic Compounds																													
Acetone	µg/L	95.9	24	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
Benzene	µg/L	5	0.04	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	
Chloroform	µg/L	1	0.015	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
Total Inorganics																													
Arsenic	µg/L	1	0.04	2.2	U	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
Barium	µg/L	40	450	0.1	U	500	J	190		230		190		130		67		56		69		81		140		98		150		100	J
Beryllium	µg/L	4	4	0.32	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
Cadmium	µg/L	--	0.62	0.23	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
Chromium	µg/L	8	12	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
Cobalt	µg/L	--	22	0.7	U	380		80		22		20		37		21		17		39		35		8.3	J	32		13		11	J
Iron	µg/L	250	2300	3040		260000		57000		5900	B	1400		19000		14000		11000		20000		18000		850		15000		2100		980	J
Lead	µg/L	15	15	2.4	U	650		130		20		4.5	J	54		30		28		63		57		6.9		54		5		1.5	J
Manganese	µg/L	66.8	310	618		2800		830		1200		1400		880		480		290		300		340		740		330		1000		780	J
Mercury	µg/L	--	0.004	0.055	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	
Nickel	µg/L	--	260	1.1	U	1100		220		46		30		98		57		49		110		100	J	18		87	J	25		16	J
Selenium	µg/L	0.4	0.006	2.5	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	
Thallium	µg/L	--	0.17	3.1	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
Vanadium	µg/L	--	0.41	1	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
Zinc	µg/L	--	170	52		7400		7100		250		85	J	790		610	J	470		710		750		62		520		98		35	JB
Dissolved Inorganics																													
Arsenic	µg/L	1	0.04	4.7	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
Barium	µg/L	40	450	41.1	J	180	J	690		240		180		64		49		46		60	J	69		120		92		140		97	J
Beryllium	µg/L	4	4	0.1	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
Cadmium	µg/L	--	0.62	0.5	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
Chromium	µg/L	8	12	2.8		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
Cobalt	µg/L	--	22	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
Iron	µg/L	250	2300	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
Lead	µg/L	15	15	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
Manganese	µg/L	66.8	310	603		95		1400		1200		1400		350		140		110		130		130		640		240		1000	J	730	J
Mercury	µg/L	--	0.004	0.1	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	
Nickel	µg/L	--	260	5.5	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
Selenium	µg/L	0.4	0.006	4.8	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
Thallium	µg/L	--	0.17	4.8	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
Vanadium	µg/L	--	0.41	1.5	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
Zinc	µg/L	--	170	5.8		88		31	J	19	B	34	B	21	J	25	B	8	J	17	J	20	J	23	J	25	U	55		19	JB
Conventionals																													
Available Cyanide	µg/L	10	13	--	NA	15		8.6		5	U	5	U	5	U	5	U	9.2	B	5	U	5	U	5	U	5	U	2	U	2	U
Total Cyanide	µg/L	10	13	1.5	UJ	13		600		140	J	20	U	63		25		20	U	44		51		20	U	47		11		15	

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

■ - Indicates exceedence of GW Cleanup Standards - Center of plume

■ - indicates exceedence of GW Cleanup Standard - Extent of plume

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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

L - Result should be considered to be biased low

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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 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-19S																															
				7/17/2008		11/10/2010		2/22/2011		2/22/2011		5/17/2011		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		3/25/2014		8/26/2014	
				Result	Q	Result	Q	Result	Q	Duplicate	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
Semivolatile Organic Compounds																																			
2,4-Dimethylphenol	µg/L	1.15	1	10	U	0.5	U	0.51	U	0.51	U	0.54	U	2	U	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
2-Methylphenol	µg/L	12.5	1	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U	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
4-Methylphenol	µg/L	47.7	1	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U	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
Dibenzofuran	µg/L	12	0.86	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U	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
Naphthalene	µg/L	5	1	10	U	0.5	U	0.51	U	0.51	U	0.54	U	0.51	U	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
Phenol	µg/L	7860	--	10	U	2	U	2.1	U	2.2	U	2	U	2	U	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**
Volatile Organic Compounds																																			
Acetone	µg/L	95.9	24	5	R	5	UJ	10	UJ	10	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
Benzene	µg/L	5	0.04	1	U	**0.02**		**0.02**		**0.02**		**0.024**		**0.068**		**0.045**		**0.37**		**0.066**		**0.073**		**0.33**		**0.024**		0.02	U	**0.03**		**0.028**		**0.084**	
Chloroform	µg/L	1	0.015	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	0.01	U	**0.012**	**JB**	**0.011**	**JB**	0.02	U
Total Inorganics																																			
Arsenic	µg/L	1	0.04	2.2	U	**0.097**	**J**	**0.094**	**J**	**0.12**	**J**	**0.6**	**B**	**0.39**	**B**	**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**
Barium	µg/L	40	450	0.1	U	**110**		**100**		**100**		**93**		**100**		**110**		**100**		**100**		**110**		**110**		**110**		**120**		**100**		**100**		**91**	**J**
Beryllium	µg/L	4	4	0.32	U	**0.95**		**0.82**		**0.8**		**0.67**	**J**	**0.95**		**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**
Cadmium	µg/L	--	0.62	0.23	U	**0.88**	**J**	**1.1**		**0.8**	**J**	**1.2**	**B**	**0.78**	**J**	**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**
Chromium	µg/L	8	12	1.2	U	1	U	1	U	1	U	**0.73**	**B**	**0.36**	**B**	**0.43**	**J**	**1.4**		**1**	**B**	1	U	1	U	**1**	**B**	1	U	**2.6**	**B**	**2.6**	**B**	**0.6**	**J**
Cobalt	µg/L	--	22	0.7	U	10	U	**1.7**	**J**	**1.6**	**J**	**1.4**	**J**	**2.3**	**B**	**10**	**B**	**10**	**B**	**1.6**	**J**	**2.6**	**J**	**1.6**	**J**	10	U	**3.8**		**1.5**		**1.4**		**2.4**	**J**
Iron	µg/L	250	2300	15.8	U	150	U	150	U	150	U	150	U	**24**	**J**	150	U	**150**	**B**	150	U	150	U	150	U	150	U	150	U	50	U	50	U	50	UJ
Lead	µg/L	15	15	2.4	U	5	U	5	U	**2.1**	**J**	5	U	**1.6**	**J**	5	U	5	U	5	U	5	U	5	U	5	U	**3.7**	**J**	1	U	1	U	1	UJ
Manganese	µg/L	66.8	310	**2830**		**370**		**310**		**300**		**330**		**410**		**390**		**1500**		**460**		**450**		**1100**		**470**		**620**		**350**		**360**		**770**	**J**
Mercury	µg/L	--	0.004	**5.6**		**18.1**		**16.1**		**16.7**		**14.3**		**11.9**		**18.8**		**3.51**		**14.3**		**13.6**		**3.58**		**6.06**		**4.13**	**J**	**3.36**		**3.02**		**2.28**	
Nickel	µg/L	--	260	74.9		**39**	**J**	37		**36**		**34**		**41**		**41**		**38**		**39**		**42**		**42**	**J**	**41**		**42**	**J**	**33**		**34**		**34**	**J**
Selenium	µg/L	0.4	0.006	2.5	U	**3.55**	**J**	**3.75**		**3.91**		**4.14**		**3.52**		**5.89**		**4.14**		**3.93**		**4.11**		**4.01**		**5.61**		**4.61**		**4.89**		**5.89**		**3.57**	
Thallium	µg/L	--	0.17	3.1	U	**1.5**	**B**	**1.5**	**B**	**1.5**	**B**	**0.69**	**B**	**0.48**	**B**	**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**
Vanadium	µg/L	--	0.41	1	U	1	U	**1**	**B**	**1**	**B**	**0.14**	**B**	1	U	**1**	**B**	1	U	**1**	**B**	1	U	1	U	**0.2**	**J**	1	U	**9.4**	**J**	**8.1**	**J**	1	UJ
Zinc	µg/L	--	170	**99.3**		**86**		**86**		**85**		**72**		**80**	**J**	**81**		**71**	**J**	**77**		**83**		**75**		**73**		**63**		**51**		**53**		**51**	**JB**
Dissolved Inorganics																																			
Arsenic	µg/L	1	0.04	--	NA	**0.097**	**J**	--	NA	--	NA	**0.5**	**B**	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Barium	µg/L	40	450	--	NA	--	NA	--	NA	--	NA	**88**		--	NA	**100**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Beryllium	µg/L	4	4	--	NA	--	NA	--	NA	--	NA	**0.6**	**J**	--	NA	0.75	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Cadmium	µg/L	--	0.62	--	NA	--	NA	--	NA	--	NA	**1.1**	**B**	--	NA	**0.69**	**J**	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Chromium	µg/L	8	12	--	NA	--	NA	--	NA	--	NA	**0.38**	**B**	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Cobalt	µg/L	--	22	--	NA	--	NA	--	NA	--	NA	**1.3**	**J**	--	NA	**10**	**B**	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Iron	µg/L	250	2300	15.8	U	150	U	150	U	150	U	150	U	**200**	**J**	150	U	150	U	150	U	**150**	**B**	**22**	**J**	150	U	150	U	50	U	50	U	**7.6**	**J**
Lead	µg/L	15	15	--	NA	--	NA	--	NA	--	NA	**2.1**	**J**	--	NA	**1.6**	**J**	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Manganese	µg/L	66.8	310	**2820**		**320**		**340**		**340**		**320**		**460**		**380**		**1600**		**530**		**490**		**1100**		**460**		**610**		**350**	**J**	**350**	**J**	**770**	**J**
Mercury	µg/L	--	0.004	--	NA	**13.1**		--	NA	--	NA		NA	--	NA		NA	--	NA	--	NA	--	NA	--	NA	--	NA	**4.29**		--	NA	--	NA	--	NA
Nickel	µg/L	--	260	--	NA	--	NA	--	NA	**32**		--	NA	**41**			NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Selenium	µg/L	0.4	0.006	--	NA	**3.72**	**J**	--	NA	--	NA		NA	--	NA		NA	--	NA	--	NA	--	NA	--	NA	--	NA	**4.56**		--	NA	--	NA	--	NA
Thallium	µg/L	--	0.17	--	NA	--	NA	--	NA	--	NA	**0.64**	**B**	--	NA	**0.084**	**J**	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Vanadium	µg/L	--	0.41	--	NA	--	NA	--	NA	--	NA	**0.14**	B	--	NA	1	U	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Zinc	µg/L	--	170	--	NA	--	NA	--	NA	--	NA	**69**		--	NA	**81**		--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA
Conventionals																																			
Available Cyanide	µg/L	10	13	1.5	U	0.01	U	2	U	2	U	5	U	5	U	5	U	5	U	**8.5**	**B**	5	U	5	U	5	U	5	U	2	U	2	U	2	U
Total Cyanide	µg/L	10	13	1.7	UJ	2000	U	10	U	10	U	20	UJ	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	**2.5**	**J**	**3.1**	**J**	**4.2**	**J**

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

- Indicates exceedence of GW Cleanup Standards - Center of plume
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				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	1	**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	**0.2**	**J**	0.96	U
2-Methylphenol	µg/L	12.5	1	**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	0.93	U	0.96	U
4-Methylphenol	µg/L	47.7	1	**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	0.93	U	0.96	U
Dibenzofuran	µg/L	12	0.86	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	0.93	U	0.96	U
Naphthalene	µg/L	5	1	**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**		**0.32**		**0.23**	
Phenol	µg/L	7860	--	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	0.93	U	0.96	U
Volatile Organic Compounds																															
Acetone	µg/L	95.9	24	5	R	5	UJ	5	UJ	**10**		5.9	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ	10	U	**8.1**	**J**	**5.9**	**B**
Benzene	µg/L	5	0.04	**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**		**1.3**		**1.6**	
Chloroform	µg/L	1	0.015	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	0.02	U	**0.018**	**JB**
Total Inorganics																															
Arsenic	µg/L	1	0.04	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	**1.9**		**1.8**	**J**
Barium	µg/L	40	450	0.1	U	**61**		**130**		**180**		**370**		**57**		**76**		**1100**		**50**		**230**		**87**		**88**		**130**		**110**	**J**
Beryllium	µg/L	4	4	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	**1.1**		**0.83**	**J**
Cadmium	µg/L	--	0.62	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	**0.27**	**J**	**0.31**	**J**
Chromium	µg/L	8	12	1.2	U	**880**		**64**		**44**	**B**	**15**		**0.44**	**J**	**490**		**190**		1	U	**65**		**2.4**		**1.5**		**13**		**15**	**J**
Cobalt	µg/L	--	22	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		2.3		3.2	**J**
Iron	µg/L	250	2300	**21300**	**J**	**23000**		**48000**		**81000**	**B**	**69000**		**14000**		**23000**		**240000**		**5500**		**83000**		**28000**		**21000**		**21000**		**34000**	**J**
Lead	µg/L	15	15	2.4	U	5	U	**9.1**		**29**		**81**		**1.2**	**J**	**3.7**	**J**	**220**		5	U	**59**		6.5		8.8		**16**		**16**	**J**
Manganese	µg/L	66.8	310	**1110**		**330**		**460**		**370**	**B**	**1200**		**220**		**330**		**2500**		**230**		**520**		**360**		**300**		**390**		**290**	**J**
Mercury	µg/L	--	0.004	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**		**0.207**		**0.188**	
Nickel	µg/L	--	260	1.1	U	**440**	**J**	**32**	**J**	**39**		27		10	U	**290**		**130**		10	U	27	**J**	**4.6**	**J**	2.2	**J**	**8.1**		**8.9**	**J**
Selenium	µg/L	0.4	0.006	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**		**3.02**		**1.65**	
Thallium	µg/L	--	0.17	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	**0.11**	**JB**	**0.12**	**JB**
Vanadium	µg/L	--	0.41	1	U	1	U	**9.4**		**18**	**B**	**13**		**1**	**B**	1	U	**110**		1	U	**54**		**2.9**		**1.8**	**B**	**12**	**J**	**11**	**J**
Zinc	µg/L	--	170	**61.2**		25	U	**21**	**J**	**88**		**300**	**J**	**25**	**B**	**25**	**B**	**390**		**33**		**140**		**50**		**24**	**J**	**35**		**33**	**JB**
Dissolved Inorganics																															
Arsenic	µg/L	1	0.04	--	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	1	U	**1.1**	**J**
Barium	µg/L	40	450	--	NA	**66**		**130**		**110**		**94**		**57**		**67**		**100**		--	NA	**110**		**72**		**80**		**53**		**64**	**J**
Beryllium	µg/L	4	4	--	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	1	U	1	UJ
Cadmium	µg/L	--	0.62	--	NA	1	U	1	U	1	U	1	U	1	U	1	U	**1**	**B**	--	NA	1	U	1	U	1	U	1	U	1	UJ
Chromium	µg/L	8	12	--	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	2.6	**B**	2	UJ
Cobalt	µg/L	--	22	--	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**		**0.6**		**0.61**	**J**
Iron	µg/L	250	2300	**20200**		**18000**		**41000**		**32000**	**B**	**21000**		**15000**		**17000**		**22000**		**4100**		**41000**		**22000**		**22000**		**3900**		**17000**	**J**
Lead	µg/L	15	15	--	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**		1	U	1	UJ
Manganese	µg/L	66.8	310	**1090**		**210**		**500**		**390**	**B**	**560**		**220**		**270**		**470**		**230**		**370**		**280**		**300**		**210**	**J**	**240**	**J**
Mercury	µg/L	--	0.004	--	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**	**0.00155**		**0.0008**	
Nickel	µg/L	--	260	--	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**	**0.72**	**J**	**0.6**	**J**
Selenium	µg/L	0.4	0.006	--	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**		**0.548**		**0.441**	
Thallium	µg/L	--	0.17	--	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	1	U	1	UJ
Vanadium	µg/L	--	0.41	--	NA	1	U	1	U	**0.25**	**B**	1	U	1	U	1	U	**0.22**	**J**	--	NA	1	U	1	U	1	U	**6.7**	**J**	1	UJ
Zinc	µg/L	--	170	--	NA	25	U	**7.5**	**J**	**10**	**J**	**21**	**B**	**25**	**B**	**25**	**B**	**17**	**J**	--	NA	**28**	**J**	**19**	**J**	25	U	**9.5**	**B**	**5**	**JB**
Conventionals																															
Available Cyanide	µg/L	10	13	**4.8**		0.01	U	**420**		**590**	**K**	**90**		**190**		**240**		5	U	5	U	5	U	5	U	5	U	**93**		**85**	**J**
Total Cyanide	µg/L	10	13	**25.5**	**J**	**59000**		10	U	20	UJ	20	U	**21**		20	U	**40**		20	U	20	U	20	U	20	U	**2.5**	**J**	10	UJ

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

■ - Indicates exceedence of GW Cleanup Standards - Center of plume

■ - indicates exceedence of GW Cleanup Standard - Extent of plume

■ - Indicates exceedence of both GW Cleanup Standards

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

L - Result should be considered to be biased low

K - Result should be considered to be 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 4
CONSTITUENT OF INTEREST ANALYTICAL HISTORY
2014 Annual Monitored Natural Attenuation Report
Crater Resources Superfund Site
Upper Merion Township, Pennsylvania

Analyte	Units	GW Cleanup Standards Center of Plume	GW Cleanup Standards Extent of Plume	MW-21S																															
				7/15/2008		11/10/2010		11/10/2010		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	
				Result	Q	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
Semivolatile Organic Compounds																																			
2,4-Dimethylphenol	µg/L	1.15	1	10	U	0.5	U	0.5	U	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
2-Methylphenol	µg/L	12.5	1	10	U	0.5	U	0.5	U	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**
4-Methylphenol	µg/L	47.7	1	10	U	0.5	U	0.5	U	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**
Dibenzofuran	µg/L	12	0.86	10	U	0.5	U	0.5	U	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
Naphthalene	µg/L	5	1	10	U	0.5	U	0.5	U	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
Phenol	µg/L	7860	--	10	U	2	U	2	U	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**	
Volatile Organic Compounds																																			
Acetone	µg/L	95.9	24	5	R	5	UJ	5	UJ	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
Benzene	µg/L	5	0.04	1	UJ	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	**0.035**		0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chloroform	µg/L	1	0.015	5	UJ	**0.05**		**0.05**		**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**
Total Inorganics																																			
Arsenic	µg/L	1	0.04	**6.3**		**1.22**	**J**	**1.24**	**J**	**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**
Barium	µg/L	40	450	**56.2**	**J**	25	U	25	U	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**
Beryllium	µg/L	4	4	2.7		0.75	U	0.85		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**
Cadmium	µg/L	--	0.62	0.5	U	1	U	1	U	**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**
Chromium	µg/L	8	12	**8**	**J**	**4**		**4.4**		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**
Cobalt	µg/L	--	22	3.5	U	10	U	10	U	**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**
Iron	µg/L	250	2300	**13800**		**3200**		**3400**		**2500**		**3200**	**B**	**4900**		**1400**		**1100**		**1400**		**2600**		**1400**		**2100**		**1300**		**1200**	**L**	**880**	**J**
Lead	µg/L	15	15	**21**		**5.6**		**6.2**		**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**
Manganese	µg/L	66.8	310	**330**		**100**		**100**		**130**		**140**	**B**	**210**		**130**		**130**		**130**		**150**		**160**		**170**		**100**		**120**	**L**	**87**	**J**
Mercury	µg/L	--	0.004	0.1	U	**0.00885**		**0.0088**		0.00383	**B**	**0.0145**		**0.00527**		0.00132		0.00251	**B**	**0.0158**		**0.00433**		0.00098		0.00083		0.00295		0.00178		0.00173	
Nickel	µg/L	--	260	17.7	**J**	10	U	10	U	**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**
Selenium	µg/L	0.4	0.006	4.8	U	**0.709**	**J**	**0.789**	**J**	**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**
Thallium	µg/L	--	0.17	4.8	U	**1.5**	**B**	1.5	U	**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
Vanadium	µg/L	--	0.41	**20.2**	**J**	**8.5**		**8.7**		**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**
Zinc	µg/L	--	170	59.8	U	**26**		25	U	**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**
Dissolved Inorganics																																			
Arsenic	µg/L	1	0.04	4.5	U	**0.436**	**J**	**0.426**	**J**	**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**
Barium	µg/L	40	450	7.6	**J**	25	U	25	U	**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**
Beryllium	µg/L	4	4	0.1	U	0.75	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	1	UL	1	UJ
Cadmium	µg/L	--	0.62	0.5	U	1	U	1	U	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**
Chromium	µg/L	8	12	2.8	U	1	U	1	U	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**
Cobalt	µg/L	--	22	3.5	U	10	U	10	U	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**
Iron	µg/L	250	2300	**347**		150	U	150	U	**250**		73	**B**	**220**		**260**		**330**		**580**		**2100**		**990**		**1600**		**120**	**J**	**740**	**L**	**200**	**J**
Lead	µg/L	15	15	2.2	U	5	U	5	U	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**
Manganese	µg/L	66.8	310	**53**		25	U	25	U	**38**		**17**	**B**	**37**		**67**		**80**		**92**		**150**		**140**		**150**		**68**		**130**	**J**	**88**	**J**
Mercury	µg/L	--	0.004	0.1	U	**0.00059**		**0.00024**	**J**	**0.00021**	**J**	0.0004	U	0.00041	U	**0.00026**	**J**	**0.00248**		**0.0014**		**0.00072**		0.00016	U	**0.00091**		**0.00041**	**B**	**0.00034**	**J**	0.0001	UJ
Nickel	µg/L	--	260	3.9	U	10	U	10	U	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**
Selenium	µg/L	0.4	0.006	4.8	U	**0.168**	**J**	**0.192**	**J**	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**
Thallium	µg/L	--	0.17	4.8	U	**0.21**	**J**	**0.2**	**J**	**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
Vanadium	µg/L	--	0.41	1.5	U	**0.23**	**J**	**0.22**	**J**	**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
Zinc	µg/L	--	170	5.8	U	25	U	25	U	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**
Conventionals																																			
Available Cyanide	µg/L	10	13	2	U	0.01	U	0.01	U	2	U	5	U	**6.9**	**B**	**5.2**		5	U	**12**	**B**	5	U	5	U	5	U	5	U	2	U	2	U
Total Cyanide	µg/L	10	13	10	U	2000	U	2000	U	10	U	20	UJ	20	U	**360**		20	U	20	U	20	U	20	U	20	U	20	U	10	U	10	U

Notes:
MW-15 and MW-16 series well monitoring discontinued per USEPA approval letter dated 4/30/2013.

Bold - Indicates positive detection

- Indicates exceedence of GW Cleanup Standards - Center of plume
- indicates exceedence of GW Cleanup Standard - Extent of plume
- Indicates exceedence of both GW Cleanup Standards

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

L - Result should be considered to be biased low

K - Result should be considered to be 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.

Appendix E-2: OU6 Groundwater Assessment, Supporting Documentation

The FYR screening process was used with the residential groundwater RSLs.

As demonstrated below, the center-of-plume goals for dibenzofuran, naphthalene, phenol, cyanide, and chromium would contribute significantly to an HI above 1 or a cancer risk above 1E-4. The extent-of-plume goals for cyanide, cobalt, chromium, manganese, nickel, and thallium would contribute significantly to an HI above 1 or a cancer risk above 1E-4.

COC	Goal, Center (ug/L)	Goal, Extent (ug/L)	MCL (ug/L)	RSL at HQ 1 (ug/L)	RSL at CR 1e-6 (ug/L)	Center		Extent	
						Screening		Screening	
						HQ	CR	HQ	CR
acetone	95.9	24	--	14000	--	0.007	--	0.002	--
benzene	5	0.04	5	33	0.46	0.15	1e-5	0.001	9e-8
chloroform	1	0.015	80*	97	0.22	0.01	5e-6	2e-4	7e-8
dibenzo furan	12	0.86	--	7.9	--	1.5	--	0.1	--
24DMP	1.15	1	--	360	--	0.003	--	0.003	--
2MP	12.5	1	--	930	--	0.01	--	0.001	--
4MP	47.7	1	--	1900	--	0.025	--	5e-4	--
naphthalene	5	1	--	6.1	0.17	0.8	3e-5	0.2	6e-6
phenol	7860	--	--	5800	--	1.4	--	--	--
cyanide	10	13	200	1.5	--	6.7	--	8.7	--
As	1	0.04	10	6	0.052	0.2	2e-5	0.007	8e-7
Ba	40	450	2000	3800	--	0.01	--	0.1	--
Be	4	4	4	25	--	0.2	--	0.2	--
Cd	--	0.62	5	9.2	--	--	--	0.07	--
Cr	8	12	100	44	0.035	0.2	2e-4	0.3	3e-4
Co	--	22	--	6	--	--	--	3.7	--
Fe	250	2300	--	14000	--	0.02	--	0.2	--
Pb	15	15	15	--	--	--	--	--	--
Mn	66.8	310	--	430	--	0.2	--	0.7	--
Hg	--	0.004	2	0.6	--	--	--	0.007	--
Ni	--	260	--	390	--	--	--	0.7	--
Se	0.4	0.006	50	100	--	.004	--	6e-5	--
Tl	--	0.17	2; 0.5@	0.2	--	--	--	0.85	--
V	--	0.41	--	86	--	--	--	0.005	--
Zn	--	170	--	6000	--	--	--	0.03	--
TOTAL						11	3e-4	16	3.5e-4

*Total trihalomethanes; @MCLG

This is only an initial screening assessment. For the chemicals that exceeded the initial levels of concern in the FYR screening, risks at the groundwater performance standards were estimated using more detailed assumptions, as follows.

Chemical-specific inputs are listed below.

	Kp	B	tau	t*	MW	H	RfD@	CSF@	RfC	IUR
dibenzofuran	0.098	0.49	0.92	2.2	170	2.1e-4	1e-3	--	--	--
naphthalene	0.047	0.2	0.55	1.3	130	4.4e-4	0.02	--	3e-3	3.4e-5
phenol	4.3e-3	0.016	0.35	0.85	94	3.3e-7	0.3	--	0.2	--
cyanide	1e-3	2e-3	0.15	0.36	27	1.3e-4	6e-4	--	8e-4	--
Cr	2e-3	--	--	--	--	--	3e-3/ 7.5e-5	0.5/20+	na	na
Co	4e-4	--	--	--	--	--	3e-4	--	na	na
Mn	1e-3	--	--	--	--	--	0.024/ 9.6e-4	--	na	na
Ni	2e-4	--	--	--	--	--	0.02/ 8e-4	--	na	na
Tl	1e-3	--	--	--	--	--	1e-5	--	na	na

FA = 1 for every chemical; na= not applicable
@Oral and dermal factors were equivalent except where displayed in this format: oral/dermal. Factors in this table were taken from the Regional Screening Table and supporting tables (November 2015).
+Carcinogenic via a mutagenic mode of action; ADAFs used in the estimation of cancer risk.

The following updated exposure factors were used, in accordance with the OSWER Directive 9200.1-120:

	Child	Adult
IR (L/day)	0.78	2.5
EF (days/yr)	350	350
ED (yrs)	6	20
BW (kg)	15	80
AT-noncancer (days)	365 x ED	365 x ED
AT-cancer (days)	365 x 70	365 x 70
SA (cm^2)	6378	20900
T (hrs/day)	0.54	0.71

The following showering inputs were used for the Foster and Chrostowski, 1987, model: T1 (293 K), Ts (318 K), u1 (1.002 cp), us (0.596 cp), d 1 mm, ts 0.5 sec, flow rate 10 L/min, SV 12 m^3, Dt 60 min, Ra 0.01667/min.

The following risks were derived:

Center of plume

	Child HI	Adult HI (oral/derm)	Target organ*	Adult HI (inhal)	Target organ*	Cancer risk
dibenzofuran	1.5	1	body wt	--		--
naphthalene	0.02	0.01		0.09		3e-6
phenol	1.4	0.8	repro, body wt	0.005		--
cyanide	0.8	0.5	testes	0.8	thyroid	--
Cr	0.2	0.1		--		2e-4
Co	--	--		--		--
Mn	0.15	0.1		--		--
Ni	--	--		--		--
Tl	--	--		--		--

*Target organs shown for those chemicals that contribute significantly to total HI

An HI greater than 1 is driven by dibenzofuran and phenol, which both affect body weight. The cancer risk for chromium exceeds 1E-4. In conclusion, the chemicals for which the center-of-plume goals may not be protective are dibenzofuran, phenol, and chromium.

Extent of plume

	Child HI	Adult HI (oral/derm)	Target organ*	Adult HI (inhal)	Target organ*	Cancer risk
dibenzofuran	0.1	0.07	body wt	--		--
naphthalene	0.004	0.002		0.02		5e-7
phenol	--	--	repro, body wt	--		--
cyanide	1	0.6	testes	1	thyroid	--
Cr	0.3	0.2		--		3e-4
Co	4	2	thyroid	--		--
Mn	0.7	0.4	CNS	--		--
Ni	0.7	0.4	body wt	--		--
Tl	0.8	0.5	hair	--		--

*Target organs shown for those chemicals that contribute significantly to total HI

The chemicals for which the extent-of-plume goals may not be protective are cobalt, chromium, and cyanide, due to an HI above 1 and a cancer risk above 1E-4.

Wells BG-1S and BG-1D currently serve as background wells. EPA has some concerns about the finding of cyanide in these wells. However, they do not have significant concentrations of the organic site-related compounds. If these wells are representative of background, using data since the spring of 2011, then the ROD Table 13 goals for chromium and cobalt are higher than the background-well concentrations for these chemicals. Therefore, it seems unlikely that background would supersede the risk-based Table 13 remedial goals for chromium and cobalt.

In addition to the above evaluation of the groundwater goals, the actual groundwater data were screened using the most recent year for which data were available, 2014. The following table shows a comparison of the monitoring data to RSLs, ROD Goals for the center of the plume, and ROD Goals for the extent of the plume.

It is obvious from the table that many chemicals in the center of the plume still exceed screening levels and remedial goals. While some of the metals may be associated with background, there are still many site-related organic chemicals that exceed the goals. Nobody is currently consuming this water, but this indicates the need for the remediation to continue, to reduce future risks. The wells in the extent of the plume have fewer exceedances, but still have not met the groundwater ROD goals.

2014 Monitoring Well Data Screening

	Central / Extent Wells						Extent Wells			
	Total			Dissolved			Total		Dissolved	
	>RSL	>RGC	>RGE	>RSL	>RGC	>RGE	>RSL	>RGE	>RSL	>RGE
acetone		x	x	N/A					N/A	
benzene	x	x	x				x	x		
dibenzofuran	x		x							
24DMP	x	x	x							
2MP	x	x	x							
4MP	x	x	x							
naphthalene	x	x	x					x		
phenol	x	x								
As	x	x	x	x	x	x	x	x	x	x
Ba	x	x	x	x	x	x			x	x
Be										
Cd	x		x	x		x		x		
Cr	x	x	x	x			x	x	x	
Co	x		x	x			x		x	
Fe	x	x	x	x	x	x	x	x	x	x
Pb							x	x		
Mn	x	x	x	x	x	x	x	x	x	x
Hg			x				x	x		
Ni							x			
Se	x	x	x	x	x	x	x	x		x
Tl	x			x			x	x	x	x
V			x				x	x		x
Zn										
avail cyanide	x	x	x	N/A			x	x	N/A	
tot cyanide	x	x	x				x	x		

RSL = EPA Regional Screening Level (Nov 2015) for residential tap water at HQ 0.1 and cancer risk 1E-6; RGC = Remedial Goal, Center of Plume (ROD Table 13); RGE = Remedial Goal, Extent of Plume (ROD Table 13)

Central/Extent Wells = MW6, MW11S, MW11D, MW13S, based on the original risk assessment.

Extent Wells = MW8, MW17S, MW17D, MW19S, MW20S, MW21S, based on the original risk assessment.

Appendix F: Site Inspection Checklist

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Crater Resources, Inc./Keystone Coke Co./Alan Wood Steel Co.	**Date of Inspection:** 11/10/2015
Location and Region: Upper Merion Township, Montomery County, Pennsylvania. EPA Region 3	**EPA ID:** PAD980419097
Agency, Office or Company Leading the Five-Year Review: EPA Region 3	**Weather/Temperature:** Overcast and light rain, 60 degrees F.

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Ground water pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other: _____
- ☒ Monitored natural attenuation
- ☐ Ground water containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** _____ Name _____ Title _____ Date
   Interviewed ☐ at site ☐ at office ☐ by phone : _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ Name _____ Title _____ Date
   Interviewed ☐ at site ☐ at office ☐ by phone : _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency Upper Merion Township
   Contact Janet Serfass (Name) | EAC Liaison (Title) | 12/21/15 (Date) | _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ _____ _____ _____

	Name	Title	Date	Phone No.
	Problems/suggestions ☐ Report attached: _____			
	Agency _____ Contact _____	_____	_____	_____
	Name	Title	Date	Phone No.
	Problems/suggestions ☐ Report attached: _____			
4.	**Other Interviews** (optional) ☐ Report attached: _____			

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1.	**O&M Documents**			
	☐ O&M manual	☐ Readily available	☐ Up to date	☒ N/A
	☒ As-built drawings	☒ Readily available	☐ Up to date	☐ N/A
	☒ Maintenance logs	☒ Readily available	☐ Up to date	☐ N/A
	Remarks: The PRP Group maintains annual O&M inspection reports, which include documentation of any needed and/or performed maintenance activities. EPA and site PRPs maintain copies of remedial design documentation.			
2.	**Site-Specific Health and Safety Plan**	☒ Readily available	☒ Up to date	☐ N/A
	☐ Contingency plan/emergency response plan	☐ Readily available	☐ Up to date	☐ N/A
	Remarks: OU Specific			
3.	**O&M and OSHA Training Records**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: O&M and remedial contractors maintain electronic copies of O&M and Occupational Safety and Health Administration training records.			
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
	☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
7.	**Ground Water Monitoring Records**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: The PRP Group performs semi-annual groundwater monitoring and submits annual MNA reports to EPA.			

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air ☐ Readily available ☐ Up to date ☒ N/A

☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for state

☐ PRP in-house ☒ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☒ PRP Group contractor, Advanced Geoservices, performs annual inspections of Quarry 3 and semi-annual groundwater monitoring.

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☐ Funding mechanism/agreement in place ☒ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A

Remarks:

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A

Remarks:

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by): _____

Frequency: _____

Responsible party/agency: PRPs are responsible for implementing intitutional controls for the Site.

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: Additional institutional controls will be implemented for the properties that make up OU1, OU2 and OU4 following completion of remedy implementation at those areas.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks:

2. **Land Use Changes On Site** ☐ N/A

Remarks: In 2014, O'Neill met with EPA to discuss the requirements for a potential land use change from commercial/light industrial to residential for both Quarry 1 and Quarry 2. On January 24, 2016, O'Neill submitted a document titled "Environmental Work Plan for Residential Development at the 2901 and 2501 Renaissance Boulevard Properties." EPA is currently reviewing documentation submitted by O'Neill to determine if residential land use at those areas is appropriate.

3. **Land Use Changes Off Site** ☐ N/A

Remarks:

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: Roads throughout the Site appeared to be in good condition.

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☐ Settlement not evident
   Arial extent: _____ Depth: _____
   Remarks: Not applicable. Final caps have not yet been installed over Quarries 1, 2 or 4. Quarries 1 and 2 are currently covered with temporary covers of geotextile, gravel and vegetation.

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
   Lengths: _____ Widths: _____ Depths: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Arial extent: _____ Depth: _____
   Remarks:

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
   Arial extent: _____ Depth: _____
   Remarks: _____

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established
   ☐ No signs of stress ☐ Trees/shrubs (indicate size and locations on a diagram)
   Remarks: Dense grassy and wetland type vegetation is growing on Quarry 3. Excavated and restored areas associated with OU5, OU8, OU9, and OU10 have adequate grass cover.

6. **Alternative Cover** (e.g., armored rock, concrete) ☒ N/A
   Remarks: _____

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
   Arial extent: _____ Height: _____
   Remarks: _____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
   ☐ Wet areas ☐ Location shown on site map Arial extent: _____
   ☐ Ponding ☐ Location shown on site map Arial extent: _____
   ☐ Seeps ☐ Location shown on site map Arial extent: _____
   ☐ Soft subgrade ☐ Location shown on site map Arial extent: _____
   Remarks:

9. **Slope Instability** ☐ Slides ☐ Location shown on site map
   ☐ No evidence of slope instability
   Arial extent: _____
   Remarks: Not applicable.

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay

   Remarks: _____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay

   Remarks: _____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay

   Remarks: _____

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ No evidence of settlement

   Arial extent: _____ Depth: _____

   Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation

   Material type:_____ Arial extent: _____

   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion

   Arial extent: _____ Depth: _____

   Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting

   Arial extent: _____ Depth: _____

   Remarks: _____

5. **Obstructions** Type: _____ ☐ No obstructions

   ☐ Location shown on site map Arial extent: _____

   Size: _____

   Remarks: _____

6. **Excessive Vegetative Growth** Type: _____

   ☐ No evidence of excessive growth

   ☐ Vegetation in channels does not obstruct flow

   ☐ Location shown on site map Arial extent: _____

   Remarks: _____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. **Gas Vents** ☐ Active ☐ Passive
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

4. **Extraction Wells Leachate**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
   Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs maintenance
   Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs maintenance
   Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs maintenance ☐ N/A
   Remarks: _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A
   ☐ Siltation not evident
   Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____
   ☐ Erosion not evident
   Remarks: _____

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks: _____

4. **Dam** ☐ Functioning ☐ N/A
   Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement: _____ Vertical displacement: _____
   Rotational displacement: _____
   Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☐ Vegetation does not impede flow
   Area extent: _____ Type: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Area extent: _____ Depth: _____
   Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A
   Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Area extent: _____ Depth: _____

Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

☐ Performance not monitored

Frequency: _____ ☐ Evidence of breaching

Head differential: _____

Remarks: _____

IX. GROUND WATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Ground Water Extraction Wells, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☐ Applicable ☒ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters: _____

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☐ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of ground water treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: _____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Ground water plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks:

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.	
XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions). The remedy was designed to eliminate exposure to soil/sediment that presented an unacceptable risk to human health or the environment; prevent contact of soil/sediment constituents with other media such as groundwater and surface water, which may transport the contamination, so that the transport does not create an unacceptable risk to human health or the environment; prevent exposure to groundwater contamination; and restore the aquifer to beneficial reuse. A review of site documents, ARARs, risk assumptions and site inspection findings indicate that the remedy is functioning as intended by site decision documents for OUs where the remedy has been fully implemented (OUs 3, 5, 7, 8, 9 and 10). The remedy is expected to function as intended for OUs where the remedy has not yet been fully implemented (OUs 1, 2 and 4), following remedy completion at those areas. Overlapping institutional controls are in place to prevent exposure to contaminated groundwater (OU6) through ingestion at the Site. The MNA remedy for OU6 is ongoing and data show biodegradation of contaminants; however, until remaining source areas are capped, MNA will not be able to effectively achieve groundwater cleanup goals.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Currently, O&M activities are limited. The PRP Group performs annual inspection of Quarry 3 and inspects monitoring wells during semi-annual sampling events.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. None.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. In April 2013, EPA approved the PRPs' request to reduce groundwater sampling frequency to twice a year. No other opportunities for optimization have been identified.

Appendix G: Interview Forms

OSWER No. 9355.7-03B-P

INTERVIEW DOCUMENTATION FORM

The following is a list of individual interviewed for this five-year review. See the attached contact record(s) for a detailed summary of the interviews.

Name	Title/Position	Organization	Date
Janet Serfass	Staff Liaison to Environmental Advisory Committee	Upper Merion Township	12/21/2015
Name	Title/Position	Organization	Date
Name	Title/Position	Organization	Date
Name	Title/Position	Organization	Date
Name	Title/Position	Organization	Date
Name	Title/Position	Organization	Date
Name	Title/Position	Organization	Date

INTERVIEW RECORD

Site Name: Crater Resources		**EPA ID No.: PAD980419097**
Subject: Crater Resources FYR		**Time:** **Date: 12/21/15**
Type: X Telephone Visit Other **Location of Visit:**		Incoming X Outgoing

Contact Made By:

Name: Gina Soscia	**Title: CIC**	**Organization: EPA**

Individual Contacted:

Name: Janet Serfass	**Title: EAC Liaison**	**Organization: Upper Merion Twp**
Telephone No: 610-205-8506 **Fax No: 610-265-8467** **E-Mail Address:**	**Street Address: 175 West Valley Forge Road** **City, State, Zip: King of Prussia, PA 19406**	

Summary Of Conversation

On December 21, 2015, EPA Community Involvement Coordinator (CIC) Gina Soscia conducted a telephone interview with the Upper Merion Township Administrator of the Municipal Industrial Pretreatment Program (MIPP). The Administrator also serves as the Staff Liaison to the Upper Merion Township Environmental Advisory Council. The Administrator stated she felt as though the Site has been handled very well. She was initially involved with permitting the water that was pumped, treated and discharged at the Site, and felt as though everyone did an exceptional job with these efforts. The Administrator also stated she felt the site has had a positive effect on the surrounding community, especially because of the development taking place for mixed industrial use. The Administrator was not aware of any community concerns related to the Site and requested that EPA continue to update her regarding the status of the Crater Resources Site.