FINAL
FEASIBILITY STUDY FOR AREA II OF THE FORMER FRANKFORD ARSENAL PHILADELPHIA, PENNSYLVANIA FUDS PROPERTY NO: C03PA0042

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COMPLETION OF SENIOR TECHNICAL REVIEW

In compliance with EA's Senior Technical Review Program and quality procedures for review of deliverables outlined in the appropriate Quality Assurance Plan for this contract, I hereby certify that I reviewed this final deliverable as the Senior Technical Reviewer for this project. I consequently conclude that the information presented in this report was prepared in accordance with the approved procedures for the applicable Contract No. W912DR-09-D-0017 and reflects a proper presentation of the data and the conclusions drawn during the conduct of the work. This statement is based upon the standards identified in the contract/task order and/or the standard of care existing at the time of preparation.

Amy Sponaugle — 7/27/2016

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	Arsenal Business Center
amsl	Above mean sea level
AOC	Area of Concern
AOI	Area of Interest
ARAR	Applicable or relevant and appropriate requirement
BAP	Benzo(a)pyrene
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of concern
CON	Containerized
COPC	Contaminant of potential concern
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DQO	Data quality objective
EA	EA Engineering, Science, and Technology, Inc., PBC
FFA	Former Frankford Arsenal
FS	Feasibility Study
ft	Foot (feet)
ft^2	Square foot (feet)
FUDS	Formerly Used Defense Sites
GRA	General Response Action
GSA	General Services Administration
HHRA	Human health risk assessment
HTRW	Hazardous, Toxic, and Radioactive Waste
I-95	Interstate 95
IEUBK	Integrated Exposure Uptake Biokinetic
in.	Inch(es)
LUC	Land Use Control
mg/kg	Milligram(s) per kilogram
MSC	Medium-specific concentration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NIST	National Institute of Standards

O&M	Operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
PADEP	Pennsylvania Department of Environmental Protection
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated Biphenyl
PRG	Preliminary Remediation Goal
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
Rockwell	Rockwell International
RSD	Relative standard deviation
RSL	Regional screening level
SARA	Superfund Amendments and Reauthorization Act
SLERA	Screening level ecological risk assessment
SRM	Standard reference material
TBC	To be considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
U.S.	United States
USACE	United States Army Corps of Engineers
USATHAMA	United States Army Toxic and Hazardous Materials Agency
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile organic compound
XRF	X-ray fluorescence
yd^3	Cubic yard(s)
ZVI	Zero valent iron

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1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has been contracted by the United States (U.S.) Army Corps of Engineers (USACE) Baltimore District (Contract No. W912DR-09-D-0018, Delivery Order 0017) for the completion of a Feasibility Study (FS) at Area II of the former Frankford Arsenal (FFA) located in Philadelphia, Pennsylvania. The main part of the FFA known as the Arsenal Business Center (ABC) was divided into two areas of investigation by USACE, including Area I (47.4 acres consisting of the portion of the site east of Baird Street) and Area II (36.9 acres consisting of the portion of the site west of Baird Street) (Figure 1-1), which is the focus of this FS. The goal of this FS Report is to present remedial alternatives for impacted soils in identified areas of concern (AOCs) at Area II (the site).

1.1 REGULATORY CONSIDERATIONS

Environmental restoration is being conducted at the FFA under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS) administered by USACE. The 1986 Superfund Amendments and Reauthorization Act (SARA) §211 established the DERP through amendment of Title 10 U.S. Code (U.S.C.), which added Chapter 160 – Environmental Restoration (§§2701–2707 and §2810). Chapter 160 authorized the Secretary of Defense to carry out the DERP and response actions at FUDS. SARA expanded the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. § 9601 et seq.) and added major new authorities, including Section 120, Federal Facilities. SARA Section 120 requires departments and agencies of the federal government to comply with the provisions of CERCLA as amended by SARA. Executive Order 12580 (23 January 1987), Superfund Implementation, delegated to the Department of Defense (DoD) the response authority for releases or threatened releases, subject to SARA Section 120. The FUDS component of DERP is managed and executed by USACE under authority delegated by the DoD, through the Department of the Army. Remedial activities must comply with the DERP statute (10 U.S.C. 2701 et seq.), CERCLA, SARA, the Resource Conservation and Recovery Act of 1976 (RCRA), National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Executive Order 12580 (“Superfund Implementation”), and applicable USACE and DoD policies.

1.2 PURPOSE AND REPORT ORGANIZATION

The Remedial Investigation/Feasibility Study (RI/FS) process represents the methodology that CERCLA has established for characterizing the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. Whereas the primary goal of the RI phase, completed by EA in 2014, is to define nature and extent of contamination to some adequate level, the primary purpose of the FS is to identify and evaluate potential remedial alternatives. The FS will be used by decision-makers to select a remedy, which will be presented in a Proposed Plan and Decision Document in accordance with CERCLA.

The RI was conducted at the site to evaluate the nature and extent of potential impact in soil. Results of the RI are provided in the *Final Remedial Investigation Report and Baseline Human*

Health Risk Assessment for Area II of the Former Frankford Arsenal (EA 2014). Sampling under the RI was in accordance with CERCLA and the NCP. Additionally, Act 2 and its implementing regulations were considered when establishing contaminant screening levels, since it is acknowledged that the property owner intends to seek release of liability under Act 2. This FS evaluates alternatives for addressing impacts in soils at the site that were identified during the RI. The groundwater is identified by USACE as Area IV and it is being addressed in a separate FS report.

The FS process can be summarized in the following steps:

- Identify media of concern and contaminants of concern (COCs)
- Identify remedial action objectives (RAOs)
- Identify potential technologies that will satisfy RAOs
- Screen technologies based on effectiveness, implementability, and relative cost
- Assemble technologies into remedial alternatives for contaminated media.

In this FS, the results of site characterization performed during the RI (EA 2014) along with results of post-RI soil sampling completed in November 2014 are used to delineate areas with COCs and to develop RAOs. Additionally, remedial technologies are screened to identify those technologies and process options that warrant further consideration based on the applicability of the technology for the site-specific conditions. Technologies that are retained through the screening are further developed into remedial alternatives. Remedial alternatives described in this report are developed based on federal, state, and local applicable or relevant and appropriate requirements (ARARs), to be considered (TBC) regulatory guidelines, and the findings of previous investigations. The remedial alternatives were screened using evaluation criteria established by the NCP.

This FS report is divided into the following chapters:

- ***Chapter 1, Introduction*****—**Outlines the purpose and organization of the report.

- ***Chapter 2, Background Information*****—**Presents background information and physical characteristics of the site; summarizes the nature and extent of contamination, potential contaminant fate and transport, and the results of risk assessments, including the human health risk assessment (HHRA) and screening level ecological risk assessment (SLERA).

- ***Chapter 3, Remedial Action Objectives and Preliminary Remediation Goals*** **—**Provides an overview of the FS evaluation process; defines the RAOs; identifies COCs and the chemical-, location-, and action-specific ARARs; develops Preliminary Remediation Goals (PRGs), and identifies areas and volumes of media for remediation.

- ***Chapter 4, Identification and Screening of Technologies*****—**Identifies General Response Actions (GRAs) and specific technologies and process options based on the site-specific conditions and COCs; provides preliminary screening of technologies and process options for technical implementability; provides screening of applicable technologies and process options for effectiveness, implementability, and cost.

- ***Chapter 5, Development of Alternatives*—**Identifies remedial alternatives using applicable technologies and process options, Development of the alternatives also considers additional factors, including land use scenarios, exposure scenarios, and accommodation of ARARs and PRGs.

- ***Chapter 6, Detailed Analysis of Alternatives*—**Presents a detailed comparative analysis of individual alternatives and based on the assessment, provides a recommendation and justification for the preferred alternative.

- ***Chapter 7, Conclusions and Recommendation*—**Summarizes the preferred alternative for each AOC at Area II.

- ***Chapter 8, References*—**Includes references used in preparation of this FS.

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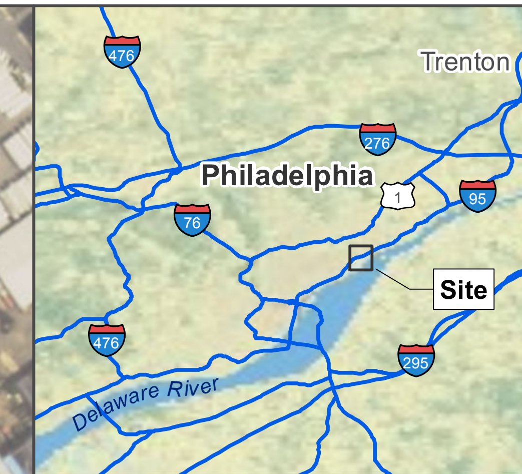

Legend

- Area I Boundary
- Area II Boundary
- Area III Boundary

Buildings

- Demolished
- Existing

NOTE: Area IV represents groundwater beneath Areas I, II, & III

Sources
ESRI (Imagery) 2011
Cabrera, 2011
USACE, 2009

EA	Frankford Arsenal Philadelphia, Pennsylvania	Project: 6233017 Date: July 2016	N	0 75 150 300 Feet 1 inch = 325 feet

Figure 1-1
Site Location

Path: Q:\GIS\Data\Northeast\Pennsylvania\FrankfordArsenal\MXD\March_2013\Figure 1-1 Site Location.mxd

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2. BACKGROUND INFORMATION

2.1 SITE DESCRIPTION

The FFA is a 109.4-acre FUDS located in northeast Philadelphia, Pennsylvania (Figure 1-1). This FS specifically focuses on Area II of the FFA FUDS which is bounded to the east by Baird Street, to the west by Bridge Street, to the north by Tacony Street, and to the south by Frankford Creek, encompassing approximately 36.9 acres. The portion of the FUDS identified as Area II currently contains 47 buildings of various sizes, ages, and conditions.[1] An additional 35 buildings that were historically located in this area have been demolished over the years, creating some open spaces between buildings. Additionally, a network of utility tunnels exists on the FFA FUDS, as discussed in greater detail in Section 2.3.3. Since its decommissioning from military use in 1977, Area II is now utilized primarily as a commercial business park with residential use, with space also leased to two charter schools. The future uses for Area II have been determined to be a mix of industrial, commercial, institutional, and residential.

The FFA is located in an urban, mixed-use area of northeast Philadelphia. The FFA is bound to the north by Tacony Street and Interstate 95 (I-95) with more industrial properties and a residential area further north of I-95, to the east by industrial properties including Dietz and Watson Inc., to the south by Frankford Creek and the Delaware River, and to the west by Bridge Street beyond which is the Honeywell (former Sunoco Chemicals Frankford Plant). Further south of Frankford Creek is open space formerly occupied by the Rohm and Haas Refinery (Figure 1-1).

2.2 SITE HISTORY AND USE

Prior to military use, the FUDS was utilized as farm land and undeveloped wetlands. In 1816, the FFA was commissioned for military use. Between 1816 and the decommissioning of the FFA in 1977, the FFA was utilized for a variety of military activities as its mission was adjusted to fit the military's changing needs. The U.S. government acquired a total of 109.36 acres between 1816 and 1951. The FFA consisted of four component areas, including: a small arms division, an artillery ammunition division, a stock section area, and an ordnance depot. Activities at the FFA during its years of operation between 1816 and 1977 included military ordnance production, testing and storage, and munitions research. Specific historical usage of Area II, and potential sources of environmental impact from DoD operations, are discussed in the Conceptual Site Model as presented in the RI (EA 2014).

In 1976, the FFA was reported excess to the General Services Administration (GSA), and in 1981 the GSA assigned 21.36 acres to the State of Pennsylvania Fish and Boat Commission. In 1983, the GSA assigned the remaining 87.37 acres to the Philadelphia Authority for Industrial Development, who subsequently sold the property to Arsenal Associates, Inc. in 1983. The property, now identified as ABC, is operated by Hankin Management. During the past 24 years, Hankin

[1] The number of buildings represented does not include less permanent structures such as car ports, buildings that have collapsed, or tunnel entrances.

Management Company has leased buildings on behalf of Arsenal Associates, Inc. to various tenants. An approximately 1-acre portion in the southeast corner was transferred to the Philadelphia Industrial Development Corporation in Spring 2014 as part of a larger land transfer associated with Area I.

After the property was transferred to the GSA, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) developed plans to decontaminate and clean up the property for unrestricted use release. The contract for the decontamination and cleanup was awarded to Rockwell International (Rockwell) in September 1979, and the decontamination and cleanup program was completed in 1980. The work included cleanup of radiological contamination, explosive residues, and heavy metal residues; however, normal operations at the FFA included the use of solvents, fuels, acids, hydraulic fluids, paints, exotic metals, and other materials.

Several investigations and removal actions have been conducted at the FFA by USATHAMA and USACE, the current property owner, and the U.S. Environmental Protection Agency (USEPA). Investigations related to Area II are summarized in the RI (EA 2014).

2.3 PHYSICAL CHARACTERISTICS

A detailed description of site physical characteristics is provided in the conceptual site model presented in the RI (EA 2014). A summary of information relevant to the FS process is included in the following sections.

2.3.1 Topography

The topography is relatively flat at the FFA. A gradual slope is present from the northern portion of the FFA to the southern portion towards the Frankford Inlet and the Delaware River. The elevation ranges from 10 to 20 feet (ft) above mean sea level (amsl), with the northern portion of the FFA along Tacony Street being at approximately 20 ft amsl, and the southern portion along the Frankford Inlet and the Delaware River being approximately 10 ft amsl.

2.3.2 Geology

The FFA is underlain by unconsolidated sediments of the Coastal Plain province. These unconsolidated materials sit on older crystalline rocks of the Piedmont. Surface deposits in reworked sections of Area II have been observed to be fill materials. Much of the site is underlain with fill material consisting of cinders, silt, bricks, concrete, wood, sand, silt, and gravel, which is present to depths of 13 ft below ground surface (bgs), but more typically present to depths of less than 5 ft bgs in the developed areas of Area II. Fill material deposits are thicker in the west and more common in areas surrounding buildings and underground utilities. Fill material is absent or thin (less than 1 ft) in areas where manicured lawn is present, such as the parade ground.

Fill material is underlain by the Trenton gravel, a Pleistocene unit of Wisconsin-age, described as a pale or reddish-brown, gravelly sand with a wide range of grain sizes, inter-bedded with crossbedded sands and gravel and clayey-silt layers (U.S. Geological Survey [USGS] 1991). Coarse sediments are composed of oblate pebbles and cobbles derived from Triassic red and gray shales, sandstones, and conglomerate and other bedrock derived up valley. Local clay and silty clay are present in the Trenton gravel (USGS 2000). Locally, this gravel layer has areas of Holocene alluvium and swamp deposits with small amounts of clay. The average thickness of this unit on the entire site is about 40 ft, but can be as great as 80 ft (Langan Environmental & Engineering Services 2005 and EA 2014).

The bedrock beneath the unconsolidated deposits is comprised of crystalline rocks of the Wissahickon Formation, believed to be of early Paleozoic-age, and is mapped in the Philadelphia area as an oligoclase-mica schist with some gneissic, quartz-rich, and feldspar-rich members. The sediments of the Trenton gravel and the Wissahickon Formation are significant aquifers in the Philadelphia area (USGS 1991). Bedrock composed of weathered schist was observed during the RI from 34 to 44 ft bgs where borings were advanced to refusal.

A majority of the surface area of Area II is covered with impervious surfaces to include asphalt, concrete, and various improvements. Pervious surfaces including manicured lawns are present in the northwestern portion of Area II, which was formerly a housing area and parade ground during DoD use of the site. In addition, pervious landscaped areas separating the sidewalks from the buildings are located adjacent to buildings in the housing area and other parts of Area II.

During the May 2012 groundwater sampling event, groundwater was observed in Area II at depths ranging from 4 ft bgs along Frankford Creek to 14 ft bgs in the Parade Ground area parallel to Tacony Street. Groundwater flow in shallow overburden wells is generally to the south towards Frankford Creek. Groundwater flow in deep overburden wells is generally to the south-southwest towards Frankford Creek. There are no wetlands, streams, or other surface watercourses located on the FFA Area II property.

Frankford Creek is located to the south of FFA Area II and it forms the boundary to the south/southwest of the FFA and acts as an inlet from the Delaware River. The upstream portion of the creek was cut off from the existing portion of Frankford Creek located to the south of the site by engineering efforts in the 1950s and relocation of the mouth of the stream; therefore, there is no natural stream flow feeding the creek except for discharge from runoff and outfalls. Flow characteristics are predominated by the tidal influence of the Delaware River, which has a tidal range of approximately 5.5 ft at Philadelphia (USGS 1991).

2.3.3 Underground Utilities

The FFA has an extensive network of underground utilities including tunnels formerly used for passage between certain buildings or for passage of utilities. These underground structures likely provide preferential pathways for subsurface impact and potentially influence groundwater flow directions locally. Only the storm/sanitary sewers have connections and/or outfalls outside of the boundaries of Area II. A portion of the site utilities is shown on Figure 2-1.

2.4 PREVIOUS INVESTIGATIONS

A thorough review of previous investigations performed at the site is presented in the RI (EA 2014). Relevant documents reviewed included:

- Installation Assessment, USATHAMA 1977
- Detailed Survey and Alternatives Assessment for FFA, Battelle, 1978
- Historical and Archeological Survey, John Milner Associates, Inc., 1979
- Preliminary Assessment of Frankford Arsenal, Ecology and Environment, 1981
- Frankford Arsenal Decontamination/Cleanup Report, Rockwell, 1981
- Remedial Action Decision Document, USATHAMA, 1988
- Radiological Historical Site Assessment, Cabrera Services, 2001
- Radiological Scoping Survey, Cabrera Services, July 2003
- Final Closeout Report for the Underground Storage Tank Removal, Battery Disposal, and Well Abandonment CON/HTRW Project, EA, 2008.

2.5 REMEDIAL INVESTIGATION

The purpose of the RI was to assess potential environmental impacts to FFA Area II resulting from former DoD use of the property. Area II has not been investigated in depth since the transfer from DoD ownership. As such, the primary goals of the RI were to (1) assess if any environmental impacts from past DoD use are present in soil and groundwater, (2) determine the nature and extent of those impacts in soils, and (3) determine if there are risks to human health and the environment from any impacts in Area II soils which require further action by USACE. In order to accomplish these goals, surface soil samples, subsurface soil samples, and groundwater samples were collected from areas of historical DoD use and analyzed to determine impacts/risk.

As part of the RI process, Area II was divided into three exposure units (termed zones; see Figure 2-2), as follows: Zone 1 – a mostly residential area which occupies the northwest corner of Area II; Zone 2 – a mostly industrial use area located in the northeast corner of Area II which housed research and support operations; and Zone 3 − a mostly industrial use area which housed former ammunition production operations in the southern portion of Area II adjacent to Frankford Creek.

During the RI, a total of 445 surface and subsurface soil samples (biased and unbiased locations) were collected to delineate soil in Zones 1, 2, and 3 of Area II. Soil samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds, and metals, with a subset of samples submitted for the analysis of explosives, radionuclides, and pesticides. Samples collected near substations were evaluated for polychlorinated biphenyls (PCBs).

Sampling data were screened against applicable screening criteria, and analytes that exceeded criteria were identified as COCs. Areas containing one or more samples with analytes at concentrations exceeding screening criteria were identified as Areas of Interest (AOIs). A total of 23 AOIs were identified. Based on an evaluation of the AOIs including human health risk results, AOCs were identified (which correlate to AOIs).

Lead was evaluated through the use the USEPA blood lead models. The Integrated Exposure Uptake Biokinetic (IEUBK) model was used to evaluate potential concerns for a resident child. The adult lead model was used to evaluate potential concerns for workers and school students. Based on the evaluation of the entire zone as an exposure area, the IEUBK model identified potential concerns (e.g., elevated blood-lead levels) for future receptor resident children exposure to soil within Zone 1. The SLERA concluded that there is risk to the robin and shrew due to food web exposure as noted for Zone 1. There are 16 sample locations within Zone 1 with lead detected at greater than 1,000 milligrams per kilogram (mg/kg). All of these sample locations are within exposed grassy areas. A majority of the sample locations above 1,000 mg/kg are located adjacent to the former residences that surround the parade ground. The widespread nature of exceedances and limited vertical impact of lead in Zone 1 indicates that the source is most likely historical deposition onto undisturbed soils. Potential sources for deposition include airborne dust particles and paint chips. Buildings in the areas with the observed highest concentration of lead in soil (Buildings 1 through 5 and 14) are among the oldest buildings at the FFA. These buildings have been historically painted (John Milner Associates 1979) and these buildings were observed to be flaking during the RI field work.

2.5.1 RI Recommendations

Recommendations for each of the 23 soil AOCs are summarized in Table 2-1. AOCs recommended for further evaluation in this FS and localized areas of “elevated” concentrations are illustrated on Figure 2-3, and recommendations are summarized below.

- Potential unacceptable risks were identified at AOCs 1, 6, 10, 13, 20, and 21. Based on the results of the HHRA, specific localized areas of “elevated” concentrations within certain AOCs warrant further action based on the unacceptable risk or potential concerns to future receptors (i.e., localized areas of “elevated” concentrations in Zones 2 and 3 and AOCs 6, 10, and 20 are currently accessible). Lead, Aroclor 1260, and benzo(a)pyrene (BAP) are associated with areas of localized “elevated” concentrations. Further action is recommended to address these localized areas of “elevated” concentrations. AOCs 13 and 21 are currently inaccessible (covered with an impervious surface), and they are also recommended for further action based on potential future use of Area II. The exposed surface soil samples in Zone 1 (AOC 1) suggest that high lead concentrations do not represent an unacceptable risk to populations of lower trophic organisms (plants and soil invertebrates), but may represent risk to the robin and shrew due to food web exposure.

- The HHRA indicates that remaining soil AOCs associated with direct contact medium-specific concentration (MSC) exceedances (AOCs 2, 4, 5, 7, 8, 9, 11, 12, 14, 16, 17, 18, 19, 22, and 23) do not have unacceptable risk or potential concerns for current or future receptors. Therefore, attainment of a Site-Specific Standard can be demonstrated for these AOCs. No remediation or institutional or engineering controls will be required to demonstrate attainment.

- At Building 201 (AOC 13), concentrations of VOCs in soil are reported to exceed vapor intrusion screening criteria, and preferential pathways are present at the southern end of the building. Further evaluation is necessary. No other AOCs were found to exceed vapor intrusion screening criteria; therefore, no action is necessary in those AOCs regarding vapor intrusion.

- Soil AOCs associated with soil-to-groundwater MSC exceedances (AOCs 1, 5, 10, 11, 13, 14, 20, and 21) can be addressed by demonstration of groundwater equivalency for those AOCs where the COC has not been detected in groundwater at concentrations exceeding groundwater MSCs. Therefore, no additional action/evaluation regarding these soil-to-groundwater exceedances is necessary in the FS.

- Exceedances of soil, groundwater, and vapor intrusion screening criteria which are related to chemicals emanating from the offsite Honeywell Frankford Facility (to include phenol, acetone, cumene, etc.) are not FUDS related and will not be addressed by the FS or the Area IV RI.

2.6 CONTAMINANT FATE AND TRANSPORT

Based on the results of the RI, the primary COCs driving risk to human health are lead, BAP, and Aroclor 1260. Detailed fate and transport is addressed in the RI (EA 2014). A general discussion of COC fate and transport and indoor air quality are provided herein.

2.6.1 General Fate and Transport

Lead is the most prevalent metal detected above screening criteria in Area II. Zone 1 lead impact is mainly limited to the 0- to 6-inch (in.) depth interval. The widespread nature and limited vertical impact indicates that the source is most likely historical deposition onto undisturbed soils. Lead impact in Zones 2 and 3 is associated with cinders/slag material. Cinders were historically spread along railroad tracks in the southern area of Zone 3, and lead and arsenic impact in this area is associated with the occurrence of these cinders. Lead and other metals in general are retained strongly in soil with little transport through runoff to surface water or leaching to groundwater except under acidic conditions. Therefore, they persist in soil indefinitely unless transported by wind or dissolution into pore water or groundwater. The majority of Area II is covered with impervious surfaces, and those portions that are not are covered by an impervious surface are covered by a vegetated mat, making movement of metals in soil via fugitive dust emissions insignificant.

Certain polycyclic aromatic hydrocarbons (PAHs) were detected above their respective MSCs, with BAP being the most prevalent. Not one point source for PAHs can be identified based on their widespread occurrence. BAP mainly partitions to soil and sediment; therefore, BAP present in soils in Area II is likely to remain in soil. PCBs at the FFA are present in surface soils adjacent to transformers; they are likely to remain in soil with limited biodegradation.

2.7 2014 SUPPLEMENTAL INVESTIGATION

As part of this FS, a supplemental investigation was conducted in November 2014 to collect data to further delineate subsurface lead soil exceedances within the Parade Ground and to assess the potential for vapor intrusion in the vicinity of Building 201 (AOC 13). The objectives of the investigation and summary of the results are provided below. A detailed discussion of the sampling methodology, results, and quality assurance/quality control protocols is provided in Appendix A.

A total of 19 soil borings were advanced to determine the extent of lead impacts deeper than 6 in. across the Parade Ground. Soil borings were installed, and were clustered around RI boring Z1D07 and across the remainder of the Parade Ground (refer to Figure 2-4 for sample locations). Each boring was advanced via direct push technology to a depth of 5 ft bgs. Field screening for lead in soil was conducted using an X-ray fluorescence (XRF) analyzer (a total of 154 samples) in 6-in. intervals, and confirmation soil samples (total of 20) were submitted for laboratory analysis for lead via USEPA Method 6010. Soil boring results indicated that lead exceedances above 1,000 mg/kg are confined to the immediate area surrounding RI location Z1D07.

Soil vapor samples were collected from three locations, two exterior locations collected from beneath the asphalt/concrete and one interior sub-slab location (as shown on Figure 2-5), during November 2014 and January and March 2015. Sample results are presented in Table 2-2. Results were compared to the residential and non- residential indoor air MSC with a soil gas to indoor air transfer ratio of 0.01. A sample was not collected from BZ3-3 during the January 2015 sampling event due to water in the sample intake line. The sample intake for BZ3-3 was reset in March 2013, and a sample was collected.

Soil vapor results indicate that although soil vapor screening criteria for carbon tetrachloride and chloroform in the exterior location (BZ3-2) placed near UBZ3-38 are exceeded, the interior sub-slab location (BZ3-1) soil vapor results do not exceed the screening criteria for these compounds. This indicates that if vapor intrusion were to occur within the occupied building, sub-slab concentrations would not exceed risk-based screening criteria. During the November 2014 sampling event vinyl chloride was detected above the residential and non-residential MSC, and cis-1,2 dichloroethene was detected above the residential MSC, at the sample location south of Building 202 (BZ3-3-SG). Additional samples were collected at BZ3-3-SG in March and September 2015 in order to resolve the anomalously high detection of vinyl chloride at location BZ3-3-SG. In the March 2015 sample, vinyl chloride was detected above the laboratory reporting limit at a concentration well below the screening criteria. Vinyl chloride was not detected above the laboratory reporting limit in the September 2015 sample. Based on the data, it can be concluded that there is no current risk to indoor receptors; however, if future structural improvements are considered in the immediate vicinity of BZ3-2, vapor mitigation should be considered as part of the construction design as a conservative measure.

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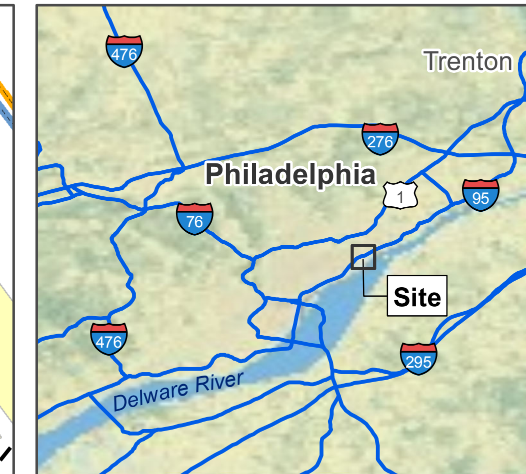


Legend

- Electric Line
- Sanitary Sewer
- Storm Drain
- Water Line
- Tunnel
- Substations
- Area I Boundary
- Area II Boundary
- PA Fish & Boat Commission (Area III Boundary)

Buildings

- Demolished
- Existing

Sources
Cabrera, 2011
USACE, 2009

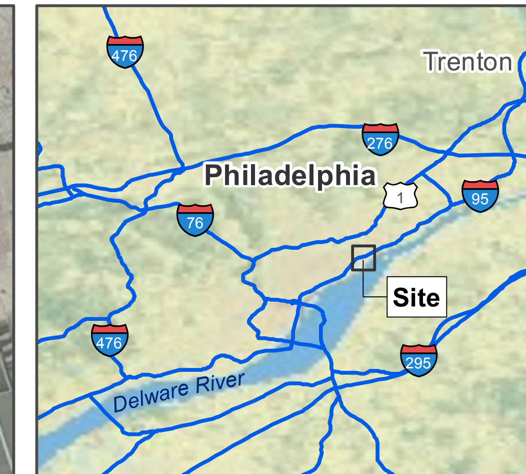
Frankford Arsenal
Philadelphia, Pennsylvania

Project: 6233017

Date: January 2015

0 100 200 400
Feet
1 inch = 200 feet

Figure 2-1
Area I and Area II
Underground Utilities



Legend

Soil Sample Locations

- Delineation Soil Sample
- Biased Soil Sample
- Unbiased Soil Sample
- Transformer Sample
- Location Not Sampled

Zones

- Zone 1, 2 and 3
- Area I Boundary
- Area II Boundary
- Philadelphia Industrial Development Corporation
- Boring Included in Geologic Cross-Section

Label Key

UBZ-	Unbiased Soil Sample
BZ-	Biased Soil Sample
D-	Delineation Soil Sample
Z1-	Zone 1
Z2-	Zone 2
Z3-	Zone 3
SO-	Soil Sample
mg/kg	Milligrams per Kilogram

Sources
ESRI (Imagery) 2011
Cabrera, 2011
USACE, 2009

Path: \\Wovetonfederal\GIS\Data\Northeast\Pennsylvania\FrankfordArsenal\MXD\Draft\FS\Figure 2-2 Soil Char and Delin Sample Loc.mxd

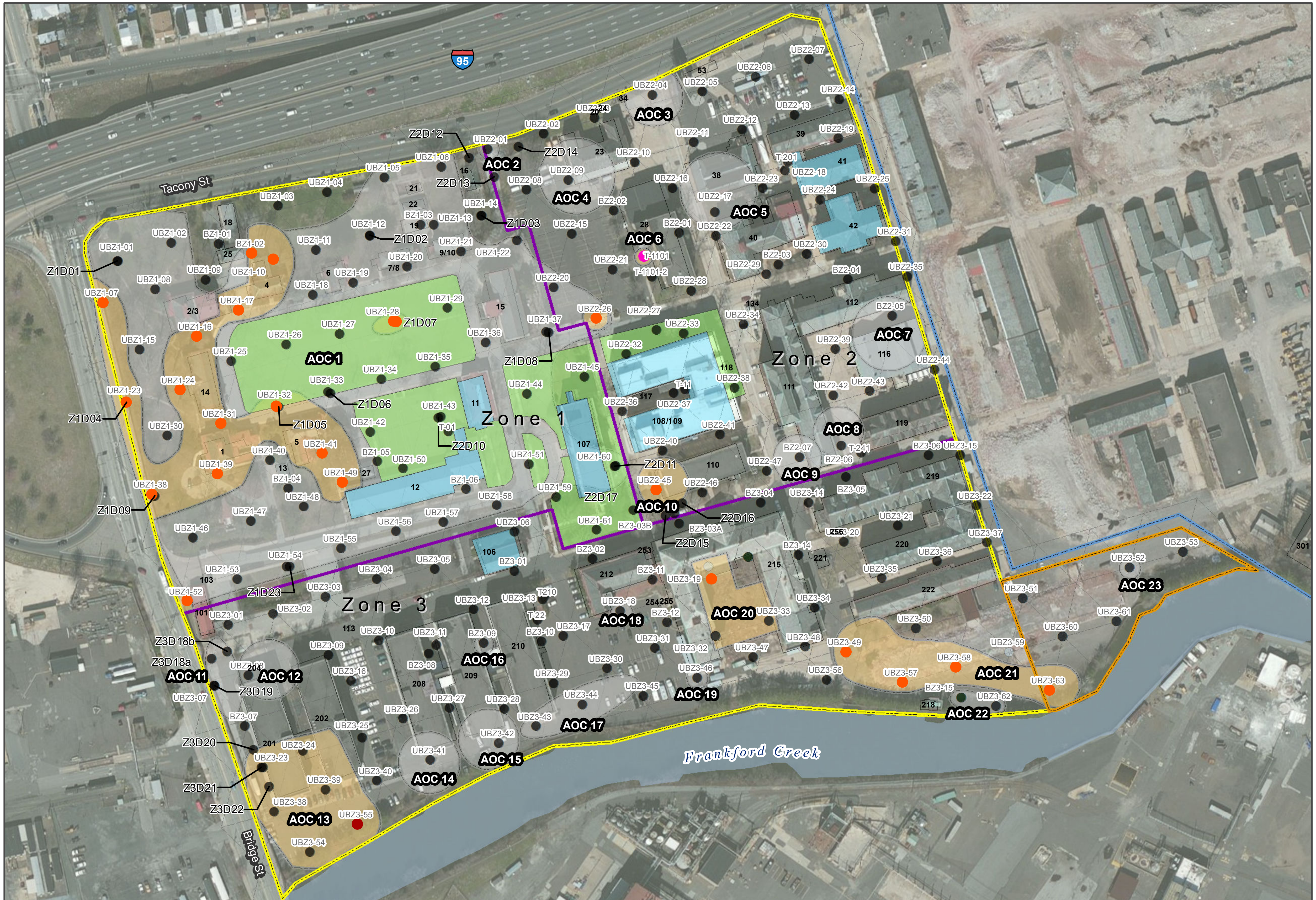
Frankford Arsenal
Philadelphia, Pennsylvania

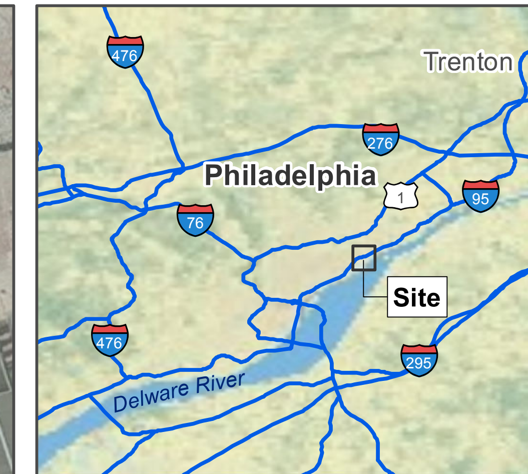
Project: 6233017

Date: July 2016

0 75 150 300
Feet
1 inch = 175 feet

Figure 2-2
Soil Characterization and Delineation Sample Locations





Legend

Soil Sample Locations

- Soil Sample Location
- Elevated Concentrations of Lead
- Elevated Concentrations of Benzo(a)pyrene
- Elevated Concentrations of PCB
- Area I Boundary
- Area II Boundary
- Philadelphia Industrial Development Corporation

Soil Area of Interest

- Recommended for Further Action
- No Risk Demonstration of Site Specific Standards

Zones

- Zone 1, 2 and 3
- Area used by schools for recreation or readily assessible to students
- School Building

Label Key

UBZ-	Unbiased Soil Sample
BZ-	Biased Soil Sample
D-	Delineation Soil Sample
Z1-	Zone 1
Z2-	Zone 2
Z3-	Zone 3

Sources
ESRI (Imagery), 2011
Cabrera, 2011
USACE, 2009

Path: \\Woveton\federal\GIS\Data\Northeast\Pennsylvania\FrankfordArsenal\MXD\Draft\FS\Figure 2-3 Soil Areas of Concern and Associated Hot Spots.mxd

EA

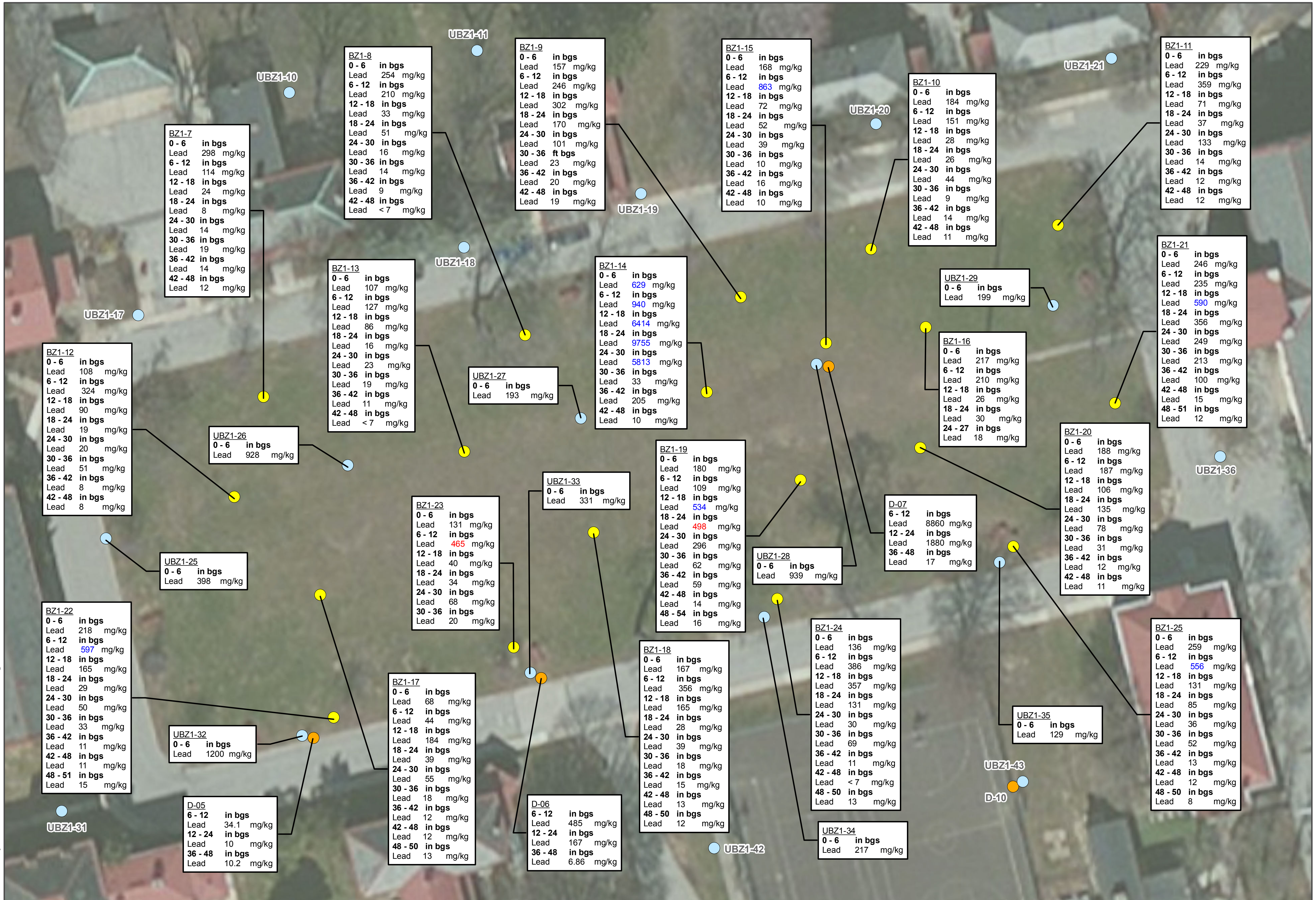
Frankford Arsenal
Philadelphia, Pennsylvania

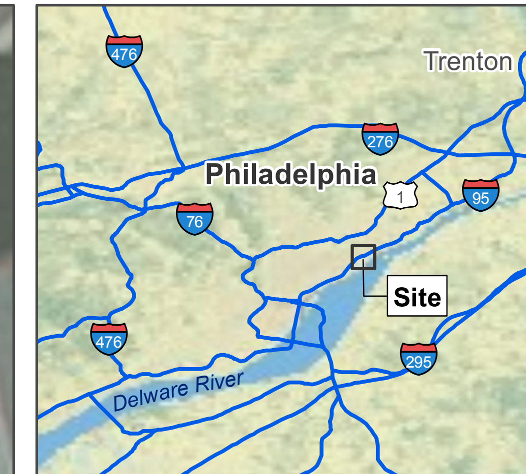
Project: 6233017

Date: July 2016

0 75 150 300
Feet
1 inch = 175 feet

Figure 2-3
Soil Areas of Interest and Locations with Elevated Concentrations





Legend

- Sample Location
- Delineation Soil Sample
- Unbiased Soil Sample
- Area II Boundary

590 = Exceeds residential direct contact and soil-to-groundwater Medium Specific Concentration (MSC)
465 = Exceeds residential soil-to-groundwater Medium Specific Concentration (MSC)

Sources
ESRI (Imagery) 2011
Cabrera, 2011
USACE, 2009

Frankford Arsenal
Philadelphia, Pennsylvania

Project: 6233017

Date: January 2015

0 20 40 80
Feet
1 inch = 40 feet

Figure 2-4
Parade Ground XRF Lead Results

Path: L:\GISData\Northeast\Pennsylvania\FrankfordArsenal\MXD\DraftFS\Figure 2-4 Parade Ground XRF Lead Results.mxd

Path: L:\GISData\Northeast\Pennsylvania\FrankfordArsenal\MXD\Draft\FS\Figure 2-5 Soil Gas Sample Locs.mxd

Legend

Soil Sample Locations

- Delineation Soil Sample
- Biased Soil Sample
- Unbiased Soil Sample
- Soil Gas Location
- Area II Boundary
- Boring Included in Geologic Cross-Section

Label Key

UBZ-	Unbiased Soil Sample
BZ-	Biased Soil Sample
D-	Delineation Soil Sample
Z1-	Zone 1
Z2-	Zone 2
Z3-	Zone 3

Sources
ESRI (Imagery) 2011
Cabrera, 2011
USACE, 2009

EA

Frankford Arsenal
Philadelphia, Pennsylvania

Project: 6233017

Date: January 2015

0 25 50 100
Feet
1 inch = 50 feet

Figure 2-5
Soil Gas Sample Locations

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Table 2-1 Summary of Soil Areas of Concern
Frankford Arsenal Area II

AOC	Zone	Adjacent Building Number(s) and Historical DoD Use(s)	Constituent(s) Exceeding MSC	MSC Type	Sample Locations	Impacted Sample Depths (ft bgs)	Surface Cover Type	Estimated Area (ft^2)	Estimated Volume (yd^3)	Direct Contact Pathway Complete	Human Health Risk Assessment Findings	Recommendation for CERCLA and Act 2 Resolution
1	1 and 2	Adjacent to identified areas of "elevated" concentrations: 1,2,3,4,5 - Housing; 14 - Storehouse and housing	Lead[1] and arsenic	RDC/SGW	16 total in Zone 1 and UBZ2-26	0-4	Grass	64605	2393	**Yes**	Unacceptable risk identified for future resident children receptor; 16 localized areas of "elevated" lead concentrations identified in HHRA (UBZ1-7, -10, -16, -17, -23, -24, -28/D7, -31, -32, -38, -39, -41,-49 and -52, BZ1-2)	Further action recommended for 16 localized areas of "elevated" lead identified in HHRA (T-1101-1) to be evaluated in FS
2	2	23 - Fire Control and Housing	BAP	RDC	UBZ2-01	0-2	Grass	978	72	**Yes**	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
3	2	23 - Fire Control and Housing	TCE	SGW	UBZ2-4	27-28	Concrete	1401	104	No (saturated)	Groundwater risk to be evaluated during Area IV RI	Saturated sample, groundwater impact confirmed; to be addressed by USACE during Area IV investigation
4	2	23 - Fire Control and Housing	BAP	RDC	UBZ2-9	0-3	Concrete	957	106	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
5	2	38 - Ordnance Factory, Storehouse, Cafeteria, and Offices 38A - Offices and Store 40 - Machine Shop, Foundry, and Offices	Lead	RDC/SGW	UBZ2-17	0-2	Grass	1195	89	**Yes**	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA. Soil to groundwater exceedance to be addressed by demonstrating adequate soil buffer.
6	2	28 - Fire Control and Offices	Aroclor 1260 [1]	RDC	T-1101	0-0.5	Bare/grass	447	33	**Yes**	Unacceptable risk identified for future residential receptor, one localized area of "elevated" concentration of Aroclor 1260 identified (T-1101-1)	Further action recommended for one localized area of "elevated" Aroclor 1260 identified in HHRA (T-1101-1) to be evaluated in FS
7	2	112 - Ordnance and Fire Control Facility, 116- Power Plant, Fire Control, and Laboratory	Arsenic and BAP	RDC	BZ2-5	3-4	Asphalt/ concrete	719	27	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
8	2	111 - Ordnance and Fire Control Facility	Arsenic	RDC	BZ2-6	3-4 and 13-14	Grass/gravel	867	353	**Yes**	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
9	2	111 - Ordnance and Fire Control Facility	BAP	RDC	BZ2-7	0-2	Asphalt	724	54	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA

Table 2-1 Summary of Soil Areas of Concern
Frankford Arsenal Area II

AOC	Zone	Adjacent Building Number(s) and Historical DoD Use(s)	Constituent(s) Exceeding MSC	MSC Type	Sample Locations	Impacted Sample Depths (ft bgs)	Surface Cover Type	Estimated Area (ft^2)	Estimated Volume (yd^3)	Direct Contact Pathway Complete	Human Health Risk Assessment Findings	Recommendation for CERCLA and Act 2 Resolution
10	2	110 - Office	Lead[1]	RDC/SGW	UBZ2-45	1-2	Grass/bare	2417	179	**Yes**	Unacceptable risk identified for future resident children receptor; one localized area of "elevated" concentration of lead (UBZ2-45) identified	Further action recommended for one localized area of "elevated" Lead identified in HHRA (UBZ2-45) to be evaluated in FS.
11	3	101 - Guardhouse 201 - Ordnance Facility	Arsenic	RDC	UBZ3-08	0-2 and 39-40	Mulch	3113	231	**Yes**	Risk is acceptable for identified receptors	HHRA concludes risk is acceptable, Site-Specific-Standard via pathway elimination
12	3	201 - Ordnance Facility	BAP and benzene	RDC/SGW	UBZ3-07, Z3D18, Z3D19	0-2, 5-6, 11-12	Asphalt/ concrete	830	369	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA for BAP. Benzene detected in saturated sample, groundwater impact and associated impacts to saturated soil from offsite source. No further action by USACE.
13	3	201 - Ordnance Facility 202- Storehouse and Ordnance Facility	Arsenic, BAP[1], BAA, BBF, TCE	RDC/SGW	UBZ3-23, -24, -38, -39, -54, and -55	0-5 ft and 12-13	Asphalt/ concrete except 1 grass (24)	12655	6093	**Partial**	Unacceptable risk for future resident receptor, one localized area of "elevated" concentration identified at one location (UBZ3-55) for BAP	Further action recommended for one localized area of "elevated" BAP concentration identified in HHRA (UBZ2-55) to be evaluated in FS
14	3	208 - Storehouse and Ordnance Facility	Arsenic, BAP, and Hg	RDC/SGW	UBZ3-41	1-3	Asphalt/ concrete	978	471	No	Risk is acceptable for identified receptors	Site-Specific-Standard via groundwater equivalency for SGW, mercury not detected in TW-16 or TW-27; therefore, soil to groundwater pathway incomplete, groundwater equivalency
15	3	209 - Storehouse and Ordnance Facility	Benzene	SGW	UBZ3-42	11.5-13.5	Asphalt/ concrete	830		No	Groundwater risk to be evaluated during Area IV RI	Saturated sample, groundwater impact and associated impacts to saturated soil from offsite source. No further action by USACE.
16	3	209 - Storehouse and Ordnance Facility 210 - Ordnance Facility and Warehouse	BAP	RDC	BZ3-9	5-7	Asphalt/ concrete	915	68	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
17	3	210 - Ordnance Facility and Warehouse 211 - Storehouse, S.A. Tool Shop, and Warehouse 214 - Storehouse and Ordnance Facility	Arsenic	RDC	UBZ3-43 and UBZ3-44	0-3	Asphalt/ concrete	5324	592	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA

Table 2-1 Summary of Soil Areas of Concern
Frankford Arsenal Area II

AOC	Zone	Adjacent Building Number(s) and Historical DoD Use(s)	Constituent(s) Exceeding MSC	MSC Type	Sample Locations	Impacted Sample Depths (ft bgs)	Surface Cover Type	Estimated Area (ft^2)	Estimated Volume (yd^3)	Direct Contact Pathway Complete	Human Health Risk Assessment Findings	Recommendation for CERCLA and Act 2 Resolution
18	3	212 and 213 - Ordnance Facility	BAP, BAA, BBF, DAHA	RDC	UBZ3-18	4-5	Asphalt/ concrete	1232	46	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
19	3	215 - Rolling Mill and Ordnance Facility	Arsenic	RDC	UBZ3-46	5-7	Asphalt/ concrete	1057	78	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
20	3	215 - Rolling Mill and Ordnance Facility 216 - Ordnance Facility 217 - Lead Shop and Ordnance Facility	Arsenic, antimony, lead[1], and BAP	RDC/SGW	UBZ3-13, -32, -33, and BZ3-13	0-3	Weeds/bare/ brick	4894	544	**Yes**	Unacceptable risk for future resident child receptor; one localized area of "elevated" concentration of lead (UBZ3-19) identified	Further action recommended for one localized area of "elevated" lead concentration identified in HHRA (UBZ3-19) to be evaluated in FS
21	3	222 - Storehouse and Ordnance Facility Former 223 - Storehouse and Warehouse Former 224 - Storehouse and Ordnance Facility Former 225 - Storehouse Former 226 - Cooling Tower Former 227 - Ordnance Facility	Lead[1] and arsenic	RDC/SGW	UZB3-49, -57, -58, and -63	0-5	Asphalt/ concrete	33053	6121	No	Unacceptable risk for future daycare students; four localized areas of "elevated" concentrations of lead (UBZ3-49, -57, -58, and -63) identified	Further action recommended for four localized areas of "elevated" lead concentrations identified in HHRA (UBZ3-49, -57, -58, and -63) to be evaluated in FS
22	3	218 - Pumping Station 225 - Storehouse 226 - Cooling Tower	Arsenic and BAP	RDC	UBZ3-62 and BZ3-15	0-2 and 5-7	Asphalt/ concrete/ gravel	2933	760	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA
23	3	None	Arsenic	RDC	UBZ3-52	0-2	Asphalt/ concrete/ gravel	1084	80	No	Risk is acceptable for identified receptors	Site-Specific-Standard to be demonstrated in Final Report based on findings from HHRA

NOTES:
1 - Unacceptable risk identified in HHRA

AOC = Area of Concern
BAP = Benzo(a)pyrene
BAA = Benzo(a)anthracene
BBF = Benzo(b)fluorene
bgs = Below ground surface
DAHA = Dibenzo(a,h)anthracene
DoD = Department of Defense
FS = Feasibility Study
ft = Foot (feet)
ft^2 = Square foot (feet)
Hg = Mercury
HHRA = Human Health Risk Assessment
MSC = Medium specific concentration
TCE = Trichloroethylene
RDC = Residential Direct Contact
RI = Remedial Investigation
SGW = Soil to groundwater
USACE = United States Army Corps of Engineers
yd^3 = Cubic yard(s)

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Table 2-2 Soil Gas Results November 2014 - Frankford Arsenal Area II

		Sample ID	**BZ3-1-SG**	**SG-DUP-1**	**BZ3-1-SG**	**SG-DUP-1**	**BZ3-2-SG**	**BZ3-2-SG**	**BZ3-3-SG**
		Parent Sample ID		**BZ3-3-SG-20141111**		**BZ3-1-SG**			
		Sample Date	**11/11/2014**	**11/11/2014**	**1/13/2015**	**1/13/2015**	**11/11/2014**	**1/13/2015**	**11/11/2014**
		Sample Location:	**Building 201**	**Building 201**	**Building 201**	**Building 201**	**Adjacent to UBZ3-38**	**Adjacent to UBZ3-38**	**South of Building 202**
Analyte	**Non-Residential[1] (ug/M3)**	**Residential[2] (ug/M3)**							
1,1,1-trichloroethane	610000	290000	< 0.16 U	< 0.16 U	< 0.16 U	< 0.16 U	< 0.16 U	< 0.16 U	< 1.64 U
1,1,2,2-tetrachloroethane	140	36	< 0.21 U	< 0.21 U	< 0.21 U	< 0.21 U	< 0.21 U	< 0.21 U	< 2.06 U
1,1,2-Trichloro-1,2,2-trifluoroethane	8800000	4200000	< 3.83 U	< 3.83 U	< 3.83 U	< 3.83 U	< 3.83 U	< 3.83 U	< 38.3 U
1,1,2-trichloroethane	510	130	< 2.73 U	< 2.73 U	< 2.73 U	< 2.73 U	< 2.73 U	< 2.73 U	< 27.3 U
1,1-dichloroethane	5000	1300	< 2.02 U	< 2.02 U	< 2.02 U	< 2.02 U	< 2.02 U	< 2.02 U	< 20.2 U
1,1-dichloroethene	58000	28000	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	111
1,2,4-trichlorobenzene	7900	2000	< 3.71 U	< 3.71 U	< 3.71 UQ	< 3.71 UQ	< 3.71 U	< 3.71 UQ	< 37.1 U
1,2,4-trimethylbenzene	1700	830	4.23	4.57	4.13	4.28	7.87	3.1	16.7 J
1,2-dibromoethane	37	9.5	< 3.84 U	< 3.84 U	< 3.84 U	< 3.84 U	< 3.84 U	< 3.84 U	< 38.4 U
1,2-dichlorobenzene	41000	19000	< 3.01 U	< 3.01 U	< 3.01 UQ	< 3.01 UQ	< 3.01 U	< 3.01 UQ	< 30.1 U
1,2-dichloroethane	310	81	< 2.02 U	< 2.02 U	< 2.02 U	< 2.02 U	< 2.02 U	< 2.02 U	< 20.2 U
1,2-dichloropropane	790	200	< 2.31 U	< 2.31 U	< 2.31 U	< 2.31 U	< 2.31 U	< 2.31 U	< 23.1 U
1,2-Dichlorotetrafluoroethane	NS	NS	< 3.49 U	< 3.49 U	< 3.49 U	< 3.49 U	< 3.49 U	< 3.49 U	< 35.0 U
1,3,5-trimethylbenzene	1700	830	1.47 J	1.38 J	0.98 J	1.03 J	2.56	0.74 J	5.41 J
1,3-butadiene	260	67	< 1.11 U	< 1.11 U	< 1.11 U	< 1.11 U	< 1.11 U	< 1.11 U	< 11.1 U
1,3-dichlorobenzene	NS	NS	0.66 J	0.96 J	< 3.01 U	< 3.01 U	3.91	< 3.01 U	13.8 J
1,4-dichlorobenzene	1300	330	< 3.01 U	< 3.01 U	< 3.01 U	< 3.01 U	< 3.01 U	0.6 J	< 30.1 U
1,4-dioxane	1100	270	< 1.8 UQ	< 1.8 UQ	< 1.8 UQ	< 1.8 UQ	< 1.8 UQ	< 1.8 UQ	< 18.0 UQ
2,2,4-Trimethylpentane	NS	NS	115 D	21.0	3.13	2.76	36.4	3.46	161
2-butanone	290000	140000	13.0	63.7 D	13.9	10.3	< 1.47 U	1.36 J	24.2
2-chlorotoluene	20000	9700	< 2.59 U	< 2.59 U	< 2.59 U	< 2.59 U	< 2.59 U	< 2.59 U	< 25.9 U
3-Chloropropene	290	140	< 1.57 U	< 1.57 U	< 1.57 U	< 1.57 U	< 1.57 U	< 1.57 U	< 15.6 U
4-Ethyltoluene	NS	NS	2.31 J	1.72 J	1.28 J	1.38 J	3.2	1.03 J	8.85 J
4-methyl-2-pentanone	20000	9700	< 2.05 U	< 2.05 U	< 2.05 U	< 2.05 U	< 2.05 U	< 2.05 U	< 20.5 U
Acetone	9100000	4300000	< 1.19 U	< 1.19 U	23.3	22.3	< 1.19 U	25.4	< 11.9 U
Benzene	1100	270	19.8	9.58	1.53 J	1.34 J	11.2	1.41 J	40.2
Bromodichloromethane	220	57	< 3.35 U	< 3.35 U	< 3.35 U	< 3.35 U	< 3.35 U	< 3.35 U	< 33.5 U
Bromoform	7400	1900	< 5.17 U	< 5.17 U	< 5.17 U	< 5.17 U	< 5.17 U	< 5.17 U	< 51.7 U
Bromomethane	1400	680	< 1.94 U	< 1.94 U	< 1.94 U	< 1.94 U	< 1.94 U	< 1.94 U	< 19.4 U
Butyl alcohol, tert-	NS	NS	< 1.52 UQ	< 1.52 UQ	< 1.52 U	< 1.52 U	< 1.52 UQ	< 1.52 U	< 15.2 UQ
Carbon disulfide	200000	97000	< 1.56 U	< 1.56 U	< 1.56 U	< 1.56 U	20.6	< 1.56 U	21.2
Carbon tetrachloride	550	140	3.77	3.21	11.3	13.2	**266 D**	**1383 D**	< 1.89 U
Chlorobenzene	5100	2400	< 2.3 U	< 2.3 U	< 2.3 U	< 2.3 U	< 2.3 U	< 2.3 U	< 23.0 U
Chloroethane	9900	2500	< 1.32 U	< 1.32 U	< 1.32 U	< 1.32 U	< 1.32 U	< 1.32 U	< 13.2 U
Chloroform	92	44	< 2.44 U	0.88 J	2.73	3.37	24.4	**103 D**	< 24.4 U
Chloromethane	4500	1200	0.72 J	1.36	0.21 J	0.23 J	0.58 J	< 1.03 U	4.13 J
cis-1,2-dichloroethene	10000	4900	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	**5550 D**
cis-1,3-dichloropropene	NS	NS	< 2.27 U	< 2.27 U	< 2.27 U	< 2.27 U	< 2.27 U	< 2.27 U	< 22.7 U
Cyclohexane	NS	NS	22.4	6.88	0.48 J	0.52 J	13.8	< 1.72 U	29.3
Dibromochloromethane	300	78	< 4.26 U	< 4.26 U	< 4.26 U	< 4.26 U	< 4.26 U	< 4.26 U	< 42.6 U
Dichlorodifluoromethane	51000	24000	2.37 J	2.67	3.07	2.97	2.32 J	2.57	< 24.7 U
Ethylbenzene	7300	1900	7.82	4.34	2.78	2.65	3.82	1.74 J	12.2 J

Table 2-2 Soil Gas Results November 2014 - Frankford Arsenal Area II

		Sample ID	BZ3-1-SG	SG-DUP-1	BZ3-1-SG	SG-DUP-1	BZ3-2-SG	BZ3-2-SG	BZ3-3-SG
		Parent Sample ID		BZ3-3-SG-20141111		BZ3-1-SG			
		Sample Date	11/11/2014	11/11/2014	1/13/2015	1/13/2015	11/11/2014	1/13/2015	11/11/2014
		Sample Location:	Building 201	Building 201	Building 201	Building 201	Adjacent to UBZ3-38	Adjacent to UBZ3-38	South of Building 202
Analyte	Non-Residential[1] (ug/M3)	Residential[2] (ug/M3)							
Hexachloro-1,3-butadiene	NS	NS	< 5.33 U	< 5.33 U	< 5.33 UQ	< 5.33 UQ	< 5.33 U	< 5.33 UQ	< 53.3 U
Hexane	58000	28000	422 D	93.8 D	4.23	3.52	144 D	< 1.76 U	493 D
m,p-Xylene	NS	NS	19.1	12.2	7.82	8.25	10.9	6.52	28.7 J
Methyl Methacrylate	200000	97000	< 2.05 U	< 2.05 U	< 2.05 U	< 2.05 U	< 2.05 U	< 2.05 U	< 20.5 U
Methyl tert-butyl ether	31000	8100	< 1.8 U	< 1.8 U	< 1.8 U	< 1.8 U	< 1.8 U	< 1.8 U	< 18.0 U
Methylene Chloride	17000	4400	46.9 B	4.17 B	26.8 B	20.8 B	4.52 B	1.91 B	14.2 JB
Naphthalene	880	420	0.58 J	1.1 J	0.84 J	0.84 J	23.1	0.42 J	< 26.2 U
n-Heptane	NS	NS	34.0	8.61	1.56 J	1.43 J	10.7	1.11 J	47.1
o-Xylene	NS	NS	7.38	4.78	3.3	3.39	6.52	2.78	11.7 J
Styrene	290000	140000	1.41 J	0.43 J	< 2.13 U	< 2.13 U	< 2.13 U	< 2.13 U	< 21.3 U
Tetrachloroethene	14000	3600	1.63	0.47	0.68	0.88	0.47	0.68	136
Tetrahydrofuran	NS	NS	< 1.47 U	2.42	< 1.47 U	< 1.47 U	< 1.47 U	< 1.47 U	< 14.8 U
Toluene	120000	56000	90.8 D	125 D	55.0	49.0	31.3	12.1	113
trans-1,2-dichloroethene	20000	9700	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	< 1.98 U	1110 D
trans-1,3-dichloropropene	NS	NS	< 2.27 U	< 2.27 U	< 2.27 U	< 2.27 U	< 2.27 U	< 2.27 U	< 22.7 U
Trichloroethene	4800	1200	0.86	0.91	7.52	11.8	2.47	36.5	32.2
Trichlorofluoromethane	200000	97000	1.85 J	2.75 J	1.69 J	1.69 J	1.85 J	1.29 J	11.8 J
Vinyl Bromide	260	67	< 2.19 U	< 2.19 U	< 2.19 U	< 2.19 U	< 2.19 U	< 2.19 U	< 21.9 U
Vinyl chloride	950	240	< 0.08 U	< 0.08 U	< 0.08 U	< 0.08 U	0.72	< 0.08 U	**18660 D**

(1) PADEP Non- Residential Air MSC, dated 2004 with 0.01 Transfer factor for soil gas to indoor air (soil gas MSC = indoor air MSC/0.01).
(2) PADEP Residential Air MSC, dated 2004 with 0.01 Transfer factor for soil gas to indoor air (soil gas MSC = indoor air MSC/0.01).

NOTES:
D = Diluted sample result.
U = Indicates the compound was analyzed for but was not detected.
J = Estimated value.
Q = Indicates the lab QC sample did not meet the control limits requirements.
B = Indicates the analyte was found in the blank as well as the sample.
NS = No screening levels available.
Bolded values exceeded the residential criteria.
Bolded and Shaded values exceeded the residential and non-residential criteria.
ug/M3 = micrograms per cubic meter.

3. REMEDIAL ACTION OBJECTIVES AND PRELIMINARY REMEDIATION GOALS

3.1 INTRODUCTION

The purpose of this chapter is to assemble pertinent information that will be used in the screening, development, and evaluation of remedial alternatives for AOCs to be addressed at Area II of FFA under this FS. Specific goals of this chapter are as follows:

- Identify the COCs and the media of concern to be addressed based on previous investigation results
- Allowable exposure based on risk
- Identify federal, state, and local ARARs and TBC guidance
- Develop PRGs based on ARARs and TBC guidance
- Define the RAO(s)
- Specify areas and volumes at Area II to be addressed.

This information will be used by the decision-makers during development of the Decision Document for FFA Area II.

3.2 MEDIUM OF CONCERN AND CONTAMINANTS OF CONCERN

Based on results of the RI and the 2014/2015 supplemental investigation, the medium of concern at Area II is soil. The COCs are lead, BAP, and Aroclor 1260 (Table 3-1).

3.3 ALLOWABLE EXPOSURE BASED ON RISK

When Area II is evaluated as a whole, the HHRA results indicate there are no exceedances of the carcinogenic or non-carcinogenic risk thresholds for any of the current or future receptors evaluated. However, to be conservative, each zone in Area II was also evaluated individually for potential localized risks due to localized areas of “elevated” concentrations. A risk range from 10^{-6} to 10^{-4} for carcinogens (BAP and Aroclor 1260) is protective of human health (USEPA 1990 and PADEP 1995). “Elevated” concentrations were identified as sample locations with contaminants of potential concern (COPCs) that potentially represent a carcinogenic risk level of 10^{-4} or a non-carcinogenic hazard quotient of 10. The carcinogenic risk level represents the upper-bound of the acceptable risk range of 10^{-6} to 10^{-4}.

Lead was not evaluated in terms of carcinogenic and non-carcinogenic risk. Alternately, potential concerns from localized areas of “elevated” lead concentrations were evaluated through the use the USEPA blood lead models. Potential localized areas of “elevated” lead concentrations were identified as those areas with sample locations having lead concentrations greater than 1,000 mg/kg. This concentration is adequately protective to the current use receptors (e.g., school students and office/commercial workers) and removal of these “elevated” concentrations may result in lead levels that are also protective for future uses.

Ecological risk was evaluated by a SLERA performed in Zone 1 (EA 2014), since Zone 1 was identified as providing a habitat for ecological organisms. The exposed surface soil samples in Zone 1 suggest that high lead concentrations do not represent an unacceptable risk to populations of lower trophic organisms (plants and soil invertebrates), but may represent risk to the robin and shrew due to food web exposure. Zones 2 and 3 contain primarily buildings, parking lots, and impervious surfaces, and consequently do not provide good habitat for ecological organisms. It should be noted that a degree of uncertainty is associated with the SLERA. Toxicological data that underpin the screening values are inherently uncertain because laboratory data are extrapolated to field sites. Because conservative screening values were used, the uncertainty was biased in the direction of overestimation of risks. Additionally, COPCs were assumed to be 100 percent available to receptors. This is a highly unlikely circumstance based on soil chemistry. Under many circumstances, both inorganic and organic compounds are chemically bound in the soil matrix and are not available for uptake by receptors. This resulted in overestimation of risks. Due to the uncertainty associated with ecological risk and elevated background concentrations in an urban environment (anthropogenic, non-DOD sources), it is assumed that levels protective of human health will also be protective of ecological receptors.

3.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The development and evaluation of remedial alternatives under CERCLA includes an assessment of alternative site remedies on the basis of their ability to comply with ARARs. In recognition of the unique characteristics and circumstances associated with remediation of individual sites, neither SARA nor the NCP provide specific standards for the determination of whether a particular remedy provides sufficient cleanup at a given site. The selected remedial action for the site must satisfy all ARARs unless specific waivers have been granted according to Section 121(d) of CERCLA.

The NCP (40 Code of Federal Regulations [CFR] Part 300) codifies the definition of procedures, techniques, materials, equipment, and methods to be employed in identifying, removing, or remedying releases of hazardous substances. In particular, the NCP specifies procedures for deciding the appropriate type and extent of remedial action at the site to effectively mitigate and minimize the threat to, and provide adequate protection of, public health, welfare, and the environment.

The national goal of remedy selection is to protect human health and the environment, to maintain protection over time, and to minimize untreated waste (40 CFR 300.430). The remedial action must comply with all non-waived ARARs, including federal standards and more stringent state standards. In addition, compliance with promulgated state laws is necessary if the state ARAR is more stringent than the federal ARAR.

CERCLA Section 121(e), as implemented by the NCP at 40 CFR Part 300.400(e), exempts any onsite response action from the need to obtain any federal, state, or local permits. However, response actions may need to comply with substantive requirements of applicable or relevant and appropriate permitting laws and regulations.

3.4.1 Definition of ARARs

The NCP defines "applicable" and "relevant and appropriate" at 40 CFR 300.5 (1994). A requirement under CERCLA/SARA, as amended, may be either "applicable" or "relevant and appropriate" to a site-specific remedial action, but not both:

- **Applicable Requirements—**as defined by 40 CFR 300.5 are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."

- **Relevant and Appropriate Requirements—**as defined by 40 CFR 300.5 are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not ''applicable'' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate."

3.4.2 Classifications of Applicable or Relevant and Appropriate Requirements

ARARs for remedial action alternatives at the site can be generally classified into one of the following three functional groups:

1. **Chemical-Specific—**Health- or risk-based numerical values or methodologies that establish cleanup levels or discharge limits for particular contaminants.

2. **Location-Specific—**Requirements that restrict remedial actions based on the characteristics of the site or its immediate environment. Generally, location-specific requirements serve to protect the individual site characteristics, resources, and specific environmental features. Typical examples of location-specific ARARs include federal/state wetlands protection requirements.

3. **Action-Specific—**Requirements that set controls or restrictions on the design, implementation, and performance levels of activities related to the management of hazardous substances, pollutants, or contaminants. Typical examples of action-specific ARARs include National Pollutant Discharge Elimination System requirements or Clean Air Act requirements.

To be consistent with the NCP definition of ARARs and changes made by SARA, the following regulations were considered during the identification process:

- Federal requirements (applicable or relevant and appropriate)
- Commonwealth of Pennsylvania requirements (applicable or relevant and appropriate).

The site does not contain wetlands or endangered species; therefore, potential ARARs associated with wetlands and endangered species were not considered for the site.

3.4.3 To Be Considered Guidance

Federal and state guidance documents or criteria that are not generally enforceable, but are advisory, do not have the status of potential ARARs are To Be Considered (TBC) Guidance. Guidance documents or advisories to be considered in determining the necessary level of cleanup for protection of human health or the environment may be used where no specific ARARs exist for a chemical or situation, or where such ARARs are not sufficient to afford protection.

3.4.4 Identification of ARARs and TBC Guidance

In conjunction with the ARAR development process, USACE requested a list of ARARs from the Pennsylvania Department of Environmental Protection (PADEP) that would be applicable to action at FFA. The list provided by PADEP was reviewed by USACE, and a determination was made as to which guidance applies to FFA Area II as an ARAR or TBC. Table 3-2 summarizes the federal and state/local ARARs and TBC guidance for remedial actions at the site. Each ARAR has been chosen for its potential applicability or relevance and appropriateness according to the procedures identified in the *CERCLA Compliance with Other Laws Manual* (Office of Solid Waste and Emergency Response [OSWER] Directive 9234.1-01, USEPA 1988b) and *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (OSWER Directive 9355.3-01) (USEPA 1988a). Additionally, applicable ARARs were reviewed and included per PADEP's *ARARs for Cleanup Response and Remediation Actions in Pennsylvania* (PADEP 2013).

3.5 PRELIMINARY REMEDIATION GOALS

PRGs are contaminant concentration levels that are based on readily available information such as risk-based doses, frequently used standards (ARARs), and guidance and advisories (To Be Considered criteria). PRGs are in turn used to determine the feasibility of proposed remedial actions.

Factors taken into consideration when identifying applicable screening criteria for a specific contaminant for a specific medium included the following:

- Do remediation goals for carcinogens (BAP and Aroclor 1260) provide protection of human health within the risk range of 10^{-4} to 10^{-6}?

- Are remediation goals for non-carcinogens (lead) sufficiently protective of human health?[2]

Both of these goals would result in unrestricted site use. Table 3-3 summarizes current (April 2014) federal and state screening criteria for COCs in soil along with maximum detected concentrations, background values for lead and BAP, with calculated risk-based PRGs based on a re-use of the site as residential. Site-specific background values for lead and BAP were taken into consideration in PRG determination since CERCLA generally does not clean up to concentrations below natural or anthropogenic background levels (USEPA 2002).

Human health risk-based PRGs are proposed cleanup levels, which are based on human health risks and are intended to be protective of human health for an unrestricted site reuse (i.e., residential). The HHRA evaluated Area II of the Frankford Arsenal based on exposure areas that correspond to zones delineated in the RI report. In addition, potential "hot spot" areas were evaluated to determine localized areas of potential elevated risks. Carcinogenic risks and non-carcinogenic hazards for each exposure area (i.e., Zones 1, 2, and 3) for the identified receptors are below the PADEP risk target level. Two COCs were identified based on localized areas of elevated carcinogenic risks, BAP in Zone 3, and Aroclor 1260 in AOC 6. In addition, blood-lead modeling identified potential concerns for lead for residential exposure in Zone 1. Similar to BAP and Aroclor 1260, lead sample results throughout Zones 1, 2, and 3 of the FFA represent localized areas of potential human health risks. The human health-based PRGs for Area II of FFA are presented in Table 3-3. Risk-based PRGs for BAP and Aroclor 1260 were developed using the following equation:

$$\text{PRG} = \text{Reasonable Maximum Exposure Point Concentration} \times \text{Target Risk Level} / \text{Calculated Risk Value}$$

The rationale for selecting the PRGs for each of the COCs (lead, BAP, and Aroclor 1260) is discussed in the following sections.

3.5.1 Lead PRG

Lead is the most prevalent COC in Area II and it is present in four AOCs (AOC 1, 10, 20 and 21) at levels requiring further action. As summarized in Section 2.5.4, areas of elevated lead concentrations were reported during the RI that are driving blood lead modeling to conclude that future child resident receptors exposed to the soils may develop elevated blood lead levels. The PRG for lead was based on review of the following TBC guidance and background levels as no ARARs were identified:

- USEPA regional screening levels (RSLs)
- PADEP MSCs
- Risk-based level (school student) developed via USEPA blood lead modeling

[2] As noted in Section 3.3, due to the uncertainty associated with ecological risk and elevated background concentrations in an urban environment (anthropogenic, non-DOD sources), it is assumed that levels protective of human health will also be protective of ecological receptors.

- Background values for Area II.

Table 3-3 presents numerical values for lead for the standards and guidance listed above. The USEPA RSL (non-promulgated, TBC) for lead for a residential scenario is 400 mg/kg. The PADEP MSC (promulgated, TBC) for lead for a residential scenario is 500 mg/kg. The site-specific surface soil background lead concentration was identified as 1,000 mg/kg (as detailed in the RI). In addition, the adult lead model was used to determine a soil lead level that would not result in elevated blood-lead levels for school students. These calculations are presented in Table 8 of the HHRA in the RI (EA 2014). The resulting soil lead level that would not result in elevated blood-lead levels for school students was calculated as 1,320 mg/kg; this was conservatively rounded to 1,000 mg/kg.

Consistent with site background concentrations, a PRG of 1,000 mg/kg has been selected for lead since the targeted removal of soil lead concentrations greater than 1,000 mg/kg will result in protectiveness of human health.

3.5.2 BAP PRG

BAP is the COC for one AOC (AOC 13) in Area II. The PRG for BAP was based on review of the following TBC guidance and background values as no ARARs were identified:

- USEPA RSLs
- PADEP MSCs
- Background values for Area II.

Table 3-3 presents numerical values for BAP for the standards and guidance listed above. The USEPA RSL (non-promulgated, TBC) for a residential scenario based on a carcinogenic risk of 10^{-6} is 0.015 mg/kg. The PADEP MSC (promulgated, TBC) for a residential scenario is 0.57 mg/kg. As shown on Table 3-3, the calculated risk-based PRGs are 1.5 mg/kg for 10^{-4} risk, 0.15 mg/kg for 10^{-5} risk, and 0.015 mg/kg for 10^{-6} risk, similar to the USEPA RSL. A comparison of the promulgated PADEP Act II MSC of 0.57 mg/kg to the site-specific and USEPA RSL of 0.015 mg/kg reveals that the PADEP MSC represents an approximate carcinogenic risk level of $4x10^{-5}$. This risk level is within the acceptable risk range and would result in acceptable risks for unrestricted exposure. Site-specific BAP background values are 0.9 mg/kg for surface soil and 1.3 mg/kg for subsurface soil as detailed in the RI. A comparison of the background surface soil value of 0.9 mg/kg to the USEPA RSL of 0.015 mg/kg reveals that the background surface soil value represents an approximate carcinogenic risk level of $6x10^{-5}$. A comparison of the background subsurface soil value of 1.3 mg/kg to the USEPA RSL of 0.015 mg/kg reveals that the background subsurface soil value represents an approximate carcinogenic risk level of $9x10^{-5}$. These risk levels are within the USEPA acceptable risk range and would result in acceptable risks for unrestricted exposure. The background values are within the acceptable risk range and cleanup to background would be protective of human health. As such, the background values of 0.9 mg/kg for surface soil and 1.3 mg/kg for subsurface soil for BAP have been selected as the PRGs.

3.5.3 Aroclor 1260 PRG

Aroclor 1260 is the COC for one AOC (AOC 6) in Area II. The PRG for Aroclor 1260 was based on review of the following TBC guidance as no ARARs were identified:

- USEPA RSLs
- PADEP MSCs.

Table 3-3 presents numerical values for Aroclor 1260 for the standards and guidance listed above. The USEPA RSL (non-promulgated) for the residential scenario based on a carcinogenic risk of 10^{-6} is 0.24 mg/kg. The PADEP MSC (promulgated/TBC) for a residential scenario is 9 mg/kg. In addition, the site-specific calculated risk-based PRGs are 22 mg/kg for 10^{-4} risk, 2.2 mg/kg for 10^{-5} risk, and 0.22 mg/kg for 10^{-6} risk. Site-specific Aroclor 1260 background values were not calculated due to the limited nature of its occurrence in Area II. A comparison of the TBC PADEP Act II MSC of 9 mg/kg to the site-specific PRG of 0.22 calculated during the HHRA and USEPA RSL of 0.24 mg/kg reveals that the PADEP MSC represents an approximate carcinogenic risk level of $5x10^{-5}$. This risk level is within the acceptable risk range and would result in acceptable risks for unrestricted exposure. The site-specific risk-based PRG of 2.2 mg/kg has been selected as the PRG for Aroclor 1260 because it is within the acceptable risk range.

3.6 REMEDIAL ACTION OBJECTIVES

In order to develop remedial alternatives to address contaminated soil at Area II, RAOs were developed to provide goals for protecting human health and the environment. The primary RAOs for Area II soils are:

- Prevent human exposure via direct contact of residential receptors to impacted soil that exceeds 2.2 mg/kg for Aroclor 1260, 0.9 mg/kg for surface soil and 1.3 mg/kg for subsurface soil for BAP, and 1,000 mg/kg for lead.

- Prevent ecological exposure via direct contact of ecological receptors to impacted soil that exceeds 1,000 mg/kg for lead in AOC 1.

3.7 AREAS AND VOLUMES OF MEDIA FOR REMEDIATION

AOCs to be addressed under this FS based on RI findings include the following AOCs: 1, 6, 10, 13, 20, and 21. The areas and associated volumes for each AOC are summarized in Table 3-1 and are illustrated on Figure 3-1. Volumes were calculated based on aerial extent and depth. Of note, these estimated volumes do not account for expansion of soils upon excavation. Vertical and horizontal boundaries were based on existing data and the assumption that soil concentrations less than the PRG were located midway between locations that were identified to exceed the PRG and the closest sampling location that did not exceed the PRG as shown on Figure 3-1.

3.7.1 AOC 1

Lead has been identified as the COC in AOC 1, which is located in the northwest portion of Area II. Since the data shows non-contiguous localized areas of "elevated" concentrations, AOC 1 is further divided into four sub-AOCs, AOC-1A, AOC-1B, AOC-1C, and AOC-1D for discussion and understanding of findings and site conditions.

AOC-1A is composed of manicured lawns, established trees, and ornamental landscaping. AOC-1A is located in the area surrounding multiple historical buildings to include Buildings 1, 2/3, 4, 5, and 14; the southwest corner of the Parade Ground; and along the western fence line. Buildings 1, 2/3, 4, 5, and 14 were constructed from 1816 to 1823 and are the oldest structures present in Area II of FFA. The parade ground is currently in use by the adjacent charter school as a recreational area, and the area surrounding the parade ground is part of the common area associated with use of the historical buildings some of which are currently occupied for residential or office use. This area, in conjunction with the rest of the parade ground and adjacent areas, represents the majority of the greenspace associated with the FFA Area II and it has been in continuous use as such since 1816. RI data indicate that lead concentrations exceeding the PRG are present from 0 to 6 in. bgs; for calculation purposes it is assumed that soil will be remediated to 0.5 ft bgs. The horizontal extent of impact was determined to be approximately 58,567 square feet (ft^2). The volume of associated impacted surrounding soils exceeding the PRG is estimated to be approximately 1,085 cubic yards (yd^3).

AOC-1B is located in the Parade Ground which is currently in use by the adjacent charter school as a recreational area. RI and supplemental investigation data (Appendix A) indicate that lead concentrations exceeding the PRG are present from 0.5 to 30 in. bgs; for calculation purposes it is assumed that soil will be remediated to an average of 2 ft bgs, since depth of observed impact varies across the AOC. The horizontal extent was determined to be approximately 4,440 ft^2. The volume of associated impacted surrounding soils exceeding the PRG is estimated to be approximately 411 yd^3. AOC-1B is composed of manicured lawn.

AOC-1C is located in Zone 2 west of historical Building 15 (circa 1835) and north of historical Building 108 (circa 1942). RI and supplemental investigation data (Appendix A) indicate that lead concentrations exceeding the PRG are present from 0 to 5 ft bgs; for calculation purposes it is assumed that soil will be remediated to 5 ft bgs. It should be noted that this is based on a PRG exceedance at one sample location (due to limited vertical delineation), and therefore is a conservative estimate. The horizontal extent was determined to be approximately 629 ft^2. The volume of associated impacted surrounding soils exceeding the PRG is estimated to be approximately 117 yd^3. AOC-1B is located in a landscaped/mulched berm between a road and a parking area.

AOC-1D is located to the east of historical Building 101 (circa 1864). RI and supplemental investigation data (Appendix A) indicate that lead concentrations exceeding the PRG are present from 0 to 0.5 ft bgs; for calculation purposes it is assumed that soil will be remediated to 0.5 ft bgs. The horizontal extent of impact was determined to be approximately 969 ft^2. The volume of associated impacted surrounding soils exceeding the PRG is estimated to be approximately 18 yd^3. AOC-1D is composed of manicured lawn.

3.7.2 AOC 6

Aroclor 1260 has been identified as the COC in AOC 6 which includes an active transformer (non-PCB) surrounded by structures. Aroclor 1260 concentrations exceeding the PRG are present from 0 to 3 ft bgs; for calculation purposes it is assumed that soil will be remediated to 3 ft bgs. The horizontal extent was determined to be approximately 447 ft^2. The volume of associated impacted surrounding soils exceeding the PRG is estimated to be approximately 50 yd^3. AOC 6 is adjacent to an active transformer; the area is bare ground or covered with wood decking and surrounded with asphalt paving.

3.7.3 AOC 10

Lead has been identified as the COC in AOC 10. This AOC is located in a grassy area to the west of historical Building 110 (circa 1941). It is bound to the north and west by roadway and to the east by Building 110. Delineation samples collected to the south in the grassy area were reported to be below the PRG. Lead was vertically delineated from 0 to 5 ft bgs; for calculation purposes it is assumed that soil will be remediated to 5 ft bgs. It should be noted that this is based on a limited vertical delineation, and therefore is a conservative estimate. The horizontal extent was determined to be approximately 2,417 ft^2. The volume of associated impacted surrounding soils exceeding the PRG was delineated during the RI and is estimated to be approximately 448 yd^3. AOC 10 is composed of manicured lawns and established trees.

3.7.4 AOC 13

BAP has been identified as the COC in AOC 13. This AOC is located to the west and south of historical Buildings 201 and 202 (circa 1941). With the exception of the grassy area between the two buildings, this AOC is paved with asphalt which covers concrete in some areas and used as a parking area for adjacent businesses. This area has a concentration of utilities and rail road tracks and it sits adjacent to Frankford Creek. BAP was vertically delineated from 0 to 5 ft bgs; for calculation purposes it is assumed that soil will be remediated to 5 ft bgs. The horizontal extent was determined to be approximately 12,655 ft^2. The volume of associated impacted surrounding soils exceeding the PRG was delineated during the RI and is estimated to be approximately 1,875 yd^3.

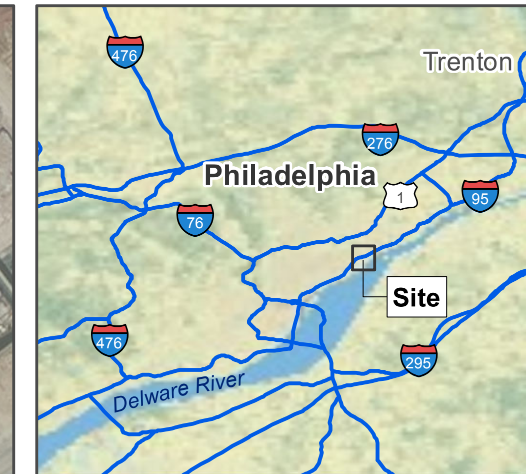
3.7.5 AOC 20

Lead has been identified as the COC in AOC 20. This AOC is located in the courtyard of historical adjacent to Building 215 (circa 1864). This building currently proposed for redevelopment and use by a charter school. Lead was vertically delineated from 0 to 2 ft bgs; for calculation purposes it is assumed that soil will be remediated to 2 ft bgs. The horizontal extent of impact was determined to be approximately 4,894 ft^2. The volume of associated impacted surrounding soils exceeding the PRG was delineated during the RI and is estimated to be approximately 363 yd^3. The nature and extent of impact in disturbed areas of this AOC are uncertain. Two former buildings (Buildings 216 and 217) occupied a majority of AOC 20. They were demolished by the current owner and any basements may have been filled with debris;

therefore, construction debris could potentially be encountered in the subsurface. AOC 20 is currently overgrown with evidence of construction debris on the surface. The estimate of impacted soil may be a liberal estimate due to the presence of construction debris, which could lower the actual volume of soil that requires removal.

3.7.6 AOC 21

Lead has been identified as the COC in AOC 21. This AOC is located in an open area in proximity to Building 215 (circa 1864) near the former location of Building 227. Lead was vertically delineated from 0 to 5 ft bgs with localized exceedances from 5 to 7 ft bgs; for calculation purposes it is assumed that soil will be remediated to an average of 5 ft bgs since impact depth varies at multiple locations. The area is partially paved and several utilities run through this area. The horizontal extent was determined to be approximately 33,053 ft^2. The volume of associated impacted surrounding soils exceeding the PRG was delineated during the RI and is estimated to be approximately 6,059 yd^3. As of the date of the RI, AOC 21 was covered with gravel and construction debris piles.



Legend

- Area of Concern (AOC)
- Area I Boundary
- Area II Boundary
- Philadelphia Industrial Development Corporation

Zones

- Zone 1, 2 and 3

Sources
ESRI (Imagery) 2011
Cabrera, 2011
USACE, 2009

Path: \\Woveton\federal\GISData\Northeast\Pennsylvania\FrankfordArsenal\MXD\DraftFS\Figure 3-1 AOCs_Areas.mxd

Frankford Arsenal Philadelphia, Pennsylvania	Project: 6233017 Date: July 2016	0 100 200 400 Feet 1 inch = 200 feet	**Figure 3-1** **Area II Summary of Soil Areas of Interest**

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Table 3-1 Summary of Areas to be Included in Remediation Effort
Area II Former Frankford Arsenal

AOC	Zone	Planned Future Use	Constituent Driving Risk	Sample Locations	Impacted Sample Depths (ft bgs)	Surface Cover Type	Estimated Area (ft^2)	Estimated Volume (yd^3)	Estimated Volume with Expansion [1] (yd^3)	Direct Contact Pathway Complete
1	1 and 2	Residential, Commercial, and School	Lead	16 total in Zone 1 and UBZ2-26 (Zone 2)	0-5	Grass	64605	1630	2038	**Yes**
1A					0-0.5		58567	1085	1356	
1B					0-2.5		4440	411	514	
1C					0-5		629	117	146	
1D					0-0.5		969	18	22	
6	2	School	Aroclor 1260	T-1101	0-3	Bare/grass	447	50	62	**Yes**
10	2	School	Lead	UBZ2-45	0-5	Grass/bare	2417	448	559	**Yes**
13	3	Residential	BAP	UBZ3-23, -24, -38, -39, -54, and -55	0-5 ft	Asphalt/concrete	12655	2344	2930	**Yes** [2]
20	3	School	Lead	UBZ3-13, -32, -33, and BZ3-13	0-2	Weeds/bare/brick	4894	363	453	**Yes**
21	3	School (recreational fields)	Lead	UZB3-49, -57, -58, and -63	0-5, 5-7 at UBZ3-63	Asphalt/concrete	33053	6059	7574	Yes [2]

NOTES:
1- exapansion factor of 1.25
2 - portions are covered by impervious surfacesuch as grass

AOC = Area of concern
BAP = Benzo(a)pyrene
bgs = Below ground surface
ft = Foot (feet)
ft^2 = Square foot (feet)
yd^3 = Cubic yard(s)

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Table 3-2
Summary of Applicable or Relevant and Appropriate Regulations (ARARs)
And To Be Considered (TBC) Material
Area II Former Frankford Arsenal, Philadelphia, Pennsylvania

ARAR OR TBC	Legal Citation	Classification	Summary of Requirement	Further Detail Regarding ARARs in the Context of the Remedy
Chemical-Specific				
Federal				
United States (U.S.) Environmental Protection Agency (USEPA) Region 3 Regional Screening Levels (RSL) Table June 2011		To Be Considered	USEPA Region 3 utilizes this table as a risk-based concentration (RBC) screening tool.	RSLs are not promulgated. To be considered during the development of preliminary remediation goals (PRGs) for lead, Aroclor 1260, and benzo(a) pyrene BAP.
Risk Assessment Guidance for Superfund – Volume 1 Human Health Manual Part A, December 1989	USEPA Office of Emergency and Remedial Response EPA/540/1-89/002, Chapters 1 to 9	To Be Considered	USEPA guidance for calculating baseline human health risk and establishing risk-based performance standards for Superfund cleanups.	Risk Assessment Guidance for Superfund (RAGS) is not promulgated. This guidance document was considered when establishing risk-based soil cleanup standards.
State				
Land Recycling and Environmental Remediation Standards Act (Act 2)	35 P.S. § 6026.303; 25 Pa. Admin. Code Ch. 250 Appendix A Tables 3 & 4, entries for CoCs.	To Be Considered	Act 2 establishes medium specific concentrations (MSCs) for protection of human health for soils and groundwater.	Act 2 is a voluntary cleanup program. MSCs are promulgated, however they are not enforceable under CERCLA because of the voluntary nature of the program; therefore. MSCs are To Be Considered during the development of PRGs for lead, BAP, and Aroclor 1260.
Location-Specific				
State				
None Identified				
Action-Specific				
Federal				
None Identified				
State				
None Identified				

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Table 3-3 Former Frankford Arsenal Preliminary Remedial Goals

				TBC										
				Site Background		Risk-Based PRG[1]				USEPA RSL			PADEP SHS	
Analyte	Units	FS PRG	Maximum RI Detection	Surface Soil (0-2 ft bgs)	Subsurface Soil	Protective of School Students per HHRA (EA 2014)	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	Resident Soil (TR=1E-6 and HQ=0.1)	Protection of Groundwater Risk-Based SSL	Protection of Groundwater MCL-Based SSL	Residential Direct Contact MSC (0-15 ft)	PADEP Residential Soil to Groundwater MSC (used aquifer TDS≤2500)
Lead	mg/kg	1,000	15,600	1,000	750	1,000	NA	NA	NA	400	NS	14	500	450
Benzo(a)pyrene	mg/kg	0.9 [2] and 1.3 [3]	8.9	0.9	1.3	NA	0.015	0.15	1.5	0.015	0.004	0.24	0.57	46
Aroclor 1260	mg/kg	2.2	38	NA	NA	NA	0.22	2.2	22	0.24	0.027	NS	9	150

NOTES:
ARAR = Applicable or Relevant and Appropriate Requirement
bgs = Below ground surface
EA = EA Engineering, Science, and Technology, Inc., PBC
FS = Feasibility Study
ft = Foot (feet)
HQ = Hazard quotient
MCL = Maximum contaminant level
mg/kg = Milligram(s) per kilogram
MSC = Medium Specific Concentration
NA = Not applicable
NS = Not standard
PADEP = Pennsylvania Department of Environmental Protection
PRG = Preliminary Remediation Goal
RSL = Regional Screening Level
SHS = Statewide Health Standard
SSL = Soil Screening Level
TBC = To be considered
TR = Target Risk
TSCA = Toxic Substances Control Act
USEPA = United States Environmental Protection Agency
1 Based on residential use
2 Surface soil
3 Subsurface soil

4. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

4.1 INTRODUCTION

The purpose of this section is to identify GRAs that will achieve (either alone or in combination with each other) the RAOs for the site. This section also identifies specific technologies and process options, and screens applicable technologies and process options for each GRA against the criteria of effectiveness, implementability, and cost. Those technologies and process options that are retained through the screening process are assembled (in Chapter 5) into specific, comprehensive RAOs.

4.2 METHODOLOGY

Appropriate GRAs were selected based on the media of concern and COCs identified in Chapter 3 and outlined in section 4.3. Specific technologies and process options were then developed for each GRA, and these technologies and process options were assessed for preliminary general technical implementability (i.e., ability to construct/implement, applicability to COCs, feasibility to achieve RAOs) and reliability (Section 4.4).

The next step is a general evaluation of the technologies/process options that passed the preliminary screening based on technical implementability to determine the process options to be explored in more detail (Section 4.5). The evaluation in this section is based mainly on effectiveness. A qualitative assessment of the implementability (both technical and administrative feasibility) and general cost of the technologies is also performed. The objective of this step is to evaluate the technologies/process options and select the most viable processes to represent each technology for inclusion in alternatives (Section 5). The three criteria for this evaluation (effectiveness, implementability, and cost) are discussed below.

Effectiveness – The effectiveness criterion includes comparison of process options for the same technology relative to each other. The evaluation focuses on the effectiveness of each process option to treat or contain the contaminated media and thus meet RAOs, the potential impacts to human health and the environment resulting from implementation of the process option, and the reliability of the process option considering the COCs and site-specific conditions.

Implementability – The implementability criterion includes evaluation of the technical and administrative feasibility of the technology. This evaluation places emphasis on the availability of equipment, materials, and personnel to perform the process option.

Cost – The cost criterion is used in a more limited role to screen the technologies/process options. Relative costs are used in lieu of detailed estimates. This evaluation is used to compare costs for process options within the same technology. At this stage in the evaluation, costs are generalized as low, moderate, or high. Detailed costing is included in the detailed analysis of alternatives in Chapter 5.

4.3 GENERAL RESPONSE ACTIONS

GRAs are broad response actions that satisfy the RAOs. GRAs are selected based on the media of concern at FFA Area II (i.e. soil) and, where applicable, the chemical properties of the COCs at the site. The six GRAs identified for implementation to address the impacts present at Area II of FFA (in no particular order of preference) are as follows:

- No Action
- Land Use Controls (LUCs)
- Excavation
- Containment
- *In Situ* Treatment
- *Ex Situ* Treatment.

By matching appropriate GRAs with the RAOs, a list of preliminary remedial technologies was developed. One or more technologies may be considered within each GRA category.

4.3.1 No Action

The NCP requires consideration of a "No Action" response. No Action serves as a baseline against which the performance of other remedial alternatives can be compared. This response assumes no active remedial measures or long-term maintenance and monitoring are implemented, although any processes that naturally attenuate the contamination would continue under this GRA.

4.3.2 Land Use Controls

LUCs include physical (engineering controls), legal, or administrative mechanisms (institutional controls) that restrict the use of, or limit access to real property to prevent or reduce risks to human health and the environment. Generally, this GRA is used in combination with other actions in cases where risks above acceptable levels are expected to persist for some period of time while the remedial measures are implemented. However, in some cases, this response action alone is sufficient to protect human health and/or the environment. In addition, this action may be implemented as the only action in circumstances where active response actions such as treatment or removal of the contaminated media are not feasible. Examples of LUCs include engineering controls (e.g., fences, signs, netting, etc.) and institutional controls (e.g., zoning changes, easements, and dig permits). The environmental covenant can incorporate both engineering and institutional controls as needed, and it needs to be implemented by the property owner.

4.3.3 Excavation

This GRA would address contaminated soils by excavating and removing the soils from the site for offsite disposal. This response action would reduce the mass of contaminants at the site and thus decrease the potential risk from exposure in the long term. Excavation would use conventional earth-moving equipment to remove contaminated media, and would require the use of dust and erosion control procedures. The soil would be disposed of in an offsite facility authorized to accept the waste stream.

4.3.4 Containment

This GRA reduces potential exposure to COCs by physically containing the contaminants and thus reducing or controlling their mobility. Technologies could include surface barriers (caps), or impermeable vertical barriers. It should be noted that containment may limit future use of the area, as the remedial measures need to remain in place to control contaminant mobility until the exposure risk, in the absence of the remedial action, has fallen to acceptable levels.

4.3.5 In Situ Treatment

In situ treatment involves the use of physical, chemical, or biological mechanisms for reducing the concentrations, mobility, or bioavailability (i.e., availability for uptake by plants or animals) of contaminants. Thus, treatment is conducted without removing the impacted medium from its existing location. Mechanisms for *in situ* treatment at the site may include natural processes (i.e., natural attenuation) and the addition of amendments to soil to retain COCs within the media or enhance degradation of COCs within the media.

4.3.6 Ex Situ Treatment

Ex situ treatment of soil involves the removal of the impacted medium followed by the application of treatment technologies to transform, destroy, or immobilize the targeted constituents. Soil excavation and treatment (e.g., thermal desorption, chemical stabilization, or solidification/encapsulation) is an example of an *ex situ* treatment technology.

4.4 PRELIMINARY IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

This section identifies and screens potentially applicable technologies and process options for GRAs identified in Section 4.3. Technology types are general categories, whereas process options are specific processes for each technology type. This section describes the screening of technologies and process options based on the criterion of *technical* implementability. Technical implementability encompasses the ability to construct/implement, the applicability of the technology for addressing risks associated with exposure to the COCs, the feasibility to achieve the RAO, as well as the reliability of those technologies being considered. Table 4-1 summarizes the GRAs and the representative technologies and process options, and indicates the technologies and process options that were eliminated from further consideration during this preliminary screening because they did not meet the technical implementability criterion.

4.4.1 No Action

This GRA indicates that no activities will be performed to address the RAO. No action would not decrease risk or exposure to COCs, nor would it achieve RAOs, as current conditions do not achieve RAOs. No action is also not reliable as it does not prevent exposure. The NCP requires retention and evaluation of this GRA to provide a baseline for comparison with other developed alternatives; therefore, it is retained for further evaluation.

4.4.2 LUCs

Engineering and institutional controls were identified as technologies corresponding to the LUC GRA. Process options associated with these technologies are described below.

***Engineering Controls*—**Access restrictions for human receptors include fences and/or signs that prevent or discourage access to the site and thereby mitigate the potential for exposure. Fences and signage can be constructed around the AOCs (technically implementable for all AOCs). The collective engineering controls are applicable to the contaminants and media (e.g. fences and signage can prevent access to impacted areas and reduce exposure to COCs). If they are successful in preventing contact with COCs they would meet the RAO for human exposure. Engineering controls can be considered reliable when there is active owner support and maintenance, but less reliable if the agency implementing the controls does not own the property or the property is sold without accompanying institutional controls to keep engineering controls in place. Fencing AOCs 1, 10, 13, 20, and 21 and affecting access to these areas would prevent use of the property for its intended use; therefore, fencing is not feasible for these AOCs. AOC 6 can be fenced without impacting its intended use.

Engineering controls for ecological receptors at FFA identified as a concern in Zone 1 (AOC 1 only) include, fine mesh fencing and avian netting. Fencing and netting would require the placement of structures and framing to support netting and fencing. Installation of fine mesh fencing and avian netting could occur around AOC 1, but installation of fencing and netting would be difficult to implement. The collective engineering controls are applicable to the contaminants and media (e.g. fine mesh fencing and avian netting can prevent access to impacted areas and reduce exposure to COCs) and if they are successful in preventing contact with COCs, they would meet the RAO for ecological exposure. The fine mesh fencing and avian netting are also considered reliable for preventing access if maintained. Placing the netting and fencing on and around AOC 1 would prevent the property from being used for its intended use (school recreational, business and residential use). Therefore, fine mesh fencing and avian netting is not considered feasible and these process options are not retained for further consideration.

***Institutional Controls*—**Future use restrictions are agreements made by the site owner with a government body to provide notice to future owners regarding potential risks and these restrictions can limit future use to a certain classification (e.g., non-residential). Examples of institutional controls include zoning changes, easements, and dig permits. Institutional controls are feasible, they can be implemented, and they are considered reliable when there is active owner support and maintenance. They are considered less reliable if the agency implementing the institutional controls does not own the property or they are not supported/maintained.
The proposed institutional controls would include preparation of an environmental covenant. The environmental covenant may include a post remedial care plan which may include dig permits to address any remaining soils exceeding PRGs which are left in place after an action is taken. These would protect receptors from being exposed to any contamination left in place and limit risks from exposure to the COCs. If the institutional control is successful in preventing

contact with COCs, it would meet the RAO for human exposure. Dig permits could potentially be part of a post-remediation care plan if soils are left in place. Institutional controls can be considered reliable when there is active owner support and maintenance, but less reliable if the agency implementing the institutional controls does not own the property or the property is sold. Future use restrictions without implementation of access restrictions (e.g. engineering controls) are not protective of ecological receptors.

As noted above, both of these technologies are implementable and would address human health risks (when future use restrictions and access restrictions are combined) in all AOCS. When properly implemented, they would feasibly achieve the RAOs. In addition, the technologies are reliable if instituted appropriately with active owner support and maintenance. When utilizing LUCs, CERCLA 5-year reviews would be required to evaluate and document compliance with the RAO and assess protectiveness of the controls. These process options were determined to be potentially applicable to the site to address human health risks based on the preliminary screening criteria, and are retained for further evaluation. These options would not address the ecological risks associated with exposure to the COCs in AOC 1.

4.4.3 Excavation and Disposal

The Excavation and disposal technology/process option would entail removal of soil with COC concentrations exceeding the PRGs. Excavation would be performed using conventional earth-moving equipment and disposal of soil would occur at a facility authorized to accept the waste stream.

Excavation with disposal would address risks from exposure to the COCs and would achieve RAOs by preventing direct contact with soil (human and ecological) through the removal of COCs exceeding the PRGs. Excavation with disposal is a technically implementable and reliable technology for all COCs/AOCs at the site and it is retained for further evaluation. It is noted that the concentrations of COCs in the AOCs do not require treatment prior to disposal offsite; therefore, *ex situ* treatment offsite (prior to offsite disposal) was not evaluated separately from offsite disposal.

4.4.4 Excavation and Ex situ Treatment Onsite

Thermal desorption, chemical stabilization, and solidification/encapsulation were process options identified under the Excavation and *Ex situ* Treatment GRA. For all of these process options, excavation of soil with COC concentrations exceeding the PRG would be performed using conventional earth-moving equipment. Excavated soil would then be treated onsite using the process options described below and placed back in the excavation after treatment as follows:

Thermal Desorption **—**This process option is only applicable for Aroclor 1260 and BAP (AOCs 6 and 13, respectively) as this process is not effective on soils with concentrations of lead. A thermal desorption system has two major components; the desorber itself and the off gas treatment system. Impacted soils would be excavated, staged, and heated to increase the volatility of contaminants and to release the contaminants from the soil matrix. The volatilized contaminants are then either collected for offsite disposal or thermally destroyed onsite. This process option would be successful in achieving the RAO by reducing risk through the reduction of contaminant volume. Thermal desorption is also considered reliable for treating soils. AOC 6 has limited surface area, an active transformer and adjacent structures in close proximity, while AOC 13 is an active parking lot adjacent to Frankford Creek; therefore, it is not feasible to treat the soils adjacent to the AOCs. In addition, there is little available room elsewhere onsite for staging and treatment of soils, given the current operations of the subject property. Furthermore, staging and treatment operations onsite would prevent the property from being used for its intended use (schools, residential use, and business/urban commercial space to include parking areas). Therefore *Ex situ* thermal desorption is not considered feasible and this process option is not retained for further consideration.

Chemical Stabilization**—**This process option is applicable for all COCs. This process option would require the excavation, staging, and treatment of soils with the addition of chemical stabilizers to prevent the leaching of COCs through the formation of insoluble compounds. This process is generally reliable. While this process option prevents COCs from migrating, it does not reduce the contaminant volume nor does it prevent exposure through direct contact with soils unless used in conjunction with other process options such as capping; therefore, used alone this process option would not be successful in achieving the RAO for all AOCs. In addition, the AOCs have limited open/unused surface areas and most have adjacent structures; therefore, it is not feasible to treat the soils with stabilizers ex situ near the AOCs. There is little available room elsewhere onsite for staging and treatment of soils, given the current operations on the subject property and placing the treatment operations onsite would prevent the use of some portion of the property for its intended use (schools, residential use, and urban commercial space to include parking areas). Therefore *Ex situ* Chemical Stabilization is not considered feasible and this process option is not retained for further consideration.

Solidification/Encapsulation**—** This technology uses a matrix (i.e. cement, asphalt, etc.) mixed with soils to encapsulate contaminated solid material in place and thus reduce the potential for leaching and contaminant mobility. It is applicable to all COCs (lead, BAP, and Aroclor 1260). Encapsulation does not lessen the volume and toxicity of hazardous wastes, but does lessen the mobility, prevents direct contact by receptors, and reduces infiltration that can lead to leaching and subsurface migration by encasing contaminants in a solid matrix. Encapsulation is most effective where the underlying wastes or COC-impacted media are isolated above the water table, which limits the mobility of COCs, as is the case at all AOCs. Encapsulation is effective in meeting the RAOs because it encases/binds contaminants in a solid matrix which prevents human and ecological receptors from directly contacting contaminated soils. The AOCs have limited surface areas and they are surrounded by adjacent structures; therefore, it is not feasible to treat the soils *ex situ* adjacent to the AOCs. In addition, there is little available room elsewhere onsite for staging and treatment of soils, given the current operations of the subject property. Placing this treatment operation onsite would prevent the use of some portion of the property for its intended use (schools, residential use, and urban commercial space to include parking areas); therefore, *Ex situ* Chemical Stabilization is not considered feasible and this process option is not retained for further consideration.

4.4.5 Containment

Two technologies were identified under this GRA, to include capping and vertical barriers. Process options associated with containment are described below.

***Capping*—**Installation of a cap on the surface above the impacted soils was identified as a technology. This process option is expected to be technically implementable based on its successful use at similar sites and reliable if maintained and monitored. This process option allows for continued use of the areas as intended; therefore, it is retained for further consideration.

***Vertical Barriers*—**Installation of vertical barriers upgradient of or surrounding the impacted soils was identified as a process option. This technology is technically implementable and typically reliable if maintained; however it is not effective at the site since there is no protection to receptors from surficial soils. Therefore the RAO cannot be achieved, and this process option is not retained for further consideration.

4.4.6 In Situ Treatment

The following technologies were identified as potential options for *in situ* treatment of COCs at the site: stabilization/solidification, bioremediation, and chemical treatment. Specific process options within these broad technologies are discussed as follows.

Bioremediation

- ***Phytoremediation*—**Phytoremediation by biouptake into plants was identified as a technology for all COCs (lead, BAP, and PCBs) in soil at FFA. This process option would use plants to remove and remediate COCs from the soil. This can be achieved by several mechanisms including:
    - Phytoextraction – the uptake of contaminants by plant roots with accumulation in plant tissues. Applicable to metals.
    - Phytodegradation – uptake and degradation of contaminants within plants. Applicable to PCBs.
    - Rhizodegradation – enhancement of microbial activity in the root zone that increases the breakdown of PAHs and PCBs.
    - Phytosequesteration – immobilization of contaminants within the root zone, limiting migration. Applicable to metals.

  Phytoremediation of the COCs in soil is implementable at the site as this technology has been proven reliable to reduce contaminants present in soils at sites with similar COCs. With regard to feasibility, access is needed to the surface in each of the areas to plant and harvest media (trees, grasses, scrubs, etc.). These areas need to be maintained and undisturbed and media need to be allowed to bioaccumulate (grasses, plants, or trees would need to grow until harvest). During the implementation period there would be risks associated with contact to COCs to workers implementing the remedy and others who could potentially come in contact with soils unless used with another process option engineering controls. Implementability would be dependent on the overall potential toxicity to plants, potential for changing site conditions due to necessary redevelopment or infrastructure repairs, and number of successful growing seasons. For some AOCs, surface area is limited and sites are occupied by structures (i.e. transformer in AOC 6). Other AOCs contain parking areas, school recreational areas, and established common areas used for recreation. Placing these ongoing treatment operations onsite until RAOs are reached, likely to be multiple growing seasons, would prevent the use of the property for its intended use (i.e. this would cause lack of use of a school playground and recreational area, limited residential use, and reduced urban/commercial space to include reduction or elimination of parking areas and sidewalks). Furthermore, infrastructure to include utilities, sidewalks, etc. are present within and surrounding most of the AOCs and phytoremediation would likely impact essential infrastructure (roots undermining sidewalks or utilities) causing further implementation issues and limiting effectiveness. Phytoremediation is not considered feasible at FFA and this process option is not retained for further consideration.

- ***Microbial Degradation*****—**Microbial degradation via reductive dechlorination or aerobic processes applies to PCBs (Aroclor 1260) in AOC 13 only. Due to the high molecular weight of BAP, it is generally recalcitrant to microbial degradation (Juhasz and Naidu 2000), and Lead is a cationic metal [3] which is resistant to microbial degradation (Olaniran, Balgobind, and Pillay). Microbial degradation has proven successful in laboratory investigations for PCBs, but *in situ* remediation has not been proven effective (Mikszewski 2004). Anaerobic organisms are responsible for the dechlorination, and given the shallow impact (6 in. to 3ft.) and presence of improvements which obstruct actions (an active transformer, sidewalk, and buildings in close proximity to the AOC 13), it would be difficult to access and sustain anaerobic conditions in these shallow depths. Studies also indicate that aerobic degradation in laboratory conditions is effective, but field-scale remediation via microbial degradation is not fully effective (Mikszewski 2004). The potential impacts to human health and the environment from the implementation of microbial degradation could potentially include contact from incompletely treated contaminated soils; therefore, the potential to meet the RAO is limited unless used with engineering controls. The reliability is also limited given the aforementioned reasons. Therefore, microbial degradation is not considered feasible at FFA and this process option is not retained for further consideration.

Chemical Treatment

- ***Zero Valent Iron*****—**Zero valent iron (ZVI) remediation applies to Aroclor 1260 and BAP impact only. Aroclor 1260 (AOC 13) could be treated by ZVI via reductive dechlorination and BAP (AOC 6) could be treated by oxidative degradation. ZVI is typically iron suspended in a liquid, and ZVI material would need to be injected throughout the impacted area to ensure complete mixing and effectiveness. The impacted soils would need to come in full contact with applied ZVI in order for dechlorination or

[3] Cationic metals are metallic elements whose forms in soil are positively charged cations.

degradation of contaminants to occur. Given the presence of improvements (an active transformer, sidewalks, and buildings in close proximity to the AOC 6 and utilities in AOC 13), effective dispersal of ZVI throughout the AOCs would be difficult and likely ineffective. The potential impacts to human health and the environment from the implementation of ZVI could potentially include contact from incompletely treated contaminated soils; therefore, the potential to meet the RAO is limited without the use of engineering controls. The reliability is also limited given the aforementioned reasons. Therefore ZVI is not considered feasible at FFA and this process option is not retained for further consideration.

Stabilization/Solidification

- ***Encapsulation by Solidification*—**This technology uses a matrix (i.e., cement, asphalt, etc.) mixed with soils to encapsulate contaminated solid material in place and thus reduce the potential for leaching and contaminant mobility. It is applicable to all COCs (lead, BAP, and Aroclor 1260). Encapsulation does not lessen the volume and toxicity of hazardous wastes, but does lessen the mobility, prevents direct contact by receptors, and reduces infiltration that can lead to leaching and subsurface migration by encasing contaminants in a solid matrix. Encapsulation is most effective where the underlying wastes or COC-impacted media are isolated above the water table, which limits the mobility of COCs, as is the case at all AOCs. Encapsulation is effective in meeting the RAOs because it encases/binds contaminants in a solid matrix which prevents human and ecological receptors from directly contacting contaminated soils. It is reliable if the binding agent successfully binds contaminants. AOCs 6, 10, 13, and 20 have impediments (transformer and other structures in AOC 6, buildings adjacent to and utilities beneath AOCs 10, 13, and 20) which will limit treatment operations and prevent complete mixing of the matrix and soils; therefore, it is not feasible to treat the soils in these AOCs. It is feasible to treat soils by solidification *in situ* in AOCs 1 and 21; therefore, encapsulation as a process option was retained for further evaluation for AOCs 1 and 21.

- ***Vitrification*—**The process of vitrification uses electrodes installed in the ground to introduce an electrical current and transform the contaminated soil into a glass. It is applicable to all COCs (lead, BAP, and Aroclor 1260). In order to vitrify the soil, soils are heated to temperatures exceeding 2,000 degrees Fahrenheit and the soils solidify and the treated area subsides. It would achieve the RAO by preventing direct contact with COCs. Factors affecting implementability include: active use of the site (residential areas with active businesses and schools), the proximity of underground utilities and tunnels and numerous buildings to the remediation areas, the large amounts of energy required, and issues with potential reuse of the areas (large solid areas requiring additional features such as topsoil or paving prior to reuse, the multitude of portable generators and cables making large areas of the site inaccessible, and the inability to re-establish grass at the current topography/elevation in certain areas given COC proximity to the surface. Installing this treatment operation onsite until RAOs are reached, would prevent the use of the property for its intended use (i.e. this would cause lack of use of a school playground and recreational area, limited residential use, and reduced urban/commercial space to include reduction or elimination of parking areas and sidewalks). Therefore, vitrification is not considered feasible at FFA and this process option is not retained for further consideration.

4.5 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Technologies and process options that have been retained from the preliminary evaluation in Section 4.4 are screened for effectiveness, implementability, and cost in the following sections using the methodology presented in Section 4.2.

4.5.1 No Action

***Effectiveness*—**The No Action response action is not effective in achieving the RAOs because neither direct contact to soil is prevented nor is ecological risk eliminated or reduced. Because no actions are conducted, there are no potential impacts to human health and the environment as a result of this action; however, soils that pose a risk to human health and the environment are left in place accessible to receptors. The No Action alternative is not reliable in preventing contact with impacted soils.

***Implementability*—**This option is very easily implemented because it requires no action. Administrative implementability may be difficult due to non-concurrence from Stakeholders. No equipment, materials, or personnel are required to implement this option.

***Cost*—**Because no actions are conducted, there are no costs associated with this action.

The NCP requires retaining the No Action alternative for comparative purposes.

4.5.2 LUCs

Technologies for LUCs that passed the initial screening are access restrictions (engineering controls) and future use restrictions (institutional controls). Applicable potential engineering controls include signage (all AOCs) and fencing (AOC 6).

***Effectiveness*—**An environmental covenant would effectively limit human exposure to contaminants through administrative or legal measures, such as limitations on land usage, and would thus be protective of human health over the short and long term. Engineering controls (signage and fencing) would prevent direct contact with the soils for human receptors over the short and long term; however, they would not prevent contact by ecological receptors. Future use restrictions are not protective of ecological receptors because they do not prevent exposure to soils exceeding the PRGs.

***Implementability*—**Both engineering controls and institutional controls can be implemented with owner support in certain AOCs. Institutional Controls include legal requirements and would necessitate future periodic reviews of compliance with the deed restrictions by USACE or others. Property owner approval may affect administrative implementability of engineering controls (such as signage, and fencing since it will provide unwelcome publicity and prevent use of the site as it was intended (i.e. signage may cause businesses and residents to consider relocating due to concerns over exposure to COCs and fencing would restrict access and use). The necessary equipment, materials, and personnel are available to perform either process option.

Cost**—**Both process options have low capital and low operation and maintenance (O&M) costs.

Considering the current site use and property owner concurrence, future use restrictions (institutional controls) are expected to be more implementable than access restrictions (engineering controls) for controlling exposure to the contaminants remaining at the site. Institutional Controls (to include future use restrictions) are retained as a technology for inclusion in the remedial alternatives. Engineering controls are not retained as a process option.

4.5.3 Excavation and Disposal

This process option would entail removal of soils containing COCs at concentrations above the PRGs to the extent determined to be practicable based on site-specific factors, such as restrictions on access to soils beneath utilities.

Effectiveness**—**Excavation and disposal would effectively remove contaminated soils from the site, and would thus prevent direct contact with impacted soil. This process option would achieve the RAO for soil. Potential impacts to human health and the environment exist due to exposure to contaminated soil, dust generation, and erosion created by excavation activities in the short term. Controls for dust and erosion would be implemented to address these impacts. Additionally, transport of the wastes to other locations has the potential for impacts to human health and the environment along the transportation corridor in the event of an accident. Engineering controls would be implemented to address those impacts. This process option is effective in the long term because it removes impacted soils exceeding PRGs, thus meeting the RAOs.

Implementability**—**Excavation and disposal would be implementable to the extent that the required access is granted by the property owners and to the extent that material can be removed while ensuring the integrity of surrounding underground utilities and structures. Standard excavation equipment such as bulldozers and excavators would be used to conduct the excavation activities, and excavated soils would be transported to an appropriate offsite disposal facility. Due to the shallow depths of excavation, it is not anticipated that shoring will be required for any of the excavations in the immediate vicinity of the buildings due to the shallow (1 ft or less) nature of impacted soils; therefore, excavations are not expected to exceed 1 ft bgs in the vicinity of improvements. In areas of deeper impacts (5 ft bgs), excavation is implementable with the required equipment, and no shoring or benching is anticipated because of the nature of the soils, which are expected to be cohesive enough to not lead to wall (excavation) failure. Where underground utilities are present, temporary de-activation or relocation of the utilities may be necessary. After removal of the impacted volume of soil, the excavation would require backfilling. The required equipment, materials, and personnel for excavation can be readily obtained and sufficient disposal capacity is available to perform this process option. This technology is commonly used and is reliable and implementable.

***Cost*—**This process option would be associated with high capital costs and low O&M costs.

Excavation and disposal is retained as a process option.

4.5.4 Containment by Cap

Installation of a cap would restrict direct contact with contaminated soils and minimize precipitation infiltration into the subsurface. Capping can consist of a layered soil cover, clay cap, geomembrane cap, asphalt, concrete, or a RCRA cap. Caps can vary in thickness and are usually covered by a layer of soil and a vegetative cover.

***Effectiveness*—**Capping does not lessen toxicity or volume of hazardous wastes, but does prevent direct contact to receptors and reduces infiltration that can lead to leaching and subsurface migration by providing a physical barrier. A cap, by itself, cannot prevent the horizontal flow of groundwater through the soil, only the vertical infiltration of water. Caps are, therefore, most effective where the underlying wastes or COC-impacted media are isolated above the water table, as is the case at all of the AOCs and for all COCs. Capping is effective in meeting the RAOs because it will prevent human and ecological receptors from directly contacting contaminated soils. Regular monitoring and maintenance would be required to ensure that the cap remains effective. Capping would not adversely impact human health or the environment other than potential short-term exposures for construction workers, students, residents, and commercial workers present onsite during construction caused by dust generation and traffic. Additionally, transport of capping materials to each AOC would increase traffic onsite.

***Implementability*—**Implementation of a cap is technically and administratively feasible for AOCs 1, 6, 10, and 20 if the required access is granted by the property owners. Technical difficulties may be encountered where capping would change the historical grade (AOCs 1, 10 and 20) and have the potential to affect surrounding historical buildings. Additional engineering controls to include grading, curbing and/or expansion or relocation of existing drainage features would need to be instituted to divert water away from existing historical buildings during times of frequent or large rain since the elevation would change if a cap was placed onsite. Technical difficulties may be encountered in AOC 6 where capping would need to be closely coordinated with the site owner due to the presence of pre-existing structures in the area (e.g., transformer and associated underground utilities, building, concrete walk, and wooden decking). AOCs 13 and AOC 21 are partially or fully covered by concrete and asphalt (capped); therefore, capping would be technically and administratively feasible in these AOCs. The required equipment, materials, and personnel to construct a cap can be readily obtained to perform this process option.

***Cost*—**Capping would have moderate capital costs and moderate O&M costs.

Capping is retained as a process option.

4.5.5 In Situ Treatment – Encapsulation by Solidification

As noted in Section 4.4.6, Encapsulation was retained for further evaluation in AOCs 1 and 21 only. Encapsulation of contaminated solid material would prevent direct contact with contaminated soils and reduce the potential for leaching and contaminant mobility. Encapsulation by solidification would require pilot testing to assess the best binding agent (such as organic binders or Portland cement) for reducing the mobility of COCs. Once the binding agent is determined, it is mixed in situ.

Effectiveness— Encapsulation does not lessen the volume and toxicity of hazardous wastes, but does lessen the mobility, prevents direct contact by receptors, and reduces infiltration that can lead to leaching and subsurface migration by encasing contaminants in a solid matrix. Encapsulation is most effective where the underlying wastes or COC-impacted media are isolated above the water table, which limits the mobility of COCs, as is the case at AOCs 1 and 21. Encapsulation is effective in meeting the RAOs because it encases/binds contaminants in a solid matrix which prevents human and ecological receptors from directly contacting contaminated soils. It is reliable if the binding agent successfully binds contaminants. Encapsulation would not adversely impact human health or the environment other than potential short-term exposures for workers and other onsite receptors including students, residents, and commercial workers during construction such as dust generation and traffic. Additionally traffic would be increased onsite due to the transport of binding agent to each AOC. Effectiveness is also a function of the degree to which the binding agent is delivered to the subsurface and uniform mixing is achieved. There will likely be difficulties effectively delivering and mixing the binding agent in areas of fill material or tight soils (silts and clays).

Implementability—The addition of binding agent changes the consistency of the soil (impermeable solid matrix) and it adds mass to the soil resulting in swelling, changing the total elevation. Most of the surface area in AOC 1 is currently manicured lawns which are historically landscaped areas that have been present since the 1800s (e.g., the Parade Ground) surrounded by historical buildings. AOC 1 would need to be restored to current conditions which include level fields of grass in conjunction with its use as a school recreational area and residential/business common area. The addition of binding agent and the addition of topsoil and grass over the encapsulated area, would necessitate additional engineering controls (i.e. new drainage features, curbing, grading, etc.) to prevent the ponding of water on top of the encapsulated soil during times of frequent or large rain events since water would not be able to naturally percolate to the water table as it does now in the grassy areas. Ponding of water could cause damage to surrounding historical buildings as well. It is anticipated that changes to the current grade will not be administratively feasible due to changes in the elevation of historically significant areas, potential impact to historical structures caused by swelling. Flooding or the addition of new drainage features.

For AOC 21, the impact is in the subsurface and the area is already partially covered by concrete and asphalt (capped). Encapsulation is expected to be technically and administratively feasible in AOC 21 as long as the required access is granted by the property owners; however, as noted, this area is already mostly covered in asphalt/concrete (capped) and solidification would change the elevation of these areas causing removal of the existing asphalt and concrete prior to solidification. The required equipment, materials, and personnel to perform solidification can be readily obtained to perform this process option.

Cost— Encapsulation of contaminated solid material would have moderate capital costs and moderate O&M costs.

Encapsulation is not retained as this process has the same effect as capping, but with more impact to the historical and existing features which necessitates the combined use with other process options for implementation. It is also likely to be less administratively feasible than capping due to greater impacts to the historical structures and current use of the site.

Table 4-1 Screening of Technologies

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening Determination	Retained for Further Evaluation	Effectiveness	Implementability	Cost	Retained for Use in Alternatives
NO ACTION	None	No action	No action. Required by National Oil and Hazardous Substances Pollution Contingency Plan as a baseline for comparison.	Not applicable – automatically retained.	Not Applicable	Does not achieve Remedial Action Objectives (RAOs).	Can be implemented	None	Yes
ACCESS RESTRICTIONS	Engineering Controls	Physical Access Restrictions	Restriction of direct access and posting trespassing and access restriction signs and/or fencing to restrict human access.	Potentially applicable	Yes	Does not achieve RAOs. Does not reduce impact to human health and the environment. Reliable in controlling access only.	Can be implemented	Low capital Low operation and maintenance (O&M)	No
	Institutional Controls	Future Use Restrictions via Environmental Covenant	Restricting use of property from digging, drilling or other specified uses without appropriate precautions.	Potentially applicable	Yes	Does not achieve RAOs. Reduces impact to human health via elimination of direct contact pathway, does not reduce impact to the environment. Reliable in controlling human health direct contact only.	Can be implemented	Low capital Low O&M	Yes
EXCAVATION	Excavation and Disposal	Excavation and Disposal	Excavation would remove source material and soil with concentrations exceeding the Preliminary Remediation Goal (PRG) to the extent practicable based on Site conditions and soil would be disposed at an approved offsite facility.	Potentially applicable.	Yes	Likely would fully meet the RAO. Reduces impact to human health and the environment Reliable in contaminated soils exceeding the PRGs.	Can be implemented	Moderate capital No O&M	Yes
	Excavation and *Ex Situ* treatment	Thermal Desorption[(1)]	Excavation would remove source material and soil with concentrations exceeding the PRG to the extent practicable based on site conditions and soil would thermally treated onsite and either placed back into the excavation or disposed at an approved offsite facility.	Not applicable for volume of soil present in the areas of concern	No	No further evaluation	No further evaluation	No further evaluation	No further evaluation
		Chemical Stabilization	Excavation would remove source material and soil with concentrations exceeding the PRG to the extent practicable based on site conditions and soil would be stabilized onsite prior to disposal at an approved offsite facility.	Potentially applicable	Yes	Likely would fully meet the RAO. Reduces impact to human health and the environment. Reliable in contaminated soils exceeding the PRGs.	Limited space and ongoing use of site limits the implementability	Moderate capital No O&M	No further evaluation

Table 4-1 Screening of Technologies

General Response Action	Remedial Technology	Process Option	Description	Preliminary Screening Determination	Retained for Further Evaluation	Effectiveness	Implementability	Cost	Retained for Use in Alternatives
EXCAVATION	Excavation and *Ex Situ* treatment	Solidification/ Encapsulation	Excavation would remove source material and soil with concentrations exceeding the PRG to the extent practicable based on site conditions and soil would be solidified or encapsulated onsite prior to disposal at an approved offsite facility.	Potentially applicable	No	Likely would fully meet the RAO. Reduces impact to human health and the environment. Reliable in contaminated soils exceeding the PRGs.	Limited space and ongoing use of site limits the implementability	Moderate capital No O&M	No further evaluation
CONTAINMENT	Capping	Impermeable Cap	Cap installed over contaminated soil to prevent exposure and transport.	Potentially applicable	Yes	Does not completely achieve RAOs.	Can be implemented	Moderate capital	Yes
***IN SITU* TREATMENT**	Physical *In Situ* Stabilization	Encapsulation	Use of matrix (cement, asphalt) to encapsulate the contaminants.	Potentially applicable	No	Does not completely achieve RAOs.	Majority of impact soils are shallow and currently landscaped. Cannot be implemented with site restoration to original state.	Moderate capital	No further evaluation
		Vitrification	Contaminated soil is converted into stable glass by use of electrical current.	Very high energy requirements for low volumes of soil make this option not implementable	No	No further evaluation	No further evaluation	No further evaluation	No further evaluation
	Bioremediation	Phyto-remediation – Biouptake	Use of plants to remediate surface water or soil/sediment.	Not feasible due to depth of contamination	No	No further evaluation	No further evaluation	No further evaluation	No further evaluation
		Microbial Degradation(2)	Microbial degradation via reductive chlorination by anaerobic organisms.	Not feasible due to depth of contamination/ ability to sustain anaerobic conditions	No	No further evaluation	No further evaluation	No further evaluation	No further evaluation
	Chemical Treatment	Zero Valent Iron (ZVI) (2)	The injection of iron oxides to remove/reduce contaminants. Aroclor 1260 is treated by ZVI via reductive dechlorination and benzo(a)pyrene is treated by oxidative degradation.	Not feasible due to silty nature of soils	No	No further evaluation	No further evaluation	No further evaluation	No further evaluation

(1) Process option specifically for Aroclor-1260.

(2) Process option for Aroclor-1260 or benzo(a)pyrene.

5. DEVELOPMENT OF ALTERNATIVES

5.1 INTRODUCTION

This chapter describes the development of remedial alternatives for Area II of FFA. The remedial alternatives are assembled using technologies and process options that were retained from the technology screening presented in Chapter 4, and are inclusive of all elements associated with additional data gap “pre-design sampling,” remedial design, construction and startup, and O&M. In assembling the retained technologies, development of the alternatives also considers factors including land use scenarios, exposure scenarios, and accommodation of ARARs and PRGs.

5.2 RATIONALE FOR ALTERNATIVE DEVELOPMENT

5.2.1 Technologies and Process Options

Remedial alternatives to achieve the RAOs were developed using the technologies and process options retained from the screening presented in Chapter 4 and as depicted on Figure 5-1. The retained GRA technologies and process options for soil are the following:

- No Action
- Future Use Restrictions
- Excavation and Disposal
- Cap.

5.2.2 Land Use Scenarios

The current and anticipated future land use in Area II is mixed use, including residential, institutional (school), and commercial. The land uses were considered when developing remedial alternatives for the site. In addition, the potential impact of remedial activities was taken into consideration. Specifically, potential health and safety hazards that may occur during implementation and impacts of the school schedule upon implementation were taken into consideration. Additionally, Area II is of historical importance and therefore remedies must maintain current general appearance and elevations.

5.2.3 Exposure Scenarios

Exposure of residents (adults and children) and office/commercial workers, construction workers, trespassers, maintenance workers, and daycare student receptors to soil were quantified as part of the HHRA in the RI. The following exposure pathways were identified as complete for all receptors:

- Ingestion of, dermal contact with, and inhalation of particulates from surface soil.

The following exposure pathways were identified as complete for residents, construction workers, and day care students:

- Ingestion of, dermal contact with, and inhalation of particulates from subsurface soil.

Rates of exposure to soil for use in the HHRA were selected based on USEPA guidance for residential exposure scenarios and for residents, office/commercial workers, construction workers, visitors, trespassers, and school children in grades 3 through 12 (ages 8 to 18).

The primary exposure pathways for ecological receptors to soil in Zone 1 (most likely zone for ecological habitat) were determined by a food-web model used to estimate the dietary intake of COPCs by wildlife species to evaluate assessment endpoint. The model utilized life history information for receptors (e.g., body weight, food-ingestion rate, etc.), in conjunction with site surface-soil concentrations of COPCs, to estimate the daily intake of COPCs (i.e., the exposure).

The remedial alternatives were crafted to address potential risks associated with these exposure pathways, in order to be protective of human health and the environment.

5.2.4 Accommodation of Applicable or Relevant and Appropriate Requirements and Preliminary Remediation Goals

ARARs and PRGs for the site are presented in Sections 3.4 and 3.5. The remedial alternatives presented in Section 5.3 are designed to achieve compliance with these ARARs and PRGs. The criteria used in detailed evaluation of alternatives (Section 6.2) include compliance with ARARs and long-term effectiveness, including achievement of RAOs and PRGs.

5.3 ALTERNATIVE DEVELOPMENT

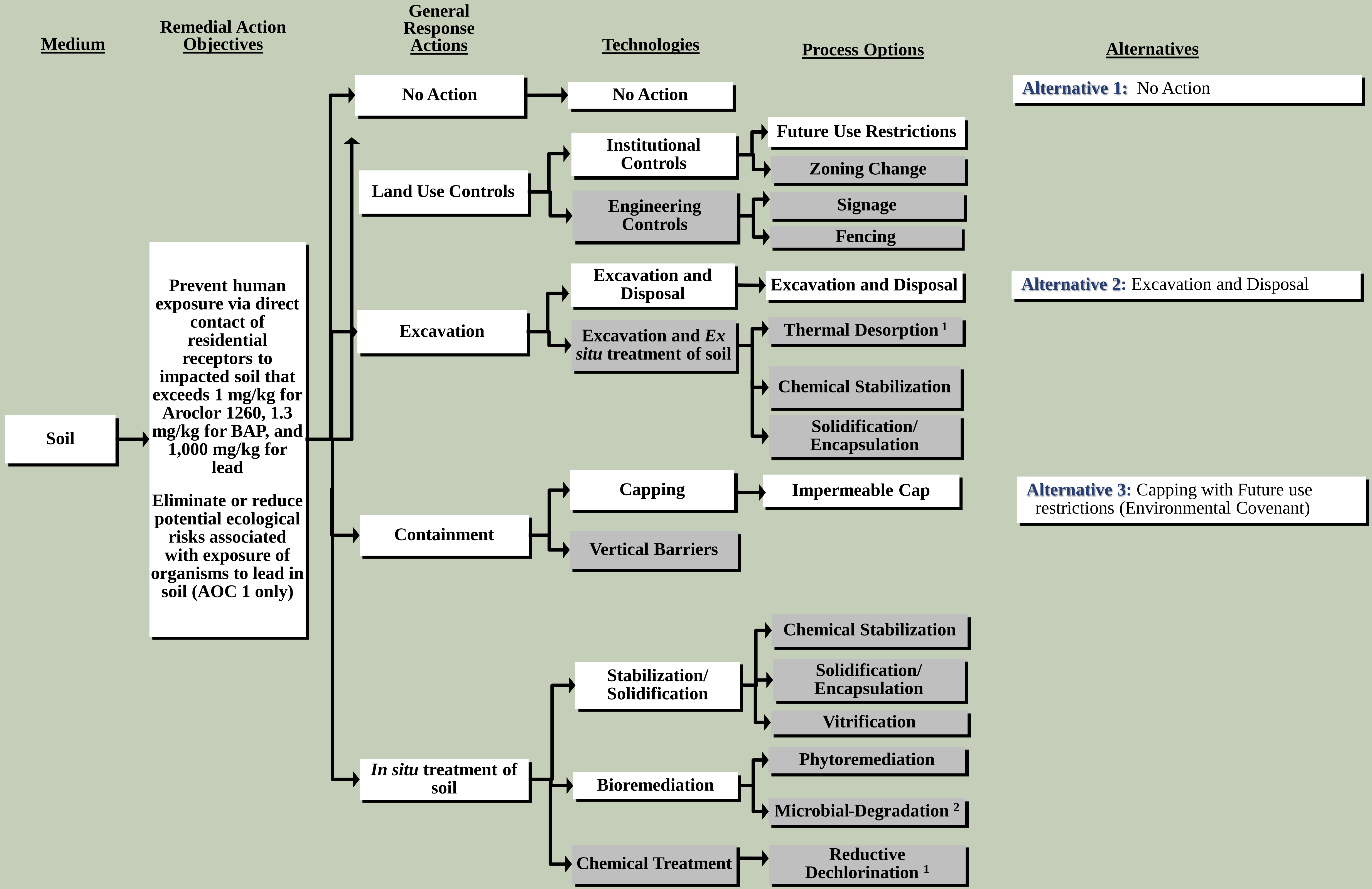
The following alternatives for soil were assembled from response actions identified in Section 5.2.1:

- ***Alternative 1—***No action

- ***Alternative 2—***Excavation and offsite disposal of soils

- ***Alternative 3—***Installation of a cap over impacted soils and future use restrictions (Environmental Covenant).

Figure 5-1 Remedial Technology Screening and Alternatives Development
Former Frankford Arsenal - Area II



Notes:
Unless indicated by a footnote technologies and process options applicable to all contaminants of concern
1 – Process option specifically for Aroclor-1260
2 – Process option for Aroclor-1260 or benzo(a)pyrene
Gray shading indicates GRA, technology type, and/or process option eliminated based on technical implementability evaluation

6. DETAILED ANALYSIS OF ALTERNATIVES

6.1 INTRODUCTION

This chapter presents descriptions and detailed analysis of the remedial alternatives for AOCs 1, 6, 10, 13, 20, and 21 that were developed in Chapter 5.

As outlined in Chapter 3, no ARARs were identified, TBC were identified for lead and BAP. RAOs and PRGs were developed to be protective of receptors that have unacceptable risk. GRAs, technologies, and process options to address the soil impacts were identified and screened in Chapter 4. In Chapter 5, technologies retained from the screening were grouped into remedial alternatives. This chapter presents detailed analysis of these alternatives. A detailed analysis of these individual remedial alternatives with respect to the NCP evaluation criteria (Section 6.2) is presented in Sections 6.3. The remedial alternatives are compared relative to each other with respect to the NCP evaluation criteria in Section 6.4. Given the complex nature of Area II, different FS alternatives may be selected for each of the AOCs based on AOC-specific conditions (impervious surface in place, manicured lawns, etc.).

6.2 DESCRIPTION OF EVALUATION CRITERIA

Pursuant to USEPA guidance, the remedial alternatives were examined for adherence to nine criteria, as specified in the NCP. These criteria are as follows:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility, or Volume through Treatment
5. Short-Term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance.

The alternatives are evaluated with respect to the first seven criteria in this FS. State acceptance will be assessed based on state review of the FS report, and community acceptance will be addressed in the Decision Document. The following factors were considered as part of the remaining seven criteria:

1. Overall Protection of Human Health and the Environment

    - Elimination or reduction of the following potential risks to human health, as identified in the HHRA:

        — Prevent human exposure to impacted soil that would result in unacceptable risk or elevated blood lead levels at identified localized areas of “elevated” concentrations.

- Elimination or reduction of the following potential risks to the environment, as identified in the ecological risk evaluation:

  — Potential ecological risks associated with exposure of organisms to lead in soil (applicable to AOC 1 only).

2. Compliance with ARARs

   - Compliance with chemical-, action-, and location-specific ARARs.

3. Long-Term Effectiveness and Permanence

   - Achievement of RAOs in the long term
   - Magnitude of residual risk
   - Adequacy and reliability of controls.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

   - Amount of hazardous materials permanently destroyed or treated, including how many principal threats are addressed
   - Degree and irreversibility of expected reductions in toxicity, mobility, or volume of soil contamination
   - The type and quantity of treatment residuals that remain after treatment is complete
   - Determination of whether the alternative satisfies the statutory preference for treatment as a principal element.

5. Short-Term Effectiveness

   - Potential impacts on community and workers during remedial actions
   - Environmental impacts during remedial actions
   - Time until remedial action objectives are achieved.

6. Implementability

   - Availability, reliability, and ease of implementation of prospective technologies
   - Administrative feasibility
   - Ability to obtain the access necessary to perform the remedial actions
   - Potential additional investigations or pilot studies required.

7. Cost[4]

- Capital costs
- O&M costs
- 30-year present worth costs (utilizing discount rate of 7 percent).

Cost estimates presented in this chapter are based on a preliminary review of the anticipated requirements for each alternative, as presented in Appendix B. The costs are based on approximate design specifications, monitoring costs, and vendor quotes, where possible. These preliminary cost estimates are anticipated to be from -30 to +50 percent of the actual costs for completing the remedial actions in accordance with CERCLA FS guidance (USEPA 1988a). [5]

6.3 ANALYSIS OF ALTERNATIVES

6.3.1 Alternative 1: No Action

6.3.1.1 Description

Pursuant to Section 300.430(e)(3)(ii)(6) of the revised NCP, the No Action alternative is developed to provide a baseline against which the other remedial alternatives are to be compared. The No Action alternative includes no remedial activities or long-term monitoring or maintenance.

6.3.1.2 Evaluation

***Overall Protection of Human Health and the Environment*—**Alternative 1 would not be protective of human health or the environment as it would not meet the PRGs. This alternative does not contain provisions that would specifically address human or environmental exposures. COCs in soil would continue to have unacceptable risks associated with exposure, as identified in the RI (EA 2014). Therefore, the No Action alternative would not be protective of human health or the environment.

***Compliance with ARARs*[6]—**No chemical-specific ARARs were identified. No ARAR waiver is justified for not complying with chemical-specific ARAR.

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[4] Costs developed in this FS are based on 2014 dollars. Present worth costs are rounded to the nearest $1,000.

[5] The extent of each AOC was delineated during the RI and the additional investigation conducted in 2014. Although there is always a degree of uncertainty with delineation, soil delineation at the Frankford site is extensive enough to determine that sensitivity analysis is not warranted. The volumes as currently delineated provide a realistic but potentially conservative estimate for costing purposes. The resolution of vertical delineation would only potentially result in reduction of costs of a magnitude that would not affect overall comparison of alternatives.

[6] Only chemical-specific ARARs were discussed, not TBCs per guidance from USACE. Also no location or action specific ARARs were identified in Section 3.

Long-Term Effectiveness and Permanence**—**Alternative 1 would not promote achievement of RAOs and would not be effective in the long term. No remedial actions or institutional controls would be enacted to address elevated COC concentrations. Unacceptable risk to human and environmental receptors would remain. The magnitude of residual risk would be high.

Reduction of Toxicity, Mobility, or Volume through Treatment**—**No principal threat wastes have been identified at Area II. No treatment or other controls are specified under Alternative 1 to reduce the toxicity, mobility, or volume of COCs. It is not expected that lead impacts would decrease in mass, and natural attenuation or degradation of Aroclor 1260 and BAP would occur slowly, so little reduction in the toxicity, mobility, or volume would occur for any of the COCs under the No Action alternative. In addition, infiltration to groundwater would be possible over time, thus groundwater impact could be possible in the future under No Action. The statutory preference for treatment as the principal element is not met.

Short-Term Effectiveness**—**There would be no increased risk to human health or the environment during implementation of Alternative 1, as no remedial actions would be conducted. This alternative would not achieve RAOs in the short term.

Implementability**—**Alternative 1 would be readily implementable in a technical sense, as no actions would be conducted. However, this alternative could be difficult to implement due to difficulties in receiving regulatory approval because potential risks would not be addressed.

Cost**—**The No Action alternative has no capital costs and no long-term costs.

6.3.2 Alternative 2: Excavation and Disposal

6.3.2.1 Description

This alternative consists of the excavation and disposal of COCs at concentrations exceeding the respective PRGs. It is assumed that future use restrictions and 5-year reviews will not be required if all COCs are removed to levels below the human-health risk-based PRGs.

Excavation and Disposal

Soils impacted with COCs exceeding the PRGs would be removed via excavation and disposed offsite at an appropriate facility. Implementation of this alternative would require that full access to each AOC be granted by the property owner. For this FS it is assumed that all soils exceeding PRGs will be fully accessible based on conditions observed during the RI. For excavations in the immediate vicinity of the existing buildings (AOCs 1, 6, 10, 13, and 20) it is assumed that excavation depths will not require any shoring of existing improvements based on the shallow nature of impacted soils (less than 1 ft bgs) since excavations will not be deeper than 1 ft bgs in the immediate vicinity of buildings. Additionally, it is also assumed that dewatering will not be required based on water levels observed during the RI. In the vicinity of Frankford Creek where it is shallowest, groundwater is encountered at approximately 5 ft bgs, which is the approximate maximum of the depth of impacted soils. It is also assumed that shoring will not be required in excavations exceeding 1 ft bgs since they are not located in the vicinity of buildings and soils are expected to be cohesive and not require shoring.

A pre-design investigation would be required to locate the numerous underground utilities present at the site. Relocation of utilities was not included in the costing assumptions. It assumed that utilities would remain in place during excavations, being de-energized as necessary. In addition, vertical delineation of soil would be performed for AOC 10 where there is limited analytical data at depth. Additional vertical delineation of impacted soils at AOC 10 would likely reduce the volume of soil to be excavated, since typically at the site lead does not exceed the PRG in native soils, which are typically found 3 to 5 ft bgs.

For AOCs where lead is the COC, for costing purposes it is assumed that XRF field screening analysis would be utilized during the excavation to determine the extent of each excavation. An instrument type-specific correlation analysis would be conducted to determine the XRF equivalent of the laboratory PRG. Confirmatory samples would be collected from the bottom and sidewall of the excavations to provide data that will demonstrate attainment of the RAO. Confirmatory samples would be submitted to an analytical laboratory.

Material would be disposed offsite at an approved facility. For this FS, it is assumed that the majority of the excavated material (80 percent) would be disposed of as non-hazardous waste, with the remaining 20 percent disposed of as characteristic hazardous waste. No Toxicity Characteristic Leaching Procedure (TCLP) samples were collected for specific AOCs soils; therefore, it is conservatively estimated that a portion of soils will be classified as hazardous based on total lead concentrations (non-TCLP) identified during the RI. Following the removal of contaminated soils, any stockpiled soils not exceeding the PRGs and clean back fill would be placed in the excavation. Site restoration would be conducted to the original pre-excavation conditions.

6.3.2.2 Evaluation

Overall Protection of Human Health and the Environment—This alternative would protect human and ecological health by decreasing the mass of COCs present at the site, and thus reducing risk to human health. The removal of soils exceeding the human-health-based PRGs would also reduce (but not eliminate) exposures to ecological receptors in AOC 1.

Compliance with ARARs— No chemical-specific ARARs were identified. The proposed PRGs for lead and BAP, which are protective of human health, are equivalent to background concentrations. The PRG for the PCB Aroclor 1260 is site-specific and risk-based. Additionally, Act 2 also allows for Background or Site-Specific Standards to be demonstrated; removal to PRGs will allow these alternate Act 2 levels to be achieved.

Long-Term Effectiveness and Permanence—Removal of the COCs exceeding PRGs would be a permanent alternative for addressing soil contamination by achieving the RAOs. This alternative would promote achievement of all RAOs, including protection of human health and reduction of risks to sensitive environments (Zone 1 ecological habitat). Residual risk would be low due to the removal of soils exceeding the PRGs. Permanent removal of soils exceeding the

PRGs would be a reliable control. Excavation of contaminated soils would not generate additional human hazards or onsite or offsite environmental impacts in the long term.

***Reduction of Toxicity, Mobility, or Volume through Treatment*—** No principal threat wastes have been identified at Area II. No treatment residuals are generated under this alternative. Excavation and disposal of COCs in soil would remove contaminated material from the site, thus reducing the volume onsite; however, this volume will be transferred to an offsite location. Toxicity is unaffected in the removed soil. Mobility of contamination is reduced by placing the soil in an engineered disposal cell. No treatment of residuals is performed under this alternative. Therefore, no reduction of toxicity, mobility, or volume is achieved. Excavation does not satisfy the statutory preference for treatment as the principal element.

***Short-Term Effectiveness*—** Potential hazards associated with excavation and disposal include short-term exposures for construction workers, students, residents, and commercial workers present onsite during construction caused by dust generation, use of heavy equipment, contact with impacted soils, and traffic. These concerns would be addressed in the site-specific Health and Safety Plan. Erosion and sediment control measures (e.g., silt fencing) and air monitoring would be implemented to minimize the potential for exposure to contaminated material outside the excavation area to avoid environmental impacts. Noise controls would be implemented as needed. Increased site traffic would occur during the implementation of this alternative (dump trucks and heavy machinery); traffic control would be addressed in the site-specific Health and Safety Plan. The excavation would create short-term site disturbance during construction. Short-term risks to the community are created during implementation. Risks to the community increase during transportation of waste to an offsite disposal facility. The potential for accidents and spilling of contaminated material exists. The use of appropriate equipment, trained personnel, planning, engineering controls, and environmental monitoring will mitigate risks. It is anticipated that this alternative would be completed in less than 6 months.

***Implementability*—**Excavation and disposal is a highly implementable remedial technology, and historically was implemented in FFA Area I. The required equipment and disposal facilities are available in the region. Owner cooperation for access and coordination of remedial activities will be needed in order to successfully implement this alternative. Active schools are present onsite; therefore, the school schedule will need to be taken into consideration during implementation of this alternative.

A pre-design investigation would be required to locate the numerous underground utilities present at the site. Additional vertical delineation could be performed for AOCs where there is limited vertical delineation (AOC 10). A pre-design investigation to vertically delineate impacted soils would likely reduce the volume of soil to be excavated, since typically at the site lead does not exceed the PRG in native soils which are typically found 3 to 5 ft bgs. These activities are easily implementable and administratively feasible.

Other logistical considerations for excavation include sediment controls (e.g., silt fencing) which would be required to prevent migration of contaminated material exposed during the excavation. Any stormwater collecting in the excavation would be collected and disposed of as appropriate. For AOCs where a pervious surface exists over all or a portion of the AOC, these surfaces would be removed and restored following excavation. For pervious surfaces, following the excavation, the area would need to be filled and re-graded with restoration to original conditions. For impervious surfaces, they would be removed and restored following excavation and backfilling. Underground utilities may need to be moved or de-energized during excavation activities. All of these logistical considerations are highly implementable.

For purposes of this FS, it is assumed that no excavation would occur below the groundwater table and, therefore, that removal and disposal of groundwater would not be required. It is also assumed that no excavations would be so deep as to require shoring. If either of these assumptions is determined to be inaccurate, the implementability of this alternative would be adversely impacted.

Cost**—**Capital costs for Alternative 2, totaling approximately $5,275,000 for all AOCs, are associated with activities supporting design of the excavation and disposal, and surveying. Costs per AOC are listed below. No O&M costs are associated with this alternative since it is assumed that no impact above the PRGs will remain in place. The total cost of this alternative, estimated over a 30-year timeframe, is approximately $5,275,000 (30-year present worth). Costing information is provided in Table 6-1, and additional backup of calculated costs is provided in Appendix B.

- AOC 1 – $832,000
- AOC 6 – $129,000
- AOC 10 – $293,000
- AOC 13 – $1,376,000
- AOC 20 – $239,000
- AOC 21 – $2,408,000.

6.3.3 Alternative 3: Installation of a Cap and Future Use Restrictions

6.3.3.1 Description

This alternative consists of the installation of a cap over COC soils exceeding the PRGs and future use restrictions.

Cap

A cap of clean fill covered by clean fill and topsoil or other cover such as asphalt would be installed over soil contamination in excess of the PRGs. A geosynthetic clay layer covered by 6 in. of clean fill and 6 in. of topsoil with grass seed (hydro-seeding) was assumed for costing purposes. For this FS, it is assumed that the capped portion in each AOC would have a 25 percent overlap. Removal of some material from the surface may be performed prior to cap placement, to allow maintenance of the current grade where possible. Capping would change the historical grade in AOCs 1, 10 and 20 and have the potential to affect surrounding historical buildings. Additional engineering controls to include grading, curbing and/or expansion or relocation of existing drainage features would need to be instituted to divert water away from existing historical buildings during times of frequent or large rain since the elevation would change if a cap was placed onsite. For costing purposes it was assumed no soil would be removed prior to cap placement and no replacement of the caps in areas where a functional cover (e.g., asphalt or concrete) is already in place (AOC 13 and AOC 21). It is also noted that no cap would be installed in AOC 6 due to technical implementability issues as previously discussed.

Future Use Restrictions

Since material exceeding the PRG would remain in place, an environmental covenant would need to be placed on the deeds of the parcels of land. Aspects of the covenants that address soil impacts include restrictions on the use of the impacted portion to limit exposure to remaining contaminated soils. The location of impacted soils, a description of the remedy, compliance reporting requirements, and any activity use limitations would be noted on the environmental covenant

5-Year Reviews

The protectiveness of the remedy to human health and the environment would be assessed in 5-year reviews. Since soils exceeding the PRGs would remain, multiple 5-year reviews would be required so long as future uses remain restricted.

6.3.3.2 Evaluation

Overall Protection of Human Health and the Environment**—**This alternative would protect human and ecological health by preventing direct contact. In the short term, future use restrictions would protect public health by limiting contact with contaminated soils.

Compliance with ARARs**—** No chemical-specific ARARs were identified. The proposed PRGs for lead and BAP, which are protective of human health, are equivalent to background concentrations. The PRG for the PCB Aroclor 1260 is site-specific and risk-based. Additionally, Act 2 also allows for Site-Specific Standards to be demonstrated; pathway elimination to soils exceeding the PRGs will achieve this alternate Act 2 standard.

Long-Term Effectiveness and Permanence**—**This alternative would promote achievement of the RAOs including protection of human health and sensitive environments. A cap would effectively prevent direct contact with human receptors as long as it is structurally intact. To ensure its long-term effectiveness and permanence, the cap would need to be maintained as long as contamination is a concern. The future use restrictions are expected to be highly reliable if overseen and enforced; however, potential risk to human health would remain if the future use restrictions were to fail, particularly if the cap was not maintained. A moderate degree of residual risk would exist since contaminated soils are left in place. Controls (capping) are adequate and reliable to prevent contact with soils.

Reduction of Toxicity, Mobility, or Volume through Treatment**—**No principal threat wastes have been identified at Area II. The cap would prevent direct contact and decrease the mobility of the COC-contaminated soil. Toxicity or volume would remain the same, but the cap would prevent direct contact with receptors. No treatment is performed under this alternative;

therefore, no reduction of toxicity, mobility, or volume through treatment is achieved. Capping does not satisfy the statutory preference for treatment as the principal element.

***Short-Term Effectiveness*—**Potential hazards associated with construction of a cap include short-term exposures for construction workers, students, residents, and commercial workers present onsite during construction caused by dust generation, use of heavy equipment, contact with impacted soils, and traffic. These concerns would be addressed in the site-specific Health and Safety Plan. Erosion and sediment control measures (e.g., silt fencing) and air monitoring would be implemented to minimize the potential for exposure to contaminated material outside the capping area to avoid environmental impacts. Noise controls would be implemented as needed. Increased site traffic would occur during the implementation of this alternative (dump trucks and heavy machinery); traffic control would be addressed in the site-specific Health and Safety Plan. The excavation would create short-term site disturbance during construction. Short-term risks to the community are created during implementation. Generally, this alternative would not generate additional human hazards or onsite or offsite environmental impacts. It is anticipated that this alternative would be completed in less than 6 months.

***Implementability*—**A cap would be highly implementable at the site if permission to modify the surface can be obtained. The site is located in an historical area, and considerations must be made in changing the grade or appearance. Where contaminated soil is shallow (AOC 1), a cap would raise the grade thus changing the physical appearance or requiring the removal and disposal of contaminated soil to keep the elevation at grade. Capping would change the historical grade in AOCs 1, 10 and 20 and have the potential to affect surrounding historical buildings. Additional engineering controls to include grading, curbing and/or expansion or relocation of existing drainage features would need to be instituted to divert water away from existing historical buildings during times of frequent or large rain since the elevation would change if a cap was placed onsite. Owner cooperation for access and coordination of remedial activities and approval of any changes to the current grade will be needed in order to successfully implement this alternative. A pre-design investigation would be needed to determine the location of any underground utilities located within the contaminated soil; relocation of underground utilities may be necessary to allow for maintenance of the cap in the future. Engineering controls (e.g., silt fencing and dust control) would be required during construction of the cap. Regular monitoring and maintenance would be required to ensure that the cap remains effective, and would need to continue as long as the cap remains in place. Future use restrictions are also highly implementable.

***Cost*—**Capital costs for Alternative 3, totaling approximately $2,287,000 for all AOCs, are associated with activities supporting design and installation of the cap, surveying, and preparation and processing of the environmental covenant and other documents needed to implement the future use restrictions. O&M costs include 5-year reviews, with average annual costs estimated to be $6,000, and a present-worth cost for O&M of $65,000 over 30 years and yearly inspections with average annual costs estimated to be $2,000 and a total present-worth cost for $25,000. The total cost estimated over a 30-year timeframe is approximately $90,000 (30-year present worth). Costing information is provided in Table 6-1, and additional backup of calculated costs is provided in Appendix B.

- AOC 1 – $829,000

- AOC 6 – $235,000
- AOC 10 – $253,000
- AOC 13 – $146,000
- AOC 20 – $290,000
- AOC 21 – $534,000.

6.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, the remedial alternatives, which were evaluated individually in Section 6.3, are compared to each other using the criteria detailed in Section 6.2. The comparison of alternatives is intended to identify the advantages and disadvantages of each alternative relative to the others, based on seven criteria evaluated, so that the key decision-making trade-offs can be identified. Table 6-2 summarizes this comparative analysis.

6.4.1 Overall Protection of Human Health and the Environment

Alternatives 2 and 3 are expected to be protective of human health and the environment. Alternative 2 will remove COCs above the PRGs eliminating risk to human health and will decrease risk to the environment. Alternative 3 will protect human health and the environment by preventing direct contact with soils that have COCs exceeding the PRGs. Alternative 1 (No Action) would not be protective of human health and the environment because it does not address potential exposure to contaminated soil. All of the alternatives except for Alternative 1 would be protective of human health and the environment.

6.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

No chemical-specific ARARs were identified. The proposed PRGs for lead and BAP, which are protective of human health, are equivalent to background concentrations. The PRG for the PCB Aroclor 1260 is site-specific and risk-based. No location- or action-specific ARARs were identified.

For Alternatives 2 and 3, meeting the TBC criteria for lead and BAP (MSCs) is technically impracticable from an engineering perspective. However, Act 2 also allows for Background or Site-Specific Standards to be demonstrated; removal to PRGs will allow these alternate Act 2 levels to be achieved.

6.4.3 Long-Term Effectiveness and Permanence

Alternatives 2 and 3 would promote achievement of all RAOs, although there is a level of uncertainty associated with the effectiveness of Alternative 3. The COC removal under Alternative 2 is a permanent alternative for addressing overall contamination at the site. For Alternative 3, effectiveness would depend on maintenance to ensure the integrity of the cap. Alternative 1 would not be effective as it would not address any of the RAOs. The magnitude of risk is high for Alternative 1, low for Alternative 2, and moderate for Alternative 3.

Overall, Alternative 2 would be the most effective and permanent option for achieving the RAOs at the site, followed by Alternative 3.

6.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Since none of the proposed alternatives achieve remediation through treatment, they do not permanently destroy hazardous materials. Additionally, no treatment residuals are associated with the proposed alternatives. Toxicity is not reduced under the alternatives; mobility is reduced under Alternatives 2 and 3. The statutory preference for treatment as the principal element is not met under the proposed alternatives.

6.4.5 Short-Term Effectiveness

Alternative 2 would have the most potential impacts to workers, the surrounding community, and the environment because it is the most invasive and would include removal and transportation of hazardous soil. Alternative 3 would create smaller impacts associated with removal of small amounts of relatively clean or low impacted soil during installation of the cap. Alternative 1 would not create any additional risks to workers, the community, or the environment beyond those already present at the site.

Alternatives 2 would meet the objective for protection of human health when excavation is complete and Alternative 3 would meet the objective as soon as additional restrictions are in place. Both would achieve protection of receptors within a year of implementation. Therefore, these RAOs are expected to be met within 1–2 years under Alternatives 2 or 3.

Overall, Alternative 3 would have the best short-term effectiveness, followed by Alternative 2. Alternative 1 would not achieve protection of receptors.

6.4.6 Implementability

Alternatives 2 and 3 have the potential to be implementable at the site. Alternative 2 relies primarily on proven and reliable technologies and standard equipment. Considerations on the implementation of this alternative include scheduling the excavation during times the onsite schools are not in session for those AOCs in close proximity to school areas and the possible relocation of underground utilities. Implementation of Alternative 3 would depend on the depth of contaminated soil and AOC-specific considerations. The site is located in an historical area, and considerations must be made in changing the grade or appearance. Where contaminated soil is shallow (AOC 1), a cap would raise the grade thus changing the physical appearance or require the removal and disposal of contaminated soil to keep the elevation at grade. Additional engineering controls to include grading, curbing and/or expansion or relocation of existing drainage features would need to be instituted to divert water away from existing historical buildings during times of frequent or large rain since the elevation would change if a cap was placed onsite. For AOCs that are currently covered by an impervious surface (AOC 13), this alternative is highly implementable. These alternatives would require pre-design investigations. Alternative 3 would also require long-term maintenance for continued reliability in the long term.

Overall, Alternatives 2 and 3 would be the most implementable. Alternative 3 would be somewhat less implementable depending on the depth of contamination. Alternative 1 would not be implementable from an administrative standpoint because it does not address contamination or risks.

6.4.7 Cost

The costs presented in this FS are approximate and are primarily used for comparison purposes. Total estimated costs (as adjusted for present worth over the specified time periods) of the alternatives, in order from highest to lowest for each AOC, are as follows:

<u>AOC 1</u>
- Alternative 3: Cap with Environmental Covenant – $829,000
- Alternative 2: Excavation and Disposal – $832,000
- Alternative 1: No Action – $0

<u>AOC 6</u>
- Alternative 3: Cap with Environmental Covenant – $235,000
- Alternative 2: Excavation and Disposal – $129,000
- Alternative 1: No Action – $0

<u>AOC 10</u>
- Alternative 2: Excavation and Disposal – $293,000
- Alternative 3: Cap with Environmental Covenant – $253,000
- Alternative 1: No Action – $0

<u>AOC 13</u>
- Alternative 2: Excavation and Disposal – $1,376,000
- Alternative 3: Cap with Environmental Covenant – $146,000
- Alternative 1: No Action – $0

<u>AOC 20</u>
- Alternative 3: Cap with Environmental Covenant – $290,000
- Alternative 2: Excavation and Disposal – $239,000
- Alternative 1: No Action – $0

<u>AOC 21</u>
- Alternative 2: Excavation and Disposal – $2,407,000
- Alternative 3: Cap with Environmental Covenant – $534,000
- Alternative 1: No Action – $0.

Table 6-1 Detailed Analysis of Remedial Action Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Excavation And Disposal	Alternative 3 Impermeable Cap With Future Use Restrictions
Overall Protection of Human Health and the Environment			
Human Health Protection	Does not provide protection.	Provides protection.	Provides protection.
Environmental Protection	Does not provide protection.	Reduces.	Provides protection.
Compliance with ARARs			
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	Does not comply with ARARs.	Complies with ARARs through removal of contaminants of concern.	Complies with ARARs by preventing contact.
Long-Term Effectiveness and Permanence			
Magnitude of Residual Risk	Does not provide long-term effectiveness and is not permanent. Does not address the identified risks at the site.	Provides long-term effectiveness since contamination greater than preliminary remediation goals is removed from the site. Permanence is provided because waste is removed from the site.	Provides long-term effectiveness with the implementation of site restrictions. Future risk is not completely eliminated since contaminant mass is not removed from the site. Permanence is dependent upon future maintenance.
Adequacy and Reliability of Controls	No controls are implemented.	No controls are implemented.	The adequacy and reliability of access restrictions is considered high. Oversight of future use restrictions would be required.
Reduction of Toxicity, Mobility, or Volume			
Treatment Process Used	Treatment is not conducted.	Treatment is not conducted.	Treatment is not conducted.
Amount Treated	Not applicable.	Not applicable.	Not applicable.
Reduction of Toxicity, Mobility, or Volume through Treatment	Not applicable.	Not applicable.	Mobility reduced through decreased infiltration.
Type/Quantity of Residuals Remaining After Treatment	Not applicable.	Not applicable.	Not applicable.

Table 6-1 Detailed Analysis of Remedial Action Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Excavation And Disposal	Alternative 3 Impermeable Cap With Future Use Restrictions
Short-Term Effectiveness			
Community Protection	No additional risks posed to the community beyond that which is already at site.	Short-term risks to the community are created during implementation. Risks to community increase during transportation of waste to offsite disposal facility. The potential for accidents and spilling of contaminated material exists. The use of appropriate equipment, trained personnel, planning, engineering controls, and environmental monitoring will mitigate risks.	Short-term risks to the community are created during implementation. The use of appropriate equipment, trained personnel, planning, engineering controls, and environmental monitoring will mitigate risks.
Worker Protection	No additional risks to workers.	Short-term risks to workers are created during implementation; however, use of personal protective equipment, safety plans, environmental monitoring, and the use of trained personnel would mitigate these risks.	Short-term risks to workers are created during implementation; however, use of personal protective equipment, safety plans, environmental monitoring, and the use of trained personnel would mitigate these risks.
Environmental Impacts	No additional risks to the environment.	Impacts to the environment are possible. Erosion and sediment controls would be used to prevent contaminant migration. Dust monitoring and control would mitigate impacts to air quality.	Impacts to the environment are possible. Erosion and sediment controls would be used to prevent contaminant migration. Dust monitoring and control would mitigate impacts to air quality.
Time to Complete Action	Not applicable.	Two months total all areas of concern (AOCs). This period does not include associated design, mobilization, and reporting.	Two months total all AOCs. This period does not include associated design, mobilization, and reporting.
Implementability			
Technical Feasibility	No activities are conducted; therefore, there is no technical difficulty associated with implementation.	Excavation is a proven and reliable technology. Implementation requires the use of standard construction equipment and methods. In addition, the equipment is available. Facilities for offsite disposal are available. The technical feasibility is considered high.	Capping is a proven and reliable technology. Implementation requires the use of standard construction equipment and methods. In addition, the equipment and required materials are available. Deed restrictions Environmental Covenant) are implementable.

Table 6-1 Detailed Analysis of Remedial Action Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Excavation And Disposal	Alternative 3 Impermeable Cap With Future Use Restrictions
Administrative Feasibility	The contamination is not addressed and risks are not eliminated or reduced. Therefore, the administrative feasibility is low.	Excavation and offsite disposal of contaminated soil is a reliable alternative. There are no future use limitations, site restrictions, or long-term oversight required. The administrative feasibility is considered high.	Any permits needed for a cap and be obtained. Future use restrictions (environmental covenant) can be obtained. The administrative feasibility is considered high.
Availability of Services and Materials	None required	Services and materials are readily available.	Services and materials are readily available.
Potential Additional Investigation or Pilot Studies	None required.	Would require detailed utility survey in proposed excavation areas. Additional delineation for AOCs where needed.	Would require detailed utility survey in proposed capping areas.
Cost (Millions)			
Cost (Net Present Value)[(a)]	$0	$5,277,000	$2,287,000
AOC 1		$832,000	$829,000
AOC 6		$129,000	$235,000
AOC 10		$293,000	$253,000
AOC 13		$1,376,000	$146,000
AOC 20		$239,000	$290,000
AOC 21		$2,408,000	$534,000

(a) Net present value costs are based upon 7% discount rate.

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Table 6-2 AOC 1 – Comparative Analysis of Remedial Action Alternatives

Alternative	Overall Protection of Human Health and the Environment	Compliance with Applicable or Relevant and Appropriate Requirements	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness/ Time to Implement	Implementability	Cost (Net Present Value in Dollars)
Alternative 1 No Action	Low	No	Low	None	Not applicable	Low	$0
Alternative 2 – Excavation and Disposal	High	Yes	High	Low	Medium	High	AOC 1 – $832,000 AOC 6 – $129,000 AOC 10 – $293,000 AOC 13 – $1,376,000 AOC 20 – $239,000 AOC 21– $2,408,000
Alternative S3 Cap and Future Use Restrictions	High	Yes	Medium	Low	High	High	AOC 1 – $829,000 AOC 6 – $235,000 AOC 10 – $253,000 AOC 13 – $146,000 AOC 20 – $290,000 AOC 21– $534,000

NOTES: Ratings: High is the most favorable rating; low is the least favorable rating.
Net present value costs are based on a 7 percent discount rate.

7. SUMMARY AND CONCLUSIONS

This FS addresses contaminated soil within Area II at the Former Frankford Arsenal in Philadelphia, Pennsylvania. The COCs are lead, BAP, and Aroclor 1260. Comparative analysis (Table 6-2) was conducted for each AOC using the seven evaluation criteria to include:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility, or Volume through Treatment
5. Short-Term Effectiveness
6. Implementability
7. Cost

A summary of the relative ranking (most favorable to least favorable) based on the comparative analysis for each AOC is presented below.

7.1 AOC 1 – LEAD

Based on the comparative analysis of proposed alternatives as described in Chapter 6 (Table 6-2), alternatives for AOC 1 are ranked from most favorable to least favorable as follows:

- *Alternative 2* – Excavation and disposal of soils to levels below the PRGs
- *Alternative 3* – Installation of a cap over impacted soils and future use restrictions
- *Alternative 1* – No Action.

Alternative 2 would be the most effective, permanent, and implementable alternative overall because it includes the removal of contaminated soil, and no future use restrictions, O&M, or 5-year reviews would be required. Contaminated soils are shallow in AOC 1 (less than 1 ft bgs); therefore, they are easily accessible. The next most favorable alternative is Alternative 3, which would cover contaminated soils, and thus eliminate the direct contact pathway. However, given the shallow depth of impact, a cap would result in the elevation of areas exceeding the PRGs. This is not favorable in the context of the historical setting.

7.2 AOC 6 – AROCLOR 1260

Based on the comparative analysis of proposed alternatives as described in Chapter 6, alternatives for AOC 6 are ranked from most favorable to least favorable as follows:

- *Alternative 2* – Excavation and disposal of soils to levels below the PRGs
- *Alternative 3* – Installation of a cap over impacted soils and future use restrictions
- *Alternative 1* – No Action.

Alternative 2 would be the most effective, permanent, and implementable alternative overall because it includes the removal of contaminated soil, and no future use restrictions, O&M, or 5-year reviews would be required. Contaminated soils are shallow in AOC 6 (0–3 ft bgs); therefore, they are easily accessible. Additionally, the cost of Alternative 2 is less than Alternative 3. The next most favorable alternative is Alternative 3, which would cover contaminated soils, and thus eliminate the direct contact pathway. However, given the shallow depth of impact, a cap would result in the elevation of areas exceeding the PRGs. A temporary loss of service may be experienced during the implementation of Alternative 2 and Alternative 3.

7.3 AOC 10 – LEAD

Based on the comparative analysis of proposed alternatives as described in Chapter 6, alternatives for AOC 10 are ranked from most favorable to least favorable as follows:

- *Alternative 2* – Excavation and disposal of soils to levels below the PRGs
- *Alternative 3* – Installation of a cap over impacted soils and future use restrictions
- *Alternative 1* – No Action.

Alternative 2 would be the most effective, permanent, and implementable alternative overall because it includes the removal of contaminated soil, and no future use restrictions, O&M, or 5-year reviews would be required. Contaminated soils are shallow in AOC 10 (0–5 ft bgs); therefore, they are easily accessible. The costs for Alternative 2 are higher than Alternative 3; however, it should be noted limited vertical delineation at this location may result in an over estimation of soil above the PRG; therefore, costs may be less than calculated for Alternative 2. The next most favorable alternative is Alternative 3, which would cap contaminated soils, and thus eliminate the direct contact pathway. However, given the shallow depth of impact, a cap would result in the elevation of areas exceeding the PRGs.

7.4 AOC 13 – BAP

Based on the comparative analysis of proposed alternatives as described in Chapter 6, alternatives for AOC 13 are ranked from most favorable to least favorable as follows:

- *Alternative 3* – Installation of a cap over impacted soils and future use restrictions
- *Alternative 2* – Excavation and disposal of soils to levels below the PRGs
- *Alternative 1* – No Action.

Alternative 3 is the most implementable and cost-effective of the proposed alternatives because areas of the AOC that exceed the PRG are located in soils located underneath existing asphalt paving, which overlies at least 8 in. of concrete in most areas of the AOC. As such, the costs for Alternative 3 are much lower than Alternative 2 (excavation). Implementation of Alternative 2 would necessitate the removal and replacement of these impervious surfaces. In addition, utilities that traverse this area would need to be supported or rerouted. Given the thickness of these impervious surfaces, it is not likely that they will be removed other than to access existing underground utilities. These activities would not expose residential receptors. The next most favorable alternative is Alternative 2, which would remove contaminated soils.

7.5 AOC 20 – LEAD

Based on the comparative analysis of proposed alternatives as described in Chapter 6, alternatives for AOC 20 are ranked from most favorable to least favorable as follows:

- *Alternative 2* – Excavation and disposal of soils to levels below the PRGs
- *Alternative 3* – Installation of a cap over impacted soils and future use restrictions
- *Alternative 1* – No Action.

Alternative 2 would be the most effective, permanent, and implementable alternative overall because it includes the removal of contaminated soil, and no future use restrictions, O&M, or 5-year reviews would be required. It is also less costly than Alternative 3. Contaminated soils are shallow in AOC 20 (0–2 ft bgs); therefore, they are easily accessible. The next most favorable alternative is Alternative 3, which would cover contaminated soils, and thus eliminate the direct contact pathway. However, given the shallow depth of impact, a cap would result in the elevation of areas exceeding the PRGs.

7.6 AOC 21 – LEAD

Based on the comparative analysis of proposed alternatives as described in Chapter 6, alternatives for AOC 21 are ranked from most favorable to least favorable as follows:

- *Alternative 3* – Installation of a cap over impacted soils and future use restrictions
- *Alternative 2* – Excavation and disposal of soils to levels below the PRGs
- *Alternative 1* – No Action.

Alternative 3 is the most implementable and cost-effective of the proposed alternatives, because a portion of the soils that exceed the PRG is currently located underneath existing asphalt paving. The next most favorable alternative is Alternative 2, which would remove contaminated soils. However, implementation of Alternative 2 would necessitate the removal and replacement of the existing paving. Potential redevelopment of this area includes future recreational use associated with onsite schools.

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Appendix A

2014 Additional Investigation

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2014 Supplemental Investigation Summary

As part of this Feasibility Study (FS), a supplemental investigation was conducted in November 2014 to collect data to further delineate subsurface lead soil exceedances within the Parade Ground and to assess the potential for vapor intrusion in the vicinity of Building 201 (Area of Concern 13). The objectives of the investigation and summary of the results are provided below.

Objectives and Sampling Rationale

Soil

A localized area of "elevated" concentration for lead was identified by the risk assessment in the Parade Ground associated with Remedial Investigation (RI) sample boring Z1D07. The RI Report indicated that elevated lead concentrations were reported to depths of 2 feet (ft) below ground surface (bgs) in the vicinity of one RI boring (Z1D07) previously installed at the Parade Ground. A review of comparison to stratigraphy observed during a historical and archeological survey of the Former Frankford Arsenal completed in 1979 by John Milner Associates indicated a possible correlation to elevated lead concentrations and a fill layer reportedly deposited in the Parade Ground in the 1970s.

The sampling objective for soil for the 2014 Supplemental Investigation was to vertically and horizontally delineation for lead in the vicinity of RI boring Z1D07. A total of 19 soil borings were advanced to determine the extent of lead impacts deeper than 6 inches (in.) across the Parade Ground. Soil borings were installed, and were clustered around RI boring Z1D07 and across the remainder of the Parade Ground (refer to Figure 2-4 of the FS for sample locations) and advanced via direct-push technology to a depth of 5 ft bgs. Field screening for lead in soil was conducted using an X-ray fluorescence (XRF) analyzer (a total of 154 samples), and confirmation soil samples (total of 20) were submitted for laboratory analysis for lead via United States Environmental Protection Agency (USEPA) Method 6010.

Soil Vapor

The RI Report indicated that two RI soil sample locations (UBZ3-38 and UBZ3-55) exceeded the Pennsylvania Department of Environmental Protection vapor intrusion soil screening criteria, UBZ3-38 and UBZ3-55. These sample locations were within approximately 25 and 100 ft of Building 201, respectively.

For the 2014 Supplemental Investigation, the sampling objective for soil vapor was to assess vapor concentrations within and in the vicinity of Building 201. One interior sub-slab soil vapor point (BZ3-1-SG) was installed and sampled in the southwest stairwell of Building 201, and two exterior soil vapor points were installed and sampled; one was adjacent to UBZ3-38 (BZ3-2-SG) and one was north of UBZ3-55 close to the south end of Building 202 (BZ3-3-SG) as illustrated on Figure 2-5 of the FS. Vapor samples were submitted for laboratory analysis for volatile organic compounds (VOCs) via USEPA Method TO-15. The ongoing collection of new soil vapor samples occurred in November 2014, and an additional (winter) round of vapor sampling was conducted in January 2015. Underground utilities in the vicinity of UBZ3-55 did not allow for sampling in the immediate vicinity; therefore, the sample was offset to the north closer to the closest occupied building.

Sampling Methodology

Soil

A total of 19 borings were advanced in the Parade Ground area. Prior to intrusive activities, sample locations were cleared for utilities by Delta Geophysics in addition to the Pennsylvania One Call (Ticket Number 20143092323-000). Samples were collected for XRF analysis field screening every 6 in. in each boring. Lithology was logged on soil boring logs (provided as Attachment A). A total of 20 confirmatory samples were submitted to ChemTech of Mountainside, New Jersey for analysis of lead via USEPA Method 6010.

A portable XRF analyzer was used to screen for lead in soil samples collected during delineation sampling. A total of 154 samples were field screened via XRF, with duplicate samples collected a rate of 10 percent per EA Engineering, Science, and Technology, Inc., PBC standard operating procedure. Soil analyses were performed using an Innov-X Delta XRF and a 60-second analysis time was utilized. Analytical results were recorded in the field logbook and were also downloaded periodically to a laptop computer. Data collected included the excitation time (per sample), sample analysis number, result, error on the result, and analysis date.

Soil Gas

Prior to intrusive activities, sample locations were cleared for utilities by Delta Geophysics in addition to the Pennsylvania One Call (Ticket Number 20143092340-000). At the exterior sample locations, permanent soil gas sampling points were constructed to allow for at least two rounds of soil gas sampling. Construction of a soil gas sampling point is similar to a monitoring well with the exception that the screen is placed above the water table. Soil gas sampling points were constructed using pre-assembled soil gas sampling points. Clean medium sand was used to construct the filter pack from the bottom of the sampling point to 3 to 6 in. above the top of the screened interval. A minimal 2-in. bentonite seal was installed after the filter pack to eliminate the infiltration of ambient or non-sample zone air. Bentonite seals were composed of commercially available 100 percent sodium bentonite chips or powder. Each soil gas sampling point was finished as a flush mount.

The interior sampling point consisted of a 0.5-in.-diameter boring advanced with an electric impact drill through the concrete and into the sub-base gravel. The resultant hole was cleared of concrete dust with a shop vacuum prior to introducing dedicated laboratory-grade, certified clean, ¼-in.-diameter tubing into the hole. The annular space around the tubing was sealed with non-toxic duct putty. After sampling was complete, tubing was removed and sealed with concrete.

Each sampling location was screened with a photoionization detector once the sample tubing was in place and prior to collecting a sample. Before soil gas sample collection, the seal between the concrete/asphalt and tubing was also tested for tightness using a helium tracer test. A plastic bucket was placed over the surface of the sampling point to serve as a shroud between the helium gas and the ambient air. Helium gas was introduced into a shroud to create a helium-enriched environment and to temporarily displace the ambient air. Helium concentrations in the shroud were measured using an MGD-2002 multi-gas detector. The interior of the shroud was allowed to reach approximately 50 percent helium. The concentration of helium in air flowing from the subsurface slab through the tubing from the sample point then was measured with the helium detector to determine the amount of helium penetrating around the seal in the annular space of the sampling point. A leak would be indicated if the borehole contained greater than 5 percent of the concentration of helium under the shroud. The comparison of results in the shroud, versus in the tubing, are considered acceptable when the concentration in the tubing is less than 5 percent of the helium concentration in the shroud. Helium testing results were within the acceptable range and sampling was commenced. Results of testing were documented on field sampling forms (Attachment B).

The Summa canisters used for sampling were cleaned and certified by the laboratory, and leak checked prior to shipment. For sample collection, each Summa canister was fitted with a laboratory-calibrated flow controller (a.k.a. "regulator"). Flow controllers are precisely calibrated by the laboratory for the project-specific requirements, in this case for a 24-hour sample. Team members made no adjustments to any of the settings or knobs on the flow controller. The flow controller was attached to the canister following laboratory instructions. Field personnel checked the vacuum pressure prior to using each Summa canister; only Summas with a vacuum of at least -25 were used. Sample collection was started by opening the canister valve. Following the sample collection period, the canister valve was closed. The time for the start and finish of each sample collection was recorded on the field sampling form and laboratory chain-of-custody. Following the conclusion of the sampling period, the canisters were hand carried to the receiving laboratory via courier, ChemTech, and analyzed for the full list of VOCs, via USEPA Method TO-15 under standard turn-around-time.

Results

Soil

The complete results of the XRF field screening are provided in Attachment C, and laboratory results are included in Attachment D and illustrated, along with sample locations, on Figure 2-8 of the FS. One location, BZ1-14, exceeds 1,000 mg/kg to a depth of 30 in. bgs. This indicates that subsurface lead impact occurs in an isolated area and is not widespread across the Parade Ground.

Soil Gas

The results of soil gas sampling are provided on Table 2-4 of the FS, and laboratory results are included in Attachment D. During the November 2014 sampling event vinyl chloride was detected above the residential and non-residential medium-specific concentration (MSC), and cis-1,2 dichloroethene was detected above the residential MSC, at the sample location south of Building 202 (BZ3-3-SG) in the sample collected from BZ3-3-SG. Carbon tetrachloride was detected above the residential MSC in the sample collected south of Building 201 from (BZ3-2-SG). No compounds were detected above screening criteria in the sub-slab sample location within the southwest corner of Building 201 (BZ3-1-SG).

A second round of soil gas sampling was conducted in January 2015 for locations BZ3-1 and BZ3-2; BZ3-3 was not sampled due to the intake of water into the sampling line. Carbon tetrachloride and chloroform were detected above the residential MSC in the sample collected south of Building 201 from (BZ3-2-SG). No compounds were detected above screening criteria in the sub-slab sample location within the southwest corner of Building 201 (BZ3-1-SG). BZ3-3 was sampled in March 2015 after the vapor point was reset to prevent the uptake of water. No compounds were detected above screening criteria. A confirmatory sample was collected at this location in September 2015, no compounds were detected above screening criteria.

XRF Quality Control and Comparability

To ensure data quality, calibration checks, blank analyses, and calibration verification analyses were performed. The following sections discuss the data quality of the XRF analyses.

XRF Comparability Analysis

Per EPA Method 6200 (Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment), a least squares regression analysis was conducted for lead in order to assess the comparability of the XRF screening data and confirmatory 6010B data. Data were log-transformed to standardize variance due to the range of lead results (varied from less to 10 to over 10,000 milligrams per kilogram [mg/kg]). A total of 20 samples that were submitted for 6010B confirmatory analysis were used in the linear regression for lead. No outliers were removed from the analysis. Figure 1 illustrates the least squares regression.

The assessment of comparability between the XRF screening data and confirmatory 6010B data resulted in a least squares regression equation with a coefficient of correlation of 0.975 (97.5 percent). Per USEPA Method 6200, a correlation coefficient 0.7 or greater is valid for screening level data; therefore, data generated in this investigation are valid to use for screening level data. The analysis resulted in the following regression equation:

$$\text{Lab} = 1.02 * \text{XRF}^{1.01}$$

Based on this equation, laboratory concentration of 1,000 mg/kg of lead equates to an XRF concentration of 916 mg/kg.

Accuracy

The accuracy of the XRF screening was assessed by evaluating the percent recovery between a known standard reference material (SRM) concentration and the reported XRF concentration. The data quality objective (DQO) for percent recovery is between 80 and 120 percent. The SRMs used during the evaluation were certified by the National Institute of Standards and

Technology (NIST) and were designated as NIST 2709 (lead concentration of 18.9 mg/kg), NIST 2710a (lead concentration of 5,520 mg/kg), and NIST 2711 (lead concentration of 1,162 mg/kg). Each SRM was analyzed before and after field screening samples were analyzed.

The percent recoveries for each of the SRMs for lead that were analyzed during the course of the investigation are included in Attachment C. Of the six lead SRM analyses, five results were within the DQO recovery range indicating the XRF data were accurate for lead. One result for SRM 2709a had a high recovery (138 percent).

Blank Analyses

Analysis of a silicon dioxide blank was performed at the beginning of the analyses for the day and at the end of the analyses. The blank was analyzed to ensure there was no cross-contamination occurring during XRF sample analysis. Lead was not detected in the blank analyses. Results are summarized in Attachment C.

Duplicate Analyses

Duplicate samples were collected at a rate slightly less than 10 percent (1 in 10) for XRF analysis, with a total of 15 duplicates analyzed and 154 total normal samples analyzed. The duplicate sample for XRF analysis was analyzed from the same sample bag as the parent with additional homogenization between analyses. Sample results for lead are presented in Attachment C. Of the 15 duplicates, 6 duplicate pairs exceeded a relative standard deviation (RSD) of 20 percent with the maximum RSD being 89.8%. Samples that exceed 20 percent relative percent difference between parent and duplicate samples can be attributed to matrix interference and variability between low detected concentrations.

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Attachment A

Soil Boring Logs

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LOG OF SOIL/ROCK BORING

Coordinates: ____________

Surface Elevation: ____________

Casing Below Surface: ____________

Reference Elevation: ____________

Reference Desc: ____________

Job. No.	Client: USACE			Locatior BZ1-7
Drilling Method: DPT				Boring No. 7
Sampling Method:				Sheet 1
				Drilling
Water Level				Start / Finish
Time	-			
Date				
Reference				

Inches Drvn/In. Recvrd	XRF Interva (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Surface Conditions: Grass in Parade Ground
48	0-6	298						0-5 ft
	6-12	114	0		1		topsoil	0-10" - Brown (7.5 YR 5/3) SILT, trace organics
	12-18	24						10-35" - Strong brown (7.5 YR 5/6), SILT, firm, hard
	18-24	8	0		2		ML	36-48" - Reddish yellow (7.5 YR 6/6) SILT and
	24-30	14						FINE SAND
	30-36	19	0		3			
	36-42	14						
	42-48	12	0		4			
							SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt Date: 14 November 2014

Drilling Contractor: Eichelbergers Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-8
Drilling Method:	DPT
Boring No.	8
Sampling Method:	
Sheet	1
Coordinates:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

Water Level				Drilling Start	Drilling Finish
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
50	0-6	254						0-5 ft
	6-12	210	0		1		topsoil	0-10" - Brown (7.5 YR 5/2) SILT, trace organics, dry
	12-18	33						10-22" - Light brown (7.5 YR 56/4), SILT, dry
	18-24	51	0		2		ML	22-38" - Reddish yellow (7.5 YR 6/6) SILT, hard, dry
	24-30	16						38-50" Light brown (7.5 YR 6/4) SILT and FINE SAND
	30-36	14	0		3			
	36-42	9						
	42-48	<LOD	0		4			
							SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-9
Drilling Method:	DPT
Boring No.	9
Sampling Method:	
Sheet	1

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

Water Level			
Time	-		
Date			
Reference			

Drilling Start	Drilling Finish

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interva (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	
52	0-6	157						0-5 ft
	6-12	246	0		1		topsoil	0-16" - Brown (7.5 YR 5/4) SILT, trace cinders, firm
	12-18	302					ML	16-47" - Strong brown (7.5 YR 5/6), SILT
	18-24	170	0		2			47-52" - Light brown (7.5 YR 6/4) SILT and FINE to MEDIUM
	24-30	101						SAND, trace gravel
	30-36	23	0		3			
	36-42	20					SM	
	42-48	19	0		4			
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

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and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-10
Drilling Method:	DPT
Boring No.	10
Sampling Method:	
Sheet	1

Coordinates: ______
Surface Elevation: ______
Casing Below Surface: ______
Reference Elevation: ______
Reference Desc: ______

Water Level			
Time	-		
Date			
Reference			

Drilling	
Start	Finish

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
50	0-6	184						0-5 ft
	6-12	151	0		1		topsoil	0-8" - Brown (7.5 YR 4/3) SILT, trace organics, moist
	12-18	28						8-14" - Brown (7.5 YR 5/4) SILT, trace cinders
	18-24	26	0		2		ML	14-42" - Strong Brown (7.5 YR 5/6) SILT, firm
	24-30	44						42-50" - Light brown (7.5 YR 6/4) SILT and FINE SAND, firm,
	30-36	9	0		3			loose
	36-42	14						
	42-48	11	0		4			
							SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	Client: USACE		Location: BZ1-11
Drilling Method: DPT			Boring No. 11
Sampling Method:			Sheet 1

Coordinates: ____________

Surface Elevation: ____________

Casing Below Surface: ____________

Reference Elevation: ____________

Reference Desc: ____________

				Drilling Start	Drilling Finish
Water Level					
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
46	0-6	229						0-5 ft
	6-12	359	0		1		topsoil	0-11" - Brown (7.5 YR 5/3) SILT, trace organics, dry, hard
	12-18	71					ML	11-33" - Pink (7.5 YR 7/4), SILT, dry, hard
	18-24	37	0		2			33-46" - Pinkish gray (7.5 YR 7/2) SILT, dry, firm, hard
	24-30	133						
	30-36	14	0		3			
	36-42	12					SM	
	42-48	12	0		4			
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt Date: 14 November 2014

Drilling Contractor: Eichelbergers Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

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LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-12
Drilling Method:	DPT
Boring No.	12
Sampling Method:	
Sheet	1

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

Water Level			
Time	-		
Date			
Reference			

Drilling Start	Drilling Finish

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	
55	0-6	108						0-5 ft
	6-12	324	0		1		topsoil	0-13" - Brown (7.5 YR 4/3) increased darkness at 13", SILT
	12-18	90						13-43" - Strong brown (7.5 YR 5/6), SILT, trace gravel, firm
	18-24	19	0		2		ML	43-55" - Reddish yellow (7.5 YR 6/6) SILT and FINE SAND,
	24-30	20						trace gravel, firm
	30-36	51	0		3			
	36-42	8						
	42-48	8	0		4			
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt   Date: 14 November 2014

Drilling Contractor: Eichelbergers   Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

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LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-13
Drilling Method:	DPT
Boring No.	13
Sampling Method:	
Sheet	1

Coordinates: ____________

Surface Elevation: ____________

Casing Below Surface: ____________

Reference Elevation: ____________

Reference Desc: ____________

Water Level				Drilling	
Time	-			Start	Finish
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
50	0-6	107						0-5 ft
	6-12	127	0		1		topsoil	0-15" - Brown (7.5 YR 5/4) SILT, trace organics
	12-18	86						15-20" - Weathered marble with schist
	18-24	16	0		2		ML	20-41" - Strong brown (7.5 YR 5/6) SILT, firm, hard
	24-30	23						41-50" - Reddish yellow (7.5 YR 6/6) SILT with some fine sand,
	30-36	19	0		3			grading to SILT and FINE SAND at 50"
	36-42	11						
	42-48	<LOD	0		4			
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-14
Drilling Method:	DPT
Boring No.	14
Sampling Method:	
Sheet	1

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

Water Level			
Time	-		
Date			
Reference			

Drilling Start	Drilling Finish

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
48	0-6	629						0-5 ft
	6-12	940	0		1		topsoil	0-18" - Brown (7.5 YR 4/3) SILT, subrounded gravel at 18"
	12-18	6414						18-41" - Strong brown (7.5 YR 5/6), SILT, firm
	18-24	9755	0		2		ML	41-48" - Light brown (7.5 YR 6/4) silty fine SAND, loose, moist
	24-30	5813						
	30-36	33	0		3			
	36-42	205						
	42-48	10	0		4			
							SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Coordinates:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

Job. No.	Client: USACE			Location: BZ1-15
Drilling Method: DPT				Boring No. 15
Sampling Method:				Sheet 1
				Drilling
Water Level				Start / Finish
Time	-			
Date				
Reference				

Inches Drvn/In. Recvrd	XRF Interva (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Surface Conditions: Grass in Parade Ground
45	0-6	168						0-5 ft
	6-12	863	0		1		topsoil	0-6" - Brown (7.5 YR 4/2) SILT, trace organics
	12-18	72						6-18" - Brown (7.5 YR 4/2) with strong brown (7.5 YR 5/6) mottles,
	18-24	52	0		2		ML	SILT, brick at 18"
	24-30	39						18-39" - Strong brown (7.5 YR 5/8) SILT, firm, moist
	30-36	10	0		3			39-45" - Strong brown (7.5 YR 5/8) clayey SILT, soft
	36-42	16						
	42-48	10	0		4			
							SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt — Date: 14 November 2014

Drilling Contractor: Eichelbergers — Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-16
Drilling Method:	DPT
Boring No.	16
Sampling Method:	
Sheet	1
Coordinates:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

Water Level			
Time	-		
Date			
Reference			

Drilling Start	Drilling Finish

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
27	0-6	217						0-5 ft
	6-12	210	0		1		topsoil	0-10" - Brown (7.5 YR 4/3) SILT with trace subrounded gravel, roots
	12-18	26						10-13" - Subrounded gravel, quartz, and coarse sand
	18-24	30	0		2		ML	13-27" - Light brown (7.5 YR 5/6) SILT
	24-27	18						
			0		3			
					4			
							SM	
					5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	Client: USACE		Location: BZ1-17
Drilling Method: DPT			Boring No. 17
Sampling Method:			Sheet 1

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

				Drilling Start	Drilling Finish
Water Level					
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
50	0-6	68						0-5 ft
	6-12	44	0		1		topsoil	0-5" - Brown (7.5 YR 4/3) SILT, roots, firm, moist
	12-18	184						5-17" - Brown (7.5 YR 5/4) with brown (7.5 YR 4/2) mottles, SILT,
	18-24	39	0		2		ML	firm, gravel at 17"
	24-30	55						17-47" - Strong brown (7.5 YR 5/6), SILT
	30-36	18	0		3			47-50" - Light brown (7.5 YR 6/4) silty VERY FINE SAND, loose, dry
	36-42	12						
	42-48	12	0		4			
	48-50	13						
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt — Date: 14 November 2014

Drilling Contractor: Eichelbergers — Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-18
Drilling Method:	DPT
Boring No.	18
Sampling Method:	
Sheet	1

Coordinates: ____
Surface Elevation: ____
Casing Below Surface: ____
Reference Elevation: ____
Reference Desc: ____

Water Level			
Time	-		
Date			
Reference			

Drilling Start	Drilling Finish

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
52	0-6	167						0-5 ft
	6-12	356	0		1		topsoil	0-4" - Brown (7.5 YR 4/2) SILT, trace organics, moist
	12-18	165						4-15" - Brown (7.5 YR 4/2) with strong brown (7.5 YR 5/6) mottles,
	18-24	28	0		2		ML	SILT, firm, trace cinders
	24-30	39						15-16" - Gravel
	30-36	18	0		3			16-44" - Brown (7.5 YR 5/4) SILT, grading to strong brown
	36-42	15						(7.5 YR 5/6) SILT
	42-48	13	0		4			44-52" - Light brown (7.5 YR 6/3) silty VERY FINE SAND
	48-52	12					SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt
Date: 14 November 2014
Drilling Contractor: Eichelbergers
Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

Job. No.	Client: USACE		Location: BZ1-19
Drilling Method: DPT			Boring No. 19
Sampling Method:			Sheet 1

Water Level				Drilling Start	Drilling Finish
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
54	0-6	180						0-5 ft
	6-12	109	0		1		topsoil	0-6" - Brown (7.5 YR 4/4) SILT, trace organics
	12-18	534						6-18" - Strong brown (7.5 YR 5/6) SILT, trace cinders
	18-24	561	0		2		ML	18-48" - Strong brown (7.5 YR 5/6) SILT, firm, dry
	24-30	296						48-54" - Reddish yellow (7.5 YR 6/6) SILT and FINE SAND, firm
	30-36	62	0		3			
	36-42	59						
	42-48	14	0		4			
	48-54	16					SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt Date: 14 November 2014

Drilling Contractor: Eichelbergers Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-20
Drilling Method:	DPT
Boring No.	20
Sampling Method:	
Sheet	1

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

				Drilling Start	Drilling Finish
Water Level					
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
48	0-6	188						0-5 ft
	6-12	187	0		1		topsoil	0-9" - Brown (10 YR 4/6) SILT, trace organics, loose, moist
	12-18	106						9-20" - Yellow brown (10 YR 5/6) SILT, trace cinders, large
	18-24	135	0		2		ML	rounded gravel
	24-30	78						20-48" - Light brown (7.5 YR 5/6) SILT, trace roots, firm
	30-36	31	0		3			
	36-42	12						
	42-48	11	0		4			
							SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-21
Drilling Method:	DPT
Boring No.	21
Sampling Method:	
Sheet	1

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

				Drilling Start	Drilling Finish
Water Level					
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
51	0-6	246						0-5 ft
	6-12	235	0		1		topsoil	0-9" - Brown (7.5 YR 4/3) SILT, trace fine sand, roots
	12-18	590						9-13.5" - Brown (7.5 YR 4/3) SILT with angular subrounded
	18-24	356	0		2		ML	gravel, and FINE SAND, loose
	24-30	249						13.5-51" - Yellowish brown (10 YR 5/6), SILT, hard, dry (Native)
	30-36	213	0		3			
	36-42	100						
	42-48	15	0		4			
	48-51	12					SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-22
Drilling Method:	DPT
Boring No.	22
Sampling Method:	
Sheet	1
Coordinates:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

Water Level				Drilling Start	Drilling Finish
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	
51	0-6	218						0-5 ft
	6-12	597	0		1		topsoil	0-8" - Brown (7.5 YR 4/3) SILT, trace organics
	12-18	165						8-13" - Brown (7.5 YR 4/2) SILT, trace gravel, cinders, and brick
	18-24	29	0		2		ML	13-30" - Reddish yellow (7.5 YR 6/6) SILT, very dry
	24-30	50						30-44" - Reddish Yellow (7.5 YR 6/6), SILT, dry
	30-36	33	0		3			44-51" - Light brown (7.5 YR 6/4) silty VERY FINE SAND, firm
	36-42	11						
	42-48	11	0		4			
	48-51	15					SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-23
Drilling Method:	DPT
Boring No.	23
Sampling Method:	
Sheet	1
Coordinates:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

				Drilling Start	Drilling Finish
Water Level					
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
36	0-6	131						0-5 ft
	6-12	465	0		1		topsoil	0-10" - Brown (7.5 YR 5/3) SILT, trace organics, dry
	12-18	40						10-36" - Strong brown (7.5 YR 5/6) SILT, trace subrounded
	18-24	34	0		2		ML	gravel, dry, loose
	24-30	68						
	30-36	20	0		3			
					4			
							SM	
					5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt — Date: 14 November 2014

Drilling Contractor: Eichelbergers — Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-24
Drilling Method:	DPT
Boring No.	24
Sampling Method:	
Sheet	1
Coordinates:	
Surface Elevation:	
Casing Below Surface:	
Reference Elevation:	
Reference Desc:	

Water Level				Drilling Start	Drilling Finish
Time	-				
Date					
Reference					

Surface Conditions: Grass in Parade Ground

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Description
50	0-6	136						0-5 ft
	6-12	386	0		1		topsoil	0-4" - Brown (7.5 YR 4/2) SILT, trace organics, moist
	12-18	357						4-18" - Dark brown (7.5 YR 3/2) with brown (7.5 YR 4/3) mottle,
	18-24	131	0		2		ML	SILT, trace subrounded gravel and cinders
	24-30	30						18-49" - Strong brown (7.5 YR 5/6) SILT
	30-36	69	0		3			49-50" - Light brown (7.5 YR 6/4) VERY FINE SAND
	36-42	11						
	42-48	<LOD	0		4			
	48-50	13					SM	
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

EA Engineering, Science, and Technology, Inc.

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL/ROCK BORING

Job. No.	
Client:	USACE
Location:	BZ1-25
Drilling Method:	DPT
Boring No.	25
Sampling Method:	
Sheet 1	

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Desc:

				Drilling Start	Drilling Finish
Water Level					
Time	-				
Date					
Reference					

Inches Drvn/In. Recvrd	XRF Interval (inches)	Pb XRF (ppm)	Reg PID		Depth in Feet		USCS Log	Surface Conditions: Grass in Parade Ground
52	0-6	259						0-5 ft
	6-12	556	0		1		topsoil	0-8" - Brown (7.5 YR 4/2) SILT,trace organics, soft, moist
	12-18	131						8-20" - Yellow brown (10 YR 5/6) SILT, trace organics, soft
	18-24	85	0		2		ML	20-52" - Strong brown (7.5 YR 4/6) SILT, trace wood, schist,
	24-30	36						trace sand 52"
	30-36	52	0		3			
	36-42	13						
	42-48	12	0		4			
	48-52	8						
			0		5			
					6			
					7			
					8			
					9			
					10			

Logged by: Denise Wilt

Date: 14 November 2014

Drilling Contractor: Eichelbergers

Driller: Gary G.

Attachment B

Soil Vapor Field Forms

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FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: 6233017 Client: USACE Site: Frankford Arsenal Description: soil gas resample
CEN	Frankford Arsenal Outside Bldg 202	

Location ID: B23-3-SG

Probe Installation Date/Time: previously installed

Slab Thickness: / Probe Length: /

Helium Leak Check Date/Time: 1/12/15 10:50

He% Shroud 27.1% He% Tubing <1% VOC Purge 0.0 ppm

Shut In Check PSI drop in 1 minute: N/A

Sample Type: ☐ Indoor Air ☒ Sub-Slab/Soil Gas ☐ Outdoor Air

Duplicate: ☐ Yes ☒ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: B23-3-SG-01-12-2015

Summa Canister ID: 10411

Initial Canister Gauge Pressure: -25.0 in Hg

Flow Control ID: 10101

Flow Control Rate: 24 hr

Canister Start Time/Date: 11:10 1/12/2015

Canister End Time/Date: 8:55 1/13/2015

Final Canister Gauge Pressure: -24.0 in Hg

SAMPLE DID NOT COMPLETE PROPERLY. NOT ANALYZED.

Comments/Observations:

Weather: Light rain & 35°F

Location: Outside Bldg 202

Ambient PID: 0.0 ppm

Could not get shroud to 50% helium

Sample tubing contained water which caused clogging. Will resample.

FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: 6233017 Client: USACE Site: Frankford Arsenal Description: soil gas re-sample
CEN	Frankford Arsenal Bldg 201	

Location ID: B23-1-SG

Probe Installation Date/Time: previously installed

Slab Thickness: / Probe Length: /

Helium Leak Check Date/Time: 1/12/15 10:05

He% Shroud 51.2% He% Tubing ≤1% VOC Purge ________

Shut In Check PSI drop in 1 minute: N/A

Sample Type: ☐ Indoor Air ☒ Sub-Slab/Soil Gas ☐ Outdoor Air

Duplicate: ☒ Yes ☐ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: B23-1-SG-01_12_2015 / SG-DUP-1_01_12_2015

Summa Canister ID: 10311 / 10496

Initial Canister Gauge Pressure: >30 in Hg / >30 in Hg

Flow Control ID: 10110 / 10201

Flow Control Rate: 24-hr

Canister Start Time/Date: 10:12 1/12/15

Canister End Time/Date: 10:12 / 8:36 1/13/2015

Final Canister Gauge Pressure: 7.0 / 4.5 in Hg

Comments/Observations:

Building 201 under stairwell.

Ambient PID = 0.0 ppm

FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: ~~1456043~~ Client: ~~AFCEC~~ Site: ~~King Salmon Divert OT027~~ Description: ~~Vapor Intrusion Assessment Sampling~~
CEN	Frankford Arsenal	

Location ID: B23-2-SG

Probe Installation Date/Time: 11/10/2014 11:30

Slab Thickness: ______ Probe Length: 2

Helium Leak Check Date/Time: 11/10/2014 13:20

He% Shroud 39.6% He% ~~Tedlar Bag~~ Probe <1% VOC Purge 2.8 ppm

Shut In Check PSI drop in 1 minute: ——

Sample Type: ☐ Indoor Air ☐ Sub-Slab ☐ Outdoor Air ☒ soil gas

Duplicate: ☐ Yes ☐ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: B23-2-SG

Summa Canister ID: 10054

Initial Canister Gauge Pressure: -26.5 in Hg

Flow Control ID: 10771

Flow Control Rate: 24 hr

Canister Start Time/Date: 11/10/2014 13:43

Canister End Time/Date: ~~11/11/14 0859~~ 11/11/14 9:11

Final Canister Gauge Pressure: ~~zero~~ -1

Comments/Observations:

Could not get shroud concentration any higher. However, got to 39% and no sign of leakage

FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: ~~1456043~~ Client: ~~AFCEC~~ Site: ~~King Salmon Divert OT027~~ Description: Vapor Intrusion Assessment Sampling
CEN	Frankford Arsenal / Bldg 202	

Location ID: BZ3-1-SG / DUP

Probe Installation Date/Time: 11/10/2014 9:35

Slab Thickness: ~12" Probe Length: ______

Helium Leak Check Date/Time: 11/10/2014 10:05

He% Shroud 40 He% ~~Tedlar Bag~~ Probe <1% VOC Purge 0.2 ppm

Shut In Check PSI drop in 1 minute: —

Sample Type: ☐ Indoor Air ☒ Sub-Slab ☐ Outdoor Air

Duplicate: ☒ Yes ☐ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: BZ3-1-SG / SG-DUP-1

Summa Canister ID: ~~[illegible]~~ 10441/10590

Initial Canister Gauge Pressure: -11.5 / -30 in Hg

Flow Control ID: 10478 / 10110

Flow Control Rate: 24 hr

Canister Start Time/Date: 11/10/2014 10:22

Canister End Time/Date: 11/11/14 9:01 -1 -Dup

Final Canister Gauge Pressure: ~~→~~ parent 11/11/14 859 zero

Comments/Observations:

Pressure low on parent sample summa.
Location is Bldg 202 under stairs
Note that floor is higher than outside grand level

FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: ~~1456043~~ Client: ~~AFCEC~~ Site: ~~King Salmon Divert OT027~~ Description: ~~Vapor Intrusion~~ Assessment Sampling
CEN	Frankford Arsenal	

Location ID: B23-3-SG

Probe Installation Date/Time: 11/10/14 10:30

Slab Thickness: ____ Probe Length: ____

Helium Leak Check Date/Time: 11/10/14 12:40

He% Shroud 43.7 He% ~~Tedlar~~ Probe Bag <1% VOC Purge 12.2 ppm

Shut In Check PSI drop in 1 minute: —

Sample Type: ☐ Indoor Air ☐ Sub-Slab ☐ Outdoor Air ☒ soil gas

Duplicate: ☐ Yes ☒ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: B23-3-SG

Summa Canister ID: 10488

Initial Canister Gauge Pressure: -26 in Hg

Flow Control ID: ~~[illegible] hr~~ 10483

Flow Control Rate: 24 hr

Canister Start Time/Date: ~~11/10/2014 13:07~~ ok

Canister End Time/Date: 11/11/2014 12:57

Final Canister Gauge Pressure: -21 in Hg

Comments/Observations:

Had trouble getting shroud concentration above 40% - however, got to 43.7% and no sign of leakage

FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: 6233017 Client: USACE Site: Frankford Arsenal Description: soil gas re-sample
CEN	Frankford Arsenal Near Bldg 201	

Location ID: BZ3-2-SG

Probe Installation Date/Time: previously installed

Slab Thickness: / Probe Length: /

Helium Leak Check Date/Time: 1/12/15 10:30

He% Shroud 34.1% He% Tubing <1% VOC Purge 0.0 ppm

Shut In Check PSI drop in 1 minute: ____________

Sample Type: ☐ Indoor Air ☒ Sub-Slab/Soil Gas ☐ Outdoor Air

Duplicate: ☐ Yes ☒ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: BZ3-2-SG-1-12-2015

Summa Canister ID: 10492

Initial Canister Gauge Pressure: 28.5 in Hg

Flow Control ID: 10545

Flow Control Rate: 24-hr

Canister Start Time/Date: 10:44 1/12/15

Canister End Time/Date: 8:39 1/13/15

Final Canister Gauge Pressure: 2.5 in Hg

Comments/Observations:

Weather: Light rain & 35°F

Location: Outside Bldg 201

Ambient PID: 0.0 ppm

Could not get shroud to 50% Helium

Pressure was low upon arriving at site on 1/13 & stopped sample immediately.

FIELD SAMPLING FORM FOR VI ASSESSMENT

Samplers:	Site ID / Bldg ID	EA Project #: 623017
CEN	Frankford Arsenal outside Bldg 202	Client: USACE Site: Frankford Arsenal Description: Soil gas resample

Location ID: B23-3-SG

Probe Installation Date/Time: previously installed

Slab Thickness: / Probe Length: /

Helium Leak Check Date/Time: 1/12/15 10:50

He% Shroud 27.1% He% Tubing <1% VOC Purge 0.0 ppm

Shut In Check PSI drop in 1 minute: N/A

Sample Type: ☐ Indoor Air ☒ Sub-Slab/Soil Gas ☐ Outdoor Air

Duplicate: ☐ Yes ☒ No

TO-15 & TO-15SIM/Fixed Gas

Summa Sample ID: B23-3-SG-01-13-2015

Summa Canister ID: 10598

Initial Canister Gauge Pressure: 27.0 in Hg

Flow Control ID: 10483

Flow Control Rate: 24 hr

Canister Start Time/Date: 10:02 1/13/2015

Canister End Time/Date: 10:25 1/13/2015

Final Canister Gauge Pressure: 27.0 in Hg

SAMPLE DID NOT COMPLETE PROPERLY. NOT ANALYZED.

Comments/Observations:

Weather: Sunny, 27°F

Note: this sample being collected because tubing for B23-3-SG-01-12-2015 filled with water & sample could not be completed.

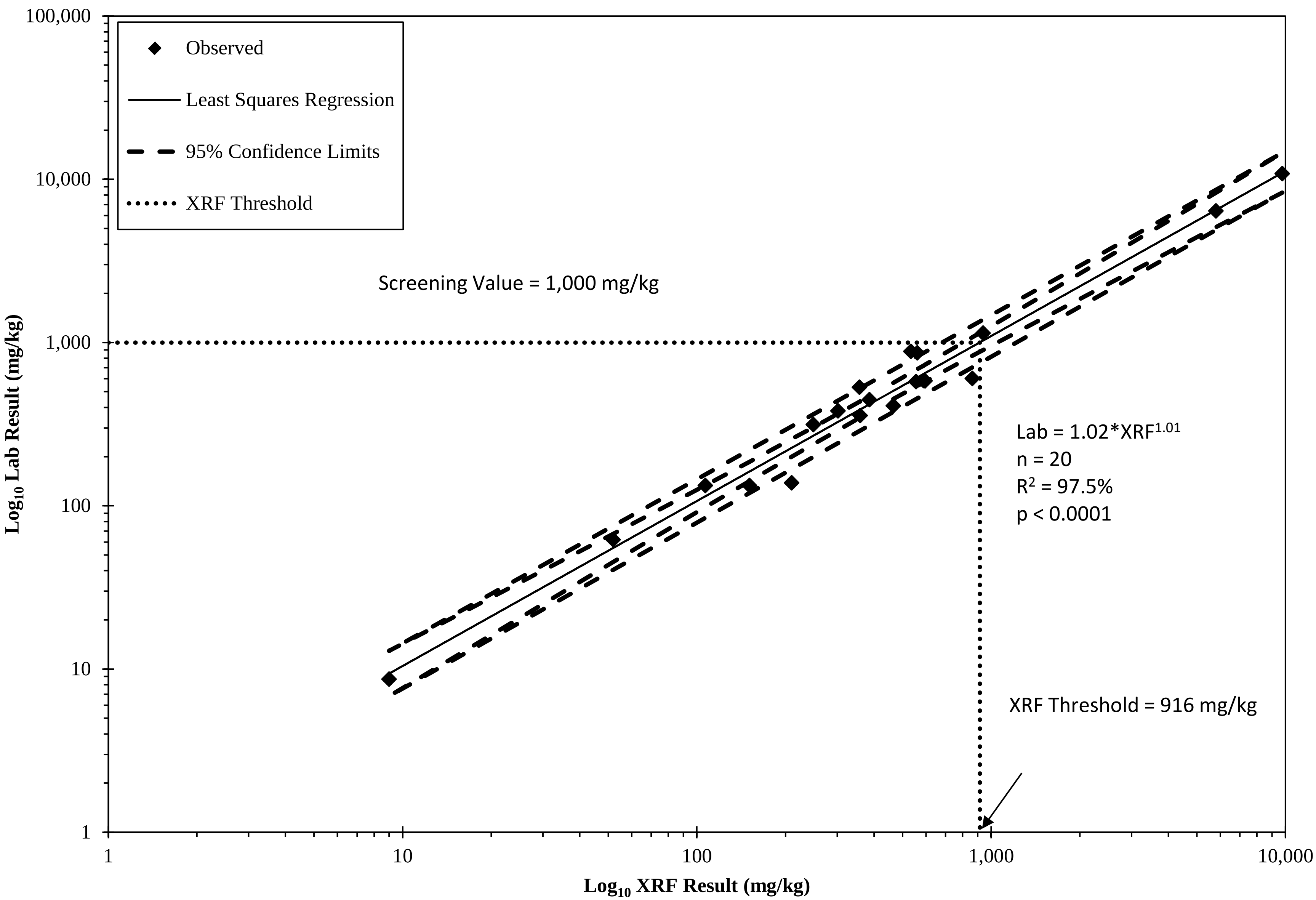
Ambient PID reading: 0.0 ppm

Water in tubing – stopped sample.

Attachment C

XRF Data

Figure 1 Least squares regression on log-transformed laboratory versus XRF results.



Comparsion of Laboratory and XRF Results for Lead

Sample Designation	Preliminary XRF Result (ppm)	Laboratory Result (mg/kg)
BZ1-23-6-12	465	409
BZ1-19-12-18	534	882
BZ1-19-18-24	561	864
BZ1-25-6-12	556	574
BZ1-21-12-18	590	583
BZ1-22-6-12	597	581
BZ1-15-6-12	863	602
BZ1-14-6-12	940	1140
BZ1-14-24-30	5813	6390
BZ1-14-18-24	9755	10800
BZ1-8-36-42	9	8.65
BZ1-15-18-24	52	61.9
BZ1-13-0-6	107	133
BZ1-10-6-12	151	133
BZ1-8-6-12	210	138
BZ1-21-24-30	249	314
BZ1-9-12-18	302	381
BZ1-11-6-12	359	356
BZ1-24-12-18	357	531
BZ1-24-6-12	386	446

Quality Control Sample - Blanks and Standard Reference Materials

Reading	Time	LiveTime	Date	Sample I	Pb	Pb +/-	Pb Pass	NIST Pb	Percent Recovery
3	#######	49.46	10-Nov-14	Blank	<LOD	6			
4	#######	49.84	10-Nov-14	2709	16	3	Pass	18.9	85
5	#######	48.8	10-Nov-14	2711	1075	16	Pass	1162	93
6	#######	48.94	10-Nov-14	2710a	5427	55	Pass	5520	98
180	#######	48.49	10-Nov-14	2710a	5385	54	Pass	5520	98
181	#######	49.62	10-Nov-14	2711	1087	16	Pass	1162	94
182	#######	49.07	10-Nov-14	2709	26	3	Pass	18.9	138
183	#######	49.97	10-Nov-14	Blank	<LOD	6			

Pb - Lead

Quality Control XRF Sample Evaluation

Reading	Date	Sample ID	Normal or QC	Pb	Relative Percent Difference
16	10-Nov-14	BZ1-21-0-6	N	246	
17	10-Nov-14	DUP1 (BZ1-21-0-6)	QC	184	28.8
27	10-Nov-14	BZ1-20-6-12	N	187	
28	10-Nov-14	DUP-2 (BZ1-20-6-12)	QC	186	0.5
38	10-Nov-14	BZ1-19-18-24	N	561	
39	10-Nov-14	DUP-3 (BZ1-19-18-24)	QC	498	11.9
49	10-Nov-14	BZ1-24-24-30	N	30	
50	10-Nov-14	DUP-4 (BZ1-24-24-30)	QC	28	6.9
60	10-Nov-14	BZ1-23-30-36	N	20	
61	10-Nov-14	DUP-5 (BZ1-23-30-36)	QC	34	51.9
71	10-Nov-14	BZ1-18-0-6	N	167	
72	10-Nov-14	DUP-6 (BZ1-18-0-6)	QC	156	6.8
82	10-Nov-14	BZ1-17-6-12	N	44	
83	10-Nov-14	DUP-7 (BZ1-17-6-12)	QC	41	7.1
93	10-Nov-14	BZ1-16-12-18	N	26	
94	10-Nov-14	DUP-8 (BZ1-16-12-18)	QC	54	70.0
105	10-Nov-14	BZ1-15-0-6	N	168	
106	10-Nov-14	DUP-9 (BZ1-15-0-6)	QC	176	4.7
107	10-Nov-14	BZ1-15-6-12	N	863	
108	10-Nov-14	DUP-10 (BZ1-15-6-12)	QC	328	89.8
125	10-Nov-14	BZ1-12-12-18	N	90	
127	10-Nov-14	DUP-11 (BZ1-12-12-18)	QC	97	7.5
141	10-Nov-14	BZ1-11-0-6	N	229	
142	10-Nov-14	DUP-12 (BZ1-11-0-6)	QC	239	4.3
146	10-Nov-14	BZ1-11-24-30	N	133	
147	10-Nov-14	DUP-13 (BZ1-11-24-30)	QC	136	2.2
160	10-Nov-14	BZ1-9-6-12	N	246	
161	10-Nov-14	DUP-14 (BZ1-9-6-12)	QC	385	44.1
171	10-Nov-14	BZ1-8-6-12	N	210	
172	10-Nov-14	DUP-15 (BZ1-8-6-12)	QC	148	34.6

Pb - Lead

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Pb	Pb +/-	As	As +/-	Fe	Fe +/-	Ti	Ti +/-	Cr	Cr +/-	Mn
Standard Clip	QC												
Blank	QC		<LOD	8	<LOD	5	112	18	<LOD	558	<LOD	65	<LOD
Blank	QC		<LOD	6	<LOD	4	89	12	<LOD	405	<LOD	54	<LOD
2709	QC		16	3	17	2	29054	252	2142	346	<LOD	116	451
2711	QC		1075	16	87	10	22928	216	3736	359	<LOD	110	440
2710	QC		5427	55	1549	30	47266	437	3232	475	<LOD	152	2236
BZ1-25-0-6	N	0-6	259	7	31	4	15123	138	4793	313	<LOD	84	270
BZ1-25-6-12	N	6-12	556	10	73	6	16266	147	3932	302	<LOD	83	257
BZ1-25-12-18	N	12-18	131	5	15	3	14480	133	3671	288	<LOD	79	344
BZ1-25-18-24	N	18-24	85	4	12	3	15203	144	4148	302	<LOD	84	215
BZ1-25-24-30	N	24-30	36	3	6	2	12529	120	3856	283	<LOD	76	263
BZ1-25-30-36	N	30-36	52	4	11	2	17623	156	3516	292	<LOD	88	165
BZ1-25-36-42	N	36-42	13	3	7	2	15803	144	4444	300	<LOD	84	165
BZ1-25-42-48	N	42-48	12	3	<LOD	4	14379	137	3635	288	<LOD	80	134
BZ1-25-48-52	N	48-52	8	2	9	2	13919	134	4319	301	<LOD	81	476
BZ1-21-0-6	N	0-6	246	7	19	4	15008	145	4307	315	<LOD	88	295
DUP1 (BZ1-21-0-6)	QC	0-6	184	6	<LOD	11	15412	144	4608	316	<LOD	86	384
BZ1-21-6-12	N	6-12	235	7	24	4	17295	157	3806	313	<LOD	90	259
BZ1-21-12-18	N	12-18	590	11	29	6	16009	150	4441	318	<LOD	88	375
BZ1-21-18-24	N	18-24	356	8	<LOD	15	15957	148	3196	299	<LOD	89	280
BZ1-21-24-30	N	24-30	249	7	22	4	15640	145	3726	308	<LOD	87	369
BZ1-21-30-36	N	30-36	213	7	14	4	21239	188	4169	335	<LOD	100	212
BZ1-21-36-42	N	36-42	100	5	19	3	20086	180	3634	320	<LOD	93	214
BZ1-21-42-48	N	42-48	15	3	9	2	18055	166	4588	327	<LOD	91	196
BZ1-21-48-51	N	48-51	12	3	6	2	16431	153	3705	308	<LOD	87	229
BZ1-20-0-6	N	0-6	188	6	18	4	14344	134	4584	303	<LOD	84	318
BZ1-20-6-12	N	6-12	187	6	16	4	16304	150	3881	310	<LOD	89	352
DUP-2 (BZ1-20-6-12	QC	6-12	186	6	15	4	15805	150	4010	318	<LOD	83	382
BZ1-20-12-18	N	12-18	106	5	12	3	17804	163	4444	322	<LOD	88	171
BZ1-20-18-24	N	18-24	135	5	11	3	17250	158	4520	326	<LOD	90	336
BZ1-20-24-30	N	24-30	78	4	<LOD	8	15303	141	4144	311	<LOD	83	273
BZ1-20-30-36	N	30-36	31	3	<LOD	6	16748	150	4375	310	<LOD	85	239
BZ1-20-36-42	N	36-42	12	3	7	2	18003	161	3699	303	<LOD	88	144
BZ1-20-42-48	N	42-48	11	2	<LOD	5	14169	135	3275	282	<LOD	83	190
BZ1-19-0-6	N	0-6	180	6	12	4	13702	130	4454	298	<LOD	79	356
BZ1-19-6-12	N	6-12	109	5	<LOD	9	15075	141	4538	316	<LOD	85	402
BZ1-19-12-18	N	12-18	534	10	89	6	16411	150	4226	316	99	31	278

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Mn +/-	Co	Co +/-	Ni	Ni +/-	Cu	Cu +/-	Zn	Zn +/-	Se	Se +/-
Standard Clip	QC												
Blank	QC		38	<LOD	25	<LOD	36	<LOD	20	11	3	<LOD	3
Blank	QC		32	<LOD	20	<LOD	25	<LOD	14	<LOD	6	<LOD	2
2709	QC		37	251	59	90	15	22	7	91	5	<LOD	3
2711	QC		36	177	53	<LOD	41	107	9	292	9	<LOD	5
2710	QC		79	<LOD	260	<LOD	54	3390	48	4199	50	19	4
BZ1-25-0-6	N	0-6	26	222	38	<LOD	32	50	6	125	6	<LOD	3
BZ1-25-6-12	N	6-12	26	<LOD	118	<LOD	34	49	7	117	5	<LOD	4
BZ1-25-12-18	N	12-18	27	122	37	<LOD	32	<LOD	16	65	4	<LOD	3
BZ1-25-18-24	N	18-24	25	172	39	<LOD	33	25	6	71	5	<LOD	3
BZ1-25-24-30	N	24-30	24	148	34	<LOD	30	<LOD	16	57	4	<LOD	3
BZ1-25-30-36	N	30-36	24	154	41	<LOD	33	22	6	62	4	<LOD	3
BZ1-25-36-42	N	36-42	23	169	39	<LOD	32	18	6	37	4	<LOD	3
BZ1-25-42-48	N	42-48	23	205	38	<LOD	32	26	6	39	4	<LOD	3
BZ1-25-48-52	N	48-52	30	116	37	<LOD	33	<LOD	17	43	4	<LOD	3
BZ1-21-0-6	N	0-6	28	140	40	<LOD	34	60	7	132	6	<LOD	3
DUP1 (BZ1-21-0-6)	QC	0-6	29	123	39	<LOD	32	43	6	123	6	<LOD	3
BZ1-21-6-12	N	6-12	27	203	42	<LOD	34	30	6	102	5	<LOD	3
BZ1-21-12-18	N	12-18	29	181	41	<LOD	33	26	6	68	5	<LOD	4
BZ1-21-18-24	N	18-24	27	195	40	<LOD	32	<LOD	17	42	4	<LOD	3
BZ1-21-24-30	N	24-30	29	159	40	<LOD	32	25	6	101	5	<LOD	3
BZ1-21-30-36	N	30-36	28	269	48	<LOD	36	<LOD	18	41	4	<LOD	3
BZ1-21-36-42	N	36-42	27	224	46	<LOD	35	23	6	44	4	<LOD	3
BZ1-21-42-48	N	42-48	26	280	45	<LOD	34	23	6	38	4	<LOD	3
BZ1-21-48-51	N	48-51	26	123	41	<LOD	33	23	6	44	4	<LOD	3
BZ1-20-0-6	N	0-6	27	<LOD	110	<LOD	32	40	6	119	5	<LOD	3
BZ1-20-6-12	N	6-12	29	<LOD	119	<LOD	34	46	7	100	5	<LOD	3
DUP-2 (BZ1-20-6-12	QC	6-12	30	206	41	<LOD	34	57	7	102	5	<LOD	3
BZ1-20-12-18	N	12-18	25	<LOD	128	<LOD	35	30	6	102	5	<LOD	3
BZ1-20-18-24	N	18-24	29	<LOD	125	<LOD	34	19	6	63	4	<LOD	3
BZ1-20-24-30	N	24-30	26	158	39	<LOD	32	22	6	59	4	<LOD	3
BZ1-20-30-36	N	30-36	26	213	41	<LOD	33	21	6	45	4	<LOD	3
BZ1-20-36-42	N	36-42	24	248	43	<LOD	33	22	6	43	4	<LOD	3
BZ1-20-42-48	N	42-48	24	123	37	<LOD	32	<LOD	17	33	3	<LOD	3
BZ1-19-0-6	N	0-6	27	172	37	<LOD	32	32	6	91	5	<LOD	3
BZ1-19-6-12	N	6-12	29	161	39	<LOD	32	22	6	65	4	<LOD	3
BZ1-19-12-18	N	12-18	27	<LOD	120	<LOD	33	43	7	96	5	<LOD	4

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Br	Br +/-	Rb	Rb +/-	Sr	Sr +/-	Zr	Zr +/-	Mo	Mo +/-	Ag
Standard Clip	QC												
Blank	QC		<LOD	5	<LOD	4	<LOD	4	<LOD	9	<LOD	8	<LOD
Blank	QC		<LOD	3	<LOD	3	<LOD	3	<LOD	6	<LOD	6	<LOD
2709	QC		6	2	87	3	222	4	196	5	<LOD	7	<LOD
2711	QC		<LOD	8	110	3	236	4	350	6	<LOD	8	<LOD
2710	QC		<LOD	20	107	4	245	5	128	7	<LOD	9	<LOD
BZ1-25-0-6	N	0-6	8	2	49	2	56	2	648	7	<LOD	7	<LOD
BZ1-25-6-12	N	6-12	<LOD	6	43	2	47	2	517	6	<LOD	7	<LOD
BZ1-25-12-18	N	12-18	5	1	46	2	40	2	654	7	<LOD	7	<LOD
BZ1-25-18-24	N	18-24	5	2	47	2	46	2	571	7	<LOD	7	<LOD
BZ1-25-24-30	N	24-30	5	1	46	2	38	2	599	6	<LOD	7	<LOD
BZ1-25-30-36	N	30-36	<LOD	4	52	2	35	2	562	6	<LOD	7	<LOD
BZ1-25-36-42	N	36-42	<LOD	4	46	2	31	1	566	6	<LOD	7	<LOD
BZ1-25-42-48	N	42-48	<LOD	4	42	2	29	1	573	7	<LOD	7	<LOD
BZ1-25-48-52	N	48-52	<LOD	4	38	2	30	1	699	7	<LOD	7	<LOD
BZ1-21-0-6	N	0-6	6	2	46	2	45	2	613	7	<LOD	7	<LOD
DUP1 (BZ1-21-0-6)	QC	0-6	6	2	52	2	57	2	692	7	<LOD	7	<LOD
BZ1-21-6-12	N	6-12	<LOD	5	39	2	33	2	424	6	<LOD	7	<LOD
BZ1-21-12-18	N	12-18	<LOD	5	55	2	44	2	536	7	<LOD	7	<LOD
BZ1-21-18-24	N	18-24	<LOD	5	54	2	45	2	532	6	<LOD	7	<LOD
BZ1-21-24-30	N	24-30	<LOD	5	45	2	52	2	487	6	<LOD	7	<LOD
BZ1-21-30-36	N	30-36	<LOD	5	58	2	39	2	580	7	<LOD	7	<LOD
BZ1-21-36-42	N	36-42	<LOD	4	59	2	39	2	588	7	<LOD	7	<LOD
BZ1-21-42-48	N	42-48	<LOD	4	52	2	37	2	593	7	<LOD	8	<LOD
BZ1-21-48-51	N	48-51	<LOD	4	46	2	36	2	588	7	<LOD	7	<LOD
BZ1-20-0-6	N	0-6	9	2	48	2	50	2	637	7	<LOD	7	<LOD
BZ1-20-6-12	N	6-12	<LOD	5	50	2	53	2	683	7	<LOD	7	<LOD
DUP-2 (BZ1-20-6-12	QC	6-12	<LOD	5	51	2	58	2	650	7	<LOD	7	<LOD
BZ1-20-12-18	N	12-18	4	1	53	2	47	2	611	7	<LOD	7	<LOD
BZ1-20-18-24	N	18-24	<LOD	4	50	2	45	2	652	7	<LOD	7	<LOD
BZ1-20-24-30	N	24-30	4	1	50	2	44	2	593	7	<LOD	7	<LOD
BZ1-20-30-36	N	30-36	<LOD	4	53	2	41	2	540	6	<LOD	7	<LOD
BZ1-20-36-42	N	36-42	<LOD	4	53	2	37	2	524	6	<LOD	7	<LOD
BZ1-20-42-48	N	42-48	<LOD	4	41	2	33	2	567	6	<LOD	7	<LOD
BZ1-19-0-6	N	0-6	9	1	50	2	52	2	693	7	<LOD	7	<LOD
BZ1-19-6-12	N	6-12	5	1	52	2	55	2	798	8	<LOD	7	<LOD
BZ1-19-12-18	N	12-18	<LOD	6	49	2	52	2	634	7	<LOD	7	<LOD

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Ag +/-	Cd	Cd +/-	Sn	Sn +/-	Sb	Sb +/-	Ba	Ba +/-	Hg	Hg +/-
Standard Clip	QC												
Blank	QC		46	<LOD	55	<LOD	78	<LOD	84	<LOD	0	<LOD	9
Blank	QC		32	<LOD	39	<LOD	55	<LOD	59	<LOD	0	<LOD	6
2709	QC		39	<LOD	46	<LOD	69	<LOD	74	<LOD	0	<LOD	9
2711	QC		40	56	16	<LOD	71	<LOD	77	<LOD	0	<LOD	15
2710	QC		47	<LOD	54	<LOD	81	<LOD	87	<LOD	0	35	12
BZ1-25-0-6	N	0-6	34	<LOD	40	<LOD	59	<LOD	65	<LOD	0	<LOD	9
BZ1-25-6-12	N	6-12	34	<LOD	41	<LOD	60	<LOD	66	<LOD	0	<LOD	10
BZ1-25-12-18	N	12-18	33	<LOD	40	<LOD	58	<LOD	64	<LOD	0	<LOD	8
BZ1-25-18-24	N	18-24	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-25-24-30	N	24-30	33	<LOD	40	<LOD	59	<LOD	64	<LOD	0	<LOD	7
BZ1-25-30-36	N	30-36	34	49	14	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-25-36-42	N	36-42	34	<LOD	41	<LOD	60	<LOD	66	<LOD	0	<LOD	7
BZ1-25-42-48	N	42-48	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-25-48-52	N	48-52	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	7
BZ1-21-0-6	N	0-6	35	<LOD	42	<LOD	61	<LOD	66	<LOD	0	<LOD	9
DUP1 (BZ1-21-0-6)	QC	0-6	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-21-6-12	N	6-12	35	44	14	<LOD	64	<LOD	69	<LOD	0	<LOD	9
BZ1-21-12-18	N	12-18	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	11
BZ1-21-18-24	N	18-24	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	10
BZ1-21-24-30	N	24-30	35	<LOD	41	<LOD	61	<LOD	67	<LOD	0	<LOD	9
BZ1-21-30-36	N	30-36	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	9
BZ1-21-36-42	N	36-42	36	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	8
BZ1-21-42-48	N	42-48	36	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	8
BZ1-21-48-51	N	48-51	36	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	8
BZ1-20-0-6	N	0-6	33	<LOD	40	<LOD	59	<LOD	65	<LOD	0	<LOD	8
BZ1-20-6-12	N	6-12	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	9
DUP-2 (BZ1-20-6-12	QC	6-12	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	9
BZ1-20-12-18	N	12-18	36	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	8
BZ1-20-18-24	N	18-24	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-20-24-30	N	24-30	34	<LOD	41	<LOD	60	<LOD	65	<LOD	0	<LOD	8
BZ1-20-30-36	N	30-36	34	67	14	<LOD	61	<LOD	66	<LOD	0	<LOD	7
BZ1-20-36-42	N	36-42	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-20-42-48	N	42-48	35	55	14	<LOD	62	<LOD	67	<LOD	0	<LOD	7
BZ1-19-0-6	N	0-6	34	57	14	<LOD	59	<LOD	64	<LOD	0	<LOD	8
BZ1-19-6-12	N	6-12	34	<LOD	41	<LOD	60	<LOD	66	<LOD	0	<LOD	8
BZ1-19-12-18	N	12-18	35	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	10

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Tl	Tl +/-	U	U +/-	Mode	Pass/Fail	Pass Fail Standard	Reading	Time	LiveTime
Standard Clip	QC						Standardizatio	-0.003501	PASS	1	12:09:15	34.88
Blank	QC		<LOD	9	<LOD	3	Soil			2	12:11:34	24.71
Blank	QC		<LOD	6	<LOD	2	Soil			3	12:13:11	49.46
2709	QC		<LOD	9	<LOD	4	Soil			4	12:15:23	49.84
2711	QC		<LOD	25	<LOD	4	Soil			5	12:18:12	48.8
2710	QC		104	20	<LOD	5	Soil			6	12:20:24	48.94
BZ1-25-0-6	N	0-6	<LOD	13	<LOD	3	Soil			7	12:22:54	47.39
BZ1-25-6-12	N	6-12	<LOD	16	<LOD	3	Soil			8	12:24:37	47.73
BZ1-25-12-18	N	12-18	<LOD	10	<LOD	3	Soil			9	12:26:26	47.39
BZ1-25-18-24	N	18-24	<LOD	10	<LOD	3	Soil			10	12:28:15	47.82
BZ1-25-24-30	N	24-30	<LOD	8	<LOD	3	Soil			11	12:30:37	47.29
BZ1-25-30-36	N	30-36	<LOD	9	<LOD	3	Soil			12	12:33:41	47.72
BZ1-25-36-42	N	36-42	<LOD	7	<LOD	3	Soil			13	12:35:29	48.15
BZ1-25-42-48	N	42-48	<LOD	7	<LOD	3	Soil			14	12:37:28	47.27
BZ1-25-48-52	N	48-52	<LOD	7	<LOD	3	Soil			15	12:39:43	47.39
BZ1-21-0-6	N	0-6	<LOD	12	<LOD	3	Soil			16	12:42:16	49.16
DUP1 (BZ1-21-0-6)	QC	0-6	<LOD	11	<LOD	3	Soil			17	12:43:47	48.44
BZ1-21-6-12	N	6-12	<LOD	12	<LOD	3	Soil			18	12:45:42	48.3
BZ1-21-12-18	N	12-18	<LOD	17	<LOD	3	Soil			19	12:47:21	48.43
BZ1-21-18-24	N	18-24	<LOD	14	<LOD	3	Soil			20	12:49:04	48.24
BZ1-21-24-30	N	24-30	<LOD	12	<LOD	3	Soil			21	12:50:44	48.2
BZ1-21-30-36	N	30-36	<LOD	12	<LOD	3	Soil			22	12:52:35	47.51
BZ1-21-36-42	N	36-42	<LOD	10	<LOD	3	Soil			23	12:54:11	48.84
BZ1-21-42-48	N	42-48	<LOD	8	<LOD	3	Soil			24	12:55:51	48.23
BZ1-21-48-51	N	48-51	<LOD	8	<LOD	3	Soil			25	12:58:04	48.46
BZ1-20-0-6	N	0-6	<LOD	11	<LOD	3	Soil			26	12:59:38	47.07
BZ1-20-6-12	N	6-12	<LOD	11	<LOD	3	Soil			27	13:01:14	47.86
DUP-2 (BZ1-20-6-12	QC	6-12	<LOD	12	<LOD	3	Soil			28	13:02:42	48.92
BZ1-20-12-18	N	12-18	<LOD	10	<LOD	3	Soil			29	13:04:26	48.24
BZ1-20-18-24	N	18-24	<LOD	11	<LOD	3	Soil			30	13:06:13	48.48
BZ1-20-24-30	N	24-30	<LOD	9	<LOD	3	Soil			31	13:09:07	48.25
BZ1-20-30-36	N	30-36	<LOD	8	<LOD	3	Soil			32	13:11:32	47.79
BZ1-20-36-42	N	36-42	<LOD	7	<LOD	3	Soil			33	13:13:39	48.07
BZ1-20-42-48	N	42-48	<LOD	7	<LOD	3	Soil			34	13:15:18	49.38
BZ1-19-0-6	N	0-6	<LOD	11	<LOD	3	Soil			35	13:17:13	48.05
BZ1-19-6-12	N	6-12	<LOD	10	<LOD	3	Soil			36	13:18:53	47.64
BZ1-19-12-18	N	12-18	<LOD	17	<LOD	3	Soil			37	13:20:30	47.96

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Date
Standard Clip	QC		10-Nov-14
Blank	QC		10-Nov-14
Blank	QC		10-Nov-14
2709	QC		10-Nov-14
2711	QC		10-Nov-14
2710	QC		10-Nov-14
BZ1-25-0-6	N	0-6	10-Nov-14
BZ1-25-6-12	N	6-12	10-Nov-14
BZ1-25-12-18	N	12-18	10-Nov-14
BZ1-25-18-24	N	18-24	10-Nov-14
BZ1-25-24-30	N	24-30	10-Nov-14
BZ1-25-30-36	N	30-36	10-Nov-14
BZ1-25-36-42	N	36-42	10-Nov-14
BZ1-25-42-48	N	42-48	10-Nov-14
BZ1-25-48-52	N	48-52	10-Nov-14
BZ1-21-0-6	N	0-6	10-Nov-14
DUP1 (BZ1-21-0-6)	QC	0-6	10-Nov-14
BZ1-21-6-12	N	6-12	10-Nov-14
BZ1-21-12-18	N	12-18	10-Nov-14
BZ1-21-18-24	N	18-24	10-Nov-14
BZ1-21-24-30	N	24-30	10-Nov-14
BZ1-21-30-36	N	30-36	10-Nov-14
BZ1-21-36-42	N	36-42	10-Nov-14
BZ1-21-42-48	N	42-48	10-Nov-14
BZ1-21-48-51	N	48-51	10-Nov-14
BZ1-20-0-6	N	0-6	10-Nov-14
BZ1-20-6-12	N	6-12	10-Nov-14
DUP-2 (BZ1-20-6-12	QC	6-12	10-Nov-14
BZ1-20-12-18	N	12-18	10-Nov-14
BZ1-20-18-24	N	18-24	10-Nov-14
BZ1-20-24-30	N	24-30	10-Nov-14
BZ1-20-30-36	N	30-36	10-Nov-14
BZ1-20-36-42	N	36-42	10-Nov-14
BZ1-20-42-48	N	42-48	10-Nov-14
BZ1-19-0-6	N	0-6	10-Nov-14
BZ1-19-6-12	N	6-12	10-Nov-14
BZ1-19-12-18	N	12-18	10-Nov-14

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Pb	Pb +/-	As	As +/-	Fe	Fe +/-	Ti	Ti +/-	Cr	Cr +/-	Mn
BZ1-19-18-24	N	18-24	561	10	18	6	15304	140	4895	310	104	30	275
DUP-3 (BZ1-19-18-2	QC	18-24	498	10	24	6	15489	147	4368	312	<LOD	84	231
BZ1-19-24-30	N	24-30	296	7	26	5	13179	128	4228	303	<LOD	80	236
BZ1-19-30-36	N	30-36	62	4	14	3	19455	169	4167	319	<LOD	89	173
BZ1-19-36-42	N	36-42	59	4	<LOD	7	18686	166	4582	319	<LOD	90	190
BZ1-19-42-48	N	42-48	14	3	5	2	15012	139	4310	308	<LOD	85	131
BZ1-19-48-54	N	48-54	16	3	<LOD	5	20174	178	5923	365	<LOD	91	517
BZ1-24-0-6	N	0-6	136	5	11	3	13214	127	4098	295	<LOD	85	359
BZ1-24-6-12	N	6-12	386	9	42	5	18420	166	4453	325	<LOD	91	271
BZ1-24-12-18	N	12-18	357	8	43	5	15157	143	3337	296	<LOD	82	235
BZ1-24-18-24	N	18-24	131	5	<LOD	10	14375	138	4003	307	<LOD	86	184
BZ1-24-24-30	N	24-30	30	3	<LOD	6	17166	158	3678	306	<LOD	90	133
DUP-4 (BZ1-24-24-3	QC	24-30	28	3	6	2	18591	166	3446	312	<LOD	86	155
BZ1-24-30-36	N	30-36	69	4	12	3	18075	159	3708	304	<LOD	91	241
BZ1-24-36-42	N	36-42	11	2	5	2	15623	143	3316	285	<LOD	81	146
BZ1-24-42-48	N	42-48	<LOD	7	6	2	13705	134	3252	288	<LOD	85	126
BZ1-24-48-50	N	48-50	13	3	<LOD	5	13840	136	3742	306	<LOD	87	405
BZ1-23-0-6	N	0-6	131	5	15	3	15449	145	4542	320	<LOD	88	598
BZ1-23-6-12	N	6-12	465	10	69	6	21559	189	5335	364	111	34	340
BZ1-23-12-18	N	12-18	40	3	11	2	20757	183	6506	374	<LOD	91	313
BZ1-23-18-24	N	18-24	34	3	<LOD	6	21296	189	7133	396	<LOD	95	375
BZ1-23-24-30	N	24-30	68	4	9	3	22949	204	8556	425	<LOD	97	407
BZ1-23-30-36	N	30-36	20	3	8	2	23032	205	7801	409	<LOD	105	379
DUP-5 (BZ1-23-30-36)		30-36	34	3	<LOD	6	19834	179	5813	368	<LOD	97	297
BZ1-22-0-6	N	0-6	218	6	26	4	13792	132	4527	302	<LOD	78	356
BZ1-22-6-12	N	6-12	597	10	69	7	16699	151	3823	308	<LOD	90	341
BZ1-22-12-18	N	12-18	165	6	29	4	15677	147	3777	317	<LOD	87	215
BZ1-22-18-24	N	18-24	29	3	13	2	19767	177	4750	336	<LOD	94	158
BZ1-22-24-30	N	24-30	50	4	10	2	17223	158	4564	325	<LOD	86	195
BZ1-22-30-36	N	30-36	33	3	8	2	20438	183	4320	335	<LOD	92	197
BZ1-22-36-42	N	36-42	11	3	13	2	18270	165	3882	320	<LOD	90	124
BZ1-22-42-48	N	42-48	11	3	<LOD	5	17640	162	5689	354	<LOD	90	262
BZ1-22-48-51	N	48-51	15	3	<LOD	5	21334	186	6738	383	<LOD	98	206
BZ1-18-0-6	N	0-6	167	5	30	4	15028	137	4720	295	<LOD	83	280
DUP-6 (BZ1-18-0-6)	QC	0-6	156	5	29	4	14950	136	4045	291	<LOD	80	380
BZ1-18-6-12	N	6-12	356	8	23	5	17079	154	4515	313	<LOD	89	360
BZ1-18-12-18	N	12-18	165	6	<LOD	10	15806	145	4659	315	<LOD	86	277
BZ1-18-18-24	N	18-24	28	3	<LOD	6	13667	134	4149	304	<LOD	86	196

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Mn +/-	Co	Co +/-	Ni	Ni +/-	Cu	Cu +/-	Zn	Zn +/-	Se	Se +/-
BZ1-19-18-24	N	18-24	26	210	39	<LOD	32	19	6	66	4	<LOD	3
DUP-3 (BZ1-19-18-2	QC	18-24	26	193	40	<LOD	33	21	6	47	4	<LOD	3
BZ1-19-24-30	N	24-30	25	147	36	<LOD	30	31	6	73	4	<LOD	3
BZ1-19-30-36	N	30-36	25	168	44	<LOD	35	<LOD	18	47	4	<LOD	3
BZ1-19-36-42	N	36-42	25	198	44	<LOD	34	23	6	50	4	<LOD	3
BZ1-19-42-48	N	42-48	23	177	38	<LOD	31	18	6	40	4	<LOD	3
BZ1-19-48-54	N	48-54	33	220	46	<LOD	36	<LOD	18	43	4	<LOD	3
BZ1-24-0-6	N	0-6	27	137	36	<LOD	30	40	6	113	5	<LOD	3
BZ1-24-6-12	N	6-12	28	<LOD	129	<LOD	34	64	7	166	7	<LOD	3
BZ1-24-12-18	N	12-18	26	120	39	<LOD	33	34	6	110	5	<LOD	3
BZ1-24-18-24	N	18-24	24	214	39	<LOD	32	<LOD	17	54	4	<LOD	3
BZ1-24-24-30	N	24-30	24	193	42	<LOD	33	<LOD	18	53	4	<LOD	3
DUP-4 (BZ1-24-24-3	QC	24-30	25	135	43	<LOD	34	<LOD	17	53	4	<LOD	2
BZ1-24-30-36	N	30-36	26	219	42	<LOD	34	19	6	74	4	<LOD	3
BZ1-24-36-42	N	36-42	23	224	40	<LOD	33	18	6	39	4	<LOD	3
BZ1-24-42-48	N	42-48	22	174	38	<LOD	32	18	6	36	4	<LOD	3
BZ1-24-48-50	N	48-50	30	<LOD	112	<LOD	34	20	6	37	4	<LOD	3
BZ1-23-0-6	N	0-6	33	<LOD	116	<LOD	32	42	6	107	5	<LOD	3
BZ1-23-6-12	N	6-12	31	265	48	<LOD	36	80	8	203	7	<LOD	4
BZ1-23-12-18	N	12-18	29	177	46	<LOD	35	28	6	62	4	<LOD	3
BZ1-23-18-24	N	18-24	32	215	48	<LOD	38	27	6	46	4	<LOD	3
BZ1-23-24-30	N	24-30	33	<LOD	150	<LOD	38	35	7	72	5	<LOD	3
BZ1-23-30-36	N	30-36	33	172	51	<LOD	37	26	7	51	4	<LOD	3
DUP-5 (BZ1-23-30-36)		30-36	29	230	46	<LOD	36	<LOD	18	41	4	<LOD	3
BZ1-22-0-6	N	0-6	28	176	37	<LOD	31	40	6	127	6	<LOD	3
BZ1-22-6-12	N	6-12	28	231	41	<LOD	33	56	7	161	6	<LOD	4
BZ1-22-12-18	N	12-18	26	213	40	<LOD	33	42	6	110	5	<LOD	3
BZ1-22-18-24	N	18-24	26	213	46	<LOD	35	22	6	71	5	<LOD	3
BZ1-22-24-30	N	24-30	25	159	42	<LOD	34	18	6	69	5	<LOD	3
BZ1-22-30-36	N	30-36	27	212	47	<LOD	35	<LOD	18	53	4	<LOD	3
BZ1-22-36-42	N	36-42	24	143	43	<LOD	35	<LOD	18	45	4	<LOD	3
BZ1-22-42-48	N	42-48	28	<LOD	128	<LOD	35	22	6	39	4	<LOD	3
BZ1-22-48-51	N	48-51	27	241	47	<LOD	35	<LOD	18	48	4	<LOD	3
BZ1-18-0-6	N	0-6	26	<LOD	111	<LOD	30	50	6	81	5	<LOD	3
DUP-6 (BZ1-18-0-6)	QC	0-6	28	154	37	<LOD	31	36	6	98	5	<LOD	3
BZ1-18-6-12	N	6-12	29	199	41	<LOD	33	57	7	101	5	<LOD	3
BZ1-18-12-18	N	12-18	27	<LOD	117	<LOD	34	37	6	77	5	<LOD	3
BZ1-18-18-24	N	18-24	24	131	37	<LOD	33	19	6	41	4	<LOD	3

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Br	Br +/-	Rb	Rb +/-	Sr	Sr +/-	Zr	Zr +/-	Mo	Mo +/-	Ag
BZ1-19-18-24	N	18-24	8	2	52	2	43	2	616	7	<LOD	7	<LOD
DUP-3 (BZ1-19-18-2	QC	18-24	<LOD	5	51	2	36	2	573	7	<LOD	7	<LOD
BZ1-19-24-30	N	24-30	<LOD	5	44	2	44	2	616	7	<LOD	7	<LOD
BZ1-19-30-36	N	30-36	<LOD	4	63	2	40	2	541	6	<LOD	7	<LOD
BZ1-19-36-42	N	36-42	6	1	53	2	38	2	533	6	<LOD	7	<LOD
BZ1-19-42-48	N	42-48	<LOD	4	45	2	31	1	498	6	<LOD	7	<LOD
BZ1-19-48-54	N	48-54	<LOD	4	44	2	38	2	1069	10	<LOD	8	<LOD
BZ1-24-0-6	N	0-6	8	1	48	2	55	2	719	7	<LOD	7	<LOD
BZ1-24-6-12	N	6-12	<LOD	5	49	2	58	2	706	8	<LOD	7	<LOD
BZ1-24-12-18	N	12-18	<LOD	5	41	2	40	2	563	7	<LOD	7	<LOD
BZ1-24-18-24	N	18-24	<LOD	4	46	2	35	2	521	6	<LOD	7	<LOD
BZ1-24-24-30	N	24-30	5	1	48	2	31	2	497	6	<LOD	7	<LOD
DUP-4 (BZ1-24-24-3	QC	24-30	<LOD	4	57	2	34	2	497	6	<LOD	7	<LOD
BZ1-24-30-36	N	30-36	<LOD	4	54	2	44	2	626	7	<LOD	7	<LOD
BZ1-24-36-42	N	36-42	<LOD	4	46	2	32	1	576	7	<LOD	7	<LOD
BZ1-24-42-48	N	42-48	<LOD	4	43	2	30	2	583	7	<LOD	7	<LOD
BZ1-24-48-50	N	48-50	<LOD	4	47	2	39	2	986	9	<LOD	8	<LOD
BZ1-23-0-6	N	0-6	6	2	53	2	56	2	770	8	<LOD	8	<LOD
BZ1-23-6-12	N	6-12	8	2	56	2	61	2	709	8	<LOD	8	<LOD
BZ1-23-12-18	N	12-18	<LOD	4	48	2	41	2	1005	10	<LOD	8	<LOD
BZ1-23-18-24	N	18-24	<LOD	4	53	2	38	2	1424	12	<LOD	9	<LOD
BZ1-23-24-30	N	24-30	<LOD	5	55	2	56	2	1450	13	<LOD	9	<LOD
BZ1-23-30-36	N	30-36	<LOD	4	61	2	42	2	1515	13	<LOD	9	<LOD
DUP-5 (BZ1-23-30-36)		30-36	<LOD	4	46	2	44	2	1225	11	<LOD	8	<LOD
BZ1-22-0-6	N	0-6	7	2	48	2	47	2	629	7	<LOD	7	<LOD
BZ1-22-6-12	N	6-12	6	2	47	2	53	2	556	7	<LOD	7	<LOD
BZ1-22-12-18	N	12-18	<LOD	5	51	2	49	2	610	7	<LOD	7	<LOD
BZ1-22-18-24	N	18-24	9	2	58	2	42	2	539	7	<LOD	7	<LOD
BZ1-22-24-30	N	24-30	<LOD	4	59	2	43	2	560	7	<LOD	7	<LOD
BZ1-22-30-36	N	30-36	7	1	62	2	40	2	532	7	<LOD	7	<LOD
BZ1-22-36-42	N	36-42	<LOD	4	55	2	41	2	564	7	<LOD	7	<LOD
BZ1-22-42-48	N	42-48	<LOD	4	47	2	37	2	1174	11	<LOD	8	<LOD
BZ1-22-48-51	N	48-51	<LOD	4	48	2	36	2	1491	13	<LOD	9	<LOD
BZ1-18-0-6	N	0-6	7	2	50	2	44	2	625	7	<LOD	7	<LOD
DUP-6 (BZ1-18-0-6)	QC	0-6	5	2	55	2	46	2	645	7	<LOD	7	<LOD
BZ1-18-6-12	N	6-12	<LOD	5	51	2	45	2	567	7	<LOD	7	<LOD
BZ1-18-12-18	N	12-18	6	2	50	2	44	2	588	7	<LOD	7	<LOD
BZ1-18-18-24	N	18-24	<LOD	4	48	2	35	2	556	7	<LOD	7	<LOD

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Ag +/-	Cd	Cd +/-	Sn	Sn +/-	Sb	Sb +/-	Ba	Ba +/-	Hg	Hg +/-
BZ1-19-18-24	N	18-24	34	45	14	<LOD	59	<LOD	65	<LOD	0	<LOD	10
DUP-3 (BZ1-19-18-2	QC	18-24	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	10
BZ1-19-24-30	N	24-30	34	<LOD	41	<LOD	59	<LOD	64	<LOD	0	<LOD	9
BZ1-19-30-36	N	30-36	35	<LOD	42	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-19-36-42	N	36-42	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-19-42-48	N	42-48	34	43	14	<LOD	61	<LOD	66	<LOD	0	<LOD	7
BZ1-19-48-54	N	48-54	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-24-0-6	N	0-6	34	<LOD	40	<LOD	60	<LOD	65	<LOD	0	<LOD	8
BZ1-24-6-12	N	6-12	35	52	14	<LOD	61	<LOD	67	<LOD	0	<LOD	10
BZ1-24-12-18	N	12-18	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	9
BZ1-24-18-24	N	18-24	35	<LOD	42	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-24-24-30	N	24-30	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	7
DUP-4 (BZ1-24-24-3	QC	24-30	35	66	14	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-24-30-36	N	30-36	34	46	14	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-24-36-42	N	36-42	34	<LOD	41	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-24-42-48	N	42-48	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-24-48-50	N	48-50	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-23-0-6	N	0-6	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-23-6-12	N	6-12	36	<LOD	43	<LOD	63	<LOD	68	<LOD	0	<LOD	10
BZ1-23-12-18	N	12-18	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-23-18-24	N	18-24	37	<LOD	44	<LOD	65	<LOD	71	<LOD	0	<LOD	8
BZ1-23-24-30	N	24-30	38	<LOD	44	<LOD	66	<LOD	72	<LOD	0	<LOD	9
BZ1-23-30-36	N	30-36	38	<LOD	45	<LOD	67	<LOD	72	<LOD	0	<LOD	8
DUP-5 (BZ1-23-30-36)		30-36	36	<LOD	44	<LOD	65	<LOD	70	<LOD	0	<LOD	8
BZ1-22-0-6	N	0-6	34	<LOD	41	<LOD	59	<LOD	64	<LOD	0	<LOD	8
BZ1-22-6-12	N	6-12	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	10
BZ1-22-12-18	N	12-18	35	<LOD	42	<LOD	63	<LOD	68	<LOD	0	<LOD	9
BZ1-22-18-24	N	18-24	36	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-22-24-30	N	24-30	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-22-30-36	N	30-36	36	<LOD	44	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-22-36-42	N	36-42	36	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-22-42-48	N	42-48	36	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	8
BZ1-22-48-51	N	48-51	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-18-0-6	N	0-6	33	<LOD	40	<LOD	58	<LOD	63	<LOD	0	<LOD	8
DUP-6 (BZ1-18-0-6)	QC	0-6	33	<LOD	40	<LOD	58	<LOD	63	<LOD	0	<LOD	8
BZ1-18-6-12	N	6-12	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	9
BZ1-18-12-18	N	12-18	35	57	14	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-18-18-24	N	18-24	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Tl	Tl +/-	U	U +/-	Mode	Pass/Fail	Pass Fail Standard	Reading	Time	LiveTime
BZ1-19-18-24	N	18-24	<LOD	16	<LOD	3	Soil			38	13:22:08	47.05
DUP-3 (BZ1-19-18-2	QC	18-24	<LOD	16	<LOD	3	Soil			39	13:23:44	47.81
BZ1-19-24-30	N	24-30	<LOD	13	<LOD	3	Soil			40	13:25:28	48.19
BZ1-19-30-36	N	30-36	<LOD	9	<LOD	3	Soil			41	13:27:05	48.25
BZ1-19-36-42	N	36-42	<LOD	9	<LOD	3	Soil			42	13:28:36	48.55
BZ1-19-42-48	N	42-48	<LOD	8	<LOD	3	Soil			43	13:30:40	48.06
BZ1-19-48-54	N	48-54	<LOD	8	<LOD	3	Soil			44	13:32:26	48.02
BZ1-24-0-6	N	0-6	<LOD	10	<LOD	3	Soil			45	13:34:18	48.01
BZ1-24-6-12	N	6-12	<LOD	15	<LOD	3	Soil			46	13:37:05	48.67
BZ1-24-12-18	N	12-18	<LOD	14	<LOD	3	Soil			47	13:38:53	48.58
BZ1-24-18-24	N	18-24	<LOD	10	<LOD	3	Soil			48	13:41:12	48.74
BZ1-24-24-30	N	24-30	<LOD	8	<LOD	3	Soil			49	13:42:57	48.9
DUP-4 (BZ1-24-24-3	QC	24-30	<LOD	8	<LOD	3	Soil			50	13:45:04	48.28
BZ1-24-30-36	N	30-36	<LOD	9	<LOD	3	Soil			51	13:47:34	47.37
BZ1-24-36-42	N	36-42	<LOD	7	<LOD	3	Soil			52	13:49:08	48.1
BZ1-24-42-48	N	42-48	<LOD	8	<LOD	3	Soil			53	13:50:38	48.44
BZ1-24-48-50	N	48-50	<LOD	8	<LOD	3	Soil			54	13:52:21	47.39
BZ1-23-0-6	N	0-6	<LOD	11	<LOD	3	Soil			55	13:53:53	47.53
BZ1-23-6-12	N	6-12	<LOD	16	<LOD	3	Soil			56	13:55:52	48.46
BZ1-23-12-18	N	12-18	<LOD	9	<LOD	3	Soil			57	13:57:51	48.22
BZ1-23-18-24	N	18-24	<LOD	9	<LOD	3	Soil			58	13:59:30	48.16
BZ1-23-24-30	N	24-30	<LOD	10	<LOD	3	Soil			59	14:01:23	48.7
BZ1-23-30-36	N	30-36	<LOD	9	<LOD	3	Soil			60	14:03:07	48.01
DUP-5 (BZ1-23-30-36)		30-36	<LOD	9	<LOD	3	Soil			61	14:04:35	49.69
BZ1-22-0-6	N	0-6	<LOD	12	<LOD	3	Soil			62	14:06:17	48.54
BZ1-22-6-12	N	6-12	<LOD	17	<LOD	3	Soil			63	14:07:58	47.39
BZ1-22-12-18	N	12-18	<LOD	11	<LOD	3	Soil			64	14:09:41	48.46
BZ1-22-18-24	N	18-24	<LOD	9	<LOD	3	Soil			65	14:11:14	48.18
BZ1-22-24-30	N	24-30	<LOD	8	<LOD	3	Soil			66	14:13:19	48.74
BZ1-22-30-36	N	30-36	<LOD	9	<LOD	3	Soil			67	14:15:06	48.14
BZ1-22-36-42	N	36-42	<LOD	9	<LOD	3	Soil			68	14:17:23	48.65
BZ1-22-42-48	N	42-48	<LOD	8	<LOD	3	Soil			69	14:18:58	48.2
BZ1-22-48-51	N	48-51	<LOD	9	<LOD	3	Soil			70	14:20:42	47.68
BZ1-18-0-6	N	0-6	<LOD	11	<LOD	3	Soil			71	14:22:47	48.02
DUP-6 (BZ1-18-0-6)	QC	0-6	<LOD	11	<LOD	3	Soil			72	14:24:28	47.65
BZ1-18-6-12	N	6-12	<LOD	14	<LOD	3	Soil			73	14:26:29	48.2
BZ1-18-12-18	N	12-18	<LOD	11	<LOD	3	Soil			74	14:28:04	48.07
BZ1-18-18-24	N	18-24	<LOD	8	<LOD	3	Soil			75	14:30:02	48.39

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Date
BZ1-19-18-24	N	18-24	10-Nov-14
DUP-3 (BZ1-19-18-2	QC	18-24	10-Nov-14
BZ1-19-24-30	N	24-30	10-Nov-14
BZ1-19-30-36	N	30-36	10-Nov-14
BZ1-19-36-42	N	36-42	10-Nov-14
BZ1-19-42-48	N	42-48	10-Nov-14
BZ1-19-48-54	N	48-54	10-Nov-14
BZ1-24-0-6	N	0-6	10-Nov-14
BZ1-24-6-12	N	6-12	10-Nov-14
BZ1-24-12-18	N	12-18	10-Nov-14
BZ1-24-18-24	N	18-24	10-Nov-14
BZ1-24-24-30	N	24-30	10-Nov-14
DUP-4 (BZ1-24-24-3	QC	24-30	10-Nov-14
BZ1-24-30-36	N	30-36	10-Nov-14
BZ1-24-36-42	N	36-42	10-Nov-14
BZ1-24-42-48	N	42-48	10-Nov-14
BZ1-24-48-50	N	48-50	10-Nov-14
BZ1-23-0-6	N	0-6	10-Nov-14
BZ1-23-6-12	N	6-12	10-Nov-14
BZ1-23-12-18	N	12-18	10-Nov-14
BZ1-23-18-24	N	18-24	10-Nov-14
BZ1-23-24-30	N	24-30	10-Nov-14
BZ1-23-30-36	N	30-36	10-Nov-14
DUP-5 (BZ1-23-30-36)		30-36	10-Nov-14
BZ1-22-0-6	N	0-6	10-Nov-14
BZ1-22-6-12	N	6-12	10-Nov-14
BZ1-22-12-18	N	12-18	10-Nov-14
BZ1-22-18-24	N	18-24	10-Nov-14
BZ1-22-24-30	N	24-30	10-Nov-14
BZ1-22-30-36	N	30-36	10-Nov-14
BZ1-22-36-42	N	36-42	10-Nov-14
BZ1-22-42-48	N	42-48	10-Nov-14
BZ1-22-48-51	N	48-51	10-Nov-14
BZ1-18-0-6	N	0-6	10-Nov-14
DUP-6 (BZ1-18-0-6)	QC	0-6	10-Nov-14
BZ1-18-6-12	N	6-12	10-Nov-14
BZ1-18-12-18	N	12-18	10-Nov-14
BZ1-18-18-24	N	18-24	10-Nov-14

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Pb	Pb +/-	As	As +/-	Fe	Fe +/-	Ti	Ti +/-	Cr	Cr +/-	Mn
BZ1-18-24-30	N	24-30	39	3	<LOD	6	15043	142	4326	305	<LOD	82	156
BZ1-18-30-36	N	30-36	18	3	9	2	21555	186	3799	316	<LOD	89	124
BZ1-18-36-42	N	36-42	15	3	7	2	18659	167	3632	307	<LOD	87	163
BZ1-18-42-48	N	42-48	13	3	<LOD	5	11931	121	4048	294	<LOD	82	131
BZ1-18-48-52	N	48-52	12	3	<LOD	5	17595	163	7605	386	<LOD	94	182
BZ1-17-0-6	N	0-6	68	4	8	2	13223	127	4508	298	<LOD	81	455
BZ1-17-6-12	N	6-12	44	3	<LOD	6	12415	125	4036	310	<LOD	82	402
DUP-7 (BZ1-17-6-12	QC	6-12	41	3	<LOD	6	14315	139	4716	327	<LOD	88	448
BZ1-17-12-18	N	12-18	184	6	23	4	15524	141	3464	296	<LOD	83	304
BZ1-17-18-24	N	18-24	39	3	11	2	14632	138	4544	309	<LOD	85	212
BZ1-17-24-30	N	24-30	55	4	<LOD	7	17908	162	3574	304	<LOD	88	171
BZ1-17-30-36	N	30-36	18	3	8	2	20752	181	3491	309	<LOD	90	134
BZ1-17-36-42	N	36-42	12	2	5	2	15591	143	3594	293	<LOD	83	202
BZ1-17-42-48	N	42-48	12	3	5	2	16374	153	4381	324	<LOD	87	216
BZ1-17-48-50	N	48-50	13	3	5	2	19539	174	6176	356	101	32	322
BZ1-16-0-6	N	0-6	217	6	40	4	17258	155	4291	314	<LOD	85	339
BZ1-16-6-12	N	6-12	210	6	35	4	17185	154	4307	313	<LOD	86	303
BZ1-16-12-18	N	12-18	26	3	<LOD	5	14093	136	3531	296	<LOD	87	366
DUP-8 (BZ1-16-12-1	QQ	12-18	54	4	9	2	15674	146	4309	317	<LOD	90	367
BZ1-16-18-24	N	18-24	30	3	12	2	17269	158	4332	324	<LOD	84	377
BZ1-16-24-37	N	24-27	18	3	<LOD	5	16189	147	3658	291	<LOD	85	484
BZ1-14-0-6	N	0-6	629	10	27	6	15209	139	4038	293	<LOD	84	337
BZ1-14-6-12	N	6-12	940	13	44	8	16505	151	4373	321	<LOD	87	331
BZ1-14-12-18	N	12-18	6414	54	74	22	21116	200	4084	372	<LOD	105	356
BZ1-17-18-24	N	18-24	9755	79	371	28	17221	179	3700	386	<LOD	106	282
BZ1-14-24-30	N	24-30	5813	49	200	21	19367	184	4496	358	<LOD	102	237
BZ1-14-30-36	N	30-36	33	3	<LOD	6	17464	158	4511	317	<LOD	89	121
BZ1-14-36-42	N	36-42	205	6	<LOD	11	19243	168	4553	323	<LOD	89	172
BZ1-14-42-48	N	42-48	10	3	<LOD	5	15354	146	3981	305	<LOD	86	338
BZ1-15-0-6	N	0-6	168	6	22	4	14597	139	4208	304	<LOD	83	249
DUP-9 (BZ1-15-0-6)	QC	0-6	176	6	19	4	15224	144	4103	305	<LOD	77	318
BZ1-15-6-12	N	6-12	863	13	46	8	15756	146	4970	319	100	30	314
DUP-10 (BZ1-15-6-1	QC	6-12	328	8	26	5	17463	157	4454	318	<LOD	86	291
BZ1-15-12-18	N	12-18	72	4	13	3	18745	170	5276	340	<LOD	86	270
BZ1-15-18-24	N	18-24	52	4	8	2	15145	140	3913	302	<LOD	83	257
BZ1-15-24-30	N	24-30	39	3	7	2	17898	157	4555	308	<LOD	86	140
BZ1-15-30-36	N	30-36	10	3	7	2	17316	159	4590	330	<LOD	90	183
BZ1-15-36-42	N	36-42	16	3	<LOD	5	14857	143	4373	313	<LOD	86	196
BZ1-15-42-48	N	42-48	10	3	6	2	15325	145	3760	307	<LOD	84	173

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Mn +/-	Co	Co +/-	Ni	Ni +/-	Cu	Cu +/-	Zn	Zn +/-	Se	Se +/-
BZ1-18-24-30	N	24-30	23	189	39	<LOD	33	<LOD	17	49	4	<LOD	3
BZ1-18-30-36	N	30-36	25	213	47	<LOD	34	<LOD	17	35	4	<LOD	3
BZ1-18-36-42	N	36-42	25	131	43	<LOD	34	20	6	38	4	<LOD	3
BZ1-18-42-48	N	42-48	22	<LOD	103	<LOD	32	<LOD	17	32	3	<LOD	3
BZ1-18-48-52	N	48-52	26	<LOD	127	<LOD	35	<LOD	18	33	4	<LOD	3
BZ1-17-0-6	N	0-6	29	116	36	<LOD	31	27	6	68	4	<LOD	3
BZ1-17-6-12	N	6-12	29	120	35	<LOD	31	<LOD	17	56	4	<LOD	3
DUP-7 (BZ1-17-6-12	QC	6-12	31	123	38	<LOD	32	<LOD	18	54	4	<LOD	3
BZ1-17-12-18	N	12-18	27	160	38	<LOD	32	32	6	79	5	<LOD	3
BZ1-17-18-24	N	18-24	25	<LOD	113	<LOD	31	<LOD	16	50	4	<LOD	3
BZ1-17-24-30	N	24-30	25	232	43	<LOD	35	19	6	53	4	<LOD	3
BZ1-17-30-36	N	30-36	25	176	46	<LOD	35	19	6	45	4	<LOD	3
BZ1-17-36-42	N	36-42	24	145	39	<LOD	33	<LOD	17	40	4	<LOD	2
BZ1-17-42-48	N	42-48	26	189	41	<LOD	33	<LOD	17	32	4	<LOD	3
BZ1-17-48-50	N	48-50	29	<LOD	133	<LOD	35	<LOD	18	29	3	<LOD	3
BZ1-16-0-6	N	0-6	28	169	41	<LOD	32	44	6	93	5	<LOD	3
BZ1-16-6-12	N	6-12	27	<LOD	122	<LOD	34	44	6	92	5	<LOD	3
BZ1-16-12-18	N	12-18	28	<LOD	111	<LOD	32	<LOD	17	40	4	<LOD	3
DUP-8 (BZ1-16-12-1	QQ	12-18	29	131	39	<LOD	34	<LOD	17	50	4	<LOD	3
BZ1-16-18-24	N	18-24	30	128	42	<LOD	33	<LOD	18	49	4	<LOD	3
BZ1-16-24-37	N	24-27	31	119	39	<LOD	33	22	6	30	3	<LOD	3
BZ1-14-0-6	N	0-6	27	209	39	<LOD	30	36	6	98	5	<LOD	4
BZ1-14-6-12	N	6-12	28	183	41	<LOD	34	31	6	94	5	<LOD	4
BZ1-14-12-18	N	12-18	34	193	51	<LOD	41	58	8	126	7	<LOD	9
BZ1-17-18-24	N	18-24	34	<LOD	144	<LOD	42	35	8	74	6	<LOD	12
BZ1-14-24-30	N	24-30	31	162	48	<LOD	38	36	7	75	5	<LOD	9
BZ1-14-30-36	N	30-36	23	169	42	<LOD	33	<LOD	17	34	4	<LOD	2
BZ1-14-36-42	N	36-42	25	152	43	<LOD	34	<LOD	17	48	4	<LOD	3
BZ1-14-42-48	N	42-48	28	<LOD	117	<LOD	33	<LOD	17	28	3	<LOD	3
BZ1-15-0-6	N	0-6	26	133	38	<LOD	33	37	6	81	5	<LOD	3
DUP-9 (BZ1-15-0-6)	QC	0-6	27	<LOD	117	<LOD	33	30	6	96	5	<LOD	3
BZ1-15-6-12	N	6-12	28	213	40	<LOD	32	28	6	82	5	<LOD	4
DUP-10 (BZ1-15-6-1	QC	6-12	27	206	42	<LOD	33	27	6	94	5	<LOD	3
BZ1-15-12-18	N	12-18	28	<LOD	132	<LOD	33	22	6	59	4	<LOD	3
BZ1-15-18-24	N	18-24	26	122	38	<LOD	33	<LOD	17	57	4	<LOD	3
BZ1-15-24-30	N	24-30	23	224	42	<LOD	33	<LOD	17	55	4	<LOD	3
BZ1-15-30-36	N	30-36	25	<LOD	126	<LOD	34	<LOD	18	39	4	<LOD	3
BZ1-15-36-42	N	36-42	25	183	40	<LOD	33	<LOD	16	35	4	<LOD	3
BZ1-15-42-48	N	42-48	24	189	40	<LOD	32	<LOD	18	32	3	<LOD	3

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Br	Br +/-	Rb	Rb +/-	Sr	Sr +/-	Zr	Zr +/-	Mo	Mo +/-	Ag
BZ1-18-24-30	N	24-30	<LOD	4	55	2	40	2	552	6	<LOD	7	<LOD
BZ1-18-30-36	N	30-36	<LOD	4	58	2	40	2	530	6	<LOD	7	<LOD
BZ1-18-36-42	N	36-42	<LOD	4	54	2	37	2	536	6	<LOD	7	<LOD
BZ1-18-42-48	N	42-48	<LOD	4	41	2	34	2	561	6	<LOD	7	<LOD
BZ1-18-48-52	N	48-52	<LOD	4	35	2	42	2	1472	13	<LOD	9	<LOD
BZ1-17-0-6	N	0-6	9	1	54	2	49	2	663	7	<LOD	7	<LOD
BZ1-17-6-12	N	6-12	7	1	56	2	56	2	688	7	<LOD	7	<LOD
DUP-7 (BZ1-17-6-12	QC	6-12	5	2	60	2	59	2	688	7	<LOD	8	<LOD
BZ1-17-12-18	N	12-18	5	2	46	2	48	2	595	7	<LOD	7	<LOD
BZ1-17-18-24	N	18-24	5	1	50	2	41	2	549	6	<LOD	7	<LOD
BZ1-17-24-30	N	24-30	4	1	55	2	37	2	536	6	<LOD	7	<LOD
BZ1-17-30-36	N	30-36	<LOD	4	55	2	37	2	470	6	<LOD	7	<LOD
BZ1-17-36-42	N	36-42	<LOD	4	48	2	34	2	535	6	<LOD	7	<LOD
BZ1-17-42-48	N	42-48	<LOD	4	45	2	34	2	941	9	<LOD	8	<LOD
BZ1-17-48-50	N	48-50	<LOD	4	43	2	42	2	1046	10	<LOD	8	<LOD
BZ1-16-0-6	N	0-6	8	2	47	2	63	2	669	7	<LOD	7	<LOD
BZ1-16-6-12	N	6-12	<LOD	5	47	2	42	2	667	7	<LOD	7	<LOD
BZ1-16-12-18	N	12-18	<LOD	4	45	2	34	2	517	6	<LOD	7	<LOD
DUP-8 (BZ1-16-12-1	QQ	12-18	<LOD	4	42	2	33	2	607	7	<LOD	7	<LOD
BZ1-16-18-24	N	18-24	<LOD	4	42	2	31	2	630	7	<LOD	7	<LOD
BZ1-16-24-37	N	24-27	<LOD	4	46	2	33	2	642	7	<LOD	7	<LOD
BZ1-14-0-6	N	0-6	6	2	50	2	48	2	643	7	<LOD	7	<LOD
BZ1-14-6-12	N	6-12	<LOD	6	57	2	52	2	629	7	<LOD	7	<LOD
BZ1-14-12-18	N	12-18	<LOD	12	51	3	42	2	464	8	<LOD	8	<LOD
BZ1-17-18-24	N	18-24	<LOD	15	51	3	34	2	275	7	<LOD	8	<LOD
BZ1-14-24-30	N	24-30	<LOD	11	51	3	40	2	414	7	<LOD	8	<LOD
BZ1-14-30-36	N	30-36	<LOD	4	51	2	34	2	724	8	<LOD	7	<LOD
BZ1-14-36-42	N	36-42	<LOD	4	56	2	38	2	615	7	<LOD	7	<LOD
BZ1-14-42-48	N	42-48	<LOD	4	38	2	39	2	666	7	<LOD	7	<LOD
BZ1-15-0-6	N	0-6	6	2	44	2	46	2	702	7	<LOD	7	<LOD
DUP-9 (BZ1-15-0-6)	QC	0-6	7	2	45	2	46	2	630	7	<LOD	7	<LOD
BZ1-15-6-12	N	6-12	<LOD	6	44	2	39	2	615	7	<LOD	7	<LOD
DUP-10 (BZ1-15-6-1	QC	6-12	<LOD	5	57	2	51	2	673	7	<LOD	7	<LOD
BZ1-15-12-18	N	12-18	<LOD	4	53	2	39	2	752	8	<LOD	8	<LOD
BZ1-15-18-24	N	18-24	<LOD	4	49	2	35	2	657	7	<LOD	7	<LOD
BZ1-15-24-30	N	24-30	<LOD	4	55	2	37	2	657	7	<LOD	7	<LOD
BZ1-15-30-36	N	30-36	<LOD	4	43	2	31	2	822	8	<LOD	8	<LOD
BZ1-15-36-42	N	36-42	<LOD	4	44	2	34	2	654	7	<LOD	7	<LOD
BZ1-15-42-48	N	42-48	<LOD	4	47	2	36	2	551	7	<LOD	7	<LOD

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Ag +/-	Cd	Cd +/-	Sn	Sn +/-	Sb	Sb +/-	Ba	Ba +/-	Hg	Hg +/-
BZ1-18-24-30	N	24-30	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-18-30-36	N	30-36	35	<LOD	42	<LOD	63	<LOD	68	<LOD	0	<LOD	8
BZ1-18-36-42	N	36-42	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-18-42-48	N	42-48	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-18-48-52	N	48-52	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	7
BZ1-17-0-6	N	0-6	33	<LOD	40	<LOD	58	<LOD	64	<LOD	0	<LOD	7
BZ1-17-6-12	N	6-12	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	7
DUP-7 (BZ1-17-6-12	QC	6-12	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	9
BZ1-17-12-18	N	12-18	34	<LOD	40	<LOD	60	<LOD	65	<LOD	0	<LOD	8
BZ1-17-18-24	N	18-24	34	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-17-24-30	N	24-30	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-17-30-36	N	30-36	35	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-17-36-42	N	36-42	34	<LOD	41	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-17-42-48	N	42-48	35	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-17-48-50	N	48-50	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-16-0-6	N	0-6	34	<LOD	41	<LOD	60	<LOD	65	<LOD	0	<LOD	9
BZ1-16-6-12	N	6-12	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	9
BZ1-16-12-18	N	12-18	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
DUP-8 (BZ1-16-12-1	QQ	12-18	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-16-18-24	N	18-24	35	43	14	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-16-24-37	N	24-27	34	<LOD	41	<LOD	62	<LOD	67	<LOD	0	<LOD	7
BZ1-14-0-6	N	0-6	33	<LOD	40	<LOD	59	<LOD	63	<LOD	0	<LOD	10
BZ1-14-6-12	N	6-12	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	11
BZ1-14-12-18	N	12-18	39	<LOD	46	<LOD	67	<LOD	73	<LOD	0	<LOD	26
BZ1-17-18-24	N	18-24	40	<LOD	48	<LOD	72	<LOD	77	<LOD	0	<LOD	33
BZ1-14-24-30	N	24-30	38	<LOD	45	<LOD	67	<LOD	72	<LOD	0	<LOD	25
BZ1-14-30-36	N	30-36	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-14-36-42	N	36-42	35	<LOD	42	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-14-42-48	N	42-48	36	44	14	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-15-0-6	N	0-6	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	8
DUP-9 (BZ1-15-0-6)	QC	0-6	35	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	9
BZ1-15-6-12	N	6-12	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	11
DUP-10 (BZ1-15-6-1	QC	6-12	35	<LOD	42	<LOD	61	<LOD	66	<LOD	0	<LOD	9
BZ1-15-12-18	N	12-18	36	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	8
BZ1-15-18-24	N	18-24	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-15-24-30	N	24-30	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-15-30-36	N	30-36	35	<LOD	43	<LOD	64	<LOD	69	<LOD	0	<LOD	7
BZ1-15-36-42	N	36-42	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	7
BZ1-15-42-48	N	42-48	35	<LOD	42	<LOD	63	<LOD	68	<LOD	0	<LOD	8

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Tl	Tl +/-	U	U +/-	Mode	Pass/Fail	Pass Fail Standard	Reading	Time	LiveTime
BZ1-18-24-30	N	24-30	<LOD	9	<LOD	3	Soil			76	14:31:37	48.53
BZ1-18-30-36	N	30-36	<LOD	7	<LOD	3	Soil			77	14:33:41	48.63
BZ1-18-36-42	N	36-42	<LOD	9	<LOD	3	Soil			78	14:35:26	48.43
BZ1-18-42-48	N	42-48	<LOD	8	<LOD	3	Soil			79	14:37:01	48.36
BZ1-18-48-52	N	48-52	<LOD	8	<LOD	3	Soil			80	14:38:36	48.19
BZ1-17-0-6	N	0-6	<LOD	9	<LOD	3	Soil			81	14:40:28	48.05
BZ1-17-6-12	N	6-12	<LOD	9	<LOD	3	Soil			82	14:42:44	48.43
DUP-7 (BZ1-17-6-12	QC	6-12	<LOD	9	<LOD	3	Soil			83	14:44:37	49.06
BZ1-17-12-18	N	12-18	<LOD	11	<LOD	3	Soil			84	14:46:23	47.93
BZ1-17-18-24	N	18-24	<LOD	9	<LOD	3	Soil			85	14:48:32	48.34
BZ1-17-24-30	N	24-30	<LOD	10	<LOD	3	Soil			86	14:50:39	48.82
BZ1-17-30-36	N	30-36	<LOD	8	<LOD	3	Soil			87	14:52:23	48.8
BZ1-17-36-42	N	36-42	<LOD	8	<LOD	3	Soil			88	14:54:01	47.93
BZ1-17-42-48	N	42-48	<LOD	8	<LOD	3	Soil			89	14:55:36	48.22
BZ1-17-48-50	N	48-50	<LOD	8	<LOD	3	Soil			90	14:57:14	48.09
BZ1-16-0-6	N	0-6	<LOD	12	<LOD	3	Soil			91	14:58:51	48.58
BZ1-16-6-12	N	6-12	<LOD	12	<LOD	3	Soil			92	15:00:29	47.82
BZ1-16-12-18	N	12-18	<LOD	8	<LOD	3	Soil			93	15:02:05	48.83
DUP-8 (BZ1-16-12-1	QQ	12-18	<LOD	9	<LOD	3	Soil			94	15:03:39	48.22
BZ1-16-18-24	N	18-24	<LOD	8	<LOD	3	Soil			95	15:05:16	48.87
BZ1-16-24-37	N	24-27	<LOD	8	<LOD	3	Soil			96	15:06:58	49.09
BZ1-14-0-6	N	0-6	<LOD	16	<LOD	3	Soil			97	15:08:31	47.81
BZ1-14-6-12	N	6-12	<LOD	20	<LOD	3	Soil			98	15:10:19	47.56
BZ1-14-12-18	N	12-18	<LOD	54	<LOD	3	Soil			99	15:11:55	47.11
BZ1-17-18-24	N	18-24	115	23	<LOD	4	Soil			100	15:13:45	45.9
BZ1-14-24-30	N	24-30	61	17	<LOD	3	Soil			101	15:15:19	47.47
BZ1-14-30-36	N	30-36	<LOD	8	<LOD	3	Soil			102	15:16:53	48.32
BZ1-14-36-42	N	36-42	<LOD	11	<LOD	3	Soil			103	15:18:25	47.93
BZ1-14-42-48	N	42-48	<LOD	8	<LOD	3	Soil			104	15:19:56	48.14
BZ1-15-0-6	N	0-6	<LOD	11	<LOD	3	Soil			105	15:21:29	48.46
DUP-9 (BZ1-15-0-6)	QC	0-6	<LOD	12	<LOD	3	Soil			106	15:22:58	48.83
BZ1-15-6-12	N	6-12	<LOD	20	<LOD	3	Soil			107	15:24:30	47.53
DUP-10 (BZ1-15-6-1	QC	6-12	<LOD	13	<LOD	3	Soil			108	15:26:07	48.2
BZ1-15-12-18	N	12-18	<LOD	10	<LOD	3	Soil			109	15:28:01	48.84
BZ1-15-18-24	N	18-24	<LOD	9	<LOD	3	Soil			110	15:29:35	47.65
BZ1-15-24-30	N	24-30	<LOD	8	<LOD	3	Soil			111	15:31:17	47.88
BZ1-15-30-36	N	30-36	<LOD	8	<LOD	3	Soil			112	15:33:01	48.6
BZ1-15-36-42	N	36-42	<LOD	8	<LOD	3	Soil			113	15:34:32	49.27
BZ1-15-42-48	N	42-48	<LOD	8	<LOD	3	Soil			114	15:36:17	48.73

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Date
BZ1-18-24-30	N	24-30	10-Nov-14
BZ1-18-30-36	N	30-36	10-Nov-14
BZ1-18-36-42	N	36-42	10-Nov-14
BZ1-18-42-48	N	42-48	10-Nov-14
BZ1-18-48-52	N	48-52	10-Nov-14
BZ1-17-0-6	N	0-6	10-Nov-14
BZ1-17-6-12	N	6-12	10-Nov-14
DUP-7 (BZ1-17-6-12	QC	6-12	10-Nov-14
BZ1-17-12-18	N	12-18	10-Nov-14
BZ1-17-18-24	N	18-24	10-Nov-14
BZ1-17-24-30	N	24-30	10-Nov-14
BZ1-17-30-36	N	30-36	10-Nov-14
BZ1-17-36-42	N	36-42	10-Nov-14
BZ1-17-42-48	N	42-48	10-Nov-14
BZ1-17-48-50	N	48-50	10-Nov-14
BZ1-16-0-6	N	0-6	10-Nov-14
BZ1-16-6-12	N	6-12	10-Nov-14
BZ1-16-12-18	N	12-18	10-Nov-14
DUP-8 (BZ1-16-12-1	QQ	12-18	10-Nov-14
BZ1-16-18-24	N	18-24	10-Nov-14
BZ1-16-24-37	N	24-27	10-Nov-14
BZ1-14-0-6	N	0-6	10-Nov-14
BZ1-14-6-12	N	6-12	10-Nov-14
BZ1-14-12-18	N	12-18	10-Nov-14
BZ1-17-18-24	N	18-24	10-Nov-14
BZ1-14-24-30	N	24-30	10-Nov-14
BZ1-14-30-36	N	30-36	10-Nov-14
BZ1-14-36-42	N	36-42	10-Nov-14
BZ1-14-42-48	N	42-48	10-Nov-14
BZ1-15-0-6	N	0-6	10-Nov-14
DUP-9 (BZ1-15-0-6)	QC	0-6	10-Nov-14
BZ1-15-6-12	N	6-12	10-Nov-14
DUP-10 (BZ1-15-6-1	QC	6-12	10-Nov-14
BZ1-15-12-18	N	12-18	10-Nov-14
BZ1-15-18-24	N	18-24	10-Nov-14
BZ1-15-24-30	N	24-30	10-Nov-14
BZ1-15-30-36	N	30-36	10-Nov-14
BZ1-15-36-42	N	36-42	10-Nov-14
BZ1-15-42-48	N	42-48	10-Nov-14

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Pb	Pb +/-	As	As +/-	Fe	Fe +/-	Ti	Ti +/-	Cr	Cr +/-	Mn
BZ1-13-0-6	N	0-6	107	5	12	3	12983	124	3956	289	<LOD	74	311
BZ1-13-6-12	N	6-12	127	5	11	3	15595	143	4757	316	<LOD	84	427
BZ1-13-12-18	N	12-18	86	4	12	3	14126	137	2705	283	<LOD	86	294
BZ1-13-18-24	N	18-24	16	3	8	2	17426	164	4567	323	<LOD	84	173
BZ1-13-24-30	N	24-30	23	3	<LOD	6	17936	163	3551	304	97	31	217
BZ1-13-30-36	N	30-36	19	3	<LOD	6	19592	178	4389	343	<LOD	91	293
BZ1-13-36-42	N	36-42	11	3	<LOD	5	22134	193	5373	368	<LOD	101	643
BZ1-13-42-48	N	42-48	<LOD	7	<LOD	5	19430	175	4219	331	<LOD	95	170
BZ1-12-0-6	N	0-6	108	5	18	3	14247	133	4152	295	<LOD	82	310
BZ1-12-6-12	N	6-12	324	8	67	5	18389	166	3891	321	<LOD	89	325
BZ1-12-12-18	N	12-18	90	4	12	3	15171	140	4314	303	<LOD	80	296
BZ1-12-18-24	N	18-24	19	3	<LOD	5	18343	165	4380	330	<LOD	86	186
DUP-11 (BZ1-12-12-	QC	12-18	97	4	20	3	15632	145	3720	301	<LOD	84	301
BZ1-12-24-30	N	24-30	20	3	8	2	18820	171	4443	327	<LOD	95	158
BZ1-12-30-36	N	30-36	51	4	10	2	20343	178	4478	332	<LOD	92	259
BZ1-12-36-42	N	36-42	8	2	6	2	18265	167	4466	323	<LOD	88	231
BZ1-12-42-48	N	42-48	8	3	8	2	20854	190	6882	387	<LOD	97	405
BZ1-10-0-6	N	0-6	184	6	15	4	14590	137	3123	283	<LOD	81	296
BZ1-10-6-12	N	6-12	151	5	15	3	17108	155	4666	328	<LOD	89	311
Standard Clip	QC												
BZ1-10-12-18	N	12-18	28	3	<LOD	6	14657	139	4537	311	<LOD	79	243
BZ1-10-18-24	N	18-24	26	3	10	2	17978	163	3935	313	<LOD	85	161
BZ1-10-24-30	N	24-30	44	3	11	2	15806	150	4005	312	<LOD	84	219
BZ1-10-30-36	N	30-36	9	2	9	2	17529	161	4308	327	<LOD	89	182
BZ1-10-36-42	N	36-42	14	3	<LOD	5	17178	164	4178	319	<LOD	92	148
BZ1-10-42-48	N	42-48	11	3	6	2	16105	150	4021	319	<LOD	85	193
BZ1-11-0-6	N	0-6	229	6	21	4	15946	145	4700	312	<LOD	83	301
DUP-12 (BZ1-11-0-6	QC	6-12	239	7	26	4	15837	146	4257	315	<LOD	82	316
BZ1-11-6-12	N	6-12	359	8	47	5	19168	172	4240	332	<LOD	96	303
BZ1-11-12-18	N	12-18	71	4	10	3	17752	162	4351	323	<LOD	90	252
BZ1-11-18-24	N	18-24	37	3	9	2	19785	176	4379	330	<LOD	87	194
BZ1-11-24-30	N	24-30	133	5	20	3	18125	165	4609	334	<LOD	94	269
DUP-13 (BZ1-11-24-	QC	24-30	136	5	17	3	18554	170	4657	337	<LOD	92	251
BZ1-11-30-36	N	30-36	14	3	<LOD	5	18903	174	5088	343	<LOD	94	250
BZ1-11-36-42	N	36-42	12	3	7	2	19150	174	5180	335	<LOD	92	229
BZ1-11-42-48	N	42-48	12	3	5	2	15441	148	4284	306	<LOD	88	388
BZ1-7-0-6	N	0-6	298	7	46	5	18503	165	3874	316	<LOD	88	316
BZ1-7-6-12	N	6-12	114	5	<LOD	9	14668	140	3716	304	<LOD	87	292
BZ1-7-12-18	N	12-18	24	3	8	2	17318	156	4182	307	<LOD	88	151

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Mn +/-	Co	Co +/-	Ni	Ni +/-	Cu	Cu +/-	Zn	Zn +/-	Se	Se +/-
BZ1-13-0-6	N	0-6	26	154	35	<LOD	31	18	6	93	5	<LOD	3
BZ1-13-6-12	N	6-12	29	<LOD	116	<LOD	32	<LOD	17	78	5	<LOD	3
BZ1-13-12-18	N	12-18	27	<LOD	113	<LOD	32	41	6	77	5	<LOD	3
BZ1-13-18-24	N	18-24	25	197	44	<LOD	34	<LOD	18	35	4	<LOD	3
BZ1-13-24-30	N	24-30	26	199	43	<LOD	35	20	6	36	4	<LOD	3
BZ1-13-30-36	N	30-36	29	210	46	<LOD	37	<LOD	18	39	4	<LOD	3
BZ1-13-36-42	N	36-42	37	<LOD	143	<LOD	35	26	6	34	4	<LOD	3
BZ1-13-42-48	N	42-48	26	145	45	<LOD	35	<LOD	18	19	3	<LOD	3
BZ1-12-0-6	N	0-6	26	132	37	<LOD	31	<LOD	17	83	5	<LOD	3
BZ1-12-6-12	N	6-12	29	192	44	<LOD	34	26	6	120	6	<LOD	3
BZ1-12-12-18	N	12-18	26	176	38	<LOD	30	30	6	80	5	<LOD	3
BZ1-12-18-24	N	18-24	25	212	44	<LOD	34	19	6	60	4	<LOD	3
DUP-11 (BZ1-12-12-	QC	12-18	27	142	39	<LOD	32	20	6	78	5	<LOD	3
BZ1-12-24-30	N	24-30	25	177	45	<LOD	34	<LOD	18	53	4	<LOD	3
BZ1-12-30-36	N	30-36	28	208	46	<LOD	35	28	6	59	4	<LOD	3
BZ1-12-36-42	N	36-42	27	<LOD	129	<LOD	34	<LOD	17	37	4	<LOD	3
BZ1-12-42-48	N	42-48	32	<LOD	141	<LOD	36	21	6	32	4	<LOD	3
BZ1-10-0-6	N	0-6	26	156	38	<LOD	32	41	6	112	5	<LOD	3
BZ1-10-6-12	N	6-12	28	160	41	<LOD	33	29	6	108	5	<LOD	3
Standard Clip	QC												
BZ1-10-12-18	N	12-18	25	171	38	<LOD	32	24	6	48	4	<LOD	3
BZ1-10-18-24	N	18-24	25	264	44	<LOD	33	25	6	44	4	<LOD	3
BZ1-10-24-30	N	24-30	26	<LOD	120	<LOD	33	22	6	56	4	<LOD	3
BZ1-10-30-36	N	30-36	25	137	42	<LOD	34	<LOD	18	42	4	<LOD	3
BZ1-10-36-42	N	36-42	25	213	44	<LOD	34	<LOD	18	38	4	<LOD	3
BZ1-10-42-48	N	42-48	25	168	41	<LOD	34	<LOD	17	37	4	<LOD	3
BZ1-11-0-6	N	0-6	27	154	39	<LOD	32	57	7	149	6	<LOD	3
DUP-12 (BZ1-11-0-6	QC	6-12	27	228	40	<LOD	32	60	7	166	6	<LOD	3
BZ1-11-6-12	N	6-12	29	192	45	<LOD	34	60	7	176	7	<LOD	3
BZ1-11-12-18	N	12-18	27	145	43	<LOD	34	<LOD	18	64	4	<LOD	3
BZ1-11-18-24	N	18-24	26	<LOD	134	<LOD	35	<LOD	18	47	4	<LOD	3
BZ1-11-24-30	N	24-30	28	179	44	<LOD	35	67	7	107	5	<LOD	3
DUP-13 (BZ1-11-24-	QC	24-30	28	167	44	<LOD	35	62	7	108	6	<LOD	3
BZ1-11-30-36	N	30-36	28	200	46	<LOD	36	19	6	52	4	<LOD	3
BZ1-11-36-42	N	36-42	27	219	45	<LOD	35	<LOD	18	44	4	<LOD	3
BZ1-11-42-48	N	42-48	30	190	41	<LOD	33	26	6	29	3	<LOD	3
BZ1-7-0-6	N	0-6	28	147	43	<LOD	34	100	8	142	6	<LOD	3
BZ1-7-6-12	N	6-12	27	137	38	<LOD	32	21	6	68	4	<LOD	3
BZ1-7-12-18	N	12-18	24	185	42	<LOD	33	<LOD	17	52	4	<LOD	2

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Br	Br +/-	Rb	Rb +/-	Sr	Sr +/-	Zr	Zr +/-	Mo	Mo +/-	Ag
BZ1-13-0-6	N	0-6	7	1	53	2	45	2	635	7	<LOD	7	<LOD
BZ1-13-6-12	N	6-12	5	1	55	2	59	2	630	7	<LOD	7	<LOD
BZ1-13-12-18	N	12-18	<LOD	4	76	3	74	2	325	5	<LOD	7	<LOD
BZ1-13-18-24	N	18-24	<LOD	4	59	2	43	2	559	7	<LOD	7	<LOD
BZ1-13-24-30	N	24-30	<LOD	4	61	2	45	2	605	7	<LOD	7	<LOD
BZ1-13-30-36	N	30-36	<LOD	4	59	2	57	2	675	8	<LOD	8	<LOD
BZ1-13-36-42	N	36-42	<LOD	4	43	2	48	2	791	8	<LOD	8	<LOD
BZ1-13-42-48	N	42-48	<LOD	4	34	2	38	2	439	6	<LOD	7	<LOD
BZ1-12-0-6	N	0-6	6	1	47	2	48	2	610	7	<LOD	7	<LOD
BZ1-12-6-12	N	6-12	<LOD	5	55	2	46	2	534	7	<LOD	7	<LOD
BZ1-12-12-18	N	12-18	<LOD	4	55	2	44	2	602	7	<LOD	7	<LOD
BZ1-12-18-24	N	18-24	<LOD	4	54	2	39	2	583	7	<LOD	7	<LOD
DUP-11 (BZ1-12-12-	QC	12-18	<LOD	4	46	2	39	2	652	7	<LOD	7	<LOD
BZ1-12-24-30	N	24-30	<LOD	4	56	2	39	2	539	7	<LOD	7	<LOD
BZ1-12-30-36	N	30-36	<LOD	4	56	2	36	2	580	7	<LOD	7	<LOD
BZ1-12-36-42	N	36-42	<LOD	4	46	2	31	2	567	7	<LOD	7	<LOD
BZ1-12-42-48	N	42-48	<LOD	4	36	2	36	2	1062	10	<LOD	8	<LOD
BZ1-10-0-6	N	0-6	7	2	44	2	39	2	661	7	<LOD	7	<LOD
BZ1-10-6-12	N	6-12	8	2	50	2	43	2	641	7	<LOD	7	<LOD
Standard Clip	QC												
BZ1-10-12-18	N	12-18	<LOD	4	44	2	36	2	650	7	<LOD	7	<LOD
BZ1-10-18-24	N	18-24	<LOD	4	51	2	38	2	734	8	<LOD	8	<LOD
BZ1-10-24-30	N	24-30	<LOD	4	47	2	37	2	717	8	<LOD	8	<LOD
BZ1-10-30-36	N	30-36	<LOD	4	49	2	34	2	770	8	<LOD	8	<LOD
BZ1-10-36-42	N	36-42	<LOD	4	50	2	34	2	545	7	<LOD	8	<LOD
BZ1-10-42-48	N	42-48	<LOD	4	45	2	37	2	682	7	<LOD	7	<LOD
BZ1-11-0-6	N	0-6	14	2	48	2	51	2	671	7	<LOD	7	<LOD
DUP-12 (BZ1-11-0-6	QC	6-12	9	2	50	2	50	2	608	7	<LOD	7	<LOD
BZ1-11-6-12	N	6-12	9	2	50	2	62	2	613	7	<LOD	8	<LOD
BZ1-11-12-18	N	12-18	5	2	56	2	47	2	651	7	<LOD	8	<LOD
BZ1-11-18-24	N	18-24	7	1	54	2	39	2	732	8	<LOD	8	<LOD
BZ1-11-24-30	N	24-30	7	2	50	2	45	2	677	7	<LOD	8	<LOD
DUP-13 (BZ1-11-24-	QC	24-30	<LOD	5	54	2	47	2	674	8	<LOD	8	<LOD
BZ1-11-30-36	N	30-36	<LOD	4	57	2	41	2	679	8	<LOD	8	<LOD
BZ1-11-36-42	N	36-42	<LOD	4	57	2	41	2	596	7	<LOD	8	<LOD
BZ1-11-42-48	N	42-48	<LOD	4	47	2	35	2	589	7	<LOD	7	<LOD
BZ1-7-0-6	N	0-6	<LOD	5	49	2	47	2	599	7	<LOD	7	<LOD
BZ1-7-6-12	N	6-12	7	1	44	2	33	2	612	7	<LOD	7	<LOD
BZ1-7-12-18	N	12-18	7	1	54	2	37	2	583	7	<LOD	7	<LOD

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Ag +/-	Cd	Cd +/-	Sn	Sn +/-	Sb	Sb +/-	Ba	Ba +/-	Hg	Hg +/-
BZ1-13-0-6	N	0-6	33	<LOD	40	<LOD	58	<LOD	64	<LOD	0	<LOD	7
BZ1-13-6-12	N	6-12	34	42	14	<LOD	60	<LOD	65	<LOD	0	<LOD	8
BZ1-13-12-18	N	12-18	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	9
BZ1-13-18-24	N	18-24	36	<LOD	44	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-13-24-30	N	24-30	35	<LOD	43	<LOD	62	<LOD	69	<LOD	0	<LOD	8
BZ1-13-30-36	N	30-36	37	<LOD	44	<LOD	66	<LOD	71	<LOD	0	<LOD	8
BZ1-13-36-42	N	36-42	36	63	14	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-13-42-48	N	42-48	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	7
BZ1-12-0-6	N	0-6	33	<LOD	40	<LOD	59	<LOD	64	<LOD	0	<LOD	8
BZ1-12-6-12	N	6-12	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	10
BZ1-12-12-18	N	12-18	34	46	14	<LOD	60	<LOD	65	<LOD	0	<LOD	7
BZ1-12-18-24	N	18-24	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	7
DUP-11 (BZ1-12-12-	QC	12-18	35	<LOD	41	<LOD	60	<LOD	66	<LOD	0	<LOD	8
BZ1-12-24-30	N	24-30	36	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	7
BZ1-12-30-36	N	30-36	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-12-36-42	N	36-42	36	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-12-42-48	N	42-48	37	<LOD	45	<LOD	66	<LOD	71	<LOD	0	<LOD	8
BZ1-10-0-6	N	0-6	34	<LOD	41	<LOD	59	<LOD	64	<LOD	0	<LOD	9
BZ1-10-6-12	N	6-12	35	<LOD	42	<LOD	61	<LOD	66	<LOD	0	<LOD	9
Standard Clip	QC												
BZ1-10-12-18	N	12-18	35	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	8
BZ1-10-18-24	N	18-24	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-10-24-30	N	24-30	36	49	14	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-10-30-36	N	30-36	36	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-10-36-42	N	36-42	37	<LOD	44	<LOD	65	<LOD	70	<LOD	0	<LOD	9
BZ1-10-42-48	N	42-48	35	52	14	<LOD	62	<LOD	68	<LOD	0	<LOD	7
BZ1-11-0-6	N	0-6	34	<LOD	40	<LOD	59	<LOD	63	<LOD	0	<LOD	8
DUP-12 (BZ1-11-0-6	QC	6-12	34	<LOD	41	<LOD	60	<LOD	65	<LOD	0	<LOD	9
BZ1-11-6-12	N	6-12	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	10
BZ1-11-12-18	N	12-18	36	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-11-18-24	N	18-24	36	55	14	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-11-24-30	N	24-30	36	<LOD	42	<LOD	63	<LOD	68	<LOD	0	<LOD	9
DUP-13 (BZ1-11-24-	QC	24-30	36	<LOD	43	<LOD	63	<LOD	68	<LOD	0	<LOD	9
BZ1-11-30-36	N	30-36	36	<LOD	44	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-11-36-42	N	36-42	36	<LOD	43	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-11-42-48	N	42-48	36	<LOD	43	<LOD	63	<LOD	68	<LOD	0	<LOD	8
BZ1-7-0-6	N	0-6	35	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	9
BZ1-7-6-12	N	6-12	35	<LOD	41	<LOD	61	<LOD	67	<LOD	0	<LOD	8
BZ1-7-12-18	N	12-18	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	7

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Tl	Tl +/-	U	U +/-	Mode	Pass/Fail	Pass Fail Standard	Reading	Time	LiveTime
BZ1-13-0-6	N	0-6	<LOD	10	<LOD	3	Soil			115	15:38:29	48.54
BZ1-13-6-12	N	6-12	<LOD	10	<LOD	3	Soil			116	15:40:03	47.88
BZ1-13-12-18	N	12-18	<LOD	10	<LOD	3	Soil			117	15:42:08	49.04
BZ1-13-18-24	N	18-24	<LOD	8	<LOD	3	Soil			118	15:44:11	48.86
BZ1-13-24-30	N	24-30	<LOD	9	<LOD	3	Soil			119	15:45:55	47.93
BZ1-13-30-36	N	30-36	<LOD	8	<LOD	3	Soil			120	15:47:59	47.5
BZ1-13-36-42	N	36-42	<LOD	9	<LOD	3	Soil			121	15:49:31	49.9
BZ1-13-42-48	N	42-48	<LOD	8	<LOD	3	Soil			122	15:51:05	49.31
BZ1-12-0-6	N	0-6	<LOD	10	<LOD	3	Soil			123	15:52:52	48.22
BZ1-12-6-12	N	6-12	<LOD	14	<LOD	3	Soil			124	15:54:24	48.71
BZ1-12-12-18	N	12-18	<LOD	9	<LOD	3	Soil			125	15:56:18	47.99
BZ1-12-18-24	N	18-24	<LOD	8	<LOD	3	Soil			126	15:57:50	48.91
DUP-11 (BZ1-12-12-	QC	12-18	<LOD	9	<LOD	3	Soil			127	15:59:34	48.22
BZ1-12-24-30	N	24-30	<LOD	8	<LOD	3	Soil			128	16:01:15	49.02
BZ1-12-30-36	N	30-36	<LOD	9	<LOD	3	Soil			129	16:02:55	48.64
BZ1-12-36-42	N	36-42	<LOD	8	<LOD	3	Soil			130	16:04:52	48.84
BZ1-12-42-48	N	42-48	<LOD	8	<LOD	3	Soil			131	16:06:27	48.34
BZ1-10-0-6	N	0-6	<LOD	11	<LOD	3	Soil			132	16:08:11	48.34
BZ1-10-6-12	N	6-12	<LOD	11	<LOD	3	Soil			133	16:10:21	48.07
Standard Clip	QC						Standardizatio	-0.004082	PASS	134	16:11:51	34.7
BZ1-10-12-18	N	12-18	<LOD	8	<LOD	3	Soil			135	16:13:19	48.48
BZ1-10-18-24	N	18-24	<LOD	8	<LOD	3	Soil			136	16:14:47	48.77
BZ1-10-24-30	N	24-30	<LOD	9	<LOD	3	Soil			137	16:16:38	48.46
BZ1-10-30-36	N	30-36	<LOD	8	<LOD	3	Soil			138	16:18:26	48.86
BZ1-10-36-42	N	36-42	<LOD	8	<LOD	3	Soil			139	16:19:59	50
BZ1-10-42-48	N	42-48	<LOD	7	<LOD	3	Soil			140	16:21:49	48.39
BZ1-11-0-6	N	0-6	<LOD	12	<LOD	3	Soil			141	16:23:37	48.33
DUP-12 (BZ1-11-0-6	QC	6-12	<LOD	12	<LOD	3	Soil			142	16:25:20	48.54
BZ1-11-6-12	N	6-12	<LOD	15	<LOD	3	Soil			143	16:27:07	47.91
BZ1-11-12-18	N	12-18	<LOD	9	<LOD	3	Soil			144	16:29:12	48.82
BZ1-11-18-24	N	18-24	<LOD	9	<LOD	3	Soil			145	16:30:43	48.45
BZ1-11-24-30	N	24-30	<LOD	11	<LOD	3	Soil			146	16:32:19	48.93
DUP-13 (BZ1-11-24-	QC	24-30	<LOD	11	<LOD	3	Soil			147	16:34:00	48.71
BZ1-11-30-36	N	30-36	<LOD	8	<LOD	3	Soil			148	16:36:03	49.29
BZ1-11-36-42	N	36-42	<LOD	8	<LOD	3	Soil			149	16:37:35	49.2
BZ1-11-42-48	N	42-48	<LOD	8	<LOD	3	Soil			150	16:39:07	48.78
BZ1-7-0-6	N	0-6	<LOD	13	<LOD	3	Soil			151	16:40:48	48.24
BZ1-7-6-12	N	6-12	<LOD	10	<LOD	3	Soil			152	16:43:01	48.55
BZ1-7-12-18	N	12-18	<LOD	9	<LOD	3	Soil			153	16:44:37	48.34

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Date
BZ1-13-0-6	N	0-6	10-Nov-14
BZ1-13-6-12	N	6-12	10-Nov-14
BZ1-13-12-18	N	12-18	10-Nov-14
BZ1-13-18-24	N	18-24	10-Nov-14
BZ1-13-24-30	N	24-30	10-Nov-14
BZ1-13-30-36	N	30-36	10-Nov-14
BZ1-13-36-42	N	36-42	10-Nov-14
BZ1-13-42-48	N	42-48	10-Nov-14
BZ1-12-0-6	N	0-6	10-Nov-14
BZ1-12-6-12	N	6-12	10-Nov-14
BZ1-12-12-18	N	12-18	10-Nov-14
BZ1-12-18-24	N	18-24	10-Nov-14
DUP-11 (BZ1-12-12-	QC	12-18	10-Nov-14
BZ1-12-24-30	N	24-30	10-Nov-14
BZ1-12-30-36	N	30-36	10-Nov-14
BZ1-12-36-42	N	36-42	10-Nov-14
BZ1-12-42-48	N	42-48	10-Nov-14
BZ1-10-0-6	N	0-6	10-Nov-14
BZ1-10-6-12	N	6-12	10-Nov-14
Standard Clip	QC		10-Nov-14
BZ1-10-12-18	N	12-18	10-Nov-14
BZ1-10-18-24	N	18-24	10-Nov-14
BZ1-10-24-30	N	24-30	10-Nov-14
BZ1-10-30-36	N	30-36	10-Nov-14
BZ1-10-36-42	N	36-42	10-Nov-14
BZ1-10-42-48	N	42-48	10-Nov-14
BZ1-11-0-6	N	0-6	10-Nov-14
DUP-12 (BZ1-11-0-6	QC	6-12	10-Nov-14
BZ1-11-6-12	N	6-12	10-Nov-14
BZ1-11-12-18	N	12-18	10-Nov-14
BZ1-11-18-24	N	18-24	10-Nov-14
BZ1-11-24-30	N	24-30	10-Nov-14
DUP-13 (BZ1-11-24-	QC	24-30	10-Nov-14
BZ1-11-30-36	N	30-36	10-Nov-14
BZ1-11-36-42	N	36-42	10-Nov-14
BZ1-11-42-48	N	42-48	10-Nov-14
BZ1-7-0-6	N	0-6	10-Nov-14
BZ1-7-6-12	N	6-12	10-Nov-14
BZ1-7-12-18	N	12-18	10-Nov-14

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Pb	Pb +/-	As	As +/-	Fe	Fe +/-	Ti	Ti +/-	Cr	Cr +/-	Mn
BZ1-7-18-24	N	18-24	8	2	8	2	18222	163	3132	288	<LOD	87	179
BZ1-7-24-30	N	24-30	14	3	<LOD	5	17373	160	3674	313	<LOD	88	265
BZ1-7-30-36	N	30-36	19	3	<LOD	5	17062	155	5196	327	<LOD	85	248
BZ1-7-36-42	N	36-42	14	3	<LOD	5	19689	179	7054	392	<LOD	97	348
BZ1-7-42-48	N	42-48	12	3	<LOD	5	16619	158	5833	348	<LOD	88	279
BZ1-9-0-6	N	0-6	157	5	<LOD	10	16462	150	4139	309	<LOD	83	299
BZ1-9-6-12	N	6-12	246	7	26	4	17624	159	5542	338	<LOD	92	344
DUP-14	QC	6-12	385	8	<LOD	15	16874	155	4217	313	<LOD	84	364
BZ1-9-12-18	N	12-18	302	7	18	5	17911	158	4298	310	<LOD	89	251
BZ1-9-18-24	N	18-24	170	6	18	4	15730	146	4367	310	<LOD	88	266
BZ1-9-24-30	N	24-30	101	5	<LOD	9	17819	162	4441	317	<LOD	88	207
BZ1-9-30-36	N	30-36	23	3	7	2	16382	149	4426	311	<LOD	84	158
BZ1-9-36-42	N	36-42	20	3	<LOD	5	17387	160	3717	311	<LOD	89	380
Standard Clip	QC												
Standard Clip	QC												
BZ1-9-42-48	N	42-48	19	3	5	2	17586	158	5345	335	<LOD	91	195
BZ1-8-0-6	N	0-6	254	7	25	4	17348	158	4193	313	124	32	288
BZ1-8-6-12	N	6-12	210	6	19	4	17256	158	4718	326	<LOD	90	258
DUP-15 (BZ1-8-6-12	QC	6-12	148	5	22	4	16748	157	4664	324	<LOD	90	282
Standard Clip	QC												
BZ1-8-12-18	N	12-18	33	3	8	2	20352	180	4289	337	<LOD	94	147
BZ1-8-18-24	N	18-24	51	4	10	2	19631	174	4233	323	<LOD	90	219
BZ1-8-24-30	N	24-30	16	3	6	2	19961	178	4230	328	117	33	169
BZ1-8-30-36	N	30-36	14	3	<LOD	5	17839	164	4704	326	<LOD	93	189
BZ1-8-36-42	N	36-42	9	2	<LOD	5	16281	151	4659	322	<LOD	91	356
BZ1-8-42-48	N	42-48	<LOD	7	<LOD	4	10246	108	1693	233	<LOD	78	266
2710	QC		5385	54	1593	30	46319	426	2300	449	<LOD	157	2103
2711	QC		1087	16	101	10	22942	215	2535	351	<LOD	103	564
2709	QC		26	3	10	2	28185	245	3034	350	<LOD	110	468
Blank	QC		<LOD	6	<LOD	3	102	13	<LOD	430	<LOD	54	<LOD

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Mn +/-	Co	Co +/-	Ni	Ni +/-	Cu	Cu +/-	Zn	Zn +/-	Se	Se +/-
BZ1-7-18-24	N	18-24	25	249	43	<LOD	33	<LOD	17	41	4	<LOD	3
BZ1-7-24-30	N	24-30	27	153	42	<LOD	35	<LOD	18	41	4	<LOD	3
BZ1-7-30-36	N	30-36	26	241	42	<LOD	33	<LOD	17	39	4	<LOD	3
BZ1-7-36-42	N	36-42	31	<LOD	136	<LOD	36	23	6	36	4	<LOD	3
BZ1-7-42-48	N	42-48	28	180	42	<LOD	35	23	6	29	4	<LOD	3
BZ1-9-0-6	N	0-6	27	<LOD	119	<LOD	32	45	6	82	5	<LOD	3
BZ1-9-6-12	N	6-12	29	231	43	<LOD	34	41	6	104	5	<LOD	3
DUP-14	QC	6-12	29	154	41	<LOD	34	59	7	92	5	<LOD	3
BZ1-9-12-18	N	12-18	26	164	42	<LOD	34	32	6	87	5	<LOD	3
BZ1-9-18-24	N	18-24	27	178	40	<LOD	34	29	6	78	5	<LOD	3
BZ1-9-24-30	N	24-30	26	221	43	<LOD	34	26	6	59	4	<LOD	3
BZ1-9-30-36	N	30-36	24	143	40	<LOD	33	<LOD	17	42	4	<LOD	3
BZ1-9-36-42	N	36-42	30	164	42	<LOD	34	19	6	38	4	<LOD	3
Standard Clip	QC												
Standard Clip	QC												
BZ1-9-42-48	N	42-48	25	<LOD	124	44	12	<LOD	17	35	4	<LOD	3
BZ1-8-0-6	N	0-6	28	182	42	<LOD	34	47	7	154	6	<LOD	3
BZ1-8-6-12	N	6-12	27	264	43	<LOD	33	47	7	111	5	<LOD	3
DUP-15 (BZ1-8-6-12	QC	6-12	28	199	42	<LOD	33	46	7	148	6	<LOD	3
Standard Clip	QC												
BZ1-8-12-18	N	12-18	26	236	47	<LOD	35	19	6	56	4	<LOD	3
BZ1-8-18-24	N	18-24	27	145	45	<LOD	34	33	6	63	4	<LOD	3
BZ1-8-24-30	N	24-30	26	268	46	<LOD	37	<LOD	18	35	4	<LOD	3
BZ1-8-30-36	N	30-36	26	156	43	<LOD	34	22	6	39	4	<LOD	3
BZ1-8-36-42	N	36-42	29	<LOD	120	36	11	<LOD	17	37	4	<LOD	3
BZ1-8-42-48	N	42-48	24	<LOD	92	<LOD	29	<LOD	16	20	3	<LOD	2
2710	QC		76	281	85	<LOD	54	3357	48	4151	49	<LOD	11
2711	QC		38	233	54	<LOD	40	107	9	278	9	<LOD	5
2709	QC		36	278	58	80	15	36	7	86	5	<LOD	3
Blank	QC		35	<LOD	21	<LOD	23	<LOD	14	<LOD	7	<LOD	2

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Br	Br +/-	Rb	Rb +/-	Sr	Sr +/-	Zr	Zr +/-	Mo	Mo +/-	Ag
BZ1-7-18-24	N	18-24	5	1	43	2	26	1	428	6	<LOD	7	<LOD
BZ1-7-24-30	N	24-30	<LOD	4	47	2	35	2	628	7	<LOD	7	<LOD
BZ1-7-30-36	N	30-36	<LOD	4	48	2	35	2	765	8	<LOD	8	<LOD
BZ1-7-36-42	N	36-42	<LOD	4	37	2	40	2	1304	12	<LOD	9	<LOD
BZ1-7-42-48	N	42-48	<LOD	4	41	2	44	2	1370	12	<LOD	9	<LOD
BZ1-9-0-6	N	0-6	7	2	49	2	50	2	584	7	<LOD	7	<LOD
BZ1-9-6-12	N	6-12	7	2	48	2	54	2	613	7	<LOD	7	<LOD
DUP-14	QC	6-12	9	2	46	2	53	2	528	6	<LOD	7	<LOD
BZ1-9-12-18	N	12-18	<LOD	5	57	2	52	2	637	7	<LOD	7	<LOD
BZ1-9-18-24	N	18-24	7	2	51	2	46	2	638	7	<LOD	7	<LOD
BZ1-9-24-30	N	24-30	5	1	49	2	40	2	565	7	<LOD	7	<LOD
BZ1-9-30-36	N	30-36	<LOD	4	46	2	35	2	657	7	<LOD	7	<LOD
BZ1-9-36-42	N	36-42	<LOD	4	52	2	40	2	604	7	<LOD	7	<LOD
Standard Clip	QC												
Standard Clip	QC												
BZ1-9-42-48	N	42-48	<LOD	4	48	2	48	2	497	6	<LOD	7	<LOD
BZ1-8-0-6	N	0-6	11	2	52	2	54	2	607	7	<LOD	7	<LOD
BZ1-8-6-12	N	6-12	10	2	55	2	52	2	623	7	<LOD	7	<LOD
DUP-15 (BZ1-8-6-12	QC	6-12	11	2	52	2	51	2	636	7	<LOD	8	<LOD
Standard Clip	QC												
BZ1-8-12-18	N	12-18	7	2	62	2	41	2	664	7	<LOD	8	<LOD
BZ1-8-18-24	N	18-24	6	2	58	2	43	2	603	7	<LOD	7	<LOD
BZ1-8-24-30	N	24-30	<LOD	4	60	2	41	2	617	7	<LOD	8	<LOD
BZ1-8-30-36	N	30-36	<LOD	4	55	2	38	2	604	7	<LOD	7	<LOD
BZ1-8-36-42	N	36-42	<LOD	4	38	2	33	2	632	7	<LOD	7	<LOD
BZ1-8-42-48	N	42-48	<LOD	4	29	2	35	2	115	3	<LOD	6	<LOD
2710	QC		<LOD	19	114	4	249	5	119	6	<LOD	9	<LOD
2711	QC		<LOD	8	104	3	246	4	346	6	<LOD	8	<LOD
2709	QC		8	2	86	3	219	4	186	5	<LOD	7	<LOD
Blank	QC		<LOD	3	<LOD	3	<LOD	3	<LOD	6	<LOD	6	<LOD

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Ag +/-	Cd	Cd +/-	Sn	Sn +/-	Sb	Sb +/-	Ba	Ba +/-	Hg	Hg +/-
BZ1-7-18-24	N	18-24	35	<LOD	42	<LOD	61	<LOD	68	<LOD	0	<LOD	7
BZ1-7-24-30	N	24-30	35	<LOD	42	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-7-30-36	N	30-36	35	49	14	<LOD	62	<LOD	67	<LOD	0	<LOD	8
BZ1-7-36-42	N	36-42	37	<LOD	44	<LOD	65	<LOD	71	<LOD	0	<LOD	8
BZ1-7-42-48	N	42-48	36	<LOD	44	<LOD	64	<LOD	70	<LOD	0	<LOD	8
BZ1-9-0-6	N	0-6	34	<LOD	41	<LOD	60	<LOD	66	<LOD	0	<LOD	8
BZ1-9-6-12	N	6-12	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	9
DUP-14	QC	6-12	35	51	14	<LOD	61	<LOD	66	<LOD	0	<LOD	9
BZ1-9-12-18	N	12-18	34	44	14	<LOD	61	<LOD	67	<LOD	0	<LOD	10
BZ1-9-18-24	N	18-24	35	<LOD	42	<LOD	61	<LOD	67	<LOD	0	<LOD	9
BZ1-9-24-30	N	24-30	35	43	14	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-9-30-36	N	30-36	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	7
BZ1-9-36-42	N	36-42	35	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
Standard Clip	QC												
Standard Clip	QC												
BZ1-9-42-48	N	42-48	35	<LOD	42	<LOD	63	<LOD	68	<LOD	0	<LOD	8
BZ1-8-0-6	N	0-6	35	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	9
BZ1-8-6-12	N	6-12	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	9
DUP-15 (BZ1-8-6-12	QC	6-12	35	<LOD	42	<LOD	62	<LOD	67	<LOD	0	<LOD	8
Standard Clip	QC												
BZ1-8-12-18	N	12-18	36	63	14	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-8-18-24	N	18-24	35	47	14	<LOD	62	<LOD	68	<LOD	0	<LOD	8
BZ1-8-24-30	N	24-30	36	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-8-30-36	N	30-36	36	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	8
BZ1-8-36-42	N	36-42	35	<LOD	43	<LOD	63	<LOD	69	<LOD	0	<LOD	7
BZ1-8-42-48	N	42-48	34	<LOD	41	<LOD	61	<LOD	66	<LOD	0	<LOD	7
2710	QC		46	<LOD	53	<LOD	79	<LOD	86	<LOD	0	<LOD	32
2711	QC		40	56	16	<LOD	70	<LOD	77	<LOD	0	<LOD	15
2709	QC		39	<LOD	46	<LOD	68	<LOD	74	<LOD	0	<LOD	9
Blank	QC		33	<LOD	39	<LOD	55	<LOD	59	<LOD	0	<LOD	6

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Tl	Tl +/-	U	U +/-	Mode	Pass/Fail	Pass Fail Standard	Reading	Time	LiveTime
BZ1-7-18-24	N	18-24	<LOD	8	<LOD	3	Soil			154	16:46:45	48.67
BZ1-7-24-30	N	24-30	<LOD	8	<LOD	3	Soil			155	16:48:27	48.84
BZ1-7-30-36	N	30-36	<LOD	8	<LOD	3	Soil			156	16:50:36	48.31
BZ1-7-36-42	N	36-42	<LOD	9	<LOD	3	Soil			157	16:52:10	48.16
BZ1-7-42-48	N	42-48	<LOD	8	<LOD	3	Soil			158	16:53:57	48.68
BZ1-9-0-6	N	0-6	<LOD	11	<LOD	3	Soil			159	16:55:40	48.38
BZ1-9-6-12	N	6-12	<LOD	13	<LOD	3	Soil			160	16:57:46	48.25
DUP-14	QC	6-12	<LOD	15	<LOD	3	Soil			161	16:59:29	48.42
BZ1-9-12-18	N	12-18	<LOD	13	<LOD	3	Soil			162	17:01:16	47.89
BZ1-9-18-24	N	18-24	<LOD	11	<LOD	3	Soil			163	17:02:48	48.11
BZ1-9-24-30	N	24-30	<LOD	10	<LOD	3	Soil			164	17:04:30	48.96
BZ1-9-30-36	N	30-36	<LOD	8	<LOD	3	Soil			165	17:06:34	48.2
BZ1-9-36-42	N	36-42	<LOD	8	<LOD	3	Soil			166	17:08:21	47.49
Standard Clip	QC						Standardizatio	-0.006651	PASS	167	17:16:06	34.21
Standard Clip	QC						Standardizatio	-0.004264	PASS	168	17:22:07	34.58
BZ1-9-42-48	N	42-48	<LOD	8	<LOD	3	Soil			169	17:23:44	47.64
BZ1-8-0-6	N	0-6	<LOD	13	<LOD	3	Soil			170	17:25:32	48.24
BZ1-8-6-12	N	6-12	<LOD	12	<LOD	3	Soil			171	17:27:19	48.34
DUP-15 (BZ1-8-6-12	QC	6-12	<LOD	11	<LOD	3	Soil			172	17:28:56	49.42
Standard Clip	QC						Standardizatio	-0.004798	PASS	173	17:34:36	34.61
BZ1-8-12-18	N	12-18	<LOD	9	<LOD	3	Soil			174	17:36:35	48.58
BZ1-8-18-24	N	18-24	<LOD	9	<LOD	3	Soil			175	17:38:29	48.8
BZ1-8-24-30	N	24-30	<LOD	8	<LOD	3	Soil			176	17:40:07	48.38
BZ1-8-30-36	N	30-36	<LOD	8	<LOD	3	Soil			177	17:41:44	48.72
BZ1-8-36-42	N	36-42	<LOD	8	<LOD	3	Soil			178	17:43:23	48.33
BZ1-8-42-48	N	42-48	<LOD	7	<LOD	2	Soil			179	17:44:58	48.77
2710	QC		<LOD	58	<LOD	5	Soil			180	17:46:45	48.49
2711	QC		<LOD	25	<LOD	4	Soil			181	17:48:28	49.62
2709	QC		<LOD	9	<LOD	3	Soil			182	17:50:04	49.07
Blank	QC		<LOD	6	<LOD	2	Soil			183	17:51:39	49.97

Frankford Arsenal Area II XRF Screening Results

Sample ID	Normal or QC	Depth Interval	Date
BZ1-7-18-24	N	18-24	10-Nov-14
BZ1-7-24-30	N	24-30	10-Nov-14
BZ1-7-30-36	N	30-36	10-Nov-14
BZ1-7-36-42	N	36-42	10-Nov-14
BZ1-7-42-48	N	42-48	10-Nov-14
BZ1-9-0-6	N	0-6	10-Nov-14
BZ1-9-6-12	N	6-12	10-Nov-14
DUP-14	QC	6-12	10-Nov-14
BZ1-9-12-18	N	12-18	10-Nov-14
BZ1-9-18-24	N	18-24	10-Nov-14
BZ1-9-24-30	N	24-30	10-Nov-14
BZ1-9-30-36	N	30-36	10-Nov-14
BZ1-9-36-42	N	36-42	10-Nov-14
Standard Clip	QC		10-Nov-14
Standard Clip	QC		10-Nov-14
BZ1-9-42-48	N	42-48	10-Nov-14
BZ1-8-0-6	N	0-6	10-Nov-14
BZ1-8-6-12	N	6-12	10-Nov-14
DUP-15 (BZ1-8-6-12	QC	6-12	10-Nov-14
Standard Clip	QC		10-Nov-14
BZ1-8-12-18	N	12-18	10-Nov-14
BZ1-8-18-24	N	18-24	10-Nov-14
BZ1-8-24-30	N	24-30	10-Nov-14
BZ1-8-30-36	N	30-36	10-Nov-14
BZ1-8-36-42	N	36-42	10-Nov-14
BZ1-8-42-48	N	42-48	10-Nov-14
2710	QC		10-Nov-14
2711	QC		10-Nov-14
2709	QC		10-Nov-14
Blank	QC		10-Nov-14

Attachment D

Laboratory Data
(Provided on CD)

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CHEMTECH
284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

DATA PACKAGE

METALS

PROJECT NAME : FRANKFORD ARSENAL

EA ENGINEERING SCIENCE & TECHNOLOGY

225 Schilling Circle, Suite 400

Hunt Valley, MD - 21031

Phone No: 410-584-7000

ORDER ID : F4712

ATTENTION : Denise Wilt

DoD ELAP

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CHEMTECH
284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

Cover Page

Order ID : F4712

Project ID : Frankford Arsenal

Client : EA Engineering Science & Technology

Lab Sample Number	Client Sample Number
F4712-01	BZ1-23-6-12
F4712-02	BZ1-19-12-18
F4712-03	BZ1-19-18-24
F4712-04	BZ1-25-6-12
F4712-05	BZ1-21-12-18
F4712-06	BZ1-22-6-12
F4712-07	BZ1-15-6-12
F4712-08	BZ1-14-6-12
F4712-09	BZ1-14-24-30
F4712-10	BZ1-14-18-24
F4712-11	BZ1-8-36-42
F4712-12	BZ1-15-18-24
F4712-13	BZ1-13-0-6
F4712-14	BZ1-10-6-12
F4712-15	BZ1-8-6-12
F4712-16	BZ1-21-24-30
F4712-17	BZ1-9-12-18
F4712-18	BZ1-11-6-12
F4712-19	BZ1-24-12-18
F4712-20	BZ1-24-6-12

I certify that the data package is in compliance with the terms and conditions of the contract,both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the laboratory manager or his designee, as verified by the following signature.

Signature : Mildred V Reyes

APPROVED
Date: 11/27/2014
By Mildred V Reyes QA/QC Supervisor at 8:37 am, Nov 28, 2014

NYDOH CERTIFICATION NO - 11376

NJDEP CERTIFICATION NO - 20012

CHEMTECH
284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

CASE NARRATIVE

EA Engineering Science & Technology
Project Name: Frankford Arsenal
Project # N/A
Chemtech Project # F4712
Test Name: Metals Group3

A. Number of Samples and Date of Receipt:
20 Solid samples were received on 11/11/2014.

B. Parameters:
According to the Chain of Custody document, the following analyses were requested: Metals Group3. This data package contains results for Metals Group3.

C. Analytical Techniques:
The analysis of Metals Group3 was based on method 6010C and digestion based on method 3050 (soils).

D. QA/ QC Samples:
The Holding Times were met for all analysis.
The Blank Spike met requirements for all samples.
The Duplicate analysis met criteria for all samples.
The Matrix Spike analysis met criteria for all samples.
The Matrix Spike Duplicate analysis met criteria for all samples.
The Blank analysis did not indicate the presence of lab contamination.
The Calibration met the requirements.
The Serial Dilution met the acceptable requirements.

E. Additional Comments:

I certify that the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. The laboratory manager or his designee, as verified by the following signature has authorized release of the data contained in this hard copy data package.

Signature Mildred V Reyes

APPROVED
By Mildred V Reyes QA/QC Supervisor at 8:37 am, Nov 28, 2014

CHEMTECH
284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

METALS CONFORMANCE/NON-CONFORMANCE SUMMARY

CHEMTECH PROJECT NUMBER: F4712 MATRIX: Solid

METHOD: 6010C

		NA	NO	YES
1.	Calibration Summary met criteria.			✓
2.	ICP Interference Check Sample Results Summary Submitted.			✓
3.	Serial Dilution Summary (if applicable) Submitted.			✓
4.	Laboratory Control Sample Summary (if applicable) Submitted.			✓
5.	Blank Contamination - If yes, list compounds and concentrations in each blank:		✓	
6.	Matrix Spike/Matrix Spike Duplicate Recoveries Met Criteria If not met, list those compounds and their recoveries which fall outside the acceptable range.			✓
7.	Sample Duplicate Analysis Met QC Criteria If not met, list those compounds and their recoveries which fall outside the acceptable range.			✓
8.	Digestion Holding Time Met If not met, list number of days exceeded for each sample:			✓
9.	Analysis Holding Time Met If not met, list those compounds and their recoveries which fall outside the acceptable range.			✓

ADDITIONAL COMMENTS:

REVIEWED
By Mildred V Reyes QA/QC Supervisor at 8:37 am, Nov 28, 2014

QA REVIEW

DATA REPORTING QUALIFIERS- INORGANIC

For reporting results, the following " Results Qualifiers" are used:

J	Indicates the reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).
U	Indicates the analyte was analyzed for, but not detected.
ND	Indicates the analyte was analyzed for, but not detected
E	Indicates the reported value is estimated because of the presence of interference
M	Indicates Duplicate injection precision not met.
N	Indicates the spiked sample recovery is not within control limits.
S	Indicates the reported value was determined by the Method of Standard Addition (MSA).
*****	Indicates that the duplicate analysis is not within control limits.
+	Indicates the correlation coefficient for the MSA is less than 0.995.
D	Indicates the reported value is from a secondary analysis with a dilution factor. The original analysis exceeded the calibration range.
M	Method qualifiers **"P"** for ICP instrument **"PM"** for ICP when Microwave Digestion is used **"CV"** for Manual Cold Vapor AA **"AV"** for automated Cold Vapor AA **"CA"** for MIDI-Distillation Spectrophotometric **"AS"** for Semi –Automated Spectrophotometric **"C"** for Manual Spectrophotometric **"T"** for Titrimetric **"NR"** for analyte not required to be analyzed
OR	Indicates the analyte's concentration exceeds the calibrated range of the instrument for that specific analysis.
Q	Indicates the LCS did not meet the control limits requirements
H	Sample Analysis Out Of Hold Time

QA Control # A3040961

APPENDIX A

QA REVIEW GENERAL DOCUMENTATION

Project #: **F4712**

	Completed
For thorough review, the report must have the following:	
GENERAL:	
Are all original paperwork present (chain of custody, record of communication,airbill, sample management lab chronicle, login page)	✓
Check chain-of-custody for proper relinquish/return of samples	✓
Is the chain of custody signed and complete	✓
Check internal chain-of-custody for proper relinquish/return of samples /sample extracts	✓
Collect information for each project id from server. Were all requirements followed	✓
COVER PAGE:	
Do numbers of samples correspond to the number of samples in the Chain of Custody on login page	✓
Do lab numbers and client Ids on cover page agree with the Chain of Custody	✓
CHAIN OF CUSTODY:	
Do requested analyses on Chain of Custody agree with form I results	✓
Do requested analyses on Chain of Custody agree with the log-in page	✓
Were the correct method log-in for analysis according to the Analytical Request and Chain of Castody	✓
Were the samples received within hold time	✓
Were any problems found with the samples at arrival recorded in the Sample Management Laboratory Chronicle	✓
ANALYTICAL:	
Was method requirement followed?	✓
Was client requirement followed?	✓
Does the case narrative summarize all QC failure?	✓
All runlogs and manual integration are reviewed for requirements	✓
All manual calculations and /or hand notations verified	✓

1st Level QA Review Signature: PRADIP PRAJAPATI **Date:** 11/27/2014

2nd Level QA Review Signature: Mildred V Reyes **Date:**

APPROVED
By Mildred V Reyes QA/QC Supervisor at 8:37 am, Nov 28, 2014

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A
B
C
D

Hit Summary Sheet
SW-846

SDG No.:	F4712	**Order ID:**	F4712
Client:	EA Engineering Science & Technology	**Project ID:**	Frankford Arsenal

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
Client ID :	**BZ1-23-6-12**								
F4712-01	BZ1-23-6-12	SOIL	Lead	409.000		0.121	0.252	0.606	mg/Kg
Client ID :	**BZ1-19-12-18**								
F4712-02	BZ1-19-12-18	SOIL	Lead	882.000		0.115	0.239	0.573	mg/Kg
Client ID :	**BZ1-19-18-24**								
F4712-03	BZ1-19-18-24	SOIL	Lead	864.000		0.122	0.254	0.611	mg/Kg
Client ID :	**BZ1-25-6-12**								
F4712-04	BZ1-25-6-12	SOIL	Lead	574.000		0.124	0.258	0.619	mg/Kg
Client ID :	**BZ1-21-12-18**								
F4712-05	BZ1-21-12-18	SOIL	Lead	583.000		0.104	0.216	0.519	mg/Kg
Client ID :	**BZ1-22-6-12**								
F4712-06	BZ1-22-6-12	SOIL	Lead	581.000		0.12	0.25	0.599	mg/Kg
Client ID :	**BZ1-15-6-12**								
F4712-07	BZ1-15-6-12	SOIL	Lead	602.000		0.121	0.253	0.606	mg/Kg
Client ID :	**BZ1-14-6-12**								
F4712-08	BZ1-14-6-12	SOIL	Lead	1,140.000		0.12	0.249	0.598	mg/Kg
Client ID :	**BZ1-14-24-30**								
F4712-09	BZ1-14-24-30	SOIL	Lead	6,390.000		0.121	0.252	0.604	mg/Kg
Client ID :	**BZ1-14-18-24**								
F4712-10	BZ1-14-18-24	SOIL	Lead	10,800.000		0.114	0.236	0.568	mg/Kg
Client ID :	**BZ1-8-36-42**								
F4712-11	BZ1-8-36-42	SOIL	Lead	8.650		0.117	0.244	0.585	mg/Kg
Client ID :	**BZ1-15-18-24**								
F4712-12	BZ1-15-18-24	SOIL	Lead	61.900		0.126	0.262	0.628	mg/Kg
Client ID :	**BZ1-13-0-6**								
F4712-13	BZ1-13-0-6	SOIL	Lead	133.000		0.127	0.265	0.636	mg/Kg
Client ID :	**BZ1-10-6-12**								
F4712-14	BZ1-10-6-12	SOIL	Lead	133.000		0.116	0.241	0.578	mg/Kg
Client ID :	**BZ1-8-6-12**								
F4712-15	BZ1-8-6-12	SOIL	Lead	138.000		0.109	0.227	0.545	mg/Kg

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Hit Summary Sheet
SW-846

SDG No.: F4712 **Order ID:** F4712

Client: EA Engineering Science & Technology **Project ID:** Frankford Arsenal

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
Client ID :	**BZ1-21-24-30**								
F4712-16	BZ1-21-24-30	SOIL	Lead	314.000		0.113	0.235	0.563	mg/Kg
Client ID :	**BZ1-9-12-18**								
F4712-17	BZ1-9-12-18	SOIL	Lead	381.000		0.113	0.235	0.565	mg/Kg
Client ID :	**BZ1-11-6-12**								
F4712-18	BZ1-11-6-12	SOIL	Lead	356.000		0.115	0.239	0.573	mg/Kg
Client ID :	**BZ1-24-12-18**								
F4712-19	BZ1-24-12-18	SOIL	Lead	531.000		0.118	0.246	0.59	mg/Kg
Client ID :	**BZ1-24-6-12**								
F4712-20	BZ1-24-6-12	SOIL	Lead	446.000		0.12	0.249	0.598	mg/Kg

SAMPLE DATA

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-23-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-01	Matrix:	SOIL
Level (low/med):	low	% Solid:	86.1

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	409		1	0.121	0.252	0.606	mg/Kg	11/12/14 08:00	11/13/14 14:57	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-19-12-18	SDG No.:	F4712
Lab Sample ID:	F4712-02	Matrix:	SOIL
Level (low/med):	low	% Solid:	86.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	882		1	0.115	0.239	0.573	mg/Kg	11/12/14 08:00	11/13/14 15:38	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

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N =Spiked sample recovery not within control limits

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-19-18-24	SDG No.:	F4712
Lab Sample ID:	F4712-03	Matrix:	SOIL
Level (low/med):	low	% Solid:	82.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	864		1	0.122	0.254	0.611	mg/Kg	11/12/14 08:00	11/13/14 15:42	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-25-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-04	Matrix:	SOIL
Level (low/med):	low	% Solid:	82.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	574		1	0.124	0.258	0.619	mg/Kg	11/12/14 08:00	11/13/14 15:47	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-21-12-18	SDG No.:	F4712
Lab Sample ID:	F4712-05	Matrix:	SOIL
Level (low/med):	low	% Solid:	93.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	583		1	0.104	0.216	0.519	mg/Kg	11/12/14 08:00	11/13/14 15:51	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

A B C D

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-22-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-06	Matrix:	SOIL
Level (low/med):	low	% Solid:	85.6

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	581		1	0.12	0.25	0.599	mg/Kg	11/12/14 08:00	11/13/14 15:55	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-15-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-07	Matrix:	SOIL
Level (low/med):	low	% Solid:	83.5

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	602		1	0.121	0.253	0.606	mg/Kg	11/12/14 08:00	11/13/14 15:59	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-14-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-08	Matrix:	SOIL
Level (low/med):	low	% Solid:	83.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	1140		1	0.12	0.249	0.598	mg/Kg	11/12/14 08:00	11/13/14 16:04	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-14-24-30	SDG No.:	F4712
Lab Sample ID:	F4712-09	Matrix:	SOIL
Level (low/med):	low	% Solid:	85.6

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	6390		1	0.121	0.252	0.604	mg/Kg	11/12/14 08:00	11/13/14 16:16	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-14-18-24	SDG No.:	F4712
Lab Sample ID:	F4712-10	Matrix:	SOIL
Level (low/med):	low	% Solid:	88.1

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	10800		1	0.114	0.236	0.568	mg/Kg	11/12/14 08:00	11/13/14 16:20	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-8-36-42	SDG No.:	F4712
Lab Sample ID:	F4712-11	Matrix:	SOIL
Level (low/med):	low	% Solid:	88.4

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	8.65		1	0.117	0.244	0.585	mg/Kg	11/12/14 08:00	11/13/14 16:27	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

6

A B C D

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-15-18-24	SDG No.:	F4712
Lab Sample ID:	F4712-12	Matrix:	SOIL
Level (low/med):	low	% Solid:	78.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	61.9		1	0.126	0.262	0.628	mg/Kg	11/12/14 08:00	11/13/14 16:31	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-13-0-6	SDG No.:	F4712
Lab Sample ID:	F4712-13	Matrix:	SOIL
Level (low/med):	low	% Solid:	81

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	133		1	0.127	0.265	0.636	mg/Kg	11/12/14 08:00	11/13/14 16:35	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-10-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-14	Matrix:	SOIL
Level (low/med):	low	% Solid:	87.2

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	133		1	0.116	0.241	0.578	mg/Kg	11/12/14 08:00	11/13/14 16:40	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
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E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-8-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-15	Matrix:	SOIL
Level (low/med):	low	% Solid:	90.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	138		1	0.109	0.227	0.545	mg/Kg	11/12/14 08:00	11/13/14 16:44	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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6

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-21-24-30	SDG No.:	F4712
Lab Sample ID:	F4712-16	Matrix:	SOIL
Level (low/med):	low	% Solid:	89.5

A B C D

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	314		1	0.113	0.235	0.563	mg/Kg	11/12/14 08:00	11/13/14 16:48	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-9-12-18	SDG No.:	F4712
Lab Sample ID:	F4712-17	Matrix:	SOIL
Level (low/med):	low	% Solid:	87.4

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	381		1	0.113	0.235	0.565	mg/Kg	11/12/14 08:00	11/13/14 16:52	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-11-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-18	Matrix:	SOIL
Level (low/med):	low	% Solid:	91.1

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	356		1	0.115	0.239	0.573	mg/Kg	11/12/14 08:00	11/13/14 16:57	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-24-12-18	SDG No.:	F4712
Lab Sample ID:	F4712-19	Matrix:	SOIL
Level (low/med):	low	% Solid:	86.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	531		1	0.118	0.246	0.59	mg/Kg	11/12/14 08:00	11/13/14 17:13	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/10/14
Project:	Frankford Arsenal	Date Received:	11/11/14
Client Sample ID:	BZ1-24-6-12	SDG No.:	F4712
Lab Sample ID:	F4712-20	Matrix:	SOIL
Level (low/med):	low	% Solid:	84.6

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ / CRQL	Units(Dry Weight)	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	446		1	0.12	0.249	0.598	mg/Kg	11/12/14 08:00	11/13/14 17:18	SW6010

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	No
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution
Q = indicates LCS control criteria did not meet requirements

J = Estimated Value
B = Analyte Found in Associated Method Blank
* = indicates the duplicate analysis is not within control limits.
E = Indicates the reported value is estimated because of the presence of interference.
OR = Over Range
N =Spiked sample recovery not within control limits

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6

A
B
C
D

LAB CHRONICLE

OrderID:	F4712	**OrderDate:**	11/11/2014 3:11:52 PM
Client:	EA Engineering Science & Technology	**Project:**	Frankford Arsenal
Contact:	Denise Wilt	**Location:**	D62

LabID	ClientID	Matrix	Test	Method	Sample Date	Prep Date	Anal Date	Received
F4712-01	**BZ1-23-6-12**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-02	**BZ1-19-12-18**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-03	**BZ1-19-18-24**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-04	**BZ1-25-6-12**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-05	**BZ1-21-12-18**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-06	**BZ1-22-6-12**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-07	**BZ1-15-6-12**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-08	**BZ1-14-6-12**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-09	**BZ1-14-24-30**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-10	**BZ1-14-18-24**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-11	**BZ1-8-36-42**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	
F4712-12	**BZ1-15-18-24**	**SOIL**			**11/10/14**			**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14	

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6

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B
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LAB CHRONICLE

F4712-13	**BZ1-13-0-6**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-14	**BZ1-10-6-12**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-15	**BZ1-8-6-12**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-16	**BZ1-21-24-30**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-17	**BZ1-9-12-18**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-18	**BZ1-11-6-12**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-19	**BZ1-24-12-18**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14
F4712-20	**BZ1-24-6-12**	**SOIL**			**11/10/14**		**11/11/14**
			Metals Group3	6010C		11/12/14	11/13/14

SHIPPING DOCUMENTS

CHEMTECH
CHAIN OF CUSTODY RECORD

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www.chemtech.net

CHEMTECH PROJECT NO.
QUOTE NO. F4712
COC Number 033166

7.1

CLIENT INFORMATION
REPORT TO BE SENT TO:
COMPANY: EA
ADDRESS: 225 Schilling Circle
CITY: Hunt Valley STATE: MD ZIP: 21031
ATTENTION: Denise Wilt
PHONE: 410 584 7000 FAX:

CLIENT PROJECT INFORMATION
PROJECT NAME: Frankford Arsenal (FFA)
PROJECT NO.: 6233017 LOCATION: Phila PA
PROJECT MANAGER: Mike O'Neill
e-mail: MOneill@eaest.com
PHONE: 410.329.5142 FAX:

CLIENT BILLING INFORMATION
BILL TO: PO#:
ADDRESS:
CITY: STATE: ZIP:
ATTENTION: PHONE:

DATA TURNAROUND INFORMATION
FAX: ______ DAYS *
HARD COPY: ______ DAYS *
EDD: ______ DAYS *
PREAPPROVED TAT: ☐ YES ☐ NO
* STANDARD TURNAROUND TIME IS 10 BUSINESS DAYS

DATA DELIVERABLE INFORMATION
☐ LEVEL 1: Results only ☐ Others ______
☐ LEVEL 2: Results + QC
☐ LEVEL 3: Results (plus results raw data) + QC
☐ LEVEL 4: Results + QC (all raw data)
☐ EDD Format: ______

ANALYSIS
1. Lead (Pb) only 6010
2. 3. 4. 5. 6. 7. 8. 9.

CHEMTECH SAMPLE ID	PROJECT SAMPLE IDENTIFICATION	SAMPLE MATRIX	SAMPLE TYPE COMP	SAMPLE TYPE GRAB	SAMPLE COLLECTION DATE	SAMPLE COLLECTION TIME	# OF BOTTLES	1	2	3	4	5	6	7	8	9	COMMENTS
1.	BZ1-23-6-12	Soil			11/10/14	1530	1	X									
2.	BZ1-19-12-18	↓	↓		↓	~~1540~~ 1500	↓	X									
3.	BZ1-19-18-24					1505		X									
4.	BZ1-25-6-12					1520		X									
5.	BZ1-21-12-18					1355		X									
6.	BZ1-22-6-12					1405		X									
7.	BZ1-15-6-12					1330		X									
8.	BZ1-14-6-12					1430		X									
9.	BZ1-~~24-30~~ 14-24-30					1440		X									
10.	BZ1-14-18-24					1435		X									

PRESERVATIVES — Specify Preservatives: A-HCl B-HNO_3 C-H_2SO_4 D-NaOH E-ICE F-Other

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESSION INCLUDING COURIER DELIVERY

RELINQUISHED BY	DATE/TIME	RECEIVED BY
RELINQUISHED BY SAMPLER: 1. [signature] 11/11/14	11/11/14 1430	1. [signature]
RELINQUISHED BY: 2.	DATE/TIME:	RECEIVED BY: 2.
RELINQUISHED BY: 3. [signature]	11/11/14 1615	RECEIVED FOR LAB BY: 3. RSJ

Conditions of bottles or coolers at receipt: ☑ Compliant ☐ Non Compliant Cooler Temp. UM
MeOH extraction requires an additional 4 oz jar for percent solid.
Comments: Ice in Cooler?: ✓

Page ______ of ______

SHIPPED VIA: CLIENT: ☐ HAND DELIVERED ☐ OVERNIGHT
CHEMTECH: ☑ PICKED UP ☐ OVERNIGHT
Shipment Complete: ☑ YES ☐ NO

Revision 8/2007
F4712

WHITE - CHEMTECH COPY FOR RETURN TO CLIENT YELLOW - CHEMTECH COPY PINK - SAMPLER COPY

CHEMTECH
CHAIN OF CUSTODY RECORD

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www.chemtech.net

CHEMTECH PROJECT NO.
QUOTE NO. F4712
COC Number 033165 7.1

CLIENT INFORMATION

REPORT TO BE SENT TO:
COMPANY: EA
ADDRESS: 225 Schilling Circle
CITY: Hunt Valley STATE: MD ZIP: 21031
ATTENTION: Denise Wilt
PHONE: 410-584-7000 FAX:

CLIENT PROJECT INFORMATION

PROJECT NAME: Frankford Arsenal (FSA)
PROJECT NO.: 6233017 LOCATION:
PROJECT MANAGER: Mike O'Neill
e-mail: moneill@eaest.com
PHONE: 410-329-5142 FAX:

CLIENT BILLING INFORMATION

BILL TO: Same PO#:
ADDRESS:
CITY: STATE: ZIP:
ATTENTION: PHONE:

DATA TURNAROUND INFORMATION

FAX: ______ DAYS *
HARD COPY: ______ DAYS *
EDD: ______ DAYS *
PREAPPROVED TAT: ☐ YES ☐ NO
* STANDARD TURNAROUND TIME IS 10 BUSINESS DAYS

DATA DELIVERABLE INFORMATION

☐ LEVEL 1: Results only ☐ Others______
☐ LEVEL 2: Results + QC
☐ LEVEL 3: Results (plus results raw data) + QC
☐ LEVEL 4: Results + QC (all raw data)
☐ EDD Format: ______

ANALYSIS

1 Lead (Pb) only 6010
2 3 4 5 6 7 8 9

CHEMTECH SAMPLE ID	PROJECT SAMPLE IDENTIFICATION	SAMPLE MATRIX	SAMPLE TYPE COMP	SAMPLE TYPE GRAB	SAMPLE COLLECTION DATE	SAMPLE COLLECTION TIME	# OF BOTTLES	1 (e)	2	3	4	5	6	7	8	9	COMMENTS
1.	BZ1-8-36-42	Soil			11/10/14	1350	1	X									
2.	BZ1-15-18-24					1335		X									1335
3.	BZ1-13-0-6					1455		X									
4.	BZ1-10-6-12					1320		X									
5.	BZ1-8-6-12					1345		X									
6.	BZ1-21-24-30					1400		X									
7.	BZ1-9-12-18					1340		X									
8.	BZ1-11-6-12					1325		X									
9.	BZ1-24-12-18					1400		X									
10.	BZ1-24-6-12	Soil				1415		X									

PRESERVATIVES — ← Specify Preservatives: A–HCl B–HNO_3 C–H_2SO_4 D–NaOH E–ICE F–Other

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESSION INCLUDING COURIER DELIVERY

RELINQUISHED BY	DATE/TIME	RECEIVED BY
RELINQUISHED BY SAMPLER: 1. [signature]	11/11/14 1430	1. [signature]
RELINQUISHED BY: 2.		RECEIVED BY: 2.
RELINQUISHED BY: 3. [signature]	11/11/14 1615	RECEIVED FOR LAB BY: 3. RSJ

Conditions of bottles or coolers at receipt: ☒ Compliant ☐ Non Compliant Cooler Temp. 6°C
MeOH extraction requires an additional 4 oz jar for percent solid. Ice in Cooler?: ✓
Comments:

Page 1 of ______

SHIPPED VIA: CLIENT: ☐ HAND DELIVERED ☐ OVERNIGHT
CHEMTECH: ☒ PICKED UP ☐ OVERNIGHT
Shipment Complete: ☒ YES ☐ NO

Revision 8/2007
F4712

WHITE - CHEMTECH COPY FOR RETURN TO CLIENT YELLOW - CHEMTECH COPY PINK - SAMPLER COPY

CHEMTECH 284 Sheffield Street Mountainside NJ 07092 Tel. 908-7898900

Laboratory Certification

State	License No.
New Jersey	20012
New York	11376
Connecticut	PH-0649
Florida	E87935
Louisiana	5035
Maryland	296
Massachusetts	M-NJ503
Pennsylvania	68-548
Rhode Island	LAO00259
Virginia	460220
Texas	T10470448-10-1

Other :

DOD ELAP Certified (L-A-B Accredited), ISO/IEC 17025	L2219
Soil Permit	P330-11-00012
CLP Inorganic Contract	EPW09038
CLP Organic Contract	EPW11030

QA Control Code: A2070148

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ANALYTICAL RESULTS SUMMARY

VOLATILE ORGANICS

PROJECT NAME : FRANKFORD ARSENAL AIR

EA ENGINEERING SCIENCE & TECHNOLOGY

225 Schilling Circle, Suite 400

Hunt Valley, MD - 21031

Phone No: 410-584-7000

ORDER ID : F4715

ATTENTION : Denise Wilt

DoD ELAP

CHEMTECH

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Cover Page

Order ID : F4715

Project ID : Frankford Arsenal Air

Client : EA Engineering Science & Technology

Lab Sample Number	Client Sample Number
F4715-01	BZ3-1-SG
F4715-02	BZ3-2-SG
F4715-03	BZ3-3-SG
F4715-04	SG-DUP-1

I certify that the data package is in compliance with the terms and conditions of the contract,both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the laboratory manager or his designee, as verified by the following signature.

Signature : Mildred V Reyes

APPROVED
Date: 11/27/2014
By Mildred V Reyes QA/QC Supervisor at 9:39 am, Dec 03, 2014

NYDOH CERTIFICATION NO - 11376

NJDEP CERTIFICATION NO - 20012

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CASE NARRATIVE

EA Engineering Science & Technology
Project Name: Frankford Arsenal Air
Project # N/A
Chemtech Project # F4715
Test Name: TO-15

A. Number of Samples and Date of Receipt:
4 Air samples were received on 11/11/2014.

B. Parameters
According to the Chain of Custody document, the following analysis were requested: TO-15. This data package contains results for TO-15.

C. Analytical Techniques:
The analysis performed on instrument MSVOA_L were done using GC column RTX-1, which is 60 meters, 0.32 mm id, 1.0 um df, Restek Cat. #10157. The Trap was supplied by Entech, glass bead and Tenax , Entech 7100A Preconcentrator.The analysis of TO-15 was based on method TO-15.

D. QA/ QC Samples:
The Holding Times were met for all analysis.
The Surrogate recoveries met the acceptable criteria.
The Internal Standards Areas met the acceptable requirements.
The Retention Times were acceptable for all samples.
The Blank Spike for {VL1112ABS} with File ID: VL024192.D met requirements for all samples except for 1,4-Dioxane[166%], tert-Butyl Alcohol[134%] .
The RPD for {F4715-01DUP} with File ID: VL024198.D recoveries met criteria except for Methyl tert-Butyl Ether[200%] .
The Blank analysis indicated presence of Acetone 0.36ug/M3[0.15 ppbv],Methylene Chloride 0.35ug/M3[0.1 ppbv] FileID:VL024191.D{VL1112ABL} due to possible lab contamination.
The Initial Calibration met the requirements .The Initial Calibration met the requirements except for 1,4-Dioxane had more than 30% RSD in the Initial Calibration with dated 11/04/2014 with L Instrument but as per method two compounds as allowed to be failed.
The Continuous Calibration met the requirements .
The Tuning criteria met requirements.
Samples BZ3-3-SG was diluted due to bad matrix.
Samples BZ3-1-SG, BZ3-2-SG, BZ3-3-SG, BZ3-3-SGDL and SG-DUP-1 were diluted due to high concentrations.

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E. Additional Comments:

Manual Integration Report				
Sequence	VL110414	Instrument	MSVOA_I	

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDICC0.1	VL024126.D	1,1,2,2-Tetrachloroethane	Feifei	11/6/2014 1:22:32 PM	MMDadoda	11/6/2014 5:55:33 PM	Peak Integrated by Software incorrectly
VSTDICC0.03	VL024127.D	Tetrachloroethene	Feifei	11/6/2014 1:22:38 PM	MMDadoda	11/6/2014 5:55:37 PM	Peak Integrated by Software incorrectly
VSTDICCC010	VL024128.D	Chlorobenzene-d5	Feifei	11/6/2014 1:22:42 PM	MMDadoda	11/6/2014 5:55:42 PM	Coelution Of the peak
VSTDICC002	VL024129.D	1,4-Dioxane	Feifei	11/6/2014 1:22:46 PM	MMDadoda	11/6/2014 5:55:48 PM	Peak Integrated by Software incorrectly
VSTDICC002	VL024129.D	m/p-Xylene	Feifei	11/6/2014 1:22:46 PM	MMDadoda	11/6/2014 5:55:48 PM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024130.D	1,4-Dioxane	Feifei	11/6/2014 1:22:50 PM	MMDadoda	11/6/2014 5:55:53 PM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024130.D	Ethanol	Feifei	11/6/2014 1:22:50 PM	MMDadoda	11/6/2014 5:55:53 PM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024130.D	Isopropyl Alcohol	Feifei	11/6/2014 1:22:50 PM	MMDadoda	11/6/2014 5:55:53 PM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024130.D	m/p-Xylene	Feifei	11/6/2014 1:22:50 PM	MMDadoda	11/6/2014 5:55:53 PM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024130.D	tert-Butyl alcohol	Feifei	11/6/2014 1:22:50 PM	MMDadoda	11/6/2014 5:55:53 PM	Peak Integrated by Software incorrectly
VSTDICC001	VL024131.D	1,4-Dioxane	Feifei	11/6/2014 1:22:53 PM	MMDadoda	11/6/2014 5:55:58 PM	Peak Integrated by Software incorrectly

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Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDICC001	VL024131.D	m/p-Xylene	Feifei	11/6/2014 1:22:53 PM	MMDadoda	11/6/2014 5:55:58 PM	Peak Integrated by Software incorrectly
VSTDICC015	VL024132.D	1,4-Dioxane	Feifei	11/6/2014 1:23:00 PM	MMDadoda	11/6/2014 5:56:02 PM	Peak Integrated by Software incorrectly
VSTDICC015	VL024132.D	Chlorobenzene-d5	Feifei	11/6/2014 1:23:00 PM	MMDadoda	11/6/2014 5:56:02 PM	Coelution Of the peak
VSTDICV010	VL024133.D	Chlorobenzene-d5	Feifei	11/6/2014 1:23:11 PM	MMDadoda	11/6/2014 5:56:08 PM	Coelution Of the peak

Manual Integration Report				
Sequence	VL111214	Instrument	MSVOA_I	

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDCCC010	VL024190.D	Chlorobenzene-d5	sam	11/14/2014 8:16:23 PM	MMDadoda	11/17/2014 9:45:09 AM	Coelution Of the peak
VL1112ABL	VL024191.D	Tetrachloroethene	sam	11/14/2014 8:16:31 PM	MMDadoda	11/17/2014 9:45:20 AM	Peak Integrated by Software incorrectly
VL1112ABS	VL024192.D	Chlorobenzene-d5	sam	11/14/2014 8:17:18 PM	MMDadoda	11/17/2014 9:45:25 AM	Coelution Of the peak
F4715-01DL	VL024193.D	2-Butanone	Feifei	11/17/2014 12:57:20 PM	MMDadoda	11/17/2014 12:58:18 PM	Peak Integrated by Software incorrectly
F4715-01DL	VL024193.D	Carbon Tetrachloride	Feifei	11/17/2014 12:57:20 PM	MMDadoda	11/17/2014 12:58:18 PM	Peak Integrated by Software incorrectly
F4715-01DL	VL024193.D	Propene	Feifei	11/17/2014 12:57:20 PM	MMDadoda	11/17/2014 12:58:18 PM	Peak Integrated by Software incorrectly

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F4715-02DL	VL024194.D	Ethanol	Feifei	11/17/2014 12:57:23 PM	MMDadoda	11/17/2014 12:58:25 PM	Peak Integrated by Software incorrectly
F4715-02DL	VL024194.D	m/p-Xylene	Feifei	11/17/2014 12:57:23 PM	MMDadoda	11/17/2014 12:58:25 PM	Peak Integrated by Software incorrectly
F4715-02DL	VL024194.D	Propene	Feifei	11/17/2014 12:57:23 PM	MMDadoda	11/17/2014 12:58:25 PM	Peak Integrated by Software incorrectly
F4715-03	VL024195.D	Ethanol	sam	11/14/2014 8:18:53 PM	MMDadoda	11/17/2014 9:45:30 AM	Peak Integrated by Software incorrectly
F4715-03	VL024195.D	Vinyl Chloride	sam	11/14/2014 8:18:53 PM	MMDadoda	11/17/2014 9:45:30 AM	Peak Integrated by Software incorrectly

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
F4715-04DL	VL024196.D	Carbon Tetrachloride	Feifei	11/17/2014 12:57:27 PM	MMDadoda	11/17/2014 12:58:31 PM	Peak Integrated by Software incorrectly
F4715-04DL	VL024196.D	Ethanol	Feifei	11/17/2014 12:57:27 PM	MMDadoda	11/17/2014 12:58:31 PM	Peak Integrated by Software incorrectly
F4715-04DL	VL024196.D	Propene	Feifei	11/17/2014 12:57:27 PM	MMDadoda	11/17/2014 12:58:31 PM	Peak Integrated by Software incorrectly
F4715-01	VL024197.D	n-propylbenzene	sam	11/14/2014 8:16:46 PM	MMDadoda	11/17/2014 9:45:35 AM	Peak Integrated by Software incorrectly
F4715-01	VL024197.D	Propene	sam	11/14/2014 8:16:46 PM	MMDadoda	11/17/2014 9:45:35 AM	Peak missed by the software
F4715-01DUP	VL024198.D	Propene	sam	11/14/2014 8:16:51 PM	MMDadoda	11/17/2014 9:45:41 AM	Peak missed by the software
F4715-01DUP	VL024198.D	Trichloroethene	sam	11/14/2014 8:16:51 PM	MMDadoda	11/17/2014 9:45:41 AM	Peak Integrated by Software incorrectly
F4715-02	VL024199.D	Ethanol	sam	11/14/2014 8:17:32	MMDadoda	11/17/2014 9:45:46 AM	Peak Integrated by Software

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				PM			incorrectly
F4715-02	VL024199.D	Propene	sam	11/14/2014 8:17:32 PM	MMDadoda	11/17/2014 9:45:46 AM	Peak missed by the software
F4715-04	VL024200.D	Propene	sam	11/14/2014 8:18:58 PM	MMDadoda	11/17/2014 9:45:58 AM	Peak missed by the software

F4715-03DL2	VL024208.D	Isopropyl Alcohol	sam	11/14/2014 8:17:05 PM	MMDadoda	11/17/2014 9:46:34 AM	Peak Integrated by Software incorrectly

F. Manual Integration Comments:
Please refer to the Manual integration Report included with the Run Logs for information on the manual integrations performed.

I certify that the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. The laboratory manager or his designee, as verified by the following signature has authorized release of the data contained in this hard copy data package.

Signature__ Mildred V Reyes

APPROVED
By Mildred V Reyes QA/QC Supervisor at 9:39 am, Dec 03, 2014

DATA REPORTING QUALIFIERS- ORGANIC

For reporting results, the following " Results Qualifiers" are used:

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates the compound was analyzed for but was not detected. Report the minimum detection limit for the sample with the U, i.e. "10 U". This is not necessarily the instrument detection limit attainable for this particular sample based on any concentration or dilution that may have been required.
ND	Indicates the analyte was analyzed for, but not detected
J	Indicates an estimated value**.** This flag is used: (1) When estimating a concentration for a tentatively identified compound (library search hits, where a 1:1 response is assumed.) (2) When the mass spectral data indicated the identification, however the result was less than the specified detection limit greater than zero. If the detection limit was 10ug/L and a concentration of 3 ug/L was calculated report as 3 J. This is flag is used when similar situation arise on any organic parameter i.e. Pest, PCB and others.
B	Indicates the analyte was found in the blank as well as the sample report as "12 B".
E	Indicates the analyte 's concentration exceeds the calibrated range of the instrument for that specific analysis.
D	This flag identifies all compounds identified in an analysis at a secondary dilution factor.
P	This flag is used for Pesticide/PCB target analyte when there is >25% difference for detected concentrations between the two GC columns. The lower of the two values is reported on Form 1 and flagged with a "P".
N	This flag indicates presumptive evidence of a compound. This is only used for tentatively identified compounds (TICs), where the identification is based on a mass spectral library search. It applies to all TIC results. For generic characterization of a TIC, such as chlorinated hydrocarbon, the flag is not used.
A	This flag indicates that a Tentatively Identified Compound is a suspected aldol-condensation product.
Q	Indicates the LCS did not meet the control limits requirements

QA Control # A3040960

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APPENDIX A

QA REVIEW GENERAL DOCUMENTATION

Project #: F4715

	Completed
For thorough review, the report must have the following:	
GENERAL:	
Are all original paperwork present (chain of custody, record of communication,airbill, sample management lab chronicle, login page)	✓
Check chain-of-custody for proper relinquish/return of samples	✓
Is the chain of custody signed and complete	✓
Check internal chain-of-custody for proper relinquish/return of samples /sample extracts	✓
Collect information for each project id from server. Were all requirements followed	✓
COVER PAGE:	
Do numbers of samples correspond to the number of samples in the Chain of Custody on login page	✓
Do lab numbers and client Ids on cover page agree with the Chain of Custody	✓
CHAIN OF CUSTODY:	
Do requested analyses on Chain of Custody agree with form I results	✓
Do requested analyses on Chain of Custody agree with the log-in page	✓
Were the correct method log-in for analysis according to the Analytical Request and Chain of Castody	✓
Were the samples received within hold time	✓
Were any problems found with the samples at arrival recorded in the Sample Management Laboratory Chronicle	✓
ANALYTICAL:	
Was method requirement followed?	✓
Was client requirement followed?	✓
Does the case narrative summarize all QC failure?	✓
All runlogs and manual integration are reviewed for requirements	✓
All manual calculations and /or hand notations verified	✓

1st Level QA Review Signature: JAYESH RAMANI **Date:** 11/27/2014

2nd Level QA Review Signature: Mildred V Reyes **Date:**

APPROVED
By Mildred V Reyes QA/QC Supervisor at 9:39 am, Dec 03, 2014

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LAB CHRONICLE

OrderID:	F4715	**OrderDate:**	11/11/2014 4:30:18 PM
Client:	EA Engineering Science & Technology	**Project:**	Frankford Arsenal Air
Contact:	Denise Wilt	**Location:**	Air Lab

LabID	ClientID	Matrix	Test	Method	Sample Date	Prep Date	Anal Date	Received
F4715-01	**BZ3-1-SG**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-01DL	**BZ3-1-SGDL**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-02	**BZ3-2-SG**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-02DL	**BZ3-2-SGDL**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-03	**BZ3-3-SG**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-03DL	**BZ3-3-SGDL**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-03DL 2	**BZ3-3-SGDL2**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-04	**SG-DUP-1**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	
F4715-04DL	**SG-DUP-1DL**	**Air**			**11/11/14**			**11/11/14**
			TO-15	TO-15			11/12/14	

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A B C D E F G H

Hit Summary Sheet
SW-846

SDG No.: F4715

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
Client ID:	**BZ3-1-SG**								
F4715-01	BZ3-1-SG	Air	Dichlorodifluoromethane	2.37	J	0.2	0.49	2.47	ug/m3
F4715-01	BZ3-1-SG	Air	Chloromethane	0.72	J	0.21	0.21	1.03	ug/m3
F4715-01	BZ3-1-SG	Air	Trichlorofluoromethane	1.85	J	0.22	0.56	2.81	ug/m3
F4715-01	BZ3-1-SG	Air	Heptane	34.00		0.41	0.41	2.05	ug/m3
F4715-01	BZ3-1-SG	Air	Methylene Chloride	46.90	B	0.17	0.35	1.74	ug/m3
F4715-01	BZ3-1-SG	Air	Cyclohexane	22.40		0.34	0.34	1.72	ug/m3
F4715-01	BZ3-1-SG	Air	2-Butanone	13.00		0.29	0.29	1.47	ug/m3
F4715-01	BZ3-1-SG	Air	Carbon Tetrachloride	3.77		0.19	0.19	0.19	ug/m3
F4715-01	BZ3-1-SG	Air	2,2,4-Trimethylpentane	113.00	E	0.19	0.47	2.34	ug/m3
F4715-01	BZ3-1-SG	Air	Benzene	19.80		0.13	0.32	1.6	ug/m3
F4715-01	BZ3-1-SG	Air	Trichloroethene	0.86		0.11	0.16	0.16	ug/m3
F4715-01	BZ3-1-SG	Air	Toluene	90.80	E	0.19	0.38	1.88	ug/m3
F4715-01	BZ3-1-SG	Air	Tetrachloroethene	1.63		0.2	0.2	0.2	ug/m3
F4715-01	BZ3-1-SG	Air	Ethyl Benzene	7.82		0.43	0.43	2.17	ug/m3
F4715-01	BZ3-1-SG	Air	m/p-Xylene	19.10		0.43	0.87	4.34	ug/m3
F4715-01	BZ3-1-SG	Air	o-Xylene	7.38		0.43	0.43	2.17	ug/m3
F4715-01	BZ3-1-SG	Air	Styrene	1.41	J	0.43	0.43	2.13	ug/m3
F4715-01	BZ3-1-SG	Air	1,3,5-Trimethylbenzene	1.47	J	0.49	0.49	2.46	ug/m3
F4715-01	BZ3-1-SG	Air	1,2,4-Trimethylbenzene	4.23		0.49	0.49	2.46	ug/m3
F4715-01	BZ3-1-SG	Air	1,3-Dichlorobenzene	0.66	J	0.6	0.6	3.01	ug/m3
F4715-01	BZ3-1-SG	Air	Naphthalene	0.58	J	0.21	0.52	2.62	ug/m3
F4715-01	BZ3-1-SG	Air	4-Ethyltoluene	2.31	J	0.49	0.49	2.46	ug/m3
F4715-01	BZ3-1-SG	Air	Hexane	387.00	E	0.14	0.35	1.76	ug/m3
			Total Voc :	783.06					
			Total Concentration:	783.06					
Client ID:	**BZ3-1-SGDL**								
F4715-01DL	BZ3-1-SGDL	Air	Heptane	34.80	D	4.1	4.1	20.5	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	Methylene Chloride	59.10	DB	1.74	3.47	17.4	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	Cyclohexane	24.40	D	3.44	3.44	17.2	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	2-Butanone	14.40	JD	2.95	2.95	14.8	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	Carbon Tetrachloride	4.03	D	1.89	1.89	1.89	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	2,2,4-Trimethylpentane	115.00	D	1.87	4.67	23.4	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	Benzene	20.40	D	1.28	3.19	16.0	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	Toluene	90.80	D	1.88	3.77	18.8	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	Ethyl Benzene	7.82	JD	4.34	4.34	21.7	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	m/p-Xylene	19.10	JD	4.34	8.69	43.4	ug/m3
F4715-01DL	BZ3-1-SGDL	Air	o-Xylene	7.38	JD	4.34	4.34	21.7	ug/m3

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A B C D E F G H

Hit Summary Sheet
SW-846

SDG No.: F4715

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
F4715-01DL	BZ3-1-SGDL	Air	Hexane	422.00	D	1.41	3.52	17.6	ug/m3
			Total Voc :	819.23					
			Total Concentration:	819.23					
Client ID:	**BZ3-2-SG**								
F4715-02	BZ3-2-SG	Air	Dichlorodifluoromethane	2.32	J	0.2	0.49	2.47	ug/m3
F4715-02	BZ3-2-SG	Air	Chloromethane	0.58	J	0.21	0.21	1.03	ug/m3
F4715-02	BZ3-2-SG	Air	Vinyl Chloride	0.72		0.08	0.08	0.08	ug/m3
F4715-02	BZ3-2-SG	Air	Trichlorofluoromethane	1.85	J	0.22	0.56	2.81	ug/m3
F4715-02	BZ3-2-SG	Air	Heptane	10.70		0.41	0.41	2.05	ug/m3
F4715-02	BZ3-2-SG	Air	Carbon Disulfide	20.60		0.16	0.31	1.56	ug/m3
F4715-02	BZ3-2-SG	Air	Methylene Chloride	4.52	B	0.17	0.35	1.74	ug/m3
F4715-02	BZ3-2-SG	Air	Cyclohexane	13.80		0.34	0.34	1.72	ug/m3
F4715-02	BZ3-2-SG	Air	Carbon Tetrachloride	220.00	E	0.19	0.19	0.19	ug/m3
F4715-02	BZ3-2-SG	Air	Chloroform	24.40		0.1	0.49	2.44	ug/m3
F4715-02	BZ3-2-SG	Air	2,2,4-Trimethylpentane	36.40		0.19	0.47	2.34	ug/m3
F4715-02	BZ3-2-SG	Air	Benzene	11.20		0.13	0.32	1.6	ug/m3
F4715-02	BZ3-2-SG	Air	Trichloroethene	2.47		0.11	0.16	0.16	ug/m3
F4715-02	BZ3-2-SG	Air	Toluene	31.30		0.19	0.38	1.88	ug/m3
F4715-02	BZ3-2-SG	Air	Tetrachloroethene	0.47		0.2	0.2	0.2	ug/m3
F4715-02	BZ3-2-SG	Air	Ethyl Benzene	3.82		0.43	0.43	2.17	ug/m3
F4715-02	BZ3-2-SG	Air	m/p-Xylene	10.90		0.43	0.87	4.34	ug/m3
F4715-02	BZ3-2-SG	Air	o-Xylene	6.52		0.43	0.43	2.17	ug/m3
F4715-02	BZ3-2-SG	Air	1,3,5-Trimethylbenzene	2.56		0.49	0.49	2.46	ug/m3
F4715-02	BZ3-2-SG	Air	1,2,4-Trimethylbenzene	7.87		0.49	0.49	2.46	ug/m3
F4715-02	BZ3-2-SG	Air	1,3-Dichlorobenzene	3.91		0.6	0.6	3.01	ug/m3
F4715-02	BZ3-2-SG	Air	Naphthalene	23.10		0.21	0.52	2.62	ug/m3
F4715-02	BZ3-2-SG	Air	4-Ethyltoluene	3.20		0.49	0.49	2.46	ug/m3
F4715-02	BZ3-2-SG	Air	Hexane	144.00	E	0.14	0.35	1.76	ug/m3
			Total Voc :	587.21					
			Total Concentration:	587.21					
Client ID:	**BZ3-2-SGDL**								
F4715-02DL	BZ3-2-SGDL	Air	Heptane	10.70	JD	4.1	4.1	20.5	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Carbon Disulfide	20.90	D	1.56	3.11	15.6	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Methylene Chloride	9.03	JDB	1.74	3.47	17.4	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Cyclohexane	14.50	JD	3.44	3.44	17.2	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Carbon Tetrachloride	266.00	D	1.89	1.89	1.89	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Chloroform	25.90	D	0.98	4.88	24.4	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	2,2,4-Trimethylpentane	36.40	D	1.87	4.67	23.4	ug/m3

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A B C D E F G H

Hit Summary Sheet
SW-846

SDG No.: F4715

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
F4715-02DL	BZ3-2-SGDL	Air	Benzene	11.80	JD	1.28	3.19	16.0	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Trichloroethene	2.42	D	0.81	1.61	1.61	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Toluene	31.30	D	1.88	3.77	18.8	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	m/p-Xylene	10.90	JD	4.34	8.69	43.4	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	o-Xylene	6.52	JD	4.34	4.34	21.7	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	1,2,4-Trimethylbenzene	8.36	JD	4.92	4.92	24.6	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Naphthalene	21.00	JD	2.1	5.24	26.2	ug/m3
F4715-02DL	BZ3-2-SGDL	Air	Hexane	144.00	D	1.41	3.52	17.6	ug/m3
			Total Voc :	619.73					
			Total Concentration:	619.73					
Client ID:	**BZ3-3-SG**								
F4715-03	BZ3-3-SG	Air	Chloromethane	4.13	J	2.07	2.07	10.3	ug/m3
F4715-03	BZ3-3-SG	Air	Vinyl Chloride	12,014.00	E	0.77	0.77	0.77	ug/m3
F4715-03	BZ3-3-SG	Air	Trichlorofluoromethane	11.80	J	2.25	5.62	28.1	ug/m3
F4715-03	BZ3-3-SG	Air	Heptane	47.10		4.1	4.1	20.5	ug/m3
F4715-03	BZ3-3-SG	Air	1,1-Dichloroethene	111.00		1.98	3.96	19.8	ug/m3
F4715-03	BZ3-3-SG	Air	Carbon Disulfide	21.20		1.56	3.11	15.6	ug/m3
F4715-03	BZ3-3-SG	Air	Methylene Chloride	14.20	JB	1.74	3.47	17.4	ug/m3
F4715-03	BZ3-3-SG	Air	trans-1,2-Dichloroethene	1,110.00	E	1.98	3.96	19.8	ug/m3
F4715-03	BZ3-3-SG	Air	Cyclohexane	29.30		3.44	3.44	17.2	ug/m3
F4715-03	BZ3-3-SG	Air	2-Butanone	24.20		2.95	2.95	14.8	ug/m3
F4715-03	BZ3-3-SG	Air	cis-1,2-Dichloroethene	5,550.00	E	1.98	3.96	19.8	ug/m3
F4715-03	BZ3-3-SG	Air	2,2,4-Trimethylpentane	161.00		1.87	4.67	23.4	ug/m3
F4715-03	BZ3-3-SG	Air	Benzene	40.20		1.28	3.19	16.0	ug/m3
F4715-03	BZ3-3-SG	Air	Trichloroethene	32.20		0.81	1.61	1.61	ug/m3
F4715-03	BZ3-3-SG	Air	Toluene	113.00		1.88	3.77	18.8	ug/m3
F4715-03	BZ3-3-SG	Air	Tetrachloroethene	136.00		2.03	2.03	2.03	ug/m3
F4715-03	BZ3-3-SG	Air	Ethyl Benzene	12.20	J	4.34	4.34	21.7	ug/m3
F4715-03	BZ3-3-SG	Air	m/p-Xylene	28.70	J	4.34	8.69	43.4	ug/m3
F4715-03	BZ3-3-SG	Air	o-Xylene	11.70	J	4.34	4.34	21.7	ug/m3
F4715-03	BZ3-3-SG	Air	1,3,5-Trimethylbenzene	5.41	J	4.92	4.92	24.6	ug/m3
F4715-03	BZ3-3-SG	Air	1,2,4-Trimethylbenzene	16.70	J	4.92	4.92	24.6	ug/m3
F4715-03	BZ3-3-SG	Air	1,3-Dichlorobenzene	13.80	J	6.01	6.01	30.1	ug/m3
F4715-03	BZ3-3-SG	Air	4-Ethyltoluene	8.85	J	4.92	4.92	24.6	ug/m3
F4715-03	BZ3-3-SG	Air	Hexane	528.00	E	1.41	3.52	17.6	ug/m3
			Total Voc :	20044.69					
			Total Concentration:	20044.69					
Client ID:	**BZ3-3-SGDL**								

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Hit Summary Sheet
SW-846

SDG No.: F4715

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
F4715-03DL	BZ3-3-SGDL	Air	Vinyl Chloride	17,126.00	ED	11.5	11.5	11.5	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	1,1-Dichloroethene	122.00	JD	29.7	59.5	297	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	trans-1,2-Dichloroethene	1,110.00	D	29.7	59.5	297	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	cis-1,2-Dichloroethene	5,550.00	D	29.7	59.5	297	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	2,2,4-Trimethylpentane	139.00	JD	28.0	70.1	350	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	Benzene	110.00	JD	19.2	47.9	239	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	Trichloroethene	29.00	D	12.4	24.2	24.2	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	Toluene	166.00	JD	28.3	56.5	282	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	Tetrachloroethene	134.00	D	30.5	30.5	30.5	ug/m3
F4715-03DL	BZ3-3-SGDL	Air	Hexane	493.00	D	21.2	52.9	264	ug/m3
			Total Voc :	24979					
			Total Concentration:	24979					
Client ID:	**BZ3-3-SGDL2**								
F4715-03DL2	BZ3-3-SGDL2	Air	Vinyl Chloride	18,660.00	D	92.0	92.0	92.0	ug/m3
F4715-03DL2	BZ3-3-SGDL2	Air	trans-1,2-Dichloroethene	1,189.00	JD	237	475	2378	ug/m3
F4715-03DL2	BZ3-3-SGDL2	Air	cis-1,2-Dichloroethene	5,947.00	D	237	475	2378	ug/m3
			Total Voc :	25796					
			Total Concentration:	25796					
Client ID:	**SG-DUP-1**								
F4715-04	SG-DUP-1	Air	Dichlorodifluoromethane	2.67		0.2	0.49	2.47	ug/m3
F4715-04	SG-DUP-1	Air	Chloromethane	1.36		0.21	0.21	1.03	ug/m3
F4715-04	SG-DUP-1	Air	Tetrahydrofuran	2.42		0.29	0.29	1.47	ug/m3
F4715-04	SG-DUP-1	Air	Trichlorofluoromethane	2.75	J	0.22	0.56	2.81	ug/m3
F4715-04	SG-DUP-1	Air	Heptane	8.61		0.41	0.41	2.05	ug/m3
F4715-04	SG-DUP-1	Air	Methylene Chloride	4.17	B	0.17	0.35	1.74	ug/m3
F4715-04	SG-DUP-1	Air	Cyclohexane	6.88		0.34	0.34	1.72	ug/m3
F4715-04	SG-DUP-1	Air	2-Butanone	64.90	E	0.29	0.29	1.47	ug/m3
F4715-04	SG-DUP-1	Air	Carbon Tetrachloride	3.21		0.19	0.19	0.19	ug/m3
F4715-04	SG-DUP-1	Air	Chloroform	0.88	J	0.1	0.49	2.44	ug/m3
F4715-04	SG-DUP-1	Air	2,2,4-Trimethylpentane	21.00		0.19	0.47	2.34	ug/m3
F4715-04	SG-DUP-1	Air	Benzene	9.58		0.13	0.32	1.6	ug/m3
F4715-04	SG-DUP-1	Air	Trichloroethene	0.91		0.11	0.16	0.16	ug/m3
F4715-04	SG-DUP-1	Air	Toluene	120.00	E	0.19	0.38	1.88	ug/m3
F4715-04	SG-DUP-1	Air	Tetrachloroethene	0.47		0.2	0.2	0.2	ug/m3
F4715-04	SG-DUP-1	Air	Ethyl Benzene	4.34		0.43	0.43	2.17	ug/m3
F4715-04	SG-DUP-1	Air	m/p-Xylene	12.20		0.43	0.87	4.34	ug/m3
F4715-04	SG-DUP-1	Air	o-Xylene	4.78		0.43	0.43	2.17	ug/m3
F4715-04	SG-DUP-1	Air	Styrene	0.43	J	0.43	0.43	2.13	ug/m3

Hit Summary Sheet
SW-846

SDG No.: F4715

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
F4715-04	SG-DUP-1	Air	1,3,5-Trimethylbenzene	1.38	J	0.49	0.49	2.46	ug/m3
F4715-04	SG-DUP-1	Air	1,2,4-Trimethylbenzene	4.57		0.49	0.49	2.46	ug/m3
F4715-04	SG-DUP-1	Air	1,3-Dichlorobenzene	0.96	J	0.6	0.6	3.01	ug/m3
F4715-04	SG-DUP-1	Air	Naphthalene	1.10	J	0.21	0.52	2.62	ug/m3
F4715-04	SG-DUP-1	Air	4-Ethyltoluene	1.72	J	0.49	0.49	2.46	ug/m3
F4715-04	SG-DUP-1	Air	Hexane	93.00	E	0.14	0.35	1.76	ug/m3
			Total Voc :	374.29					
			Total Concentration:	374.29					
Client ID:	**SG-DUP-1DL**								
F4715-04DL	SG-DUP-1DL	Air	Heptane	9.02	JD	4.1	4.1	20.5	ug/m3
F4715-04DL	SG-DUP-1DL	Air	2-Butanone	63.70	D	2.95	2.95	14.8	ug/m3
F4715-04DL	SG-DUP-1DL	Air	Carbon Tetrachloride	3.46	D	1.89	1.89	1.89	ug/m3
F4715-04DL	SG-DUP-1DL	Air	2,2,4-Trimethylpentane	21.50	JD	1.87	4.67	23.4	ug/m3
F4715-04DL	SG-DUP-1DL	Air	Benzene	9.58	JD	1.28	3.19	16.0	ug/m3
F4715-04DL	SG-DUP-1DL	Air	Toluene	125.00	D	1.88	3.77	18.8	ug/m3
F4715-04DL	SG-DUP-1DL	Air	m/p-Xylene	11.70	JD	4.34	8.69	43.4	ug/m3
F4715-04DL	SG-DUP-1DL	Air	Hexane	93.80	D	1.41	3.52	17.6	ug/m3
			Total Voc :	337.76					
			Total Concentration:	337.76					

Project : Frankford Arsenal Air

Field Id Number : BZ3-1-SG

Laboratory Id Number : F4715-01

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	0.48	J	2.37		
Chloromethane	74-87-3	50.49	0.35	J	0.72		
Vinyl Chloride	75-01-4	62.5	0.03	U	0.08		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.1	U	0.29		
Trichlorofluoromethane	75-69-4	137.4	0.33	J	1.85		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.1	U	0.3		
Heptane	142-82-5	100.2	8.3		34.0		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	0.1	U	0.24		
Carbon Disulfide	75-15-0	76.14	0.1	U	0.31		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	13.5		46.9		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	6.5		22.4		
2-Butanone	78-93-3	72.11	4.4		13.0		
Carbon Tetrachloride	56-23-5	153.8	0.6		3.77		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	0.1	U	0.49		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	24.4	E	113		
Benzene	71-43-2	78.11	6.2		19.8		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	0.16		0.86		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.1	U	0.41		
Toluene	108-88-3	92.14	24.1	E	90.8		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		

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Project : Frankford Arsenal Air

Field Id Number : BZ3-1-SG

Laboratory Id Number : F4715-01

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.24		1.63		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	1.8		7.82		
m/p-Xylene	179601-23-1	106.2	4.4		19.1		
o-Xylene	95-47-6	106.2	1.7		7.38		
Styrene	100-42-5	104.1	0.33	J	1.41		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		
2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.3	J	1.47		
1,2,4-Trimethylbenzene	95-63-6	120.2	0.86		4.23		
1,3-Dichlorobenzene	541-73-1	147	0.11	J	0.66		
1,4-Dichlorobenzene	106-46-7	147	0.1	U	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	0.11	J	0.58		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.47	J	2.31		
Hexane	110-54-3	86.17	110	E	387		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

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Project : Frankford Arsenal Air

Field Id Number : BZ3-1-SGDL

Laboratory Id Number : F4715-01DL

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	1	UD	4.94		
Chloromethane	74-87-3	50.49	1	UD	2.07		
Vinyl Chloride	75-01-4	62.5	0.3	UD	0.77		
Bromomethane	74-83-9	94.94	1	UD	3.88		
Chloroethane	75-00-3	64.52	1	UD	2.64		
Tetrahydrofuran	109-99-9	72.11	1	UD	2.95		
Trichlorofluoromethane	75-69-4	137.4	1	UD	5.62		
Dichlorotetrafluoroethane	76-14-2	170.9	1	UD	6.99		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	1	UD	7.66		
Bromoethene	593-60-2	106.9	1	UD	4.37		
tert-Butyl alcohol	75-65-0	74.12	1	UD	3.03		
Heptane	142-82-5	100.2	8.5	D	34.8		
1,1-Dichloroethene	75-35-4	96.94	1	UD	3.96		
Acetone	67-64-1	58.08	1	UD	2.38		
Carbon Disulfide	75-15-0	76.14	1	UD	3.11		
Methyl tert-Butyl Ether	1634-04-4	88.15	1	UD	3.61		
Methylene Chloride	75-09-2	84.94	17	D	59.1		
trans-1,2-Dichloroethene	156-60-5	96.94	1	UD	3.96		
1,1-Dichloroethane	75-34-3	98.96	1	UD	4.05		
Cyclohexane	110-82-7	84.16	7.1	D	24.4		
2-Butanone	78-93-3	72.11	4.9	JD	14.4		
Carbon Tetrachloride	56-23-5	153.8	0.64	D	4.03		
cis-1,2-Dichloroethene	156-59-2	96.94	1	UD	3.96		
Chloroform	67-66-3	119.4	1	UD	4.88		
1,1,1-Trichloroethane	71-55-6	133.4	0.3	UD	1.64		
2,2,4-Trimethylpentane	540-84-1	114.2	24.8	D	115		
Benzene	71-43-2	78.11	6.4	D	20.4		
1,2-Dichloroethane	107-06-2	98.96	1	UD	4.05		
Trichloroethene	79-01-6	131.4	0.3	UD	1.61		
1,2-Dichloropropane	78-87-5	113	1	UD	4.62		
Bromodichloromethane	75-27-4	163.8	1	UD	6.7		
4-Methyl-2-Pentanone	108-10-1	100.2	1	UD	4.1		
Toluene	108-88-3	92.14	24.1	D	90.8		
t-1,3-Dichloropropene	10061-02-6	111	1	UD	4.54		
cis-1,3-Dichloropropene	10061-01-5	111	1	UD	4.54		
1,1,2-Trichloroethane	79-00-5	133.4	1	UD	5.46		

Project : Frankford Arsenal Air

Sampling Date : 11/11/14

Field Id Number : BZ3-1-SGDL

Analysis Date : 11/12/14

Laboratory Id Number : F4715-01DL

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	1	UD	8.52		
1,2-Dibromoethane	106-93-4	187.9	1	UD	7.69		
Tetrachloroethene	127-18-4	165.8	0.3	UD	2.03		
Chlorobenzene	108-90-7	112.6	1	UD	4.61		
Ethyl Benzene	100-41-4	106.2	1.8	JD	7.82		
m/p-Xylene	179601-23-1	106.2	4.4	JD	19.1		
o-Xylene	95-47-6	106.2	1.7	JD	7.38		
Styrene	100-42-5	104.1	1	UD	4.26		
Bromoform	75-25-2	252.8	1	UD	10.3		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.3	UD	2.06		
2-Chlorotoluene	95-49-8	126.6	1	UD	5.18		
1,3,5-Trimethylbenzene	108-67-8	120.2	1	UD	4.92		
1,2,4-Trimethylbenzene	95-63-6	120.2	1	UD	4.92		
1,3-Dichlorobenzene	541-73-1	147	1	UD	6.01		
1,4-Dichlorobenzene	106-46-7	147	1	UD	6.01		
1,2-Dichlorobenzene	95-50-1	147	1	UD	6.01		
1,2,4-Trichlorobenzene	120-82-1	181.5	1	UD	7.42		
Hexachloro-1,3-Butadiene	87-68-3	260.8	1	UD	10.7		
1,3-Butadiene	106-99-0	54.09	1	UD	2.21		
Naphthalene	91-20-3	128.17	1	UD	5.24		
4-Ethyltoluene	622-96-8	120.2	1	UD	4.92		
Hexane	110-54-3	86.17	120	D	422		
Allyl Chloride	107-05-1	76.53	1	UD	3.13		
1,4-Dioxane	123-91-1	88.12	1	UD	3.6		
Methyl Methacrylate	80-62-6	100.117	1	UD	4.09		

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Project : Frankford Arsenal Air | **Sampling Date :** 11/11/14

Field Id Number : BZ3-2-SG | **Analysis Date :** 11/12/14

Laboratory Id Number : F4715-02 | **Target Analyts :** Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	0.47	J	2.32		
Chloromethane	74-87-3	50.49	0.28	J	0.58		
Vinyl Chloride	75-01-4	62.5	0.28		0.72		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.1	U	0.29		
Trichlorofluoromethane	75-69-4	137.4	0.33	J	1.85		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.1	U	0.3		
Heptane	142-82-5	100.2	2.6		10.7		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	0.1	U	0.24		
Carbon Disulfide	75-15-0	76.14	6.6		20.6		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	1.3		4.52		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	4		13.8		
2-Butanone	78-93-3	72.11	0.1	U	0.29		
Carbon Tetrachloride	56-23-5	153.8	35.1	E	220		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	5		24.4		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	7.8		36.4		
Benzene	71-43-2	78.11	3.5		11.2		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	0.46		2.47		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.1	U	0.41		
Toluene	108-88-3	92.14	8.3		31.3		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		

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Project : Frankford Arsenal Air

Field Id Number : BZ3-2-SG

Laboratory Id Number : F4715-02

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.07		0.47		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	0.88		3.82		
m/p-Xylene	179601-23-1	106.2	2.5		10.9		
o-Xylene	95-47-6	106.2	1.5		6.52		
Styrene	100-42-5	104.1	0.1	U	0.43		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		
2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.52		2.56		
1,2,4-Trimethylbenzene	95-63-6	120.2	1.6		7.87		
1,3-Dichlorobenzene	541-73-1	147	0.65		3.91		
1,4-Dichlorobenzene	106-46-7	147	0.1	U	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	4.4		23.1		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.65		3.2		
Hexane	110-54-3	86.17	41	E	144		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

A B C D E F G H

Project : Frankford Arsenal Air **Sampling Date :** 11/11/14

Field Id Number : BZ3-2-SGDL **Analysis Date :** 11/12/14

Laboratory Id Number : F4715-02DL **Target Analyts :** Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	1	UD	4.94		
Chloromethane	74-87-3	50.49	1	UD	2.07		
Vinyl Chloride	75-01-4	62.5	0.3	UD	0.77		
Bromomethane	74-83-9	94.94	1	UD	3.88		
Chloroethane	75-00-3	64.52	1	UD	2.64		
Tetrahydrofuran	109-99-9	72.11	1	UD	2.95		
Trichlorofluoromethane	75-69-4	137.4	1	UD	5.62		
Dichlorotetrafluoroethane	76-14-2	170.9	1	UD	6.99		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	1	UD	7.66		
Bromoethene	593-60-2	106.9	1	UD	4.37		
tert-Butyl alcohol	75-65-0	74.12	1	UD	3.03		
Heptane	142-82-5	100.2	2.6	JD	10.7		
1,1-Dichloroethene	75-35-4	96.94	1	UD	3.96		
Acetone	67-64-1	58.08	1	UD	2.38		
Carbon Disulfide	75-15-0	76.14	6.7	D	20.9		
Methyl tert-Butyl Ether	1634-04-4	88.15	1	UD	3.61		
Methylene Chloride	75-09-2	84.94	2.6	JD	9.03		
trans-1,2-Dichloroethene	156-60-5	96.94	1	UD	3.96		
1,1-Dichloroethane	75-34-3	98.96	1	UD	4.05		
Cyclohexane	110-82-7	84.16	4.2	JD	14.5		
2-Butanone	78-93-3	72.11	1	UD	2.95		
Carbon Tetrachloride	56-23-5	153.8	42.4	D	266		
cis-1,2-Dichloroethene	156-59-2	96.94	1	UD	3.96		
Chloroform	67-66-3	119.4	5.3	D	25.9		
1,1,1-Trichloroethane	71-55-6	133.4	0.3	UD	1.64		
2,2,4-Trimethylpentane	540-84-1	114.2	7.8	D	36.4		
Benzene	71-43-2	78.11	3.7	JD	11.8		
1,2-Dichloroethane	107-06-2	98.96	1	UD	4.05		
Trichloroethene	79-01-6	131.4	0.45	D	2.42		
1,2-Dichloropropane	78-87-5	113	1	UD	4.62		
Bromodichloromethane	75-27-4	163.8	1	UD	6.7		
4-Methyl-2-Pentanone	108-10-1	100.2	1	UD	4.1		
Toluene	108-88-3	92.14	8.3	D	31.3		
t-1,3-Dichloropropene	10061-02-6	111	1	UD	4.54		
cis-1,3-Dichloropropene	10061-01-5	111	1	UD	4.54		
1,1,2-Trichloroethane	79-00-5	133.4	1	UD	5.46		

Project : Frankford Arsenal Air **Sampling Date :** 11/11/14

Field Id Number : BZ3-2-SGDL **Analysis Date :** 11/12/14

Laboratory Id Number : F4715-02DL **Target Analyts :** Air Results

Dibromochloromethane	124-48-1	208.3	1	UD	8.52		
1,2-Dibromoethane	106-93-4	187.9	1	UD	7.69		
Tetrachloroethene	127-18-4	165.8	0.3	UD	2.03		
Chlorobenzene	108-90-7	112.6	1	UD	4.61		
Ethyl Benzene	100-41-4	106.2	1	UD	4.34		
m/p-Xylene	179601-23-1	106.2	2.5	JD	10.9		
o-Xylene	95-47-6	106.2	1.5	JD	6.52		
Styrene	100-42-5	104.1	1	UD	4.26		
Bromoform	75-25-2	252.8	1	UD	10.3		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.3	UD	2.06		
2-Chlorotoluene	95-49-8	126.6	1	UD	5.18		
1,3,5-Trimethylbenzene	108-67-8	120.2	1	UD	4.92		
1,2,4-Trimethylbenzene	95-63-6	120.2	1.7	JD	8.36		
1,3-Dichlorobenzene	541-73-1	147	1	UD	6.01		
1,4-Dichlorobenzene	106-46-7	147	1	UD	6.01		
1,2-Dichlorobenzene	95-50-1	147	1	UD	6.01		
1,2,4-Trichlorobenzene	120-82-1	181.5	1	UD	7.42		
Hexachloro-1,3-Butadiene	87-68-3	260.8	1	UD	10.7		
Naphthalene	91-20-3	128.17	4	JD	21.0		
1,3-Butadiene	106-99-0	54.09	1	UD	2.21		
4-Ethyltoluene	622-96-8	120.2	1	UD	4.92		
Hexane	110-54-3	86.17	40.9	D	144		
Allyl Chloride	107-05-1	76.53	1	UD	3.13		
1,4-Dioxane	123-91-1	88.12	1	UD	3.6		
Methyl Methacrylate	80-62-6	100.117	1	UD	4.09		

Project : Frankford Arsenal Air

Field Id Number : BZ3-3-SG

Laboratory Id Number : F4715-03

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	1	U	4.94		
Chloromethane	74-87-3	50.49	2	J	4.13		
Vinyl Chloride	75-01-4	62.5	4700	E	12014		
Bromomethane	74-83-9	94.94	1	U	3.88		
Chloroethane	75-00-3	64.52	1	U	2.64		
Tetrahydrofuran	109-99-9	72.11	1	U	2.95		
Trichlorofluoromethane	75-69-4	137.4	2.1	J	11.8		
Dichlorotetrafluoroethane	76-14-2	170.9	1	U	6.99		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	1	U	7.66		
Bromoethene	593-60-2	106.9	1	U	4.37		
tert-Butyl alcohol	75-65-0	74.12	1	U	3.03		
Heptane	142-82-5	100.2	11.5		47.1		
1,1-Dichloroethene	75-35-4	96.94	28.1		111		
Acetone	67-64-1	58.08	1	U	2.38		
Carbon Disulfide	75-15-0	76.14	6.8		21.2		
Methyl tert-Butyl Ether	1634-04-4	88.15	1	U	3.61		
Methylene Chloride	75-09-2	84.94	4.1	J	14.2		
trans-1,2-Dichloroethene	156-60-5	96.94	280	E	1110		
1,1-Dichloroethane	75-34-3	98.96	1	U	4.05		
Cyclohexane	110-82-7	84.16	8.5		29.3		
2-Butanone	78-93-3	72.11	8.2		24.2		
Carbon Tetrachloride	56-23-5	153.8	0.3	U	1.89		
cis-1,2-Dichloroethene	156-59-2	96.94	1400	E	5550		
Chloroform	67-66-3	119.4	1	U	4.88		
1,1,1-Trichloroethane	71-55-6	133.4	0.3	U	1.64		
2,2,4-Trimethylpentane	540-84-1	114.2	34.5		161		
Benzene	71-43-2	78.11	12.6		40.2		
1,2-Dichloroethane	107-06-2	98.96	1	U	4.05		
Trichloroethene	79-01-6	131.4	6		32.2		
1,2-Dichloropropane	78-87-5	113	1	U	4.62		
Bromodichloromethane	75-27-4	163.8	1	U	6.7		
4-Methyl-2-Pentanone	108-10-1	100.2	1	U	4.1		
Toluene	108-88-3	92.14	30		113		
t-1,3-Dichloropropene	10061-02-6	111	1	U	4.54		
cis-1,3-Dichloropropene	10061-01-5	111	1	U	4.54		
1,1,2-Trichloroethane	79-00-5	133.4	1	U	5.46		

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Project : Frankford Arsenal Air

Field Id Number : BZ3-3-SG

Laboratory Id Number : F4715-03

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	1	U	8.52		
1,2-Dibromoethane	106-93-4	187.9	1	U	7.69		
Tetrachloroethene	127-18-4	165.8	20.2		136		
Chlorobenzene	108-90-7	112.6	1	U	4.61		
Ethyl Benzene	100-41-4	106.2	2.8	J	12.2		
m/p-Xylene	179601-23-1	106.2	6.6	J	28.7		
o-Xylene	95-47-6	106.2	2.7	J	11.7		
Styrene	100-42-5	104.1	1	U	4.26		
Bromoform	75-25-2	252.8	1	U	10.3		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.3	U	2.06		
2-Chlorotoluene	95-49-8	126.6	1	U	5.18		
1,3,5-Trimethylbenzene	108-67-8	120.2	1.1	J	5.41		
1,2,4-Trimethylbenzene	95-63-6	120.2	3.4	J	16.7		
1,3-Dichlorobenzene	541-73-1	147	2.3	J	13.8		
1,4-Dichlorobenzene	106-46-7	147	1	U	6.01		
1,2-Dichlorobenzene	95-50-1	147	1	U	6.01		
1,2,4-Trichlorobenzene	120-82-1	181.5	1	U	7.42		
Hexachloro-1,3-Butadiene	87-68-3	260.8	1	U	10.7		
1,3-Butadiene	106-99-0	54.09	1	U	2.21		
Naphthalene	91-20-3	128.17	1	U	5.24		
4-Ethyltoluene	622-96-8	120.2	1.8	J	8.85		
Hexane	110-54-3	86.17	150	E	528		
Allyl Chloride	107-05-1	76.53	1	U	3.13		
1,4-Dioxane	123-91-1	88.12	1	U	3.6		
Methyl Methacrylate	80-62-6	100.117	1	U	4.09		

A B C D E F G H

Project : Frankford Arsenal Air
Field Id Number : BZ3-3-SGDL
Laboratory Id Number : F4715-03DL
Sampling Date : 11/11/14
Analysis Date : 11/12/14
Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	15	UD	74.2		
Chloromethane	74-87-3	50.49	15	UD	31.0		
Vinyl Chloride	75-01-4	62.5	6700	ED	17126		
Bromomethane	74-83-9	94.94	15	UD	58.2		
Chloroethane	75-00-3	64.52	15	UD	39.6		
Tetrahydrofuran	109-99-9	72.11	15	UD	44.2		
Trichlorofluoromethane	75-69-4	137.4	15	UD	84.3		
Dichlorotetrafluoroethane	76-14-2	170.9	15	UD	104		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	15	UD	114		
Bromoethene	593-60-2	106.9	15	UD	65.6		
tert-Butyl alcohol	75-65-0	74.12	15	UD	45.5		
Heptane	142-82-5	100.2	15	UD	61.5		
1,1-Dichloroethene	75-35-4	96.94	30.8	JD	122		
Acetone	67-64-1	58.08	15	UD	35.6		
Carbon Disulfide	75-15-0	76.14	15	UD	46.7		
Methyl tert-Butyl Ether	1634-04-4	88.15	15	UD	54.1		
Methylene Chloride	75-09-2	84.94	15	UD	52.1		
trans-1,2-Dichloroethene	156-60-5	96.94	280	D	1110		
1,1-Dichloroethane	75-34-3	98.96	15	UD	60.7		
Cyclohexane	110-82-7	84.16	15	UD	51.6		
2-Butanone	78-93-3	72.11	15	UD	44.2		
Carbon Tetrachloride	56-23-5	153.8	4.5	UD	28.3		
cis-1,2-Dichloroethene	156-59-2	96.94	1400	D	5550		
Chloroform	67-66-3	119.4	15	UD	73.2		
1,1,1-Trichloroethane	71-55-6	133.4	4.5	UD	24.6		
2,2,4-Trimethylpentane	540-84-1	114.2	29.9	JD	139		
Benzene	71-43-2	78.11	34.7	JD	110		
1,2-Dichloroethane	107-06-2	98.96	15	UD	60.7		
Trichloroethene	79-01-6	131.4	5.4	D	29.0		
1,2-Dichloropropane	78-87-5	113	15	UD	69.3		
Bromodichloromethane	75-27-4	163.8	15	UD	100		
4-Methyl-2-Pentanone	108-10-1	100.2	15	UD	61.5		
Toluene	108-88-3	92.14	44.3	JD	166		
t-1,3-Dichloropropene	10061-02-6	111	15	UD	68.1		
cis-1,3-Dichloropropene	10061-01-5	111	15	UD	68.1		
1,1,2-Trichloroethane	79-00-5	133.4	15	UD	81.8		

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Project : Frankford Arsenal Air
Field Id Number : BZ3-3-SGDL
Laboratory Id Number : F4715-03DL
Sampling Date : 11/11/14
Analysis Date : 11/12/14
Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	15	UD	127		
1,2-Dibromoethane	106-93-4	187.9	15	UD	115		
Tetrachloroethene	127-18-4	165.8	19.8	D	134		
Chlorobenzene	108-90-7	112.6	15	UD	69.1		
Ethyl Benzene	100-41-4	106.2	15	UD	65.2		
m/p-Xylene	179601-23-1	106.2	30	UD	130		
o-Xylene	95-47-6	106.2	15	UD	65.2		
Styrene	100-42-5	104.1	15	UD	63.9		
Bromoform	75-25-2	252.8	15	UD	155		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	4.5	UD	30.9		
2-Chlorotoluene	95-49-8	126.6	15	UD	77.7		
1,3,5-Trimethylbenzene	108-67-8	120.2	15	UD	73.7		
1,2,4-Trimethylbenzene	95-63-6	120.2	15	UD	73.7		
1,3-Dichlorobenzene	541-73-1	147	15	UD	90.2		
1,4-Dichlorobenzene	106-46-7	147	15	UD	90.2		
1,2-Dichlorobenzene	95-50-1	147	15	UD	90.2		
1,2,4-Trichlorobenzene	120-82-1	181.5	15	UD	111		
Hexachloro-1,3-Butadiene	87-68-3	260.8	15	UD	160		
Naphthalene	91-20-3	128.17	15	UD	78.6		
1,3-Butadiene	106-99-0	54.09	15	UD	33.2		
4-Ethyltoluene	622-96-8	120.2	15	UD	73.7		
Hexane	110-54-3	86.17	140	D	493		
Allyl Chloride	107-05-1	76.53	15	UD	47.0		
1,4-Dioxane	123-91-1	88.12	15	UD	54.1		
Methyl Methacrylate	80-62-6	100.117	15	UD	61.4		

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Project : Frankford Arsenal Air | **Sampling Date :** 11/11/14

Field Id Number : BZ3-3-SGDL2 | **Analysis Date :** 11/12/14

Laboratory Id Number : F4715-03DL2 | **Target Analyts :** Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	120	UD	593		
Chloromethane	74-87-3	50.49	120	UD	247		
Vinyl Chloride	75-01-4	62.5	7300	D	18660		
Bromomethane	74-83-9	94.94	120	UD	465		
Chloroethane	75-00-3	64.52	120	UD	316		
Tetrahydrofuran	109-99-9	72.11	120	UD	353		
Trichlorofluoromethane	75-69-4	137.4	120	UD	674		
Dichlorotetrafluoroethane	76-14-2	170.9	120	UD	838		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	120	UD	919		
Bromoethene	593-60-2	106.9	120	UD	524		
tert-Butyl alcohol	75-65-0	74.12	120	UD	363		
Heptane	142-82-5	100.2	120	UD	491		
1,1-Dichloroethene	75-35-4	96.94	120	UD	475		
Acetone	67-64-1	58.08	120	UD	285		
Carbon Disulfide	75-15-0	76.14	120	UD	373		
Methyl tert-Butyl Ether	1634-04-4	88.15	120	UD	432		
Methylene Chloride	75-09-2	84.94	120	UD	416		
trans-1,2-Dichloroethene	156-60-5	96.94	300	JD	1189		
1,1-Dichloroethane	75-34-3	98.96	120	UD	485		
Cyclohexane	110-82-7	84.16	120	UD	413		
2-Butanone	78-93-3	72.11	120	UD	353		
Carbon Tetrachloride	56-23-5	153.8	36	UD	226		
cis-1,2-Dichloroethene	156-59-2	96.94	1500	D	5947		
Chloroform	67-66-3	119.4	120	UD	586		
1,1,1-Trichloroethane	71-55-6	133.4	36	UD	196		
2,2,4-Trimethylpentane	540-84-1	114.2	120	UD	560		
Benzene	71-43-2	78.11	120	UD	383		
1,2-Dichloroethane	107-06-2	98.96	120	UD	485		
Trichloroethene	79-01-6	131.4	36	UD	193		
1,2-Dichloropropane	78-87-5	113	120	UD	554		
Bromodichloromethane	75-27-4	163.8	120	UD	803		
4-Methyl-2-Pentanone	108-10-1	100.2	120	UD	491		
Toluene	108-88-3	92.14	120	UD	452		
t-1,3-Dichloropropene	10061-02-6	111	120	UD	544		
cis-1,3-Dichloropropene	10061-01-5	111	120	UD	544		
1,1,2-Trichloroethane	79-00-5	133.4	120	UD	654		

Project : Frankford Arsenal Air
Field Id Number : BZ3-3-SGDL2
Laboratory Id Number : F4715-03DL2

Sampling Date : 11/11/14
Analysis Date : 11/12/14
Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	120	UD	1022		
1,2-Dibromoethane	106-93-4	187.9	120	UD	922		
Tetrachloroethene	127-18-4	165.8	36	UD	244		
Chlorobenzene	108-90-7	112.6	120	UD	552		
Ethyl Benzene	100-41-4	106.2	120	UD	521		
m/p-Xylene	179601-23-1	106.2	240	UD	1042		
o-Xylene	95-47-6	106.2	120	UD	521		
Styrene	100-42-5	104.1	120	UD	510		
Bromoform	75-25-2	252.8	120	UD	1240		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	36	UD	247		
2-Chlorotoluene	95-49-8	126.6	120	UD	621		
1,3,5-Trimethylbenzene	108-67-8	120.2	120	UD	589		
1,2,4-Trimethylbenzene	95-63-6	120.2	120	UD	589		
1,3-Dichlorobenzene	541-73-1	147	120	UD	721		
1,4-Dichlorobenzene	106-46-7	147	120	UD	721		
1,2-Dichlorobenzene	95-50-1	147	120	UD	721		
1,2,4-Trichlorobenzene	120-82-1	181.5	120	UD	890		
Hexachloro-1,3-Butadiene	87-68-3	260.8	120	UD	1280		
Naphthalene	91-20-3	128.17	120	UD	629		
1,3-Butadiene	106-99-0	54.09	120	UD	265		
4-Ethyltoluene	622-96-8	120.2	120	UD	589		
Hexane	110-54-3	86.17	120	UD	422		
Allyl Chloride	107-05-1	76.53	120	UD	375		
1,4-Dioxane	123-91-1	88.12	120	UD	432		
Methyl Methacrylate	80-62-6	100.117	120	UD	491		

Project : Frankford Arsenal Air

Field Id Number : SG-DUP-1

Laboratory Id Number : F4715-04

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	0.54		2.67		
Chloromethane	74-87-3	50.49	0.66		1.36		
Vinyl Chloride	75-01-4	62.5	0.03	U	0.08		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.82		2.42		
Trichlorofluoromethane	75-69-4	137.4	0.49	J	2.75		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.1	U	0.3		
Heptane	142-82-5	100.2	2.1		8.61		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	0.1	U	0.24		
Carbon Disulfide	75-15-0	76.14	0.1	U	0.31		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	1.2		4.17		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	2		6.88		
2-Butanone	78-93-3	72.11	22	E	64.9		
Carbon Tetrachloride	56-23-5	153.8	0.51		3.21		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	0.18	J	0.88		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	4.5		21.0		
Benzene	71-43-2	78.11	3		9.58		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	0.17		0.91		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.1	U	0.41		
Toluene	108-88-3	92.14	32	E	120		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		

Project : Frankford Arsenal Air

Sampling Date : 11/11/14

Field Id Number : SG-DUP-1

Analysis Date : 11/12/14

Laboratory Id Number : F4715-04

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.07		0.47		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	1		4.34		
m/p-Xylene	179601-23-1	106.2	2.8		12.2		
o-Xylene	95-47-6	106.2	1.1		4.78		
Styrene	100-42-5	104.1	0.1	J	0.43		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		
2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.28	J	1.38		
1,2,4-Trimethylbenzene	95-63-6	120.2	0.93		4.57		
1,3-Dichlorobenzene	541-73-1	147	0.16	J	0.96		
1,4-Dichlorobenzene	106-46-7	147	0.1	U	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	0.21	J	1.1		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.35	J	1.72		
Hexane	110-54-3	86.17	26.4	E	93.0		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : (908)-789-8922

Project : Frankford Arsenal Air
Field Id Number : SG-DUP-1DL
Laboratory Id Number : F4715-04DL

Sampling Date : 11/11/14
Analysis Date : 11/12/14
Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	1	UD	4.94		
Chloromethane	74-87-3	50.49	1	UD	2.07		
Vinyl Chloride	75-01-4	62.5	0.3	UD	0.77		
Bromomethane	74-83-9	94.94	1	UD	3.88		
Chloroethane	75-00-3	64.52	1	UD	2.64		
Tetrahydrofuran	109-99-9	72.11	1	UD	2.95		
Trichlorofluoromethane	75-69-4	137.4	1	UD	5.62		
Dichlorotetrafluoroethane	76-14-2	170.9	1	UD	6.99		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	1	UD	7.66		
Bromoethene	593-60-2	106.9	1	UD	4.37		
tert-Butyl alcohol	75-65-0	74.12	1	UD	3.03		
Heptane	142-82-5	100.2	2.2	JD	9.02		
1,1-Dichloroethene	75-35-4	96.94	1	UD	3.96		
Acetone	67-64-1	58.08	1	UD	2.38		
Carbon Disulfide	75-15-0	76.14	1	UD	3.11		
Methyl tert-Butyl Ether	1634-04-4	88.15	1	UD	3.61		
Methylene Chloride	75-09-2	84.94	1	UD	3.47		
trans-1,2-Dichloroethene	156-60-5	96.94	1	UD	3.96		
1,1-Dichloroethane	75-34-3	98.96	1	UD	4.05		
Cyclohexane	110-82-7	84.16	1	UD	3.44		
2-Butanone	78-93-3	72.11	21.6	D	63.7		
Carbon Tetrachloride	56-23-5	153.8	0.55	D	3.46		
cis-1,2-Dichloroethene	156-59-2	96.94	1	UD	3.96		
Chloroform	67-66-3	119.4	1	UD	4.88		
1,1,1-Trichloroethane	71-55-6	133.4	0.3	UD	1.64		
2,2,4-Trimethylpentane	540-84-1	114.2	4.6	JD	21.5		
Benzene	71-43-2	78.11	3	JD	9.58		
1,2-Dichloroethane	107-06-2	98.96	1	UD	4.05		
Trichloroethene	79-01-6	131.4	0.3	UD	1.61		
1,2-Dichloropropane	78-87-5	113	1	UD	4.62		
Bromodichloromethane	75-27-4	163.8	1	UD	6.7		
4-Methyl-2-Pentanone	108-10-1	100.2	1	UD	4.1		
Toluene	108-88-3	92.14	33.2	D	125		
t-1,3-Dichloropropene	10061-02-6	111	1	UD	4.54		
cis-1,3-Dichloropropene	10061-01-5	111	1	UD	4.54		
1,1,2-Trichloroethane	79-00-5	133.4	1	UD	5.46		

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Project : Frankford Arsenal Air

Field Id Number : SG-DUP-1DL

Laboratory Id Number : F4715-04DL

Sampling Date : 11/11/14

Analysis Date : 11/12/14

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	1	UD	8.52		
1,2-Dibromoethane	106-93-4	187.9	1	UD	7.69		
Tetrachloroethene	127-18-4	165.8	0.3	UD	2.03		
Chlorobenzene	108-90-7	112.6	1	UD	4.61		
Ethyl Benzene	100-41-4	106.2	1	UD	4.34		
m/p-Xylene	179601-23-1	106.2	2.7	JD	11.7		
o-Xylene	95-47-6	106.2	1	UD	4.34		
Styrene	100-42-5	104.1	1	UD	4.26		
Bromoform	75-25-2	252.8	1	UD	10.3		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.3	UD	2.06		
2-Chlorotoluene	95-49-8	126.6	1	UD	5.18		
1,3,5-Trimethylbenzene	108-67-8	120.2	1	UD	4.92		
1,2,4-Trimethylbenzene	95-63-6	120.2	1	UD	4.92		
1,3-Dichlorobenzene	541-73-1	147	1	UD	6.01		
1,4-Dichlorobenzene	106-46-7	147	1	UD	6.01		
1,2-Dichlorobenzene	95-50-1	147	1	UD	6.01		
1,2,4-Trichlorobenzene	120-82-1	181.5	1	UD	7.42		
Hexachloro-1,3-Butadiene	87-68-3	260.8	1	UD	10.7		
Naphthalene	91-20-3	128.17	1	UD	5.24		
1,3-Butadiene	106-99-0	54.09	1	UD	2.21		
4-Ethyltoluene	622-96-8	120.2	1	UD	4.92		
Hexane	110-54-3	86.17	26.6	D	93.8		
Allyl Chloride	107-05-1	76.53	1	UD	3.13		
1,4-Dioxane	123-91-1	88.12	1	UD	3.6		
Methyl Methacrylate	80-62-6	100.117	1	UD	4.09		

Matrix	CAS #	Compound Name	Molecular Wt	ppbv MDL	LOD ppbv	LOQ ppbv	ug/m3 MDL	LOD ug/m3	LOQ ug/m3
Air	71-55-6	1,1,1-Trichloroethane	133	0.03	0.03	0.03	0.163190184	0.163190184	0.16
Air	79-34-5	1,1,2,2-Tetrachloroethane	168	0.1	0.1	0.5	0.687116564	0.687116564	3.435582822
Air	79-00-5	1,1,2-Trichloroethane	133	0.1	0.1	0.5	0.54396728	0.54396728	2.719836401
Air	76-13-1	1,1,2-Trichlorotrifluoroethane	187	0.042	0.1	0.5	0.321226994	0.764826176	3.824130879
Air	75-34-3	1,1-Dichloroethane	99	0.039	0.1	0.5	0.15791411	0.404907975	2.024539877
Air	75-35-4	1,1-Dichloroethene	97	0.051	0.1	0.5	0.202331288	0.396728016	1.983640082
Air	120-82-1	1,2,4-Trichlorobenzene	181	0.039	0.1	0.5	0.288711656	0.740286299	3.701431493
Air	95-63-6	1,2,4-Trimethylbenzene	120	0.101	0.1	0.5	0.495705521	0.490797546	2.45398773
Air	106-93-4	1,2-Dibromoethane	188	0.1	0.1	0.5	0.768916155	0.768916155	3.844580777
Air	95-50-1	1,2-Dichlorobenzene	147	0.1	0.1	0.5	0.601226994	0.601226994	3.006134969
Air	107-06-2	1,2-Dichloroethane	99	0.1	0.1	0.5	0.404907975	0.404907975	2.024539877
Air	78-87-5	1,2-Dichloropropane	113	0.1	0.1	0.5	0.462167689	0.462167689	2.310838446
Air	108-67-8	1,3,5-Trimethylbenzene	120	0.1	0.1	0.5	0.490797546	0.490797546	2.45398773
Air	106-99-0	1,3-Butadiene	54	0.1	0.1	0.5	0.220858896	0.220858896	1.104294479
Air	541-73-1	1,3-Dichlorobenzene	147	0.1	0.1	0.5	0.601226994	0.601226994	3.006134969
Air	106-46-7	1,4-Dichlorobenzene	147	0.1	0.1	0.5	0.601226994	0.601226994	3.006134969
Air	123-91-1	1,4-Dioxane	88	0.1	0.1	0.5	0.3599182	0.3599182	1.799591002
Air	540-84-1	2,2,4-Trimethylpentane	114	0.044	0.1	0.5	0.205153374	0.466257669	2.331288344
Air	78-93-3	2-Butanone	72	0.1	0.1	0.5	0.294478528	0.294478528	1.472392638
Air	95-49-8	2-Chlorotoluene	126.6	0.1	0.1	0.5	0.517791411	0.517791411	2.588957055
Air	591-78-6	2-Hexanone	100	0.1	0.1	0.5	0.408997955	0.408997955	2.044989775
Air	622-96-8	4-Ethyltoluene	120	0.1	0.1	0.5	0.490797546	0.490797546	2.45398773
Air	108-10-1	4-Methyl-2-Pentanone	100	0.05	0.1	0.5	0.204498978	0.408997955	2.044989775
Air	67-64-1	Acetone	58	0.1	0.1	0.5	0.237218814	0.237218814	1.18609407
Air	107-05-1	Allyl Chloride	77	0.051	0.1	0.5	0.160613497	0.314928425	1.574642127
Air	71-43-2	Benzene	78	0.039	0.1	0.5	0.124417178	0.319018405	1.595092025
Air	100-44-7	Benzyl Chloride	141	0.1	0.1	0.5	0.576687117	0.576687117	2.883435583
Air	75-27-4	Bromodichloromethane	164	0.049	0.1	0.5	0.328670757	0.670756646	3.353783231
Air	593-60-2	Bromoethene	107	0.031	0.1	0.5	0.135664622	0.437627812	2.188139059
Air	75-25-2	Bromoform	253	0.047	0.1	0.5	0.486339468	1.034764826	5.173824131
Air	74-83-9	Bromomethane	95	0.031	0.1	0.5	0.120449898	0.388548057	1.942740286
Air	75-15-0	Carbon Disulfide	76	0.045	0.1	0.5	0.139877301	0.310838446	1.554192229
Air	56-23-5	Carbon Tetrachloride	154	0.03	0.03	0.03	0.188957055	0.188957055	0.19
Air	108-90-7	Chlorobenzene	113	0.1	0.1	0.5	0.462167689	0.462167689	2.310838446
Air	75-00-3	Chloroethane	65	0.1	0.1	0.5	0.265848671	0.265848671	1.329243354
Air	67-66-3	Chloroform	119	0.016	0.1	0.5	0.077873211	0.486707566	2.433537832
Air	74-87-3	Chloromethane	50	0.1	0.1	0.5	0.204498978	0.204498978	1.022494888
Air	156-59-2	cis-1,2-Dichloroethene	97	0.05	0.1	0.5	0.198364008	0.396728016	1.983640082
Air	10061-01-5	cis-1,3-Dichloropropene	111	0.1	0.1	0.5	0.45398773	0.45398773	2.26993865
Air	110-82-7	Cyclohexane	82	0.1	0.1	0.5	0.335378323	0.335378323	1.676891616
Air	124-48-1	Dibromochloromethane	208	0.05	0.1	0.5	0.425357873	0.850715746	4.253578732
Air	75-71-8	Dichlorodifluoromethane	121	0.036	0.1	0.5	0.178159509	0.494887526	2.474437628
Air	76-14-2	Dichlorotetrafluoroethane	171	0.038	0.1	0.5	0.265766871	0.699386503	3.496932515
Air	64-17-5	Ethanol	46.1	0.1	0.1	0.5	0.188548057	0.188548057	0.942740286
Air	141-78-6	Ethyl Acetate	88	0.1	0.1	0.5	0.3599182	0.3599182	1.799591002
Air	100-41-4	Ethyl Benzene	106	0.1	0.1	0.5	0.433537832	0.433537832	2.167689162
Air	142-82-5	Heptane	100	0.1	0.1	0.5	0.408997955	0.408997955	2.044989775
Air	87-68-3	Hexachloro-1,3-Butadiene	261	0.1	0.1	0.5	1.067484663	1.067484663	5.337423313
Air	110-54-3	Hexane	86	0.042	0.1	0.5	0.147730061	0.351738241	1.758691207
Air	67-63-0	Isopropyl Alcohol	60	0.1	0.1	0.5	0.245398773	0.245398773	1.226993865
Air	136777-61-2	m/p-Xylene	106	0.1	0.2	1	0.433537832	0.867075665	4.335378323
Air	80-62-6	Methyl methacrylate	100.1	0.1	0.1	0.5	0.409406953	0.409406953	2.047034765
Air	1634-04-4	Methyl tert-Butyl Ether	88	0.053	0.1	0.5	0.190756646	0.3599182	1.799591002
Air	75-09-2	Methylene Chloride	85	0.045	0.1	0.5	0.156441718	0.347648262	1.738241309
Air	95-47-6	o-Xylene	106	0.1	0.1	0.5	0.433537832	0.433537832	2.167689162
Air	115-07-1	Propene	42	0.102	0.1	0.5	0.175214724	0.171779141	0.858895706
Air	100-42-5	Styrene	104	0.1	0.1	0.5	0.425357873	0.425357873	2.126789366
Air	10061-02-6	t-1,3-Dichloropropene	111	0.1	0.1	0.5	0.45398773	0.45398773	2.26993865
Air	27975-78-6	tert-butyl alcohol	74.1	0.1	0.1	0.5	0.303067485	0.303067485	1.515337423
Air	127-18-4	Tetrachloroethene	166	0.03	0.03	0.03	0.203680982	0.203680982	0.2
Air	109-99-9	Tetrahydrofuran	72	0.1	0.1	0.5	0.294478528	0.294478528	1.472392638
Air	108-88-3	Toluene	92	0.053	0.1	0.5	0.199427403	0.376278119	1.881390593
Air	156-60-5	trans-1,2-Dichloroethene	97	0.05	0.1	0.5	0.198364008	0.396728016	1.983640082
Air	79-01-6	Trichloroethene	131	0.03	0.03	0.03	0.16	0.160736196	0.16
Air	75-69-4	Trichlorofluoromethane	137	0.039	0.1	0.5	0.218527607	0.560327198	2.801635992
Air	108-05-4	Vinyl Acetate	86	0.1	0.1	0.5	0.351738241	0.351738241	1.758691207
Air	75-01-4	Vinyl Chloride	62.5	0.03	0.03	0.03	0.076687117	0.076687117	0.08
Air	91-20-3	Naphthalene	128.17	0.04	0.1	0.5	0.209685072	0.52	2.621063395
Air	98-82-8	Isopropylbenzene	120.194	0.1	0.1	0.5	0.49	0.49	2.45795501
Air	103-65-1	n-propylbenzene	120.2	0.1	0.1	0.5	0.49	0.49	2.45807771
Air	98-06-6	tert-butyl benzene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	135-98-8	sec-butylbenzene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	99-87-6	p-isopropyltoluene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	104-51-8	n-butylbenzene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	630-20-6	1,1,1,2-Tetrachloroethane	168	0.1	0.1	0.5	0.69	0.69	3.43
		Acetonitrile							
		Acrolein							
		Acrylonitrile							

SAMPLE DATA

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-1-SG	SDG No.:	F4715
Lab Sample ID:	F4715-01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024197.D	1		11/12/14 16:29	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.48	2.37	J	0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.35	0.72	J	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.33	1.85	J	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	UQ	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	8.3	34.0		0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	0.1	0.24	U	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	13.5	46.9	B	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	6.5	22.4		0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	4.4	13.0		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	0.6	3.77		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.1	0.49	U	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	24.4	113	E	0.19	0.47	2.34	ug/m3
71-43-2	Benzene	6.2	19.8		0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.16	0.86		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	24.1	90.8	E	0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-1-SG	SDG No.:	F4715
Lab Sample ID:	F4715-01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024197.D	1		11/12/14 16:29	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.24	1.63		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	1.8	7.82		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	4.4	19.1		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	1.7	7.38		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.33	1.41	J	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.3	1.47	J	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.86	4.23		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.11	0.66	J	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.11	0.58	J	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.47	2.31	J	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	110	387	E	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	UQ	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.8			65 - 135		98%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	613356		6.67				
540-36-3	1,4-Difluorobenzene	1921200		8.34				
3114-55-4	Chlorobenzene-d5	1685510		13.76				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-1-SGDL	SDG No.:	F4715
Lab Sample ID:	F4715-01DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024193.D	10		11/12/14 13:49	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	1	4.94	UD	1.98	4.94	24.7	ug/m3
74-87-3	Chloromethane	1	2.07	UD	2.07	2.07	10.3	ug/m3
75-01-4	Vinyl Chloride	0.3	0.77	UD	0.77	0.77	0.77	ug/m3
74-83-9	Bromomethane	1	3.88	UD	1.16	3.88	19.4	ug/m3
75-00-3	Chloroethane	1	2.64	UD	2.64	2.64	13.2	ug/m3
109-99-9	Tetrahydrofuran	1	2.95	UD	2.95	2.95	14.8	ug/m3
75-69-4	Trichlorofluoromethane	1	5.62	UD	2.25	5.62	28.1	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	1	7.66	UD	3.07	7.66	38.3	ug/m3
76-14-2	Dichlorotetrafluoroethane	1	6.99	UD	2.8	6.99	35.0	ug/m3
593-60-2	Bromoethene	1	4.37	UD	1.31	4.37	21.9	ug/m3
75-65-0	tert-Butyl alcohol	1	3.03	UDQ	3.03	3.03	15.2	ug/m3
142-82-5	Heptane	8.5	34.8	D	4.1	4.1	20.5	ug/m3
75-35-4	1,1-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-64-1	Acetone	1	2.38	UD	2.38	2.38	11.9	ug/m3
75-15-0	Carbon Disulfide	1	3.11	UD	1.56	3.11	15.6	ug/m3
1634-04-4	Methyl tert-Butyl Ether	1	3.61	UD	1.8	3.61	18.0	ug/m3
75-09-2	Methylene Chloride	17	59.1	DB	1.74	3.47	17.4	ug/m3
156-60-5	trans-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
75-34-3	1,1-Dichloroethane	1	4.05	UD	1.62	4.05	20.2	ug/m3
110-82-7	Cyclohexane	7.1	24.4	D	3.44	3.44	17.2	ug/m3
78-93-3	2-Butanone	4.9	14.4	JD	2.95	2.95	14.8	ug/m3
56-23-5	Carbon Tetrachloride	0.64	4.03	D	1.89	1.89	1.89	ug/m3
156-59-2	cis-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-66-3	Chloroform	1	4.88	UD	0.98	4.88	24.4	ug/m3
71-55-6	1,1,1-Trichloroethane	0.3	1.64	UD	1.64	1.64	1.64	ug/m3
540-84-1	2,2,4-Trimethylpentane	24.8	115	D	1.87	4.67	23.4	ug/m3
71-43-2	Benzene	6.4	20.4	D	1.28	3.19	16.0	ug/m3
107-06-2	1,2-Dichloroethane	1	4.05	UD	4.05	4.05	20.2	ug/m3
79-01-6	Trichloroethene	0.3	1.61	UD	0.81	1.61	1.61	ug/m3
78-87-5	1,2-Dichloropropane	1	4.62	UD	4.62	4.62	23.1	ug/m3
75-27-4	Bromodichloromethane	1	6.7	UD	3.35	6.7	33.5	ug/m3
108-10-1	4-Methyl-2-Pentanone	1	4.1	UD	2.05	4.1	20.5	ug/m3
108-88-3	Toluene	24.1	90.8	D	1.88	3.77	18.8	ug/m3
10061-02-6	t-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
10061-01-5	cis-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
79-00-5	1,1,2-Trichloroethane	1	5.46	UD	5.46	5.46	27.3	ug/m3
124-48-1	Dibromochloromethane	1	8.52	UD	4.26	8.52	42.6	ug/m3
106-93-4	1,2-Dibromoethane	1	7.69	UD	7.69	7.69	38.4	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-1-SGDL	SDG No.:	F4715
Lab Sample ID:	F4715-01DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024193.D	10		11/12/14 13:49	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.3	2.03	UD	2.03	2.03	2.03	ug/m3
108-90-7	Chlorobenzene	1	4.61	UD	4.61	4.61	23.0	ug/m3
100-41-4	Ethyl Benzene	1.8	7.82	JD	4.34	4.34	21.7	ug/m3
179601-23-1	m/p-Xylene	4.4	19.1	JD	4.34	8.69	43.4	ug/m3
95-47-6	o-Xylene	1.7	7.38	JD	4.34	4.34	21.7	ug/m3
100-42-5	Styrene	1	4.26	UD	4.26	4.26	21.3	ug/m3
75-25-2	Bromoform	1	10.3	UD	5.17	10.3	51.7	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.3	2.06	UD	2.06	2.06	2.06	ug/m3
95-49-8	2-Chlorotoluene	1	5.18	UD	5.18	5.18	25.9	ug/m3
108-67-8	1,3,5-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
95-63-6	1,2,4-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
541-73-1	1,3-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
106-46-7	1,4-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
95-50-1	1,2-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
120-82-1	1,2,4-Trichlorobenzene	1	7.42	UD	2.97	7.42	37.1	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	1	10.7	UD	10.7	10.7	53.3	ug/m3
106-99-0	1,3-Butadiene	1	2.21	UD	2.21	2.21	11.1	ug/m3
91-20-3	Naphthalene	1	5.24	UD	2.1	5.24	26.2	ug/m3
622-96-8	4-Ethyltoluene	1	4.92	UD	4.92	4.92	24.6	ug/m3
110-54-3	Hexane	120	422	D	1.41	3.52	17.6	ug/m3
107-05-1	Allyl Chloride	1	3.13	UD	1.57	3.13	15.6	ug/m3
123-91-1	1,4-Dioxane	1	3.6	UDQ	3.6	3.6	18.0	ug/m3
80-62-6	Methyl Methacrylate	1	4.09	UD	4.09	4.09	20.5	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.8			65 - 135		98%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	554560		6.67				
540-36-3	1,4-Difluorobenzene	1797670		8.34				
3114-55-4	Chlorobenzene-d5	1535290		13.76				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-2-SG	SDG No.:	F4715
Lab Sample ID:	F4715-02	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024199.D	1		11/12/14 17:52	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.47	2.32	J	0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.28	0.58	J	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.28	0.72		0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.33	1.85	J	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	UQ	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	2.6	10.7		0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	0.1	0.24	U	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	6.6	20.6		0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	1.3	4.52	B	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	4	13.8		0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	0.1	0.29	U	0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	35.1	220	E	0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	5	24.4		0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	7.8	36.4		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	3.5	11.2		0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.46	2.47		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	8.3	31.3		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-2-SG	SDG No.:	F4715
Lab Sample ID:	F4715-02	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024199.D	1		11/12/14 17:52	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.07	0.47		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.88	3.82		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	2.5	10.9		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	1.5	6.52		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.52	2.56		0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	1.6	7.87		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.65	3.91		0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	4.4	23.1		0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.65	3.2		0.49	0.49	2.46	ug/m3
110-54-3	Hexane	41	144	E	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	UQ	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.6			65 - 135		96%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	627570		6.67				
540-36-3	1,4-Difluorobenzene	2031170		8.34				
3114-55-4	Chlorobenzene-d5	1729130		13.75				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-2-SGDL	SDG No.:	F4715
Lab Sample ID:	F4715-02DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024194.D	10		11/12/14 14:28	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	1	4.94	UD	1.98	4.94	24.7	ug/m3
74-87-3	Chloromethane	1	2.07	UD	2.07	2.07	10.3	ug/m3
75-01-4	Vinyl Chloride	0.3	0.77	UD	0.77	0.77	0.77	ug/m3
74-83-9	Bromomethane	1	3.88	UD	1.16	3.88	19.4	ug/m3
75-00-3	Chloroethane	1	2.64	UD	2.64	2.64	13.2	ug/m3
109-99-9	Tetrahydrofuran	1	2.95	UD	2.95	2.95	14.8	ug/m3
75-69-4	Trichlorofluoromethane	1	5.62	UD	2.25	5.62	28.1	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	1	7.66	UD	3.07	7.66	38.3	ug/m3
76-14-2	Dichlorotetrafluoroethane	1	6.99	UD	2.8	6.99	35.0	ug/m3
593-60-2	Bromoethene	1	4.37	UD	1.31	4.37	21.9	ug/m3
75-65-0	tert-Butyl alcohol	1	3.03	UDQ	3.03	3.03	15.2	ug/m3
142-82-5	Heptane	2.6	10.7	JD	4.1	4.1	20.5	ug/m3
75-35-4	1,1-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-64-1	Acetone	1	2.38	UD	2.38	2.38	11.9	ug/m3
75-15-0	Carbon Disulfide	6.7	20.9	D	1.56	3.11	15.6	ug/m3
1634-04-4	Methyl tert-Butyl Ether	1	3.61	UD	1.8	3.61	18.0	ug/m3
75-09-2	Methylene Chloride	2.6	9.03	JDB	1.74	3.47	17.4	ug/m3
156-60-5	trans-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
75-34-3	1,1-Dichloroethane	1	4.05	UD	1.62	4.05	20.2	ug/m3
110-82-7	Cyclohexane	4.2	14.5	JD	3.44	3.44	17.2	ug/m3
78-93-3	2-Butanone	1	2.95	UD	2.95	2.95	14.8	ug/m3
56-23-5	Carbon Tetrachloride	42.4	266	D	1.89	1.89	1.89	ug/m3
156-59-2	cis-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-66-3	Chloroform	5.3	25.9	D	0.98	4.88	24.4	ug/m3
71-55-6	1,1,1-Trichloroethane	0.3	1.64	UD	1.64	1.64	1.64	ug/m3
540-84-1	2,2,4-Trimethylpentane	7.8	36.4	D	1.87	4.67	23.4	ug/m3
71-43-2	Benzene	3.7	11.8	JD	1.28	3.19	16.0	ug/m3
107-06-2	1,2-Dichloroethane	1	4.05	UD	4.05	4.05	20.2	ug/m3
79-01-6	Trichloroethene	0.45	2.42	D	0.81	1.61	1.61	ug/m3
78-87-5	1,2-Dichloropropane	1	4.62	UD	4.62	4.62	23.1	ug/m3
75-27-4	Bromodichloromethane	1	6.7	UD	3.35	6.7	33.5	ug/m3
108-10-1	4-Methyl-2-Pentanone	1	4.1	UD	2.05	4.1	20.5	ug/m3
108-88-3	Toluene	8.3	31.3	D	1.88	3.77	18.8	ug/m3
10061-02-6	t-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
10061-01-5	cis-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
79-00-5	1,1,2-Trichloroethane	1	5.46	UD	5.46	5.46	27.3	ug/m3
124-48-1	Dibromochloromethane	1	8.52	UD	4.26	8.52	42.6	ug/m3
106-93-4	1,2-Dibromoethane	1	7.69	UD	7.69	7.69	38.4	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-2-SGDL	SDG No.:	F4715
Lab Sample ID:	F4715-02DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024194.D	10		11/12/14 14:28	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.3	2.03	UD	2.03	2.03	2.03	ug/m3
108-90-7	Chlorobenzene	1	4.61	UD	4.61	4.61	23.0	ug/m3
100-41-4	Ethyl Benzene	1	4.34	UD	4.34	4.34	21.7	ug/m3
179601-23-1	m/p-Xylene	2.5	10.9	JD	4.34	8.69	43.4	ug/m3
95-47-6	o-Xylene	1.5	6.52	JD	4.34	4.34	21.7	ug/m3
100-42-5	Styrene	1	4.26	UD	4.26	4.26	21.3	ug/m3
75-25-2	Bromoform	1	10.3	UD	5.17	10.3	51.7	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.3	2.06	UD	2.06	2.06	2.06	ug/m3
95-49-8	2-Chlorotoluene	1	5.18	UD	5.18	5.18	25.9	ug/m3
108-67-8	1,3,5-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
95-63-6	1,2,4-Trimethylbenzene	1.7	8.36	JD	4.92	4.92	24.6	ug/m3
541-73-1	1,3-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
106-46-7	1,4-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
95-50-1	1,2-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
120-82-1	1,2,4-Trichlorobenzene	1	7.42	UD	2.97	7.42	37.1	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	1	10.7	UD	10.7	10.7	53.3	ug/m3
106-99-0	1,3-Butadiene	1	2.21	UD	2.21	2.21	11.1	ug/m3
91-20-3	Naphthalene	4	21.0	JD	2.1	5.24	26.2	ug/m3
622-96-8	4-Ethyltoluene	1	4.92	UD	4.92	4.92	24.6	ug/m3
110-54-3	Hexane	40.9	144	D	1.41	3.52	17.6	ug/m3
107-05-1	Allyl Chloride	1	3.13	UD	1.57	3.13	15.6	ug/m3
123-91-1	1,4-Dioxane	1	3.6	UDQ	3.6	3.6	18.0	ug/m3
80-62-6	Methyl Methacrylate	1	4.09	UD	4.09	4.09	20.5	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.9			65 - 135		99%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	556286		6.67				
540-36-3	1,4-Difluorobenzene	1801730		8.34				
3114-55-4	Chlorobenzene-d5	1556000		13.76				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-3-SG	SDG No.:	F4715
Lab Sample ID:	F4715-03	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024195.D	10		11/12/14 15:09	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	1	4.94	U	1.98	4.94	24.7	ug/m3
74-87-3	Chloromethane	2	4.13	J	2.07	2.07	10.3	ug/m3
75-01-4	Vinyl Chloride	4700	12014	E	0.77	0.77	0.77	ug/m3
74-83-9	Bromomethane	1	3.88	U	1.16	3.88	19.4	ug/m3
75-00-3	Chloroethane	1	2.64	U	2.64	2.64	13.2	ug/m3
109-99-9	Tetrahydrofuran	1	2.95	U	2.95	2.95	14.8	ug/m3
75-69-4	Trichlorofluoromethane	2.1	11.8	J	2.25	5.62	28.1	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	1	7.66	U	3.07	7.66	38.3	ug/m3
76-14-2	Dichlorotetrafluoroethane	1	6.99	U	2.8	6.99	35.0	ug/m3
593-60-2	Bromoethene	1	4.37	U	1.31	4.37	21.9	ug/m3
75-65-0	tert-Butyl alcohol	1	3.03	UQ	3.03	3.03	15.2	ug/m3
142-82-5	Heptane	11.5	47.1		4.1	4.1	20.5	ug/m3
75-35-4	1,1-Dichloroethene	28.1	111		1.98	3.96	19.8	ug/m3
67-64-1	Acetone	1	2.38	U	2.38	2.38	11.9	ug/m3
75-15-0	Carbon Disulfide	6.8	21.2		1.56	3.11	15.6	ug/m3
1634-04-4	Methyl tert-Butyl Ether	1	3.61	U	1.8	3.61	18.0	ug/m3
75-09-2	Methylene Chloride	4.1	14.2	JB	1.74	3.47	17.4	ug/m3
156-60-5	trans-1,2-Dichloroethene	280	1110	E	1.98	3.96	19.8	ug/m3
75-34-3	1,1-Dichloroethane	1	4.05	U	1.62	4.05	20.2	ug/m3
110-82-7	Cyclohexane	8.5	29.3		3.44	3.44	17.2	ug/m3
78-93-3	2-Butanone	8.2	24.2		2.95	2.95	14.8	ug/m3
56-23-5	Carbon Tetrachloride	0.3	1.89	U	1.89	1.89	1.89	ug/m3
156-59-2	cis-1,2-Dichloroethene	1400	5550	E	1.98	3.96	19.8	ug/m3
67-66-3	Chloroform	1	4.88	U	0.98	4.88	24.4	ug/m3
71-55-6	1,1,1-Trichloroethane	0.3	1.64	U	1.64	1.64	1.64	ug/m3
540-84-1	2,2,4-Trimethylpentane	34.5	161		1.87	4.67	23.4	ug/m3
71-43-2	Benzene	12.6	40.2		1.28	3.19	16.0	ug/m3
107-06-2	1,2-Dichloroethane	1	4.05	U	4.05	4.05	20.2	ug/m3
79-01-6	Trichloroethene	6	32.2		0.81	1.61	1.61	ug/m3
78-87-5	1,2-Dichloropropane	1	4.62	U	4.62	4.62	23.1	ug/m3
75-27-4	Bromodichloromethane	1	6.7	U	3.35	6.7	33.5	ug/m3
108-10-1	4-Methyl-2-Pentanone	1	4.1	U	2.05	4.1	20.5	ug/m3
108-88-3	Toluene	30	113		1.88	3.77	18.8	ug/m3
10061-02-6	t-1,3-Dichloropropene	1	4.54	U	4.54	4.54	22.7	ug/m3
10061-01-5	cis-1,3-Dichloropropene	1	4.54	U	4.54	4.54	22.7	ug/m3
79-00-5	1,1,2-Trichloroethane	1	5.46	U	5.46	5.46	27.3	ug/m3
124-48-1	Dibromochloromethane	1	8.52	U	4.26	8.52	42.6	ug/m3
106-93-4	1,2-Dibromoethane	1	7.69	U	7.69	7.69	38.4	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-3-SG	SDG No.:	F4715
Lab Sample ID:	F4715-03	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024195.D	10		11/12/14 15:09	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	20.2	136		2.03	2.03	2.03	ug/m3
108-90-7	Chlorobenzene	1	4.61	U	4.61	4.61	23.0	ug/m3
100-41-4	Ethyl Benzene	2.8	12.2	J	4.34	4.34	21.7	ug/m3
179601-23-1	m/p-Xylene	6.6	28.7	J	4.34	8.69	43.4	ug/m3
95-47-6	o-Xylene	2.7	11.7	J	4.34	4.34	21.7	ug/m3
100-42-5	Styrene	1	4.26	U	4.26	4.26	21.3	ug/m3
75-25-2	Bromoform	1	10.3	U	5.17	10.3	51.7	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.3	2.06	U	2.06	2.06	2.06	ug/m3
95-49-8	2-Chlorotoluene	1	5.18	U	5.18	5.18	25.9	ug/m3
108-67-8	1,3,5-Trimethylbenzene	1.1	5.41	J	4.92	4.92	24.6	ug/m3
95-63-6	1,2,4-Trimethylbenzene	3.4	16.7	J	4.92	4.92	24.6	ug/m3
541-73-1	1,3-Dichlorobenzene	2.3	13.8	J	6.01	6.01	30.1	ug/m3
106-46-7	1,4-Dichlorobenzene	1	6.01	U	6.01	6.01	30.1	ug/m3
95-50-1	1,2-Dichlorobenzene	1	6.01	U	6.01	6.01	30.1	ug/m3
120-82-1	1,2,4-Trichlorobenzene	1	7.42	U	2.97	7.42	37.1	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	1	10.7	U	10.7	10.7	53.3	ug/m3
106-99-0	1,3-Butadiene	1	2.21	U	2.21	2.21	11.1	ug/m3
91-20-3	Naphthalene	1	5.24	U	2.1	5.24	26.2	ug/m3
622-96-8	4-Ethyltoluene	1.8	8.85	J	4.92	4.92	24.6	ug/m3
110-54-3	Hexane	150	528	E	1.41	3.52	17.6	ug/m3
107-05-1	Allyl Chloride	1	3.13	U	1.57	3.13	15.6	ug/m3
123-91-1	1,4-Dioxane	1	3.6	UQ	3.6	3.6	18.0	ug/m3
80-62-6	Methyl Methacrylate	1	4.09	U	4.09	4.09	20.5	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.8			65 - 135		98%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	574962		6.67				
540-36-3	1,4-Difluorobenzene	1808370		8.34				
3114-55-4	Chlorobenzene-d5	1627990		13.76				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-3-SGDL	SDG No.:	F4715
Lab Sample ID:	F4715-03DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024207.D	150		11/12/14 23:03	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	15	74.2	UD	29.7	74.2	370	ug/m3
74-87-3	Chloromethane	15	31.0	UD	31.0	31.0	154	ug/m3
75-01-4	Vinyl Chloride	6700	17126	ED	11.5	11.5	11.5	ug/m3
74-83-9	Bromomethane	15	58.2	UD	17.5	58.2	291	ug/m3
75-00-3	Chloroethane	15	39.6	UD	39.6	39.6	197	ug/m3
109-99-9	Tetrahydrofuran	15	44.2	UD	44.2	44.2	221	ug/m3
75-69-4	Trichlorofluoromethane	15	84.3	UD	33.7	84.3	421	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	15	114	UD	46.0	114	574	ug/m3
76-14-2	Dichlorotetrafluoroethane	15	104	UD	41.9	104	524	ug/m3
593-60-2	Bromoethene	15	65.6	UD	19.7	65.6	327	ug/m3
75-65-0	tert-Butyl alcohol	15	45.5	UDQ	45.5	45.5	227	ug/m3
142-82-5	Heptane	15	61.5	UD	61.5	61.5	307	ug/m3
75-35-4	1,1-Dichloroethene	30.8	122	JD	29.7	59.5	297	ug/m3
67-64-1	Acetone	15	35.6	UD	35.6	35.6	178	ug/m3
75-15-0	Carbon Disulfide	15	46.7	UD	23.4	46.7	233	ug/m3
1634-04-4	Methyl tert-Butyl Ether	15	54.1	UD	27.0	54.1	270	ug/m3
75-09-2	Methylene Chloride	15	52.1	UD	26.1	52.1	260	ug/m3
156-60-5	trans-1,2-Dichloroethene	280	1110	D	29.7	59.5	297	ug/m3
75-34-3	1,1-Dichloroethane	15	60.7	UD	24.3	60.7	303	ug/m3
110-82-7	Cyclohexane	15	51.6	UD	51.6	51.6	258	ug/m3
78-93-3	2-Butanone	15	44.2	UD	44.2	44.2	221	ug/m3
56-23-5	Carbon Tetrachloride	4.5	28.3	UD	28.3	28.3	28.3	ug/m3
156-59-2	cis-1,2-Dichloroethene	1400	5550	D	29.7	59.5	297	ug/m3
67-66-3	Chloroform	15	73.2	UD	14.6	73.2	366	ug/m3
71-55-6	1,1,1-Trichloroethane	4.5	24.6	UD	24.6	24.6	24.6	ug/m3
540-84-1	2,2,4-Trimethylpentane	29.9	139	JD	28.0	70.1	350	ug/m3
71-43-2	Benzene	34.7	110	JD	19.2	47.9	239	ug/m3
107-06-2	1,2-Dichloroethane	15	60.7	UD	60.7	60.7	303	ug/m3
79-01-6	Trichloroethene	5.4	29.0	D	12.4	24.2	24.2	ug/m3
78-87-5	1,2-Dichloropropane	15	69.3	UD	69.3	69.3	346	ug/m3
75-27-4	Bromodichloromethane	15	100	UD	50.2	100	502	ug/m3
108-10-1	4-Methyl-2-Pentanone	15	61.5	UD	30.7	61.5	307	ug/m3
108-88-3	Toluene	44.3	166	JD	28.3	56.5	282	ug/m3
10061-02-6	t-1,3-Dichloropropene	15	68.1	UD	68.1	68.1	340	ug/m3
10061-01-5	cis-1,3-Dichloropropene	15	68.1	UD	68.1	68.1	340	ug/m3
79-00-5	1,1,2-Trichloroethane	15	81.8	UD	81.8	81.8	409	ug/m3
124-48-1	Dibromochloromethane	15	127	UD	63.9	127	638	ug/m3
106-93-4	1,2-Dibromoethane	15	115	UD	115	115	576	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-3-SGDL	SDG No.:	F4715
Lab Sample ID:	F4715-03DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024207.D	150		11/12/14 23:03	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	19.8	134	D	30.5	30.5	30.5	ug/m3
108-90-7	Chlorobenzene	15	69.1	UD	69.1	69.1	345	ug/m3
100-41-4	Ethyl Benzene	15	65.2	UD	65.2	65.2	325	ug/m3
179601-23-1	m/p-Xylene	30	130	UD	65.2	130	651	ug/m3
95-47-6	o-Xylene	15	65.2	UD	65.2	65.2	325	ug/m3
100-42-5	Styrene	15	63.9	UD	63.9	63.9	319	ug/m3
75-25-2	Bromoform	15	155	UD	77.6	155	775	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	4.5	30.9	UD	30.9	30.9	30.9	ug/m3
95-49-8	2-Chlorotoluene	15	77.7	UD	77.7	77.7	388	ug/m3
108-67-8	1,3,5-Trimethylbenzene	15	73.7	UD	73.7	73.7	368	ug/m3
95-63-6	1,2,4-Trimethylbenzene	15	73.7	UD	73.7	73.7	368	ug/m3
541-73-1	1,3-Dichlorobenzene	15	90.2	UD	90.2	90.2	450	ug/m3
106-46-7	1,4-Dichlorobenzene	15	90.2	UD	90.2	90.2	450	ug/m3
95-50-1	1,2-Dichlorobenzene	15	90.2	UD	90.2	90.2	450	ug/m3
120-82-1	1,2,4-Trichlorobenzene	15	111	UD	44.5	111	556	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	15	160	UD	160	160	800	ug/m3
106-99-0	1,3-Butadiene	15	33.2	UD	33.2	33.2	165	ug/m3
91-20-3	Naphthalene	15	78.6	UD	31.4	78.6	393	ug/m3
622-96-8	4-Ethyltoluene	15	73.7	UD	73.7	73.7	368	ug/m3
110-54-3	Hexane	140	493	D	21.2	52.9	264	ug/m3
107-05-1	Allyl Chloride	15	47.0	UD	23.5	47.0	234	ug/m3
123-91-1	1,4-Dioxane	15	54.1	UDQ	54.1	54.1	270	ug/m3
80-62-6	Methyl Methacrylate	15	61.4	UD	61.4	61.4	307	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10.2			65 - 135		102%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	401472		6.65				
540-36-3	1,4-Difluorobenzene	1276230		8.32				
3114-55-4	Chlorobenzene-d5	1057100		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-3-SGDL2	SDG No.:	F4715
Lab Sample ID:	F4715-03DL2	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024208.D	1200		11/12/14 23:41	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	120	593	UD	237	593	2966	ug/m3
74-87-3	Chloromethane	120	247	UD	247	247	1239	ug/m3
75-01-4	Vinyl Chloride	7300	18660	D	92.0	92.0	92.0	ug/m3
74-83-9	Bromomethane	120	465	UD	139	465	2329	ug/m3
75-00-3	Chloroethane	120	316	UD	316	316	1583	ug/m3
109-99-9	Tetrahydrofuran	120	353	UD	353	353	1769	ug/m3
75-69-4	Trichlorofluoromethane	120	674	UD	269	674	3371	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	120	919	UD	367	919	4598	ug/m3
76-14-2	Dichlorotetrafluoroethane	120	838	UD	335	838	4193	ug/m3
593-60-2	Bromoethene	120	524	UD	157	524	2623	ug/m3
75-65-0	tert-Butyl alcohol	120	363	UDQ	363	363	1818	ug/m3
142-82-5	Heptane	120	491	UD	491	491	2458	ug/m3
75-35-4	1,1-Dichloroethene	120	475	UD	237	475	2378	ug/m3
67-64-1	Acetone	120	285	UD	285	285	1425	ug/m3
75-15-0	Carbon Disulfide	120	373	UD	186	373	1868	ug/m3
1634-04-4	Methyl tert-Butyl Ether	120	432	UD	216	432	2163	ug/m3
75-09-2	Methylene Chloride	120	416	UD	208	416	2084	ug/m3
156-60-5	trans-1,2-Dichloroethene	300	1189	JD	237	475	2378	ug/m3
75-34-3	1,1-Dichloroethane	120	485	UD	194	485	2428	ug/m3
110-82-7	Cyclohexane	120	413	UD	413	413	2065	ug/m3
78-93-3	2-Butanone	120	353	UD	353	353	1769	ug/m3
56-23-5	Carbon Tetrachloride	36	226	UD	226	226	226	ug/m3
156-59-2	cis-1,2-Dichloroethene	1500	5947	D	237	475	2378	ug/m3
67-66-3	Chloroform	120	586	UD	117	586	2930	ug/m3
71-55-6	1,1,1-Trichloroethane	36	196	UD	196	196	196	ug/m3
540-84-1	2,2,4-Trimethylpentane	120	560	UD	224	560	2802	ug/m3
71-43-2	Benzene	120	383	UD	153	383	1916	ug/m3
107-06-2	1,2-Dichloroethane	120	485	UD	485	485	2428	ug/m3
79-01-6	Trichloroethene	36	193	UD	96.7	193	193	ug/m3
78-87-5	1,2-Dichloropropane	120	554	UD	554	554	2773	ug/m3
75-27-4	Bromodichloromethane	120	803	UD	401	803	4019	ug/m3
108-10-1	4-Methyl-2-Pentanone	120	491	UD	245	491	2458	ug/m3
108-88-3	Toluene	120	452	UD	226	452	2261	ug/m3
10061-02-6	t-1,3-Dichloropropene	120	544	UD	544	544	2723	ug/m3
10061-01-5	cis-1,3-Dichloropropene	120	544	UD	544	544	2723	ug/m3
79-00-5	1,1,2-Trichloroethane	120	654	UD	654	654	3273	ug/m3
124-48-1	Dibromochloromethane	120	1022	UD	511	1022	5111	ug/m3
106-93-4	1,2-Dibromoethane	120	922	UD	922	922	4611	ug/m3

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	BZ3-3-SGDL2	SDG No.:	F4715
Lab Sample ID:	F4715-03DL2	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024208.D	1200		11/12/14 23:41	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	36	244	UD	244	244	244	ug/m3
108-90-7	Chlorobenzene	120	552	UD	552	552	2763	ug/m3
100-41-4	Ethyl Benzene	120	521	UD	521	521	2606	ug/m3
179601-23-1	m/p-Xylene	240	1042	UD	521	1042	5212	ug/m3
95-47-6	o-Xylene	120	521	UD	521	521	2606	ug/m3
100-42-5	Styrene	120	510	UD	510	510	2554	ug/m3
75-25-2	Bromoform	120	1240	UD	620	1240	6203	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	36	247	UD	247	247	247	ug/m3
95-49-8	2-Chlorotoluene	120	621	UD	621	621	3106	ug/m3
108-67-8	1,3,5-Trimethylbenzene	120	589	UD	589	589	2949	ug/m3
95-63-6	1,2,4-Trimethylbenzene	120	589	UD	589	589	2949	ug/m3
541-73-1	1,3-Dichlorobenzene	120	721	UD	721	721	3607	ug/m3
106-46-7	1,4-Dichlorobenzene	120	721	UD	721	721	3607	ug/m3
95-50-1	1,2-Dichlorobenzene	120	721	UD	721	721	3607	ug/m3
120-82-1	1,2,4-Trichlorobenzene	120	890	UD	356	890	4453	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	120	1280	UD	1280	1280	6400	ug/m3
106-99-0	1,3-Butadiene	120	265	UD	265	265	1327	ug/m3
91-20-3	Naphthalene	120	629	UD	251	629	3145	ug/m3
622-96-8	4-Ethyltoluene	120	589	UD	589	589	2949	ug/m3
110-54-3	Hexane	120	422	UD	169	422	2114	ug/m3
107-05-1	Allyl Chloride	120	375	UD	187	375	1878	ug/m3
123-91-1	1,4-Dioxane	120	432	UDQ	432	432	2162	ug/m3
80-62-6	Methyl Methacrylate	120	491	UD	491	491	2456	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10.3			65 - 135		103%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	386660		6.65				
540-36-3	1,4-Difluorobenzene	1253010		8.32				
3114-55-4	Chlorobenzene-d5	1021470		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	SG-DUP-1	SDG No.:	F4715
Lab Sample ID:	F4715-04	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024200.D	1		11/12/14 18:33	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.54	2.67		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.66	1.36		0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.82	2.42		0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.49	2.75	J	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	UQ	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	2.1	8.61		0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	0.1	0.24	U	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	1.2	4.17	B	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	2	6.88		0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	22	64.9	E	0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	0.51	3.21		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.18	0.88	J	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	4.5	21.0		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	3	9.58		0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.17	0.91		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	32	120	E	0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	SG-DUP-1	SDG No.:	F4715
Lab Sample ID:	F4715-04	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024200.D	1		11/12/14 18:33	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.07	0.47		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	1	4.34		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	2.8	12.2		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	1.1	4.78		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	J	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.28	1.38	J	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.93	4.57		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.16	0.96	J	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.21	1.1	J	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.35	1.72	J	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	26.4	93.0	E	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	UQ	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.6			65 - 135		96%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	602793		6.67				
540-36-3	1,4-Difluorobenzene	1931220		8.34				
3114-55-4	Chlorobenzene-d5	1619430		13.75				

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* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	SG-DUP-1DL	SDG No.:	F4715
Lab Sample ID:	F4715-04DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024196.D	10		11/12/14 15:48	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	1	4.94	UD	1.98	4.94	24.7	ug/m3
74-87-3	Chloromethane	1	2.07	UD	2.07	2.07	10.3	ug/m3
75-01-4	Vinyl Chloride	0.3	0.77	UD	0.77	0.77	0.77	ug/m3
74-83-9	Bromomethane	1	3.88	UD	1.16	3.88	19.4	ug/m3
75-00-3	Chloroethane	1	2.64	UD	2.64	2.64	13.2	ug/m3
109-99-9	Tetrahydrofuran	1	2.95	UD	2.95	2.95	14.8	ug/m3
75-69-4	Trichlorofluoromethane	1	5.62	UD	2.25	5.62	28.1	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	1	7.66	UD	3.07	7.66	38.3	ug/m3
76-14-2	Dichlorotetrafluoroethane	1	6.99	UD	2.8	6.99	35.0	ug/m3
593-60-2	Bromoethene	1	4.37	UD	1.31	4.37	21.9	ug/m3
75-65-0	tert-Butyl alcohol	1	3.03	UDQ	3.03	3.03	15.2	ug/m3
142-82-5	Heptane	2.2	9.02	JD	4.1	4.1	20.5	ug/m3
75-35-4	1,1-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-64-1	Acetone	1	2.38	UD	2.38	2.38	11.9	ug/m3
75-15-0	Carbon Disulfide	1	3.11	UD	1.56	3.11	15.6	ug/m3
1634-04-4	Methyl tert-Butyl Ether	1	3.61	UD	1.8	3.61	18.0	ug/m3
75-09-2	Methylene Chloride	1	3.47	UD	1.74	3.47	17.4	ug/m3
156-60-5	trans-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
75-34-3	1,1-Dichloroethane	1	4.05	UD	1.62	4.05	20.2	ug/m3
110-82-7	Cyclohexane	1	3.44	UD	3.44	3.44	17.2	ug/m3
78-93-3	2-Butanone	21.6	63.7	D	2.95	2.95	14.8	ug/m3
56-23-5	Carbon Tetrachloride	0.55	3.46	D	1.89	1.89	1.89	ug/m3
156-59-2	cis-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-66-3	Chloroform	1	4.88	UD	0.98	4.88	24.4	ug/m3
71-55-6	1,1,1-Trichloroethane	0.3	1.64	UD	1.64	1.64	1.64	ug/m3
540-84-1	2,2,4-Trimethylpentane	4.6	21.5	JD	1.87	4.67	23.4	ug/m3
71-43-2	Benzene	3	9.58	JD	1.28	3.19	16.0	ug/m3
107-06-2	1,2-Dichloroethane	1	4.05	UD	4.05	4.05	20.2	ug/m3
79-01-6	Trichloroethene	0.3	1.61	UD	0.81	1.61	1.61	ug/m3
78-87-5	1,2-Dichloropropane	1	4.62	UD	4.62	4.62	23.1	ug/m3
75-27-4	Bromodichloromethane	1	6.7	UD	3.35	6.7	33.5	ug/m3
108-10-1	4-Methyl-2-Pentanone	1	4.1	UD	2.05	4.1	20.5	ug/m3
108-88-3	Toluene	33.2	125	D	1.88	3.77	18.8	ug/m3
10061-02-6	t-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
10061-01-5	cis-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
79-00-5	1,1,2-Trichloroethane	1	5.46	UD	5.46	5.46	27.3	ug/m3
124-48-1	Dibromochloromethane	1	8.52	UD	4.26	8.52	42.6	ug/m3
106-93-4	1,2-Dibromoethane	1	7.69	UD	7.69	7.69	38.4	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	11/11/14
Project:	Frankford Arsenal Air	Date Received:	11/11/14
Client Sample ID:	SG-DUP-1DL	SDG No.:	F4715
Lab Sample ID:	F4715-04DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024196.D	10		11/12/14 15:48	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.3	2.03	UD	2.03	2.03	2.03	ug/m3
108-90-7	Chlorobenzene	1	4.61	UD	4.61	4.61	23.0	ug/m3
100-41-4	Ethyl Benzene	1	4.34	UD	4.34	4.34	21.7	ug/m3
179601-23-1	m/p-Xylene	2.7	11.7	JD	4.34	8.69	43.4	ug/m3
95-47-6	o-Xylene	1	4.34	UD	4.34	4.34	21.7	ug/m3
100-42-5	Styrene	1	4.26	UD	4.26	4.26	21.3	ug/m3
75-25-2	Bromoform	1	10.3	UD	5.17	10.3	51.7	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.3	2.06	UD	2.06	2.06	2.06	ug/m3
95-49-8	2-Chlorotoluene	1	5.18	UD	5.18	5.18	25.9	ug/m3
108-67-8	1,3,5-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
95-63-6	1,2,4-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
541-73-1	1,3-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
106-46-7	1,4-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
95-50-1	1,2-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
120-82-1	1,2,4-Trichlorobenzene	1	7.42	UD	2.97	7.42	37.1	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	1	10.7	UD	10.7	10.7	53.3	ug/m3
106-99-0	1,3-Butadiene	1	2.21	UD	2.21	2.21	11.1	ug/m3
91-20-3	Naphthalene	1	5.24	UD	2.1	5.24	26.2	ug/m3
622-96-8	4-Ethyltoluene	1	4.92	UD	4.92	4.92	24.6	ug/m3
110-54-3	Hexane	26.6	93.8	D	1.41	3.52	17.6	ug/m3
107-05-1	Allyl Chloride	1	3.13	UD	1.57	3.13	15.6	ug/m3
123-91-1	1,4-Dioxane	1	3.6	UDQ	3.6	3.6	18.0	ug/m3
80-62-6	Methyl Methacrylate	1	4.09	UD	4.09	4.09	20.5	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.8			65 - 135		98%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	539870		6.67				
540-36-3	1,4-Difluorobenzene	1767220		8.34				
3114-55-4	Chlorobenzene-d5	1526260		13.76				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

QC SUMMARY

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

Surrogate Summary

SDG No.: F4715

Client: EA Engineering Science & Technology

Analytical Method: SWTO-15

Lab Sample ID	Client ID	Parameter	Spike	Result	Recovery	Qual	Limits Low	Limits High
F4715-01	BZ3-1-SG	1-Bromo-4-Fluorobenzene	10	9.84	98		65	135
F4715-01DL	BZ3-1-SGDL	1-Bromo-4-Fluorobenzene	10	9.816	98		65	135
F4715-01DUP	BZ3-1-SGDUP	1-Bromo-4-Fluorobenzene	10	9.802	98		65	135
F4715-02	BZ3-2-SG	1-Bromo-4-Fluorobenzene	10	9.582	96		65	135
F4715-02DL	BZ3-2-SGDL	1-Bromo-4-Fluorobenzene	10	9.895	99		65	135
F4715-03	BZ3-3-SG	1-Bromo-4-Fluorobenzene	10	9.84	98		65	135
F4715-03DL	BZ3-3-SGDL	1-Bromo-4-Fluorobenzene	10	10.193	102		65	135
F4715-03DL2	BZ3-3-SGDL2	1-Bromo-4-Fluorobenzene	10	10.252	103		65	135
F4715-04	SG-DUP-1	1-Bromo-4-Fluorobenzene	10	9.62	96		65	135
F4715-04DL	SG-DUP-1DL	1-Bromo-4-Fluorobenzene	10	9.837	98		65	135
VL1112ABL	VL1112ABL	1-Bromo-4-Fluorobenzene	10	9.97	100		65	135
VL1112ABS	VL1112ABS	1-Bromo-4-Fluorobenzene	10	10.244	102		65	135

Laboratory Control Sample/Laboratory Control Sample Duplicate Summary
SW-846

SDG No.: **F4715**

Client: **EA Engineering Science & Technology**

Analytical Method: **SWTO-15** **Datafile :** VL024192.D

								Limits		
Lab Sample ID	**Parameter**	**Spike**	**Result**	**Unit**	**Rec**	**RPD**	**Qual**	**Low**	**High**	**RPD**
VL1112ABS	Dichlorodifluoromethane	10	9.9	ppbv	99			70	130	
	Chloromethane	10	9.7	ppbv	97			70	130	
	Vinyl Chloride	10	8.9	ppbv	89			70	130	
	Bromomethane	10	9.7	ppbv	97			70	130	
	Chloroethane	10	9.6	ppbv	96			70	130	
	Tetrahydrofuran	10	11.3	ppbv	113			70	130	
	Trichlorofluoromethane	10	9.7	ppbv	97			70	130	
	1,1,2-Trichlorotrifluoroethane	10	9.8	ppbv	98			70	130	
	Dichlorotetrafluoethane	10	9.6	ppbv	96			70	130	
	Bromoethene	10	9.9	ppbv	99			70	130	
	tert-Butyl Alcohol	10	13.4	ppbv	134		*	70	130	
	Heptane	10	10.4	ppbv	104			70	130	
	1,1-Dichloroethene	10	10.2	ppbv	102			70	130	
	Acetone	10	9.2	ppbv	92			70	130	
	Carbon disulfide	10	10.7	ppbv	107			70	130	
	Methyl tert-butyl Ether	10	10.9	ppbv	109			70	130	
	Methylene Chloride	10	9.5	ppbv	95			70	130	
	trans-1,2-Dichloroethene	10	10.7	ppbv	107			70	130	
	1,1-Dichloroethane	10	9.9	ppbv	99			70	130	
	Cyclohexane	10	10.8	ppbv	108			70	130	
	2-Butanone	10	10.4	ppbv	104			70	130	
	Carbon Tetrachloride	10	9.2	ppbv	92			70	130	
	cis-1,2-Dichloroethene	10	10.8	ppbv	108			70	130	
	Chloroform	10	9.6	ppbv	96			70	130	
	1,1,1-Trichloroethane	10	9.1	ppbv	91			70	130	
	2,2,4-Trimethylpentane	10	10.9	ppbv	109			70	130	
	Benzene	10	10.9	ppbv	109			70	130	
	1,2-Dichloroethane	10	9.8	ppbv	98			70	130	
	Trichloroethene	10	10	ppbv	100			70	130	
	1,2-Dichloropropane	10	10.6	ppbv	106			70	130	
	Bromodichloromethane	10	10.2	ppbv	102			70	130	
	4-Methyl-2-Pentanone	10	11.1	ppbv	111			70	130	
	Toluene	10	10.8	ppbv	108			70	130	
	t-1,3-Dichloropropene	10	11.9	ppbv	119			70	130	
	cis-1,3-Dichloropropene	10	11.5	ppbv	115			70	130	
	1,1,2-Trichloroethane	10	10.1	ppbv	101			70	130	
	Dibromochloromethane	10	10.3	ppbv	103			70	130	
	1,2-Dibromoethane	10	10.1	ppbv	101			70	130	
	Tetrachloroethene	10	10.2	ppbv	102			70	130	
	Chlorobenzene	10	10.1	ppbv	101			70	130	
	Ethyl Benzene	10	10.9	ppbv	109			70	130	
	m/p-Xylene	20	20.6	ppbv	103			70	130	
	o-Xylene	10	10.4	ppbv	104			70	130	
	Styrene	10	11.9	ppbv	119			70	130	
	Bromoform	10	10.6	ppbv	106			70	130	
	1,1,2,2-Tetrachloroethane	10	9.8	ppbv	98			70	130	
	2-Chlorotoluene	10	10.8	ppbv	108			70	130	
	1,3,5-Trimethylbenzene	10	10.5	ppbv	105			70	130	
	1,2,4-Trimethylbenzene	10	10.2	ppbv	102			70	130	

CHEMTECH

Laboratory Control Sample/Laboratory Control Sample Duplicate Summary
SW-846

SDG No.: **F4715**
Client: **EA Engineering Science & Technology**
Analytical Method: **SWTO-15** **Datafile :** VL024192.D

Lab Sample ID	**Parameter**	**Spike**	**Result**	**Unit**	**Rec**	**RPD**	**Qual**	**Limits Low**	**Limits High**	**RPD**
VL1112ABS	1,3-Dichlorobenzene	10	9.9	ppbv	99			70	130	
	1,4-Dichlorobenzene	10	10.4	ppbv	104			70	130	
	1,2-Dichlorobenzene	10	10.3	ppbv	103			70	130	
	1,2,4-Trichlorobenzene	10	10.9	ppbv	109			70	130	
	Hexachloro-1,3-butadiene	10	9.9	ppbv	99			70	130	
	Naphthalene	10	12.4	ppbv	124			70	130	
	1,3-Butadiene	10	9.9	ppbv	99			70	130	
	4-Ethyltoluene	10	10.7	ppbv	107			70	130	
	Hexane	10	10.7	ppbv	107			70	130	
	Allyl Chloride	10	9.9	ppbv	99			70	130	
	1,4-Dioxane	10	16.6	ppbv	166	*		70	130	
	Methyl methacrylate	10	11.1	ppbv	111			70	130	

Duplicate Sample Summary

Lab Sample Id :	F4715-01DUP	F4715-01	
Client Id :	BZ3-1-SGDUP	BZ3-1-SG	
DF :	1	1	
Datafile :	VL024198.D	VL024197.D	
Anal Date & Time :	11/12/2014 17:11	11/12/2014 16:29	

Parameter	Result	Result	RPD
1,1,1-Trichloroethane	0	0	0
1,1,2,2-Tetrachloroethane	0	0	0
1,1,2-Trichloroethane	0	0	0
1,1,2-Trichlorotrifluoroethane	0	0	0
1,1-Dichloroethane	0	0	0
1,1-Dichloroethene	0	0	0
1,2,4-Trichlorobenzene	0	0	0
1,2,4-Trimethylbenzene	0.83	0.86	3.6
1,2-Dibromoethane	0	0	0
1,2-Dichlorobenzene	0	0	0
1,2-Dichloroethane	0	0	0
1,2-Dichloropropane	0	0	0
1,3,5-Trimethylbenzene	0.29	0.3	3.4
1,3-Butadiene	0	0	0
1,3-Dichlorobenzene	0.11	0.11	0
1,4-Dichlorobenzene	0	0	0
1,4-Dioxane	0	0	0
2,2,4-Trimethylpentane	24.6	24.4	0.82
2-Butanone	4.7	4.4	6.6
2-Chlorotoluene	0	0	0
4-Ethyltoluene	0.49	0.47	4.2
4-Methyl-2-Pentanone	0	0	0
Acetone	0	0	0
Allyl Chloride	0	0	0
Benzene	6.3	6.2	1.6
Bromodichloromethane	0	0	0
Bromoethene	0	0	0
Bromoform	0	0	0
Bromomethane	0	0	0
Carbon Disulfide	0	0	0

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Duplicate Sample Summary

Lab Sample Id :	F4715-01DUP		F4715-01	
Client Id :	BZ3-1-SGDUP		BZ3-1-SG	
DF :	1		1	
Datafile :	VL024198.D		VL024197.D	
Anal Date & Time :	11/12/2014	17:11	11/12/2014	16:29

Parameter	Result	Result	RPD
Carbon Tetrachloride	0.58	0.6	3.4
Chlorobenzene	0	0	0
Chloroethane	0	0	0
Chloroform	0	0	0
Chloromethane	0.39	0.35	10.8
cis-1,2-Dichloroethene	0	0	0
cis-1,3-Dichloropropene	0	0	0
Cyclohexane	6.7	6.5	3
Dibromochloromethane	0	0	0
Dichlorodifluoromethane	0.41	0.48	15.7
Dichlorotetrafluoroethane	0	0	0
Ethyl Benzene	1.8	1.8	0
Heptane	8.5	8.3	2.4
Hexachloro-1,3-Butadiene	0	0	0
Hexane	110	110	0
m/p-Xylene	4.3	4.4	2.3
Methyl Methacrylate	0	0	0
Methyl tert-Butyl Ether	0.83	0	200 *
Methylene Chloride	14.6	13.5	7.8
Naphthalene	0.11	0.11	0
o-Xylene	1.7	1.7	0
Styrene	0.33	0.33	0
t-1,3-Dichloropropene	0	0	0
tert-Butyl alcohol	0	0	0
Tetrachloroethene	0.23	0.24	4.3
Tetrahydrofuran	0	0	0
Toluene	24	24.1	0.42
trans-1,2-Dichloroethene	0	0	0
Trichloroethene	0.17	0.16	6.1
Trichlorofluoromethane	0.33	0.33	0
Vinyl Chloride	0	0	0

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VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VL1112ABL

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG NO.: F4715

Lab File ID: VL024191.D Lab Sample ID: VL1112ABL

Date Analyzed: 11/12/2014 Time Analyzed: 12:30

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: (Y/N) N

Instrument ID: MSVOA_L

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
VL1112ABS	VL1112ABS	VL024192.D	11/12/2014
BZ3-1-SGDL	F4715-01DL	VL024193.D	11/12/2014
BZ3-2-SGDL	F4715-02DL	VL024194.D	11/12/2014
BZ3-3-SG	F4715-03	VL024195.D	11/12/2014
SG-DUP-1DL	F4715-04DL	VL024196.D	11/12/2014
BZ3-1-SG	F4715-01	VL024197.D	11/12/2014
BZ3-1-SGDUP	F4715-01DUP	VL024198.D	11/12/2014
BZ3-2-SG	F4715-02	VL024199.D	11/12/2014
SG-DUP-1	F4715-04	VL024200.D	11/12/2014
BZ3-3-SGDL	F4715-03DL	VL024207.D	11/12/2014
BZ3-3-SGDL2	F4715-03DL2	VL024208.D	11/12/2014

COMMENTS:

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG NO.: F4715

Lab File ID: VL024125.D BFB Injection Date: 11/04/2014

Instrument ID: MSVOA_L BFB Injection Time: 10:23

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: Y/N N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	21.1
75	30.0 - 66.0% of mass 95	55
95	Base Peak, 100% relative abundance	100
96	5.0 - 9.0% of mass 95	6.4
173	Less than 2.0% of mass 174	0.6 (0.8) 1
174	50.0 - 120.0% of mass 95	76.7
175	4.0 - 9.0% of mass 174	5.5 (7.2) 1
176	93.0 - 101.0% of mass 174	74.6 (97.3) 1
177	5.0 - 9.0% of mass 176	4.8 (6.4) 2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
VSTDICC0.1	VSTDICC0.1	VL024126.D	11/04/2014	11:01
VSTDICC0.03	VSTDICC0.03	VL024127.D	11/04/2014	11:40
VSTDICCC010	VSTDICCC010	VL024128.D	11/04/2014	12:19
VSTDICC002	VSTDICC002	VL024129.D	11/04/2014	13:00
VSTDICC0.5	VSTDICC0.5	VL024130.D	11/04/2014	13:39
VSTDICC001	VSTDICC001	VL024131.D	11/04/2014	14:18
VSTDICC015	VSTDICC015	VL024132.D	11/04/2014	14:59

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VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG NO.: F4715

Lab File ID: VL024189.D BFB Injection Date: 11/12/2014

Instrument ID: MSVOA_L BFB Injection Time: 10:18

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: Y/N N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	21
75	30.0 - 66.0% of mass 95	55.8
95	Base Peak, 100% relative abundance	100
96	5.0 - 9.0% of mass 95	6.5
173	Less than 2.0% of mass 174	0.0 (0.0) 1
174	50.0 - 120.0% of mass 95	74.9
175	4.0 - 9.0% of mass 174	5.9 (7.9) 1
176	93.0 - 101.0% of mass 174	72.6 (96.9) 1
177	5.0 - 9.0% of mass 176	4.6 (6.3) 2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
VSTDCCC010	VSTDCCC010	VL024190.D	11/12/2014	10:57
VL1112ABL	VL1112ABL	VL024191.D	11/12/2014	12:30
VL1112ABS	VL1112ABS	VL024192.D	11/12/2014	13:09
BZ3-1-SGDL	F4715-01DL	VL024193.D	11/12/2014	13:49
BZ3-2-SGDL	F4715-02DL	VL024194.D	11/12/2014	14:28
BZ3-3-SG	F4715-03	VL024195.D	11/12/2014	15:09
SG-DUP-1DL	F4715-04DL	VL024196.D	11/12/2014	15:48
BZ3-1-SG	F4715-01	VL024197.D	11/12/2014	16:29
BZ3-1-SGDUP	F4715-01DUP	VL024198.D	11/12/2014	17:11
BZ3-2-SG	F4715-02	VL024199.D	11/12/2014	17:52
SG-DUP-1	F4715-04	VL024200.D	11/12/2014	18:33
BZ3-3-SGDL	F4715-03DL	VL024207.D	11/12/2014	23:03
BZ3-3-SGDL2	F4715-03DL2	VL024208.D	11/12/2014	23:41

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VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG NO.: F4715

Lab File ID: VL024190.D Date Analyzed: 11/12/2014

Instrument ID: MSVOA_L Time Analyzed: 10:57

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: (Y/N) N

	IS1 AREA #	RT #	IS2 AREA #	RT #	IS3 AREA #	RT #
12 HOUR STD	523984	6.67	1709160	8.35	1561260	13.77
UPPER LIMIT	733578	7.00	2392820	8.68	2185760	14.10
LOWER LIMIT	314390	6.34	1025490	8.02	936756	13.44
EPA SAMPLE NO.						
BZ3-1-SG	613356	6.67	1921203	8.34	1685513	13.76
BZ3-1-SGDL	554560	6.67	1797670	8.34	1535289	13.76
BZ3-1-SGDUP	631414	6.67	1995349	8.34	1728969	13.76
BZ3-2-SG	627570	6.67	2031169	8.34	1729129	13.75
BZ3-2-SGDL	556286	6.67	1801730	8.34	1556002	13.76
BZ3-3-SG	574962	6.67	1808369	8.34	1627987	13.76
BZ3-3-SGDL	401472	6.65	1276226	8.32	1057100	13.74
BZ3-3-SGDL2	386660	6.65	1253008	8.32	1021469	13.74
SG-DUP-1	602793	6.67	1931217	8.34	1619430	13.75
SG-DUP-1DL	539870	6.67	1767224	8.34	1526259	13.76
VL1112ABL	491210	6.67	1614979	8.34	1395862	13.76
VL1112ABS	510409	6.67	1644766	8.35	1455788	13.77

IS1 = Bromochloromethane
IS2 = 1,4-Difluorobenzene
IS3 = Chlorobenzene-d5

AREA UPPER LIMIT = +40% of internal standard area
AREA LOWER LIMIT = -40% of internal standard area
RT UPPER LIMIT = +0.33 minutes of internal standard RT
RT LOWER LIMIT = -0.33 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

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VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG NO.: F4715

Lab File ID: VL024190.D Date Analyzed: 11/12/2014

Instrument ID: MSVOA_L Time Analyzed: 10:57

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: (Y/N) N

	IS4 AREA #	RT #				
12 HOUR STD	0	0				
UPPER LIMIT	0					
LOWER LIMIT	0					
EPA SAMPLE NO.						
BZ3-1-SG	0	0.00				
BZ3-1-SGDL	0	0.00				
BZ3-2-SG	0	0.00				
BZ3-2-SGDL	0	0.00				
BZ3-3-SG	0	0.00				
BZ3-3-SGDL	0	0.00				
BZ3-3-SGDL2	0	0.00				
SG-DUP-1	0	0.00				
SG-DUP-1DL	0	0.00				
VL1112ABL	0	0.00				
VL1112ABS	0	0.00				

IS4 =

AREA UPPER LIMIT = +40% of internal standard area
AREA LOWER LIMIT = -40% of internal standard area
RT UPPER LIMIT = +0.33 minutes of internal standard RT
RT LOWER LIMIT = -0.33 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

QC SAMPLE DATA

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL1112ABL	SDG No.:	F4715
Lab Sample ID:	VL1112ABL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024191.D	1		11/12/14 12:30	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.1	0.49	U	0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.1	0.21	U	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.1	0.56	U	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	U	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.1	0.41	U	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	0.15	0.36	J	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	0.1	0.35	J	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.1	0.34	U	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	0.1	0.29	U	0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	0.03	0.19	U	0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.1	0.49	U	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.1	0.47	U	0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.1	0.32	U	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.03	0.16	U	0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	0.1	0.38	U	0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL1112ABL	SDG No.:	F4715
Lab Sample ID:	VL1112ABL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024191.D	1		11/12/14 12:30	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.03	0.2	U	0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	0.2	0.87	U	0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.1	0.52	U	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	0.1	0.35	U	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	U	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10			65 - 135		100%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	491210		6.67				
540-36-3	1,4-Difluorobenzene	1614980		8.34				
3114-55-4	Chlorobenzene-d5	1395860		13.76				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL1112ABS	SDG No.:	F4715
Lab Sample ID:	VL1112ABS	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024192.D	1		11/12/14 13:09	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	9.9	49.0		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	9.7	20.0		0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	8.9	22.8		0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	9.7	37.7		0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	9.6	25.3		0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	11.3	33.3		0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	9.7	54.5		0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	9.8	75.1		0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	9.6	67.1		0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	9.9	43.3		0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	13.4	40.6		0.3	0.3	1.52	ug/m3
142-82-5	Heptane	10.4	42.6		0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	10.2	40.4		0.2	0.4	1.98	ug/m3
67-64-1	Acetone	9.2	21.8		0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	10.7	33.3		0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	10.9	39.3		0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	9.5	33		0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	10.7	42.4		0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	9.9	40.1		0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	10.8	37.2		0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	10.4	30.7		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	9.2	57.9		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	10.8	42.8		0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	9.6	46.9		0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	9.1	49.6		0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	10.9	50.9		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	10.9	34.8		0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	9.8	39.7		0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	10	53.7		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	10.6	49.0		0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	10.2	68.3		0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	11.1	45.5		0.2	0.41	2.05	ug/m3
108-88-3	Toluene	10.8	40.7		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	11.9	54.0		0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	11.5	52.2		0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	10.1	55.1		0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	10.3	87.8		0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	10.1	77.6		0.77	0.77	3.84	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL1112ABS	SDG No.:	F4715
Lab Sample ID:	VL1112ABS	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024192.D	1		11/12/14 13:09	VL111214

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	10.2	69.2		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	10.1	46.5		0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	10.9	47.3		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	20.6	89.5		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	10.4	45.2		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	11.9	50.7		0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	10.6	109		0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	9.8	67.3		0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	10.8	55.9		0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	10.5	51.6		0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	10.2	50.1		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	9.9	59.5		0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	10.4	62.5		0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	10.3	61.9		0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	10.9	80.9		0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	9.9	105		1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	9.9	21.9		0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	12.4	65		0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	10.7	52.6		0.49	0.49	2.46	ug/m3
110-54-3	Hexane	10.7	37.7		0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	9.9	31.0		0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	16.6	59.8	E	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	11.1	45.4		0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10.2			65 - 135		102%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	510409		6.67				
540-36-3	1,4-Difluorobenzene	1644770		8.35				
3114-55-4	Chlorobenzene-d5	1455790		13.77				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

CALIBRATION SUMMARY

Response Factor Report msvoa_l

5

Method Path : W:\HPCHEM1\MSVOA_L\METHODS\
Method File : VL110414AIR.M
Title : AIR ANALYSIS BY METHOD TO-15 Instrument: MSVOA_LTue Nov 04 15:46:38 2014
Last Update : Tue Nov 04 15:46:38 2014
Response Via : Initial Calibration

Calibration Files
0.03=VL024127.D 0.1 =VL024126.D 0.5 =VL024130.D 1 =VL024131.D 2 =VL024129.D 10 =VL024128.D 15 =VL024132.D

		Compound	0.03	0.1	0.5	1	2	10	15	Avg	%RSD
1)	I	Bromochloromethane	-----	-----	-----	ISTD	-----	-----	-----		
2)	T	Dichlorodifluo...			3.196	3.090	3.112	2.767	2.153	2.864	15.00
3)		Chlorodifluoro...			1.710	1.682	1.675	1.483	1.439	1.598	7.92
4)		Chloromethane			0.738	0.705	0.715	0.606	0.606	0.674	9.36
5)	T	Vinyl Chloride	1.297	0.868	0.769	0.753	0.771	0.697	0.687	0.835	25.44
6)	T	Bromomethane			0.608	0.574	0.573	0.529	0.512	0.559	6.87
7)		Chloroethane			0.361	0.331	0.352	0.304	0.300	0.329	8.29
8)	T	Dichlorotetraf...			2.453	2.327	2.370	2.110	2.054	2.263	7.61
9)	T	Propene			0.497	0.477	0.519	0.472	0.476	0.488	4.06
10)	T	Heptane			1.449	1.445	1.520	1.437	1.439	1.458	2.39
11)	T	Trichlorofluor...			3.165	3.164	3.140	2.850	2.742	3.012	6.68
12)	T	1,1,2-Trichlor...			1.864	1.830	1.832	1.664	1.624	1.763	6.25
13)		Ethanol			0.050	0.069	0.057	0.072	0.057	0.061	15.11
14)	T	Bromoethene			0.801	0.769	0.777	0.715	0.706	0.754	5.48
15)	T	Acetone			1.725	1.637	1.626	1.313	1.281	1.516	13.47
16)	T	1,3-Butadiene			0.679	0.675	0.712	0.641	0.630	0.668	4.90
17)		tert-Butyl alc...			0.900	0.884	0.791	1.103	1.055	0.947	13.59
18)	T	1,1-Dichloroet...			0.973	0.944	0.973	0.887	0.869	0.929	5.21
19)	T	Isopropyl Alcohol			0.677	0.637	0.528	0.715	0.678	0.647	11.16
20)	T	Methylene Chlo...			0.880	0.796	0.780	0.677	0.648	0.756	12.45
21)	T	Allyl Chloride			1.169	0.870	0.910	0.848	0.845	0.928	14.76
22)	T	trans-1,2-Dich...			0.835	0.788	0.832	0.781	0.761	0.799	4.09
23)	T	Vinyl Acetate			2.520	2.542	2.776	2.655	2.595	2.618	3.92
24)	T	1,1-Dichloroet...			1.697	1.684	1.698	1.539	1.489	1.621	6.14
25)	T	Ethyl Acetate			1.876	2.552	2.716	2.562	2.533	2.448	13.40
26)	T	Hexane			1.105	1.062	1.137	1.085	1.085	1.095	2.56
27)	T	Carbon Disulfide			1.453	1.470	1.549	1.430	1.417	1.464	3.55
28)	T	Methyl tert-Bu...			2.508	2.555	2.688	2.594	2.512	2.571	2.87
29)	T	Chloroform			2.294	2.250	2.283	2.090	2.029	2.189	5.55
30)	T	Cyclohexane			1.005	1.041	1.093	1.037	1.017	1.039	3.27
31)	T	cis-1,2-Dichlo...			1.074	1.095	1.161	1.134	1.122	1.117	3.04
32)	T	1,1,1-Trichlor...	4.035	2.692	2.427	2.541	2.511	2.393	2.304	2.701	22.27
33)	I	1,4-Difluorobenzene	-----	-----	-----	ISTD	-----	-----	-----		
34)	T	2-Butanone			0.465	0.460	0.501	0.469	0.470	0.473	3.37
35)	T	Carbon Tetrach...	1.303	0.852	0.786	0.803	0.833	0.813	0.796	0.884	21.05
36)	T	Benzene			0.687	0.691	0.755	0.721	0.723	0.715	3.83
37)	T	1,2-Dichloroet...			0.583	0.572	0.598	0.571	0.568	0.579	2.14

Method Path : W:\HPCHEM1\MSVOA_L\METHODS\
Method File : VL110414AIR.M

5

38)	T	Trichloroethene	0.498	0.351	0.327	0.338	0.365	0.358	0.362	0.371	15.42
39)	T	1,2-Dichloropr...			0.232	0.222	0.236	0.229	0.230	0.230	2.16
40)	T	1,4-Dioxane			0.040	0.043	0.036	0.067	0.068	0.051	30.54
41)	T	Tetrahydrofuran			0.201	0.225	0.249	0.251	0.250	0.235	9.24
42)	T	Bromodichlorom...			0.685	0.679	0.739	0.726	0.723	0.710	3.77
43)		Methyl Methacr...			0.225	0.245	0.279	0.280	0.283	0.263	9.96
44)	T	2,2,4-Trimethy...			1.016	1.068	1.153	1.133	1.158	1.106	5.57
45)	T	t-1,3-Dichloro...			0.326	0.367	0.428	0.474	0.480	0.415	16.21
46)	T	cis-1,3-Dichlo...			0.366	0.409	0.469	0.494	0.499	0.447	12.93
47)	T	1,1,2-Trichlor...			0.275	0.262	0.291	0.281	0.280	0.278	3.83
48)	T	Dibromochlorom...			0.535	0.567	0.612	0.629	0.631	0.595	7.11
49)	T	Bromoform			0.457	0.497	0.559	0.585	0.582	0.536	10.54
50)	T	4-Methyl-2-Pen...			0.448	0.488	0.558	0.565	0.569	0.526	10.40
51)	T	2-Hexanone			0.318	0.388	0.461	0.497	0.511	0.435	18.61
52)	T	Tetrachloroethene	0.415	0.369	0.332	0.328	0.359	0.356	0.357	0.359	8.04
53)	T	Toluene			0.766	0.847	0.951	0.945	0.955	0.893	9.38
54)	T	1,2-Dibromoethane			0.907	0.932	1.008	1.001	1.008	0.971	4.93
55)	I	Chlorobenzene-d5	----------------ISTD---------------------								
56)		1,1,1,2-Tetrac...			0.501	0.501	0.499	0.487	0.470	0.491	2.74
57)	T	Chlorobenzene			0.910	0.891	0.873	0.828	0.801	0.861	5.24
58)	T	Ethyl Benzene			1.224	1.364	1.438	1.450	1.406	1.376	6.66
59)	T	m/p-Xylene			1.182	1.230	1.238	1.211	1.173	1.207	2.37
60)	T	o-Xylene			1.033	1.103	1.121	1.098	1.074	1.086	3.14
61)	T	Styrene			0.646	0.735	0.831	0.869	0.853	0.787	12.01
62)		Isopropylbenzene			1.587	1.668	1.679	1.659	1.622	1.643	2.32
63)	T	1,1,2,2-Tetrac...	0.807	0.584	0.588	0.593	0.601	0.577	0.565	0.616	13.76
64)		n-propylbenzene			0.382	0.410	0.430	0.412	0.406	0.408	4.20
65)		tert-Butylbenzene			1.246	1.336	1.391	1.374	1.351	1.339	4.22
66)	T	Benzyl Chloride			0.614	0.677	0.755	0.836	0.830	0.742	13.02
67)		sec-Butylbenzene			1.679	1.790	1.828	1.780	1.736	1.762	3.24
68)	S	1-Bromo-4-Fluo...	0.819	0.812	0.832	0.820	0.781	0.802	0.790	0.808	2.23
69)		p-Isopropyltol...			1.284	1.464	1.525	1.521	1.496	1.458	6.88
70)		n-Butylbenzene			1.068	1.225	1.318	1.297	1.275	1.237	8.12
71)		2-Chlorotoluene			1.026	1.103	1.201	1.191	1.141	1.133	6.31
72)	T	4-Ethyltoluene			1.226	1.331	1.410	1.409	1.376	1.350	5.68
73)	T	1,3,5-Trimethy...			1.342	1.396	1.437	1.429	1.391	1.399	2.70
74)	T	1,2,4-Trimethy...			1.343	1.433	1.434	1.383	1.350	1.389	3.13
75)	T	1,3-Dichlorobe...			0.970	0.967	0.958	0.894	0.870	0.932	5.00
76)	T	1,4-Dichlorobe...			0.891	0.911	0.919	0.883	0.864	0.894	2.45
77)	T	1,2-Dichlorobe...			0.792	0.832	0.850	0.804	0.790	0.814	3.22
78)	T	Hexachloro-1,3...			0.530	0.496	0.475	0.396	0.379	0.455	14.30
79)	T	Naphthalene			0.961	1.059	1.169	1.061	1.044	1.059	7.00
80)	T	Naphthalene,2-...			0.221	0.211	0.240	0.207	0.202	0.216	6.98
81)	T	1,2,4-Trichlor...			0.528	0.532	0.565	0.491	0.477	0.518	6.73

(#) = Out of Range

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG No.: F4715

Instrument ID: MSVOA_L Calibration Date/Time: 11/12/2014 10:57

Lab File ID: VL024190.D Init. Calib. Date(s): 11/04/2014 11/04/2014

Heated Purge: (Y/N) N Init. Calib. Time(s): 11:01 14:59

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Dichlorodifluoromethane	2.864	2.810		-1.88	30
Chloromethane	0.674	0.674		0	30
Vinyl Chloride	0.835	0.744		-10.9	30
Bromomethane	0.559	0.555		-0.72	30
Chloroethane	0.329	0.320		-2.74	30
Tetrahydrofuran	0.235	0.263		11.91	30
Trichlorofluoromethane	3.012	2.886		-4.18	30
1,1,2-Trichlorotrifluoroethane	1.763	1.710		-3.01	30
Dichlorotetrafluoroethane	2.263	2.176		-3.84	30
Bromoethene	0.754	0.765		1.46	30
tert-Butyl alcohol	0.947	1.166		23.13	30
Heptane	1.458	1.544		5.9	30
1,1-Dichloroethene	0.929	0.939		1.08	30
Acetone	1.516	1.363		-10.09	30
Carbon Disulfide	1.464	1.546		5.6	30
Methyl tert-Butyl Ether	2.571	2.833		10.19	30
Methylene Chloride	0.756	0.710		-6.09	30
trans-1,2-Dichloroethene	0.799	0.853		6.76	30
1,1-Dichloroethane	1.621	1.625		0.25	30
Cyclohexane	1.039	1.143		10.01	30
2-Butanone	0.473	0.494		4.44	30
Carbon Tetrachloride	0.884	0.802		-9.28	30
cis-1,2-Dichloroethene	1.117	1.204		7.79	30
Chloroform	2.189	2.135		-2.47	30
1,1,1-Trichloroethane	2.701	2.455		-9.11	30
2,2,4-Trimethylpentane	1.106	1.205		8.95	30
Benzene	0.715	0.786		9.93	30
1,2-Dichloroethane	0.579	0.557		-3.8	30
Trichloroethene	0.371	0.377		1.62	30
1,2-Dichloropropane	0.230	0.243		5.65	30
Bromodichloromethane	0.710	0.721		1.55	30
4-Methyl-2-Pentanone	0.526	0.586		11.41	30
Toluene	0.893	0.971		8.73	30
t-1,3-Dichloropropene	0.415	0.489		17.83	30
cis-1,3-Dichloropropene	0.447	0.514		14.99	30
1,1,2-Trichloroethane	0.278	0.285		2.52	30
Dibromochloromethane	0.595	0.609		2.35	30
1,2-Dibromoethane	0.971	0.982		1.13	30
Tetrachloroethene	0.359	0.363		1.11	30
Chlorobenzene	0.861	0.836		-2.9	30
Ethyl Benzene	1.376	1.458		5.96	30
m/p-Xylene	1.207	1.203		-0.33	30

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: F4715 SAS No.: F4715 SDG No.: F4715

Instrument ID: MSVOA_L Calibration Date/Time: 11/12/2014 10:57

Lab File ID: VL024190.D Init. Calib. Date(s): 11/04/2014 11/04/2014

Heated Purge: (Y/N) N Init. Calib. Time(s): 11:01 14:59

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
o-Xylene	1.086	1.091		0.46	30
Styrene	0.787	0.909		15.5	30
Bromoform	0.536	0.568		5.97	30
1,1,2,2-Tetrachloroethane	0.616	0.579		-6.01	30
2-Chlorotoluene	1.133	1.185		4.59	30
1,3,5-Trimethylbenzene	1.399	1.410		0.79	30
1,2,4-Trimethylbenzene	1.389	1.363		-1.87	30
1,3-Dichlorobenzene	0.932	0.880		-5.58	30
1,4-Dichlorobenzene	0.894	0.887		-0.78	30
1,2-Dichlorobenzene	0.814	0.800		-1.72	30
1,2,4-Trichlorobenzene	0.518	0.547		5.6	30
Hexachloro-1,3-Butadiene	0.455	0.437		-3.96	30
1,3-Butadiene	0.668	0.669		0.15	30
Naphthalene	1.059	1.278		20.68	30
4-Ethyltoluene	1.350	1.402		3.85	30
1-Bromo-4-Fluorobenzene	0.808	0.790		-2.23	30
Hexane	1.095	1.185		8.22	30
Allyl Chloride	0.928	0.896		-3.45	30
1,4-Dioxane	0.051	0.065		27.45	30
Methyl Methacrylate	0.263	0.293		11.41	30

All other compounds must meet a minimum RRF of 0.010.

SHIPPING DOCUMENTS

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : F4715

6.1

Client Contact Information	Bottle Order ID : **B1411006**	Courier :	____ of ____ COCs
Client ID : **EAEN06** Project ID :	**Frankford Arsenal Air**	Sampler Name(s) :	Analysis / Matrix
Customer Name : **EA Engineering Science & Technology**	Project Manager **Denise wilt**	AIR ANALYSIS CHAIN-OF-CUSTODY	
	Phone Number : **410-584-7000**		
Address : **225 Schilling Circle, Suite 400**	Fax Number :		
	Site Details:	Batch Certified	
City : **Hunt Valley**			
State : **MD**	Analysis Turnaround Time		
Zip Code : **21031**	Standard : **15 business days OR**	Data Package Type :	
Country :	Rush (Specify): ______ **Days**	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	Interior Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas		
BZ3-1-SG	11/10/14 11/11/14	1022	859	-11.5	0	61°F	55°F	-30	-2.8	10478	10441	6 L	4.16	VL023589.D								

Temperature (Fahrenheit)

	Ambient	Maximum	Minimum	
Start				
Stop				

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)

	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 11/4/14	Canisters Received by:	Date/Time:	
Samples Relinquished by:	Date/Time: 11/11/14	Received by:	Date/Time: 11/11/14 1430	**B1411006 - 2**
Relinquished by:	Date/Time: 11/11/14 1615	Received by:	Date/Time:	

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : F4715

6.1

Client Contact Information		Bottle Order ID : B1411006	Courier :	___ of ___ COCs
Client ID : EAEN06	Project ID :	Frankford Arsenal Air	Sampler Name(s) : CEN / DW	Analysis / Matrix
Customer Name :	EA Engineering Science & Technology	Project Manager: Denise wilt	AIR ANALYSIS CHAIN-OF-CUSTODY	
		Phone Number : 410-584-7000		
Address :	225 Schilling Circle, Suite 400	Fax Number :		
		Site Details:	Batch Certified	
City :	Hunt Valley			
State :	MD	Analysis Turnaround Time		
Zip Code :	21031	Standard : 15 business days OR	Data Package Type :	
Country :		Rush (Specify): ____ Days	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	(outdoor) ~~Interior~~ Temp. (F) (Start)	~~Interior~~ Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas		
B23-2-SG	11/10/14 11/11/14	13:43	9:11	-26.5	-1	61°F	55°F	-30	-5.9	10771	10054	6 L	4.16	VL023590.D								

Temperature (Fahrenheit)

	Ambient	Maximum	Minimum	
Start				
Stop				

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)

	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 11/4/14	Canisters Received by:	Date/Time:
Samples Relinquished by:	Date/Time: 11/11/14	Received by:	Date/Time: 11/11/14 1430
Relinquished by:	Date/Time: 11/11/14 1615	Received by:	Date/Time:

B1411006 - 1

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : F4715

6.1

Client Contact Information		Bottle Order ID : **B1411006**	Courier :	___ of ___ COCs	
Client ID : **EAEN06**	Project ID :	**Frankford Arsenal Air**	Sampler Name(s) : CEN/DW	Analysis	Matrix
Customer Name :	**EA Engineering Science & Technology**	Project Manager **Denise wilt**	AIR ANALYSIS CHAIN-OF-CUSTODY		
		Phone Number : **410-584-7000**			
Address :	**225 Schilling Circle, Suite 400**	Fax Number :			
		Site Details:	Batch Certified		
City :	**Hunt Valley**				
State :	**MD**	Analysis Turnaround Time			
Zip Code :	**21031**	Standard : **15 business days OR**	Data Package Type :		
Country :		Rush (Specify): ____ **Days**	EDD Type :		

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	(outdoor) ~~Interior~~ Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas		
B23-3-SG	11/10/14 11/11/14	13:07	12:57	-26	-21	61°F	66°F	-30	-23.9	10483	10488	6 L	4.16	VL023590.D								

Temperature (Fahrenheit)				
	Ambient	Maximum	Minimum	
Start				
Stop				

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)				
	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 11/6/14	Canisters Received by:	Date/Time:
Samples Relinquished by:	Date/Time: 11/11/14	Received by:	Date/Time: 11/11/14-1430
Relinquished by:	Date/Time: 11/11/14 1615	Received by:	Date/Time:

B1411006 - 3

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : F4715

6.1

Client Contact Information	Bottle Order ID : B1411006	Courier :	____ of ____ COCs
Client ID : EAEN06 Project ID :	Frankford Arsenal Air	Sampler Name(s) :	Analysis / Matrix
Customer Name : EA Engineering Science & Technology	Project Manager: Denise wilt	AIR ANALYSIS CHAIN-OF-CUSTODY Batch Certified	
	Phone Number : 410-584-7000		
Address : 225 Schilling Circle, Suite 400	Fax Number :		
	Site Details:		
City : Hunt Valley			
State : MD	Analysis Turnaround Time		
Zip Code : 21031	Standard : 15 business days OR	Data Package Type :	
Country :	Rush (Specify): ____ Days	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	Interior Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas		
SG-DUP-1	11/10/14 11/11/14	1022	901	-30	-1	61°F	55°F	-30	-28	10110	10590	6 L	4.16	VL023589.D								

Temperature (Fahrenheit)

	Ambient	Maximum	Minimum	
Start				
Stop				

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)

	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by: GL	Date/Time: 11/4/14	Canisters Received by:	Date/Time:
Samples Relinquished by:	Date/Time: 11/11/14	Received by:	Date/Time: 11/11/14 1430
Relinquished by:	Date/Time: 11/11/14 1615	Received by:	Date/Time:

B1411006 - 4

CHEMTECH 284 Sheffield Street Mountainside NJ 07092 Tel. 908-7898900

Laboratory Certification

State	License No.
New Jersey	20012
New York	11376
Connecticut	PH-0649
Florida	E87935
Louisiana	5035
Maryland	296
Massachusetts	M-NJ503
Pennsylvania	68-548
Rhode Island	LAO00259
Virginia	460220
Texas	T10470448-10-1

Other :

DOD ELAP Certified (L-A-B Accredited), ISO/IEC 17025	L2219
Soil Permit	P330-11-00012
CLP Inorganic Contract	EPW09038
CLP Organic Contract	EPW11030

QA Control Code: A2070148

DEP-077
Rev. 3/04

New Jersey Department of Environmental Protection

Internal Chain of Custody

Instructions: Use 1 form for each 20 samples of aliquot

Laboratory Person Breaking Field Seal on Sample Shuttle & Accepting Responsibility for Sample

Laboratory: Chemtech
Location: 284 Sheffield Street, Mountainside,NJ 7092
REGINALD
Title: Sample Custodian
Field Sample Seal No.: F4715
Date Broken 11/11/2014
Military Time Seal Broken: 16:15:00
Case No.: Frankford Arsenal Air
Analytical Parameter/Fraction: TO-15

Sample No.	Aliquot/Extract No.	Sample No.	Aliquot/Extract No.
F4715-01	BZ3-1-SG		
F4715-02	BZ3-2-SG		
F4715-03	BZ3-3-SG		
F4715-04	SG-DUP-1		

Date	Time	Relinquished By	Received By	Purpose of Change of Custody
11/11/14	1730	Signature [illegible]	Signature [illegible]	To [illegible] Air Lab
		Printed Name RL	Printed Name [illegible]	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	

Distribution: White - Original (Sent With Report) Yellow - Contractor Archive Pink - Sample Custodian - Interim Copy

8.9
-1

10441

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: BZ3-1-SG
Client Name : EA
Project Name: Frankford Arsenal
Date: 11/11/2014 Time: 8:5
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: F4715-F4715-01
Cust Sample: BZ3-1-SG

-5.9

10054

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: BZ3-2-SG
Client Name : EA
Project Name: Frankford Arsenal
Date: 11/11/2014 Time: 9:11 - -1
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: F4715-F4715-02
Cust Sample: BZ3-2-SG

-3.9

10488

12 JOY

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: BZ3-3-SG
Client Name : EA
Project Name: Frankford Arsenal
Date: 11/11/14 Time: 12:57
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: F4715-F4715-03
Cust Sample: BZ3-3-SG

2-8-1
10S20

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: SG-Dup-1
Client Name : EA
Project Name: Frankford Arsenal
Date: 1/11/2011 Time:
Analysis:
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: F4715-F4715-04
Cust Sample: SG-DUP-1

AIR SAMPLE PRESSURE & DILUTION LOGBOOK

Analyst Signature: [signature]

Supervisor Signature: [signature]

METHOD: TO-15

Date	Sample Number	Canister #	Initial Pressure psia	Initial Pressure Hg	Final Pressure psia	Final Pressure Hg	Dilution Factor	Comment
11/7/14	F4590-02	10762	0.5		15.0		30X	SY
	F4590-03	10715	0.5		15.0		30X	
11/11/14	F4715-01	10441	13.6	-2.2				JC
	F4715-02	10054	11.8	-5.9				
	F4715-03	10488	3.0	-23.9				
	F4715-04	10590	13.6	-2.2				

CHEMTECH
284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

ANALYTICAL RESULTS SUMMARY

VOLATILE ORGANICS

PROJECT NAME : FRANKFORD ARSENAL AIR

EA ENGINEERING SCIENCE & TECHNOLOGY

225 Schilling Circle, Suite 400

Hunt Valley, MD - 21031

Phone No: 410-584-7000

ORDER ID : G1083

ATTENTION : Denise Wilt

DoD ELAP

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6) Shipping Document 55

6.1) CHAIN OF CUSTODY 56

6.2) Lab Certificate 62

1
2
3
4
5
6

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Cover Page

Order ID : G1083

Project ID : Frankford Arsenal Air

Client : EA Engineering Science & Technology

Lab Sample Number	Client Sample Number
G1083-01	B23-2-SG-01-12-2015
G1083-02	SG-DUP-1-01-12-2015
G1083-03	B23-1-SG-01-12-2015

I certify that the data package is in compliance with the terms and conditions of the contract,both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the laboratory manager or his designee, as verified by the following signature.

Signature : Mildred V Reyes

APPROVED Date: 1/21/2015
By Mildred V Reyes, QA/QC Supervisor at 9:52 am, Jan 26, 2015

NYDOH CERTIFICATION NO - 11376

NJDEP CERTIFICATION NO - 20012

CHEMTECH
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CASE NARRATIVE

EA Engineering Science & Technology
Project Name: Frankford Arsenal Air
Project # N/A
Chemtech Project # G1083
Test Name: TO-15

A. Number of Samples and Date of Receipt:
3 Air samples were received on 01/14/2015.

B. Parameters
According to the Chain of Custody document, the following analyses were requested: TO-15. This data package contains results for TO-15.

C. Analytical Techniques:
The analysis performed on instrument MSVOA_L were done using GC column RTX-1, which is 60 meters, 0.32 mm id, 1.0 um df, Restek Cat. #10157. The Trap was supplied by Entech, glass bead and Tenax , Entech 7100A Preconcentrator.The analysis of TO-15 was based on method TO-15.

D. QA/ QC Samples:
The Holding Times were met for all analysis.
The Surrogate recoveries met the acceptable criteria.
The Internal Standards Areas met the acceptable requirements.
The Retention Times were acceptable for all samples.
The RPD for G1083-02DUP {SG-DUP-1-01-12-2015DUP } with File ID: VL024520.D recoveries met requirements for all samples except for Cyclohexane [200%] .
The Blank Spike for {VL0115ABS} with File ID: VL024515.D met requirements for all samples except for 1,2,4-Trichlorobenzene[63%], 1,2-Dichlorobenzene[68%], 1,4-Dioxane[224%] and Hexachloro-1,3-butadiene[63%] .
The Blank analysis indicated presence of Methylene Chloride[0.08 ppbv] FileID:VL024514.D{VL0115ABL} due to possible lab contamination.
The Initial Calibration met the requirements .
The Continuous Calibration met the requirements .
The Tuning criteria met requirements.
Sample B23-2-SG-01-12-2015 was diluted due to high concentration.

E. Additional Comments:

The Manual Integrations are performed for the followings:

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Sequence	VL122914	Instrument	MSVOA_I

VSTDICC002	VL024437.D	1,4-Dioxane	sam	12/29/2014 6:44:10 PM	MMDadoda	12/30/2014 11:16:36 AM	Peak Integrated by Software incorrectly
VSTDICC002	VL024437.D	m/p-Xylene	sam	12/29/2014 6:44:10 PM	MMDadoda	12/30/2014 11:16:36 AM	Peak Integrated by Software incorrectly
VSTDICC001	VL024438.D	1,4-Dioxane	sam	12/29/2014 6:44:42 PM	MMDadoda	12/30/2014 11:16:41 AM	Peak Integrated by Software incorrectly
VSTDICC001	VL024438.D	Ethanol	sam	12/29/2014 6:44:42 PM	MMDadoda	12/30/2014 11:16:41 AM	Peak Integrated by Software incorrectly
VSTDICC001	VL024438.D	m/p-Xylene	sam	12/29/2014 6:44:42 PM	MMDadoda	12/30/2014 11:16:41 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024439.D	1,4-Dioxane	sam	12/29/2014 6:44:48 PM	MMDadoda	12/30/2014 11:16:48 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024439.D	m/p-Xylene	sam	12/29/2014 6:44:48 PM	MMDadoda	12/30/2014 11:16:48 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024439.D	t-1,3-Dichloropropene	sam	12/29/2014 6:44:48 PM	MMDadoda	12/30/2014 11:16:48 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL024439.D	tert-Butyl alcohol	sam	12/29/2014 6:44:48 PM	MMDadoda	12/30/2014 11:16:48 AM	Peak Integrated by Software incorrectly
VSTDICC0.1	VL024440.D	Tetrachloroethene	sam	12/29/2014 6:44:17 PM	MMDadoda	12/30/2014 11:16:55 AM	Peak Integrated by Software incorrectly

Sequence	VL122914	Instrument	MSVOA_I

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDICC0.03	VL024441.D	1,1,2,2-Tetrachloroethane	sam	12/30/2014 10:23:33	MMDadoda	12/30/2014 11:17:00 AM	Peak Integrated by

				AM			Software incorrectly
VSTDICC0.03	VL024441.D	Tetrachloroethene	sam	12/30/2014 10:23:33 AM	MMDadoda	12/30/2014 11:17:00 AM	Peak Integrated by Software incorrectly
VSTDICC0.03	VL024441.D	Trichloroethene	sam	12/30/2014 10:23:33 AM	MMDadoda	12/30/2014 11:17:00 AM	Peak Integrated by Software incorrectly
VSTDICCC010	VL024442.D	Chlorobenzene-d5	sam	12/29/2014 6:45:28 PM	MMDadoda	12/30/2014 11:17:07 AM	Coelution Of the peak
VSTDICCC010	VL024442.D	m/p-Xylene	sam	12/29/2014 6:45:28 PM	MMDadoda	12/30/2014 11:17:07 AM	Peak Integrated by Software incorrectly
VSTDICC015	VL024443.D	Chlorobenzene-d5	sam	12/29/2014 6:45:47 PM	MMDadoda	12/30/2014 11:17:11 AM	Coelution Of the peak
VSTDICC015	VL024443.D	m/p-Xylene	sam	12/29/2014 6:45:47 PM	MMDadoda	12/30/2014 11:17:11 AM	Peak Integrated by Software incorrectly
VSTDICV010	VL024444.D	Chlorobenzene-d5	sam	12/30/2014 10:23:58 AM	MMDadoda	12/30/2014 11:17:16 AM	Coelution Of the peak
VSTDICV010	VL024444.D	o-Xylene	sam	12/30/2014 10:23:58 AM	MMDadoda	12/30/2014 11:17:16 AM	Peak Integrated by Software incorrectly

Sequence	VL011515	Instrument	MSVOA_I

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDCCC010	VL024513.D	Chlorobenzene-d5	sam	1/16/2015 12:16:05 PM	MMDadoda	1/16/2015 12:17:08 PM	Coelution Of the peak
VL0115ABS	VL024515.D	Chlorobenzene-d5	sam	1/16/2015 11:28:43 AM	MMDadoda	1/16/2015 12:17:13 PM	Peak Integrated by Software incorrectly

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G1083-02	VL024519.D	Cyclohexane	sam	1/16/2015 12:09:58 PM	MMDadoda	1/16/2015 12:17:52 PM	Peak Integrated by Software incorrectly
G1083-03	VL024521.D	Cyclohexane	sam	1/16/2015 12:09:39 PM	MMDadoda	1/16/2015 12:18:06 PM	Peak Integrated by Software incorrectly
G1083-03	VL024521.D	Hexane	sam	1/16/2015 12:09:39 PM	MMDadoda	1/16/2015 12:18:06 PM	Peak Integrated by Software incorrectly
G1083-01	VL024522.D	1,4-Dichlorobenzene	sam	1/16/2015 12:09:46 PM	MMDadoda	1/16/2015 12:18:11 PM	Peak Integrated by Software incorrectly

Sequence	VL011515	Instrument	MSVOA_I

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
G1083-01	VL024522.D	Naphthalene	sam	1/16/2015 12:09:46 PM	MMDadoda	1/16/2015 12:18:11 PM	Peak Integrated by Software incorrectly
G1083-01	VL024522.D	Propene	sam	1/16/2015 12:09:46 PM	MMDadoda	1/16/2015 12:18:11 PM	Peak Integrated by Software incorrectly

F. Manual Integration Comments:
Please refer to the Manual integration Report included with the Run Logs for information on the manual integrations performed.

I certify that the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. The laboratory manager or his designee, as verified by the following signature has authorized release of the data contained in this hard copy data package.

Signature Mildred V Reyes

APPROVED
By Mildred V Reyes, QA/QC Supervisor at 9:52 am, Jan 26, 2015

DATA REPORTING QUALIFIERS- ORGANIC

For reporting results, the following " Results Qualifiers" are used:

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates the compound was analyzed for but was not detected. Report the minimum detection limit for the sample with the U, i.e. "10 U". This is not necessarily the instrument detection limit attainable for this particular sample based on any concentration or dilution that may have been required.
ND	Indicates the analyte was analyzed for, but not detected
J	Indicates an estimated value**.** This flag is used: (1) When estimating a concentration for a tentatively identified compound (library search hits, where a 1:1 response is assumed.) (2) When the mass spectral data indicated the identification, however the result was less than the specified detection limit greater than zero. If the detection limit was 10ug/L and a concentration of 3 ug/L was calculated report as 3 J. This is flag is used when similar situation arise on any organic parameter i.e. Pest, PCB and others.
B	Indicates the analyte was found in the blank as well as the sample report as "12 B".
E	Indicates the analyte 's concentration exceeds the calibrated range of the instrument for that specific analysis.
D	This flag identifies all compounds identified in an analysis at a secondary dilution factor.
P	This flag is used for Pesticide/PCB target analyte when there is >25% difference for detected concentrations between the two GC columns. The lower of the two values is reported on Form 1 and flagged with a "P".
N	This flag indicates presumptive evidence of a compound. This is only used for tentatively identified compounds (TICs), where the identification is based on a mass spectral library search. It applies to all TIC results. For generic characterization of a TIC, such as chlorinated hydrocarbon, the flag is not used.
A	This flag indicates that a Tentatively Identified Compound is a suspected aldol-condensation product.
Q	Indicates the LCS did not meet the control limits requirements

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

APPENDIX A

QA REVIEW GENERAL DOCUMENTATION

Project #: G1083

	Completed
For thorough review, the report must have the following:	
GENERAL:	
Are all original paperwork present (chain of custody, record of communication,airbill, sample management lab chronicle, login page)	✓
Check chain-of-custody for proper relinquish/return of samples	✓
Is the chain of custody signed and complete	✓
Check internal chain-of-custody for proper relinquish/return of samples /sample extracts	✓
Collect information for each project id from server. Were all requirements followed	✓
COVER PAGE:	
Do numbers of samples correspond to the number of samples in the Chain of Custody on login page	✓
Do lab numbers and client Ids on cover page agree with the Chain of Custody	✓
CHAIN OF CUSTODY:	
Do requested analyses on Chain of Custody agree with form I results	✓
Do requested analyses on Chain of Custody agree with the log-in page	✓
Were the correct method log-in for analysis according to the Analytical Request and Chain of Castody	✓
Were the samples received within hold time	✓
Were any problems found with the samples at arrival recorded in the Sample Management Laboratory Chronicle	✓
ANALYTICAL:	
Was method requirement followed?	✓
Was client requirement followed?	✓
Does the case narrative summarize all QC failure?	✓
All runlogs and manual integration are reviewed for requirements	✓
All manual calculations and /or hand notations verified	✓

1st Level QA Review Signature: MOHINI SONI Date: 01/21/2015

2nd Level QA Review Signature: Date:

REVIEWED
By Nimisha, Data Reviewer at 9:45 am, Jan 26, 2015

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5

A B C D E F G H I

LAB CHRONICLE

OrderID:	G1083	**OrderDate:**	1/14/2015 10:24:00 AM
Client:	EA Engineering Science & Technology	**Project:**	Frankford Arsenal Air
Contact:	Denise Wilt	**Location:**	Air Lab

LabID	ClientID	Matrix	Test	Method	Sample Date	Prep Date	Anal Date	Received
G1083-01	**B23-2-SG-01-12-2015**	**Air**			**01/13/15**			**01/14/15**
			TO-15	TO-15			01/15/15	
G1083-01DL	**B23-2-SG-01-12-2015DL**	**Air**			**01/13/15**			**01/14/15**
			TO-15	TO-15			01/15/15	
G1083-02	**SG-DUP-1-01-12-2015**	**Air**			**01/13/15**			**01/14/15**
			TO-15	TO-15			01/15/15	
G1083-03	**B23-1-SG-01-12-2015**	**Air**			**01/13/15**			**01/14/15**
			TO-15	TO-15			01/15/15	

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

A B C D E F G H I

Hit Summary Sheet
SW-846

SDG No.: G1083

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
Client ID:	**B23-2-SG-01-12-2015**								
G1083-01	B23-2-SG-01-12-2015	Air	Dichlorodifluoromethane	2.57		0.2	0.49	2.47	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Trichlorofluoromethane	1.29	J	0.22	0.56	2.81	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Heptane	1.11	J	0.41	0.41	2.05	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Acetone	25.40		0.24	0.24	1.19	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Methylene Chloride	1.91	B	0.17	0.35	1.74	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	2-Butanone	1.36	J	0.29	0.29	1.47	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Carbon Tetrachloride	488.00	E	0.19	0.19	0.19	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Chloroform	96.20	E	0.1	0.49	2.44	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	2,2,4-Trimethylpentane	3.46		0.19	0.47	2.34	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Benzene	1.41	J	0.13	0.32	1.6	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Trichloroethene	36.50		0.11	0.16	0.16	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Toluene	12.10		0.19	0.38	1.88	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Tetrachloroethene	0.68		0.2	0.2	0.2	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Ethyl Benzene	1.74	J	0.43	0.43	2.17	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	m/p-Xylene	6.52		0.43	0.87	4.34	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	o-Xylene	2.78		0.43	0.43	2.17	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	1,3,5-Trimethylbenzene	0.74	J	0.49	0.49	2.46	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	1,2,4-Trimethylbenzene	3.10		0.49	0.49	2.46	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	1,4-Dichlorobenzene	0.60	J	0.6	0.6	3.01	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	Naphthalene	0.42	J	0.21	0.52	2.62	ug/m3
G1083-01	B23-2-SG-01-12-2015	Air	4-Ethyltoluene	1.03	J	0.49	0.49	2.46	ug/m3
			Total Voc :	688.92					
			Total Concentration:	688.92					
Client ID:	**B23-2-SG-01-12-2015DL**								
G1083-01DL	B23-2-SG-01-12-2015DL	Air	Carbon Tetrachloride	1,383.00	D	7.55	7.55	7.55	ug/m3
G1083-01DL	B23-2-SG-01-12-2015DL	Air	Chloroform	103.00	D	3.91	19.5	97.7	ug/m3
G1083-01DL	B23-2-SG-01-12-2015DL	Air	Trichloroethene	36.50	D	3.22	6.45	6.45	ug/m3
			Total Voc :	1522.5					
			Total Concentration:	1522.5					
Client ID:	**SG-DUP-1-01-12-2015**								
G1083-02	SG-DUP-1-01-12-2015	Air	Dichlorodifluoromethane	2.97		0.2	0.49	2.47	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Chloromethane	0.23	J	0.21	0.21	1.03	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Trichlorofluoromethane	1.69	J	0.22	0.56	2.81	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Heptane	1.43	J	0.41	0.41	2.05	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Acetone	22.30		0.24	0.24	1.19	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Methylene Chloride	20.80	B	0.17	0.35	1.74	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Cyclohexane	0.52	J	0.34	0.34	1.72	ug/m3

Hit Summary Sheet
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SDG No.: G1083

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
G1083-02	SG-DUP-1-01-12-2015	Air	2-Butanone	10.30		0.29	0.29	1.47	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Carbon Tetrachloride	13.20		0.19	0.19	0.19	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Chloroform	3.37		0.1	0.49	2.44	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	2,2,4-Trimethylpentane	2.76		0.19	0.47	2.34	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Benzene	1.34	J	0.13	0.32	1.6	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Trichloroethene	11.80		0.11	0.16	0.16	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Toluene	49.00		0.19	0.38	1.88	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Tetrachloroethene	0.88		0.2	0.2	0.2	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Ethyl Benzene	2.65		0.43	0.43	2.17	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	m/p-Xylene	8.25		0.43	0.87	4.34	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	o-Xylene	3.39		0.43	0.43	2.17	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	1,3,5-Trimethylbenzene	1.03	J	0.49	0.49	2.46	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	1,2,4-Trimethylbenzene	4.28		0.49	0.49	2.46	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Naphthalene	0.84	J	0.21	0.52	2.62	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	4-Ethyltoluene	1.38	J	0.49	0.49	2.46	ug/m3
G1083-02	SG-DUP-1-01-12-2015	Air	Hexane	3.52		0.14	0.35	1.76	ug/m3
			Total Voc :	167.93					
			Total Concentration:	167.93					
Client ID:	**B23-1-SG-01-12-2015**								
G1083-03	B23-1-SG-01-12-2015	Air	Dichlorodifluoromethane	3.07		0.2	0.49	2.47	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Chloromethane	0.21	J	0.21	0.21	1.03	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Trichlorofluoromethane	1.69	J	0.22	0.56	2.81	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Heptane	1.56	J	0.41	0.41	2.05	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Acetone	23.30		0.24	0.24	1.19	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Methylene Chloride	26.80	B	0.17	0.35	1.74	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Cyclohexane	0.48	J	0.34	0.34	1.72	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	2-Butanone	13.90		0.29	0.29	1.47	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Carbon Tetrachloride	11.30		0.19	0.19	0.19	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Chloroform	2.73		0.1	0.49	2.44	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	2,2,4-Trimethylpentane	3.13		0.19	0.47	2.34	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Benzene	1.53	J	0.13	0.32	1.6	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Trichloroethene	7.52		0.11	0.16	0.16	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Toluene	55.00		0.19	0.38	1.88	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Tetrachloroethene	0.68		0.2	0.2	0.2	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Ethyl Benzene	2.78		0.43	0.43	2.17	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	m/p-Xylene	7.82		0.43	0.87	4.34	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	o-Xylene	3.30		0.43	0.43	2.17	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	1,3,5-Trimethylbenzene	0.98	J	0.49	0.49	2.46	ug/m3

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Hit Summary Sheet
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SDG No.: G1083

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
G1083-03	B23-1-SG-01-12-2015	Air	1,2,4-Trimethylbenzene	4.13		0.49	0.49	2.46	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Naphthalene	0.84	J	0.21	0.52	2.62	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	4-Ethyltoluene	1.28	J	0.49	0.49	2.46	ug/m3
G1083-03	B23-1-SG-01-12-2015	Air	Hexane	4.23		0.14	0.35	1.76	ug/m3
			Total Voc :	178.26					
			Total Concentration:	178.26					

Project : Frankford Arsenal Air
Field Id Number : B23-2-SG-01-12-2015
Laboratory Id Number : G1083-01

Sampling Date : 01/13/15
Analysis Date : 01/15/15
Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	0.52		2.57		
Chloromethane	74-87-3	50.49	0.1	U	0.21		
Vinyl Chloride	75-01-4	62.5	0.03	U	0.08		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.1	U	0.29		
Trichlorofluoromethane	75-69-4	137.4	0.23	J	1.29		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.1	U	0.3		
Heptane	142-82-5	100.2	0.27	J	1.11		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	10.7		25.4		
Carbon Disulfide	75-15-0	76.14	0.1	U	0.31		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	0.55		1.91		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	0.1	U	0.34		
2-Butanone	78-93-3	72.11	0.46	J	1.36		
Carbon Tetrachloride	56-23-5	153.8	77.7	E	488		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	19.7	E	96.2		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	0.74		3.46		
Benzene	71-43-2	78.11	0.44	J	1.41		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	6.8		36.5		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.1	U	0.41		
Toluene	108-88-3	92.14	3.2		12.1		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		

Project : Frankford Arsenal Air

Field Id Number : B23-2-SG-01-12-2015

Laboratory Id Number : G1083-01

Sampling Date : 01/13/15

Analysis Date : 01/15/15

Target Analyts : Air Results

Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.1		0.68		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	0.4	J	1.74		
m/p-Xylene	179601-23-1	106.2	1.5		6.52		
o-Xylene	95-47-6	106.2	0.64		2.78		
Styrene	100-42-5	104.1	0.1	U	0.43		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		
2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.15	J	0.74		
1,2,4-Trimethylbenzene	95-63-6	120.2	0.63		3.1		
1,3-Dichlorobenzene	541-73-1	147	0.1	U	0.6		
1,4-Dichlorobenzene	106-46-7	147	0.1	J	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	0.08	J	0.42		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.21	J	1.03		
Hexane	110-54-3	86.17	0.1	U	0.35		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

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Project : Frankford Arsenal Air **Sampling Date :** 01/13/15

Field Id Number : B23-2-SG-01-12-2015DL **Analysis Date :** 01/15/15

Laboratory Id Number : G1083-01DL **Target Analyts :** Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	4	UD	19.8		
Chloromethane	74-87-3	50.49	4	UD	8.26		
Vinyl Chloride	75-01-4	62.5	1.2	UD	3.07		
Bromomethane	74-83-9	94.94	4	UD	15.5		
Chloroethane	75-00-3	64.52	4	UD	10.6		
Tetrahydrofuran	109-99-9	72.11	4	UD	11.8		
Trichlorofluoromethane	75-69-4	137.4	4	UD	22.5		
Dichlorotetrafluoroethane	76-14-2	170.9	4	UD	28.0		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	4	UD	30.7		
Bromoethene	593-60-2	106.9	4	UD	17.5		
tert-Butyl alcohol	75-65-0	74.12	4	UD	12.1		
Heptane	142-82-5	100.2	4	UD	16.4		
1,1-Dichloroethene	75-35-4	96.94	4	UD	15.9		
Acetone	67-64-1	58.08	4	UD	9.5		
Carbon Disulfide	75-15-0	76.14	4	UD	12.5		
Methyl tert-Butyl Ether	1634-04-4	88.15	4	UD	14.4		
Methylene Chloride	75-09-2	84.94	4	UD	13.9		
trans-1,2-Dichloroethene	156-60-5	96.94	4	UD	15.9		
1,1-Dichloroethane	75-34-3	98.96	4	UD	16.2		
Cyclohexane	110-82-7	84.16	4	UD	13.8		
2-Butanone	78-93-3	72.11	4	UD	11.8		
Carbon Tetrachloride	56-23-5	153.8	220	D	1383		
cis-1,2-Dichloroethene	156-59-2	96.94	4	UD	15.9		
Chloroform	67-66-3	119.4	21.2	D	103		
1,1,1-Trichloroethane	71-55-6	133.4	1.2	UD	6.55		
2,2,4-Trimethylpentane	540-84-1	114.2	4	UD	18.7		
Benzene	71-43-2	78.11	4	UD	12.8		
1,2-Dichloroethane	107-06-2	98.96	4	UD	16.2		
Trichloroethene	79-01-6	131.4	6.8	D	36.5		
1,2-Dichloropropane	78-87-5	113	4	UD	18.5		
Bromodichloromethane	75-27-4	163.8	4	UD	26.8		
4-Methyl-2-Pentanone	108-10-1	100.2	4	UD	16.4		
Toluene	108-88-3	92.14	4	UD	15.1		
t-1,3-Dichloropropene	10061-02-6	111	4	UD	18.2		
cis-1,3-Dichloropropene	10061-01-5	111	4	UD	18.2		
1,1,2-Trichloroethane	79-00-5	133.4	4	UD	21.8		

Project : Frankford Arsenal Air **Sampling Date :** 01/13/15

Field Id Number : B23-2-SG-01-12-2015DL **Analysis Date :** 01/15/15

Laboratory Id Number : G1083-01DL **Target Analyts :** Air Results

Dibromochloromethane	124-48-1	208.3	4	UD	34.1		
1,2-Dibromoethane	106-93-4	187.9	4	UD	30.7		
Tetrachloroethene	127-18-4	165.8	1.2	UD	8.14		
Chlorobenzene	108-90-7	112.6	4	UD	18.4		
Ethyl Benzene	100-41-4	106.2	4	UD	17.4		
m/p-Xylene	179601-23-1	106.2	8	UD	34.8		
o-Xylene	95-47-6	106.2	4	UD	17.4		
Styrene	100-42-5	104.1	4	UD	17.0		
Bromoform	75-25-2	252.8	4	UD	41.4		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	1.2	UD	8.24		
2-Chlorotoluene	95-49-8	126.6	4	UD	20.7		
1,3,5-Trimethylbenzene	108-67-8	120.2	4	UD	19.7		
1,2,4-Trimethylbenzene	95-63-6	120.2	4	UD	19.7		
1,3-Dichlorobenzene	541-73-1	147	4	UD	24.0		
1,4-Dichlorobenzene	106-46-7	147	4	UD	24.0		
1,2-Dichlorobenzene	95-50-1	147	4	UD	24.0		
1,2,4-Trichlorobenzene	120-82-1	181.5	4	UD	29.7		
Hexachloro-1,3-Butadiene	87-68-3	260.8	4	UD	42.7		
1,3-Butadiene	106-99-0	54.09	4	UD	8.85		
Naphthalene	91-20-3	128.17	4	UD	21.0		
4-Ethyltoluene	622-96-8	120.2	4	UD	19.7		
Hexane	110-54-3	86.17	4	UD	14.1		
Allyl Chloride	107-05-1	76.53	4	UD	12.5		
1,4-Dioxane	123-91-1	88.12	4	UD	14.4		
Methyl Methacrylate	80-62-6	100.117	4	UD	16.4		

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Project : Frankford Arsenal Air **Sampling Date :** 01/13/15

Field Id Number : SG-DUP-1-01-12-2015 **Analysis Date :** 01/15/15

Laboratory Id Number : G1083-02 **Target Analyts :** Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	0.6		2.97		
Chloromethane	74-87-3	50.49	0.11	J	0.23		
Vinyl Chloride	75-01-4	62.5	0.03	U	0.08		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.1	U	0.29		
Trichlorofluoromethane	75-69-4	137.4	0.3	J	1.69		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.1	U	0.3		
Heptane	142-82-5	100.2	0.35	J	1.43		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	9.4		22.3		
Carbon Disulfide	75-15-0	76.14	0.1	U	0.31		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	6		20.8		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	0.15	J	0.52		
2-Butanone	78-93-3	72.11	3.5		10.3		
Carbon Tetrachloride	56-23-5	153.8	2.1		13.2		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	0.69		3.37		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	0.59		2.76		
Benzene	71-43-2	78.11	0.42	J	1.34		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	2.2		11.8		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.1	U	0.41		
Toluene	108-88-3	92.14	13		49.0		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		

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Project : Frankford Arsenal Air **Sampling Date :** 01/13/15

Field Id Number : SG-DUP-1-01-12-2015 **Analysis Date :** 01/15/15

Laboratory Id Number : G1083-02 **Target Analyts :** Air Results

Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.13		0.88		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	0.61		2.65		
m/p-Xylene	179601-23-1	106.2	1.9		8.25		
o-Xylene	95-47-6	106.2	0.78		3.39		
Styrene	100-42-5	104.1	0.1	U	0.43		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		
2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.21	J	1.03		
1,2,4-Trimethylbenzene	95-63-6	120.2	0.87		4.28		
1,3-Dichlorobenzene	541-73-1	147	0.1	U	0.6		
1,4-Dichlorobenzene	106-46-7	147	0.1	U	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	0.16	J	0.84		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.28	J	1.38		
Hexane	110-54-3	86.17	1		3.52		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : (908)-789-8922

Project : Frankford Arsenal Air

Field Id Number : B23-1-SG-01-12-2015

Laboratory Id Number : G1083-03

Sampling Date : 01/13/15

Analysis Date : 01/15/15

Target Analyts : Air Results

Chemical	Cas Number	Molecular Weight	Insert Results in PPBV	Qualifier	Generate Results in ug/m3	QAS Decision	Foot Notes
Dichlorodifluoromethane	75-71-8	120.9	0.62		3.07		
Chloromethane	74-87-3	50.49	0.1	J	0.21		
Vinyl Chloride	75-01-4	62.5	0.03	U	0.08		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.1	U	0.29		
Trichlorofluoromethane	75-69-4	137.4	0.3	J	1.69		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.1	U	0.3		
Heptane	142-82-5	100.2	0.38	J	1.56		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	9.8		23.3		
Carbon Disulfide	75-15-0	76.14	0.1	U	0.31		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	7.7		26.8		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	0.14	J	0.48		
2-Butanone	78-93-3	72.11	4.7		13.9		
Carbon Tetrachloride	56-23-5	153.8	1.8		11.3		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	0.56		2.73		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	0.67		3.13		
Benzene	71-43-2	78.11	0.48	J	1.53		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	1.4		7.52		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.1	U	0.41		
Toluene	108-88-3	92.14	14.6		55.0		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		

284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : (908)-789-8922

Project : Frankford Arsenal Air | **Sampling Date :** 01/13/15
Field Id Number : B23-1-SG-01-12-2015 | **Analysis Date :** 01/15/15
Laboratory Id Number : G1083-03 | **Target Analyts :** Air Results

Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.1		0.68		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	0.64		2.78		
m/p-Xylene	179601-23-1	106.2	1.8		7.82		
o-Xylene	95-47-6	106.2	0.76		3.3		
Styrene	100-42-5	104.1	0.1	U	0.43		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		
2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.2	J	0.98		
1,2,4-Trimethylbenzene	95-63-6	120.2	0.84		4.13		
1,3-Dichlorobenzene	541-73-1	147	0.1	U	0.6		
1,4-Dichlorobenzene	106-46-7	147	0.1	U	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	0.16	J	0.84		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.26	J	1.28		
Hexane	110-54-3	86.17	1.2		4.23		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

Project :	Frankford Arsenal Air	**Sampling Date :**	01/13/15
Field Id Number :	B23-1-SG-01-12-2015	**Analysis Date :**	01/15/15
Laboratory Id Number :	G1083-03	**Target Analyts :**	Air Results

Current MDLs for Air

Method	Matrix	CAS #	Compound Name	Molecular Wt	ppbv MDL	LOD ppbv	LOQ ppbv	ug/m3 MDL	LOD ug/m3	LOQ ug/m3
TO-15	Air	71-55-6	1,1,1-Trichloroethane	133	0.04	0.04	0.5	0.22	0.22	2.72
TO-15	Air	79-34-5	1,1,2,2-Tetrachloroethane	168	0.10	0.1	0.5	0.69	0.69	3.44
TO-15	Air	79-00-5	1,1,2-Trichloroethane	133	0.08	0.1	0.5	0.44	0.54	2.72
TO-15	Air	76-13-1	1,1,2-Trichlorotrifluoroethane	187	0.04	0.1	0.5	0.32	0.76	3.82
TO-15	Air	75-34-3	1,1-Dichloroethane	99	0.04	0.1	0.5	0.16	0.40	2.02
TO-15	Air	75-35-4	1,1-Dichloroethene	97	0.05	0.1	0.5	0.20	0.40	1.98
TO-15	Air	120-82-1	1,2,4-Trichlorobenzene	181	0.04	0.1	0.5	0.29	0.74	3.70
TO-15	Air	95-63-6	1,2,4-Trimethylbenzene	120	0.10	0.1	0.5	0.50	0.49	2.45
TO-15	Air	106-93-4	1,2-Dibromoethane	188	0.07	0.1	0.5	0.55	0.77	3.84
TO-15	Air	95-50-1	1,2-Dichlorobenzene	147	0.07	0.1	0.5	0.41	0.60	3.01
TO-15	Air	107-06-2	1,2-Dichloroethane	99	0.07	0.1	0.5	0.28	0.40	2.02
TO-15	Air	78-87-5	1,2-Dichloropropane	113	0.06	0.1	0.5	0.30	0.46	2.31
TO-15	Air	108-67-8	1,3,5-Trimethylbenzene	120	0.09	0.1	0.5	0.44	0.49	2.45
TO-15	Air	106-99-0	1,3-Butadiene	54	0.09	0.1	0.5	0.20	0.22	1.10
TO-15	Air	541-73-1	1,3-Dichlorobenzene	147	0.08	0.1	0.5	0.46	0.60	3.01
TO-15	Air	106-46-7	1,4-Dichlorobenzene	147	0.06	0.1	0.5	0.35	0.60	3.01
TO-15	Air	123-91-1	1,4-Dioxane	88	0.09	0.1	0.5	0.32	0.36	1.80
TO-15	Air	540-84-1	2,2,4-Trimethylpentane	114	0.04	0.1	0.5	0.21	0.47	2.33
TO-15	Air	78-93-3	2-Butanone	72	0.10	0.1	0.5	0.29	0.29	1.47
TO-15	Air	95-49-8	2-Chlorotoluene	126.6	0.10	0.1	0.5	0.52	0.52	2.59
TO-15	Air	591-78-6	2-Hexanone	100	0.08	0.1	0.5	0.33	0.41	2.04
TO-15	Air	622-96-8	4-Ethyltoluene	120	0.08	0.1	0.5	0.38	0.49	2.45
TO-15	Air	108-10-1	4-Methyl-2-Pentanone	100	0.06	0.1	0.5	0.24	0.41	2.04
TO-15	Air	67-64-1	Acetone	58	0.10	0.1	0.5	0.24	0.24	1.19
TO-15	Air	107-05-1	Allyl Chloride	77	0.05	0.1	0.5	0.16	0.31	1.57
TO-15	Air	71-43-2	Benzene	78	0.04	0.1	0.5	0.12	0.32	1.60
TO-15	Air	100-44-7	Benzyl Chloride	141	0.06	0.1	0.5	0.37	0.58	2.88
TO-15	Air	75-27-4	Bromodichloromethane	164	0.05	0.1	0.5	0.33	0.67	3.35
TO-15	Air	593-60-2	Bromoethene	107	0.03	0.1	0.5	0.14	0.44	2.19
TO-15	Air	75-25-2	Bromoform	253	0.05	0.1	0.5	0.49	1.03	5.17
TO-15	Air	74-83-9	Bromomethane	95	0.03	0.1	0.5	0.12	0.39	1.94
TO-15	Air	75-15-0	Carbon Disulfide	76	0.05	0.1	0.5	0.14	0.31	1.55
TO-15	Air	56-23-5	Carbon Tetrachloride	154	0.04	0.04	0.5	0.25	0.25	3.15
TO-15	Air	108-90-7	Chlorobenzene	113	0.09	0.1	0.5	0.40	0.46	2.31
TO-15	Air	75-00-3	Chloroethane	65	0.07	0.1	0.5	0.18	0.27	1.33
TO-15	Air	67-66-3	Chloroform	119	0.02	0.1	0.5	0.08	0.49	2.43
TO-15	Air	74-87-3	Chloromethane	50	0.06	0.1	0.5	0.12	0.20	1.02
TO-15	Air	156-59-2	cis-1,2-Dichloroethene	97	0.06	0.1	0.5	0.22	0.40	1.98
TO-15	Air	10061-01-5	cis-1,3-Dichloropropene	111	0.06	0.1	0.5	0.29	0.45	2.27
TO-15	Air	110-82-7	Cyclohexane	82	0.08	0.1	0.5	0.28	0.34	1.68
TO-15	Air	124-48-1	Dibromochloromethane	208	0.05	0.1	0.5	0.43	0.85	4.25
TO-15	Air	75-71-8	Dichlorodifluoromethane	121	0.04	0.1	0.5	0.18	0.49	2.47
TO-15	Air	76-14-2	Dichlorotetrafluoroethane	171	0.04	0.1	0.5	0.27	0.70	3.50
TO-15	Air	64-17-5	Ethanol	46.1	0.10	0.1	0.5	0.19	0.19	0.94
TO-15	Air	141-78-6	Ethyl Acetate	88	0.06	0.1	0.5	0.23	0.36	1.80
TO-15	Air	100-41-4	Ethyl Benzene	106	0.08	0.1	0.5	0.35	0.43	2.17
TO-15	Air	142-82-5	Heptane	100	0.06	0.1	0.5	0.25	0.41	2.04
TO-15	Air	87-68-3	Hexachloro-1,3-Butadiene	261	0.08	0.1	0.5	0.82	1.07	5.34

Current MDLs for Air

TO-15	Air	110-54-3	Hexane	86	0.04	0.1	0.5	0.15	0.35	1.76
TO-15	Air	67-63-0	Isopropyl Alcohol	60	0.10	0.1	0.5	0.25	0.25	1.23
TO-15	Air	136777-61-2	m/p-Xylene	106	0.10	0.2	1	0.43	0.87	4.34
TO-15	Air	80-62-6	Methyl methacrylate	100.1	0.10	0.1	0.5	0.41	0.41	2.05
TO-15	Air	1634-04-4	Methyl tert-Butyl Ether	88	0.05	0.1	0.5	0.19	0.36	1.80
TO-15	Air	75-09-2	Methylene Chloride	85	0.05	0.1	0.5	0.16	0.35	1.74
TO-15	Air	95-47-6	o-Xylene	106	0.07	0.1	0.5	0.29	0.43	2.17
TO-15	Air	115-07-1	Propene	42	0.10	0.1	0.5	0.18	0.18	0.86
TO-15	Air	100-42-5	Styrene	104	0.07	0.1	0.5	0.29	0.43	2.13
TO-15	Air	10061-02-6	t-1,3-Dichloropropene	111	0.07	0.1	0.5	0.30	0.45	2.27
TO-15	Air	27975-78-6	tert-butyl alcohol	74.1	0.10	0.1	0.5	0.30	0.30	1.52
TO-15	Air	127-18-4	Tetrachloroethene	166	0.03	0.03	0.5	0.20	0.20	3.39
TO-15	Air	109-99-9	Tetrahydrofuran	72	0.08	0.1	0.5	0.23	0.29	1.47
TO-15	Air	108-88-3	Toluene	92	0.05	0.1	0.5	0.20	0.38	1.88
TO-15	Air	156-60-5	trans-1,2-Dichloroethene	97	0.06	0.1	0.5	0.24	0.40	1.98
TO-15	Air	79-01-6	Trichloroethene	131	0.04	0.04	0.5	0.21	0.21	2.68
TO-15	Air	75-69-4	Trichlorofluoromethane	137	0.04	0.1	0.5	0.22	0.56	2.80
TO-15	Air	108-05-4	Vinyl Acetate	86	0.10	0.1	0.5	0.35	0.35	1.76
TO-15	Air	75-01-4	Vinyl Chloride	62.5	0.07	0.07	0.5	0.17	0.17	1.28

TO-15	Air	91-20-3	Naphthalene	128	0.04	0.25	0.50	0.21	1.31	2.62
TO-15	Air	98-82-8	Isopropylbenzene	120			0.5			2.46
TO-15	Air	103-65-1	n-propylbenzene	120			0.5			2.46
TO-15	Air	98-06-6	tert-butyl benzene	134			0.5			2.74
TO-15	Air	135-98-8	sec-butylbenzene	134			0.5			2.74
TO-15	Air	99-87-6	p-isopropyltoluene	134			0.5			2.74
TO-15	Air	104-51-8	n-butylbenzene	134			0.5			2.74
			Acetonitrile							
			Acrolein							
			Acrylonitrile							
			1,1,1,2-Tetrachloroethane							
			Tert-butanol							

SAMPLE DATA

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	B23-2-SG-01-12-2015	SDG No.:	G1083
Lab Sample ID:	G1083-01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024522.D	1		01/15/15 20:13	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.52	2.57		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.1	0.21	U	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.23	1.29	J	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	U	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.27	1.11	J	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	10.7	25.4		0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	0.55	1.91	B	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.1	0.34	U	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	0.46	1.36	J	0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	77.7	488	E	0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	19.7	96.2	E	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.74	3.46		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.44	1.41	J	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	6.8	36.5		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	3.2	12.1		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	B23-2-SG-01-12-2015	SDG No.:	G1083
Lab Sample ID:	G1083-01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024522.D	1		01/15/15 20:13	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.1	0.68		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.4	1.74	J	0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	1.5	6.52		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.64	2.78		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.15	0.74	J	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.63	3.1		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	J	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	UQ	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	UQ	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	UQ	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.08	0.42	J	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.21	1.03	J	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	0.1	0.35	U	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	UQ	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.6			65 - 135		96%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	1079250		6.67				
540-36-3	1,4-Difluorobenzene	2174500		8.34				
3114-55-4	Chlorobenzene-d5	2224420		13.75				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	B23-2-SG-01-12-2015DL	SDG No.:	G1083
Lab Sample ID:	G1083-01DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024523.D	40		01/15/15 20:51	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	4	19.8	UD	7.91	19.8	98.9	ug/m3
74-87-3	Chloromethane	4	8.26	UD	8.26	8.26	41.3	ug/m3
75-01-4	Vinyl Chloride	1.2	3.07	UD	3.07	3.07	3.07	ug/m3
74-83-9	Bromomethane	4	15.5	UD	4.66	15.5	77.7	ug/m3
75-00-3	Chloroethane	4	10.6	UD	10.6	10.6	52.8	ug/m3
109-99-9	Tetrahydrofuran	4	11.8	UD	11.8	11.8	59.0	ug/m3
75-69-4	Trichlorofluoromethane	4	22.5	UD	8.99	22.5	112	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	4	30.7	UD	12.3	30.7	153	ug/m3
76-14-2	Dichlorotetrafluoroethane	4	28.0	UD	11.2	28.0	139	ug/m3
593-60-2	Bromoethene	4	17.5	UD	5.25	17.5	87.4	ug/m3
75-65-0	tert-Butyl alcohol	4	12.1	UD	12.1	12.1	60.6	ug/m3
142-82-5	Heptane	4	16.4	UD	16.4	16.4	82.0	ug/m3
75-35-4	1,1-Dichloroethene	4	15.9	UD	7.93	15.9	79.3	ug/m3
67-64-1	Acetone	4	9.5	UD	9.5	9.5	47.5	ug/m3
75-15-0	Carbon Disulfide	4	12.5	UD	6.23	12.5	62.3	ug/m3
1634-04-4	Methyl tert-Butyl Ether	4	14.4	UD	7.21	14.4	72.1	ug/m3
75-09-2	Methylene Chloride	4	13.9	UD	6.95	13.9	69.5	ug/m3
156-60-5	trans-1,2-Dichloroethene	4	15.9	UD	7.93	15.9	79.3	ug/m3
75-34-3	1,1-Dichloroethane	4	16.2	UD	6.48	16.2	81.0	ug/m3
110-82-7	Cyclohexane	4	13.8	UD	13.8	13.8	68.8	ug/m3
78-93-3	2-Butanone	4	11.8	UD	11.8	11.8	59.0	ug/m3
56-23-5	Carbon Tetrachloride	220	1383	D	7.55	7.55	7.55	ug/m3
156-59-2	cis-1,2-Dichloroethene	4	15.9	UD	7.93	15.9	79.3	ug/m3
67-66-3	Chloroform	21.2	103	D	3.91	19.5	97.7	ug/m3
71-55-6	1,1,1-Trichloroethane	1.2	6.55	UD	6.55	6.55	6.55	ug/m3
540-84-1	2,2,4-Trimethylpentane	4	18.7	UD	7.47	18.7	93.4	ug/m3
71-43-2	Benzene	4	12.8	UD	5.11	12.8	63.9	ug/m3
107-06-2	1,2-Dichloroethane	4	16.2	UD	16.2	16.2	81.0	ug/m3
79-01-6	Trichloroethene	6.8	36.5	D	3.22	6.45	6.45	ug/m3
78-87-5	1,2-Dichloropropane	4	18.5	UD	18.5	18.5	92.4	ug/m3
75-27-4	Bromodichloromethane	4	26.8	UD	13.4	26.8	133	ug/m3
108-10-1	4-Methyl-2-Pentanone	4	16.4	UD	8.2	16.4	82.0	ug/m3
108-88-3	Toluene	4	15.1	UD	7.54	15.1	75.4	ug/m3
10061-02-6	t-1,3-Dichloropropene	4	18.2	UD	18.2	18.2	90.8	ug/m3
10061-01-5	cis-1,3-Dichloropropene	4	18.2	UD	18.2	18.2	90.8	ug/m3
79-00-5	1,1,2-Trichloroethane	4	21.8	UD	21.8	21.8	109	ug/m3
124-48-1	Dibromochloromethane	4	34.1	UD	17.0	34.1	170	ug/m3
106-93-4	1,2-Dibromoethane	4	30.7	UD	30.7	30.7	153	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	B23-2-SG-01-12-2015DL	SDG No.:	G1083
Lab Sample ID:	G1083-01DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024523.D	40		01/15/15 20:51	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	1.2	8.14	UD	8.14	8.14	8.14	ug/m3
108-90-7	Chlorobenzene	4	18.4	UD	18.4	18.4	92.1	ug/m3
100-41-4	Ethyl Benzene	4	17.4	UD	17.4	17.4	86.9	ug/m3
179601-23-1	m/p-Xylene	8	34.8	UD	17.4	34.8	173	ug/m3
95-47-6	o-Xylene	4	17.4	UD	17.4	17.4	86.9	ug/m3
100-42-5	Styrene	4	17.0	UD	17.0	17.0	85.2	ug/m3
75-25-2	Bromoform	4	41.4	UD	20.7	41.4	206	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	1.2	8.24	UD	8.24	8.24	8.24	ug/m3
95-49-8	2-Chlorotoluene	4	20.7	UD	20.7	20.7	103	ug/m3
108-67-8	1,3,5-Trimethylbenzene	4	19.7	UD	19.7	19.7	98.3	ug/m3
95-63-6	1,2,4-Trimethylbenzene	4	19.7	UD	19.7	19.7	98.3	ug/m3
541-73-1	1,3-Dichlorobenzene	4	24.0	UD	24.0	24.0	120	ug/m3
106-46-7	1,4-Dichlorobenzene	4	24.0	UD	24.0	24.0	120	ug/m3
95-50-1	1,2-Dichlorobenzene	4	24.0	UDQ	24.0	24.0	120	ug/m3
120-82-1	1,2,4-Trichlorobenzene	4	29.7	UDQ	11.9	29.7	148	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	4	42.7	UDQ	42.7	42.7	213	ug/m3
106-99-0	1,3-Butadiene	4	8.85	UD	8.85	8.85	44.2	ug/m3
91-20-3	Naphthalene	4	21.0	UD	8.39	21.0	104	ug/m3
622-96-8	4-Ethyltoluene	4	19.7	UD	19.7	19.7	98.3	ug/m3
110-54-3	Hexane	4	14.1	UD	5.64	14.1	70.5	ug/m3
107-05-1	Allyl Chloride	4	12.5	UD	6.26	12.5	62.6	ug/m3
123-91-1	1,4-Dioxane	4	14.4	UDQ	14.4	14.4	72.1	ug/m3
80-62-6	Methyl Methacrylate	4	16.4	UD	16.4	16.4	81.9	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.6			65 - 135		96%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	831527		6.65				
540-36-3	1,4-Difluorobenzene	2105630		8.33				
3114-55-4	Chlorobenzene-d5	2089530		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	SG-DUP-1-01-12-2015	SDG No.:	G1083
Lab Sample ID:	G1083-02	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024519.D	1		01/15/15 18:10	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.6	2.97		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.11	0.23	J	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.3	1.69	J	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	U	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.35	1.43	J	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	9.4	22.3		0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	6	20.8	B	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.15	0.52	J	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	3.5	10.3		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	2.1	13.2		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.69	3.37		0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.59	2.76		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.42	1.34	J	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	2.2	11.8		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	13	49.0		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	SG-DUP-1-01-12-2015	SDG No.:	G1083
Lab Sample ID:	G1083-02	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024519.D	1		01/15/15 18:10	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.13	0.88		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.61	2.65		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	1.9	8.25		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.78	3.39		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.21	1.03	J	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.87	4.28		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	UQ	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	UQ	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	UQ	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.16	0.84	J	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.28	1.38	J	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	1	3.52		0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	UQ	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.6			65 - 135		96%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	1142620		6.65				
540-36-3	1,4-Difluorobenzene	2346000		8.32				
3114-55-4	Chlorobenzene-d5	2336550		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	B23-1-SG-01-12-2015	SDG No.:	G1083
Lab Sample ID:	G1083-03	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024521.D	1		01/15/15 19:32	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.62	3.07		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.1	0.21	J	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.3	1.69	J	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	U	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.38	1.56	J	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	9.8	23.3		0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	7.7	26.8	B	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.14	0.48	J	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	4.7	13.9		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	1.8	11.3		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.56	2.73		0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.67	3.13		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.48	1.53	J	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	1.4	7.52		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	14.6	55.0		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	01/13/15
Project:	Frankford Arsenal Air	Date Received:	01/14/15
Client Sample ID:	B23-1-SG-01-12-2015	SDG No.:	G1083
Lab Sample ID:	G1083-03	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024521.D	1		01/15/15 19:32	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.1	0.68		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.64	2.78		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	1.8	7.82		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.76	3.3		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.2	0.98	J	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.84	4.13		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	UQ	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	UQ	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	UQ	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.16	0.84	J	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.26	1.28	J	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	1.2	4.23		0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	UQ	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.6			65 - 135		96%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	1086150		6.65				
540-36-3	1,4-Difluorobenzene	2282910		8.32				
3114-55-4	Chlorobenzene-d5	2265700		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

QC SUMMARY

284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

Surrogate Summary

SDG No.: **G1083**

Client: **EA Engineering Science & Technology**

Analytical Method: **SWTO-15**

Lab Sample ID	Client ID	Parameter	Spike	Result	Recovery	Qual	Limits Low	Limits High
G1083-01	B23-2-SG-01-12-2015	1-Bromo-4-Fluorobenzene	10	9.63	96		65	135
G1083-01DL	B23-2-SG-01-12-2015DL	1-Bromo-4-Fluorobenzene	10	9.61	96		65	135
G1083-02	SG-DUP-1-01-12-2015	1-Bromo-4-Fluorobenzene	10	9.58	96		65	135
G1083-02DUP	SG-DUP-1-01-12-2015DUP	1-Bromo-4-Fluorobenzene	10	9.43	94		65	135
G1083-03	B23-1-SG-01-12-2015	1-Bromo-4-Fluorobenzene	10	9.62	96		65	135
VL0115ABL	VL0115ABL	1-Bromo-4-Fluorobenzene	10	10	100		65	135
VL0115ABS	VL0115ABS	1-Bromo-4-Fluorobenzene	10	9.215	92		65	135

CHEMTECH

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Laboratory Control Sample/Laboratory Control Sample Duplicate Summary
SW-846

SDG No.: G1083

Client: EA Engineering Science & Technology

Analytical Method: SWTO-15 **Datafile :** VL024515.D

Lab Sample ID	Parameter	Spike	Result	Unit	Rec	RPD	Qual	Limits Low	Limits High	RPD
VL0115ABS	Dichlorodifluoromethane	10	11.7	ppbv	117			70	130	
	Chloromethane	10	10.3	ppbv	103			70	130	
	Vinyl Chloride	10	10.1	ppbv	101			70	130	
	Bromomethane	10	9.3	ppbv	93			70	130	
	Chloroethane	10	9.4	ppbv	94			70	130	
	Tetrahydrofuran	10	10.9	ppbv	109			70	130	
	Trichlorofluoromethane	10	9.5	ppbv	95			70	130	
	1,1,2-Trichlorotrifluoroethane	10	9.2	ppbv	92			70	130	
	Dichlorotetrafluoethane	10	9.2	ppbv	92			70	130	
	Bromoethene	10	8.8	ppbv	88			70	130	
	tert-Butyl Alcohol	10	7.8	ppbv	78			70	130	
	Heptane	10	10.6	ppbv	106			70	130	
	1,1-Dichloroethene	10	8.8	ppbv	88			70	130	
	Acetone	10	9.4	ppbv	94			70	130	
	Carbon disulfide	10	9.9	ppbv	99			70	130	
	Methyl tert-butyl Ether	10	9.3	ppbv	93			70	130	
	Methylene Chloride	10	8.3	ppbv	83			70	130	
	trans-1,2-Dichloroethene	10	9.6	ppbv	96			70	130	
	1,1-Dichloroethane	10	10	ppbv	100			70	130	
	Cyclohexane	10	10.5	ppbv	105			70	130	
	2-Butanone	10	10.1	ppbv	101			70	130	
	Carbon Tetrachloride	10	10.5	ppbv	105			70	130	
	cis-1,2-Dichloroethene	10	11.1	ppbv	111			70	130	
	Chloroform	10	10.8	ppbv	108			70	130	
	1,1,1-Trichloroethane	10	10.8	ppbv	108			70	130	
	2,2,4-Trimethylpentane	10	10.2	ppbv	102			70	130	
	Benzene	10	10.8	ppbv	108			70	130	
	1,2-Dichloroethane	10	11.1	ppbv	111			70	130	
	Trichloroethene	10	9.1	ppbv	91			70	130	
	1,2-Dichloropropane	10	10.9	ppbv	109			70	130	
	Bromodichloromethane	10	11.1	ppbv	111			70	130	
	4-Methyl-2-Pentanone	10	10.2	ppbv	102			70	130	
	Toluene	10	9.7	ppbv	97			70	130	
	t-1,3-Dichloropropene	10	9.8	ppbv	98			70	130	
	cis-1,3-Dichloropropene	10	10.6	ppbv	106			70	130	
	1,1,2-Trichloroethane	10	9.8	ppbv	98			70	130	
	Dibromochloromethane	10	10.1	ppbv	101			70	130	
	1,2-Dibromoethane	10	9.3	ppbv	93			70	130	
	Tetrachloroethene	10	8.2	ppbv	82			70	130	
	Chlorobenzene	10	10.1	ppbv	101			70	130	
	Ethyl Benzene	10	9.9	ppbv	99			70	130	
	m/p-Xylene	20	19.3	ppbv	97			70	130	
	o-Xylene	10	9.7	ppbv	97			70	130	
	Styrene	10	10.2	ppbv	102			70	130	
	Bromoform	10	9.2	ppbv	92			70	130	
	1,1,2,2-Tetrachloroethane	10	9.1	ppbv	91			70	130	
	2-Chlorotoluene	10	9.7	ppbv	97			70	130	
	1,3,5-Trimethylbenzene	10	9.5	ppbv	95			70	130	
	1,2,4-Trimethylbenzene	10	9.2	ppbv	92			70	130	

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Laboratory Control Sample/Laboratory Control Sample Duplicate Summary
SW-846

SDG No.: G1083

Client: EA Engineering Science & Technology

Analytical Method: SWTO-15 **Datafile :** VL024515.D

Lab Sample ID	Parameter	Spike	Result	Unit	Rec	RPD	Qual	Limits Low	Limits High	RPD
VL0115ABS	1,3-Dichlorobenzene	10	9.2	ppbv	92			70	130	
	1,4-Dichlorobenzene	10	9.3	ppbv	93			70	130	
	1,2-Dichlorobenzene	10	6.8	ppbv	68		*	70	130	
	1,2,4-Trichlorobenzene	10	6.3	ppbv	63		*	70	130	
	Hexachloro-1,3-butadiene	10	6.3	ppbv	63		*	70	130	
	Naphthalene	10	7.6	ppbv	76			70	130	
	1,3-Butadiene	10	9.6	ppbv	96			70	130	
	4-Ethyltoluene	10	9.8	ppbv	98			70	130	
	Hexane	10	10.5	ppbv	105			70	130	
	Allyl Chloride	10	8.7	ppbv	87			70	130	
	1,4-Dioxane	10	22.4	ppbv	224		*	70	130	
	Methyl methacrylate	10	11	ppbv	110			70	130	

Duplicate Sample Summary

Lab Sample Id :	G1083-02DUP	G1083-02
Client Id :	SG-DUP-1-01-12-2015DUI	SG-DUP-1-01-12-2015
DF :	1	1
Datafile :	VL024520.D	VL024519.D
Anal Date & Time :	01/15/2015 18:51	01/15/2015 18:10

Parameter	Result	Result	RPD
1,1,1-Trichloroethane	0	0	0
1,1,2,2-Tetrachloroethane	0	0	0
1,1,2-Trichloroethane	0	0	0
1,1,2-Trichlorotrifluoroethane	0	0	0
1,1-Dichloroethane	0	0	0
1,1-Dichloroethene	0	0	0
1,2,4-Trichlorobenzene	0	0	0
1,2,4-Trimethylbenzene	0.88	0.87	1.1
1,2-Dibromoethane	0	0	0
1,2-Dichlorobenzene	0	0	0
1,2-Dichloroethane	0	0	0
1,2-Dichloropropane	0	0	0
1,3,5-Trimethylbenzene	0.2	0.21	4.9
1,3-Butadiene	0	0	0
1,3-Dichlorobenzene	0	0	0
1,4-Dichlorobenzene	0	0	0
1,4-Dioxane	0	0	0
2,2,4-Trimethylpentane	0.61	0.59	3.3
2-Butanone	3.5	3.5	0
2-Chlorotoluene	0	0	0
4-Ethyltoluene	0.29	0.28	3.5
4-Methyl-2-Pentanone	0	0	0
Acetone	9.5	9.4	1.1
Allyl Chloride	0	0	0
Benzene	0.42	0.42	0
Bromodichloromethane	0	0	0
Bromoethene	0	0	0
Bromoform	0	0	0
Bromomethane	0	0	0
Carbon Disulfide	0	0	0

Duplicate Sample Summary

Lab Sample Id :	G1083-02DUP	G1083-02
Client Id :	SG-DUP-1-01-12-2015DUI	SG-DUP-1-01-12-2015
DF :	1	1
Datafile :	VL024520.D	VL024519.D
Anal Date & Time :	01/15/2015 18:51	01/15/2015 18:10

Parameter	Result	Result	RPD
Carbon Tetrachloride	2.1	2.1	0
Chlorobenzene	0	0	0
Chloroethane	0	0	0
Chloroform	0.67	0.69	2.9
Chloromethane	0.11	0.11	0
cis-1,2-Dichloroethene	0	0	0
cis-1,3-Dichloropropene	0	0	0
Cyclohexane	0	0.15	200 *
Dibromochloromethane	0	0	0
Dichlorodifluoromethane	0.6	0.6	0
Dichlorotetrafluoroethane	0	0	0
Ethyl Benzene	0.66	0.61	7.9
Heptane	0.37	0.35	5.6
Hexachloro-1,3-Butadiene	0	0	0
Hexane	1	1	0
m/p-Xylene	1.9	1.9	0
Methyl Methacrylate	0	0	0
Methyl tert-Butyl Ether	0	0	0
Methylene Chloride	6.1	6	1.7
Naphthalene	0.15	0.16	6.5
o-Xylene	0.82	0.78	5
Styrene	0	0	0
t-1,3-Dichloropropene	0	0	0
tert-Butyl alcohol	0	0	0
Tetrachloroethene	0.14	0.13	7.4
Tetrahydrofuran	0	0	0
Toluene	13	13	0
trans-1,2-Dichloroethene	0	0	0
Trichloroethene	2.2	2.2	0
Trichlorofluoromethane	0.31	0.3	3.3
Vinyl Chloride	0	0	0

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Duplicate Sample Summary

Lab Sample Id :	G1083-02DUP	G1083-02
Client Id :	SG-DUP-1-01-12-2015DUI	SG-DUP-1-01-12-2015
DF :	1	1
Datafile :	VL024520.D	VL024519.D
Anal Date & Time :	01/15/2015 18:51	01/15/2015 18:10

Parameter	Result	Result	RPD

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VL0115ABL

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG NO.: G1083

Lab File ID: VL024514.D Lab Sample ID: VL0115ABL

Date Analyzed: 01/15/2015 Time Analyzed: 14:29

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: (Y/N) N

Instrument ID: MSVOA_L

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
VL0115ABS	VL0115ABS	VL024515.D	01/15/2015
SG-DUP-1-01-12-2015	G1083-02	VL024519.D	01/15/2015
SG-DUP-1-01-12-2015DUP	G1083-02DUP	VL024520.D	01/15/2015
B23-1-SG-01-12-2015	G1083-03	VL024521.D	01/15/2015
B23-2-SG-01-12-2015	G1083-01	VL024522.D	01/15/2015
B23-2-SG-01-12-2015DL	G1083-01DL	VL024523.D	01/15/2015

COMMENTS:

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG NO.: G1083

Lab File ID: VL024435.D BFB Injection Date: 12/29/2014

Instrument ID: MSVOA_L BFB Injection Time: 10:32

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: Y/N N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	24.7
75	30.0 - 66.0% of mass 95	57.3
95	Base Peak, 100% relative abundance	100
96	5.0 - 9.0% of mass 95	6.7
173	Less than 2.0% of mass 174	0.0 (0.0) 1
174	50.0 - 120.0% of mass 95	61.5
175	4.0 - 9.0% of mass 174	4.7 (7.6) 1
176	93.0 - 101.0% of mass 174	60.1 (97.8) 1
177	5.0 - 9.0% of mass 176	3.8 (6.4) 2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
VSTDICC002	VSTDICC002	VL024437.D	12/29/2014	11:55
VSTDICC001	VSTDICC001	VL024438.D	12/29/2014	12:34
VSTDICC0.5	VSTDICC0.5	VL024439.D	12/29/2014	13:13
VSTDICC0.1	VSTDICC0.1	VL024440.D	12/29/2014	13:51
VSTDICC0.03	VSTDICC0.03	VL024441.D	12/29/2014	14:30
VSTDICCC010	VSTDICCC010	VL024442.D	12/29/2014	16:31
VSTDICC015	VSTDICC015	VL024443.D	12/29/2014	17:28

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VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG NO.: G1083

Lab File ID: VL024512.D BFB Injection Date: 01/15/2015

Instrument ID: MSVOA_L BFB Injection Time: 10:43

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: Y/N N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	22.1
75	30.0 - 66.0% of mass 95	55.3
95	Base Peak, 100% relative abundance	100
96	5.0 - 9.0% of mass 95	6.7
173	Less than 2.0% of mass 174	0.0 (0.0) 1
174	50.0 - 120.0% of mass 95	54.2
175	4.0 - 9.0% of mass 174	3.7 (6.8) 1
176	93.0 - 101.0% of mass 174	52.1 (96.1) 1
177	5.0 - 9.0% of mass 176	3.4 (6.4) 2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
VSTDCCC010	VSTDCCC010	VL024513.D	01/15/2015	12:38
VL0115ABL	VL0115ABL	VL024514.D	01/15/2015	14:29
VL0115ABS	VL0115ABS	VL024515.D	01/15/2015	15:07
SG-DUP-1-01-12-2015	G1083-02	VL024519.D	01/15/2015	18:10
SG-DUP-1-01-12-2015DUP	G1083-02DUP	VL024520.D	01/15/2015	18:51
B23-1-SG-01-12-2015	G1083-03	VL024521.D	01/15/2015	19:32
B23-2-SG-01-12-2015	G1083-01	VL024522.D	01/15/2015	20:13
B23-2-SG-01-12-2015DL	G1083-01DL	VL024523.D	01/15/2015	20:51

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: CHEMTECH　　Contract: EAEN06

Lab Code: CHEM　　Case No.: G1083　　SAS No.: G1083　　SDG NO.: G1083

Lab File ID: VL024513.D　　Date Analyzed: 01/15/2015

Instrument ID: MSVOA_L　　Time Analyzed: 12:38

GC Column: RTX-1　　ID: 0.32 (mm)　　Heated Purge: (Y/N) N

	IS1 AREA #	RT #	IS2 AREA #	RT #	IS3 AREA #	RT #
12 HOUR STD	1078950	6.65	2331220	8.32	2131920	13.74
UPPER LIMIT	1510540	6.98	3263710	8.65	2984690	14.07
LOWER LIMIT	647372	6.32	1398730	7.99	1279150	13.41
EPA SAMPLE NO.						
B23-2-SG-01-12-2015	1079254	6.67	2174501	8.34	2224418	13.75
B23-2-SG-01-12-2015DL	831527	6.65	2105627	8.33	2089525	13.74
SG-DUP-1-01-12-2015	1142615	6.65	2345995	8.32	2336551	13.74
SG-DUP-1-01-12-2015DUP	1076213	6.65	2220939	8.32	2193276	13.74
B23-1-SG-01-12-2015	1086148	6.65	2282906	8.32	2265696	13.74
VL0115ABL	1107665	6.65	2280687	8.32	2220539	13.74
VL0115ABS	1044760	6.66	2261109	8.33	2407593	13.75

IS1 = Bromochloromethane
IS2 = 1,4-Difluorobenzene
IS3 = Chlorobenzene-d5

AREA UPPER LIMIT = +40% of internal standard area
AREA LOWER LIMIT = -40% of internal standard area
RT UPPER LIMIT = +0.33 minutes of internal standard RT
RT LOWER LIMIT = -0.33 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

CHEMTECH

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QC SAMPLE DATA

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0115ABL	SDG No.:	G1083
Lab Sample ID:	VL0115ABL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024514.D	1		01/15/15 14:29	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.1	0.49	U	0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.1	0.21	U	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.1	0.56	U	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	U	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.1	0.41	U	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	0.1	0.24	U	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	0.08	0.28	J	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.1	0.34	U	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	0.1	0.29	U	0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	0.03	0.19	U	0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.1	0.49	U	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.1	0.47	U	0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.1	0.32	U	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.03	0.16	U	0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	0.1	0.38	U	0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0115ABL	SDG No.:	G1083
Lab Sample ID:	VL0115ABL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024514.D	1		01/15/15 14:29	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.03	0.2	U	0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	0.2	0.87	U	0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.1	0.52	U	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	0.1	0.35	U	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	U	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10			65 - 135		100%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	1107670		6.65				
540-36-3	1,4-Difluorobenzene	2280690		8.32				
3114-55-4	Chlorobenzene-d5	2220540		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0115ABS	SDG No.:	G1083
Lab Sample ID:	VL0115ABS	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024515.D	1		01/15/15 15:07	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	11.7	57.8		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	10.3	21.3		0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	10.1	25.8		0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	9.3	36.1		0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	9.4	24.8		0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	10.9	32.2		0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	9.5	53.4		0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	9.2	70.5		0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	9.2	64.3		0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	8.8	38.5		0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	7.8	23.6		0.3	0.3	1.52	ug/m3
142-82-5	Heptane	10.6	43.4		0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	8.8	34.9		0.2	0.4	1.98	ug/m3
67-64-1	Acetone	9.4	22.3		0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	9.9	30.8		0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	9.3	33.5		0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	8.3	28.8		0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	9.6	38.1		0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	10	40.5		0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	10.5	36.1		0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	10.1	29.8		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	10.5	66.0		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	11.1	44.0		0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	10.8	52.7		0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	10.8	58.9		0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	10.2	47.6		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	10.8	34.5		0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	11.1	44.9		0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	9.1	48.9		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	10.9	50.4		0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	11.1	74.4		0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	10.2	41.8		0.2	0.41	2.05	ug/m3
108-88-3	Toluene	9.7	36.6		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	9.8	44.5		0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	10.6	48.1		0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	9.8	53.5		0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	10.1	86.0		0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	9.3	71.5		0.77	0.77	3.84	ug/m3

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0115ABS	SDG No.:	G1083
Lab Sample ID:	VL0115ABS	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL024515.D	1		01/15/15 15:07	VL011515

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	8.2	55.6		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	10.1	46.5		0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	9.9	43		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	19.3	83.8		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	9.7	42.1		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	10.2	43.4		0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	9.2	95.1		0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	9.1	62.5		0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	9.7	50.2		0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	9.5	46.7		0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	9.2	45.2		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	9.2	55.3		0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	9.3	55.9		0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	6.8	40.9		0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	6.3	46.8		0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	6.3	67.2		1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	9.6	21.2		0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	7.6	39.8		0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	9.8	48.2		0.49	0.49	2.46	ug/m3
110-54-3	Hexane	10.5	37.0		0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	8.7	27.2		0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	22.4	80.7	E	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	11	45.0		0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	9.2			65 - 135		92%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	1044760		6.66				
540-36-3	1,4-Difluorobenzene	2261110		8.33				
3114-55-4	Chlorobenzene-d5	2407590		13.75				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

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CALIBRATION SUMMARY

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG No.: G1083

Instrument ID: MSVOA_L Calibration Date(s): 12/29/2014 12/29/2014

Heated Purge: (Y/N) N Calibration Time(s): 11:55 17:28

GC Column: RTX-1 ID: 0.32 (mm)

LAB FILE ID: RRF002 = VL024437.D RRF001 = VL024438.D RRF0.5 = VL024439.D
RRF0.1 = VL024440.D RRF.03 = VL024441.D RRF010 = VL024442.D

COMPOUND	RRF002	RRF001	RRF0.5	RRF0.1	RRF.03	RRF010	$\overline{RRF}$	% RSD
Dichlorodifluoromethane	1.949	1.559	1.266			1.514	1.472	22.6
Chloromethane	0.909	0.631	0.531			0.888	0.734	22.3
Vinyl Chloride	0.845	0.578	0.489	0.519	0.690	0.818	0.657	21.1
Bromomethane	0.472	0.314	0.259			0.442	0.368	24.1
Chloroethane	0.343	0.239	0.206			0.317	0.276	20.3
Tetrahydrofuran	0.490	0.358	0.460			0.503	0.451	12.7
Trichlorofluoromethane	1.816	1.263	1.034			1.611	1.411	21.7
1,1,2-Trichlorotrifluoroethane	0.931	0.756	0.852			0.944	0.837	12.7
Dichlorotetrafluoroethane	1.871	1.338	1.109			1.686	1.457	21.4
Bromoethene	0.547	0.379	0.308			0.488	0.426	22
tert-Butyl alcohol	1.029	0.653	0.599			1.169	0.859	28.2
Heptane	1.940	2.240	2.089			1.658	1.835	21.5
1,1-Dichloroethene	0.667	0.452	0.477			0.580	0.528	17.6
Acetone	1.484	1.025	0.848			1.305	1.149	21.6
Carbon Disulfide	0.847	0.786	0.880			1.061	0.880	12.1
Methyl tert-Butyl Ether	1.979	2.343	2.046			2.392	2.108	12.2
Methylene Chloride	0.582	0.402	0.508			0.472	0.462	19.8
trans-1,2-Dichloroethene	0.589	0.693	0.644			0.769	0.657	11.5
1,1-Dichloroethane	1.323	1.651	1.416			1.692	1.478	12.3
Cyclohexane	1.037	1.236	1.151			0.907	1.005	21.4
2-Butanone	0.769	0.685	0.713			0.969	0.816	16.2
Carbon Tetrachloride	0.600	0.614	0.570	0.599	0.783	0.537	0.604	14.3
cis-1,2-Dichloroethene	1.039	1.061	1.065			1.125	1.009	14.5
Chloroform	1.437	1.426	1.512			1.280	1.398	6.5
1,1,1-Trichloroethane	1.393	1.612	1.454	1.367	1.285	1.224	1.337	13.9
2,2,4-Trimethylpentane	2.083	2.154	2.126			1.646	1.896	16.6
Benzene	1.147	1.172	1.137			0.991	1.082	9
1,2-Dichloroethane	0.585	0.510	0.564			0.563	0.554	5.1
Trichloroethene	0.369	0.378	0.375	0.387	0.455	0.311	0.366	14.8
1,2-Dichloropropane	0.433	0.442	0.434			0.394	0.417	6.7
Bromodichloromethane	0.779	0.796	0.757			0.690	0.739	7.3
4-Methyl-2-Pentanone	1.270	1.099	1.036			0.931	1.054	13.3
Toluene	1.612	1.424	1.362			1.153	1.369	12.4

* Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG No.: G1083

Instrument ID: MSVOA_L Calibration Date(s): 12/29/2014 12/29/2014

Heated Purge: (Y/N) N Calibration Time(s): 11:55 17:28

GC Column: RTX-1 ID: 0.32 (mm)

LAB FILE ID: RRF002 = VL024437.D RRF001 = VL024438.D RRF0.5 = VL024439.D
RRF0.1 = VL024440.D RRF.03 = VL024441.D RRF010 = VL024442.D

COMPOUND	RRF002	RRF001	RRF0.5	RRF0.1	RRF.03	RRF010	RRF	% RSD
t-1,3-Dichloropropene	0.710	0.594	0.551			0.559	0.648	18.2
cis-1,3-Dichloropropene	0.841	0.713	0.685			0.640	0.704	11.8
1,1,2-Trichloroethane	0.457	0.387	0.377			0.333	0.409	15.6
Dibromochloromethane	0.652	0.558	0.507			0.476	0.554	12.2
1,2-Dibromoethane	1.394	1.216	1.172			0.947	1.178	13.5
Tetrachloroethene	0.447	0.385	0.372	0.388	0.455	0.312	0.395	12.2
Chlorobenzene	0.918	0.958	0.940			0.737	0.869	11.4
Ethyl Benzene	1.858	1.876	1.933			1.461	1.742	11.9
m/p-Xylene	1.499	1.534	1.558			1.143	1.388	14.2
o-Xylene	1.324	1.390	1.340			1.016	1.244	12.5
Styrene	1.114	1.114	1.055			0.902	1.050	8.3
Bromoform	0.624	0.510	0.463			0.426	0.524	16.3
1,1,2,2-Tetrachloroethane	0.918	0.926	0.905	1.014	1.380	0.669	0.942	23.7
2-Chlorotoluene	1.466	1.596	1.463			1.211	1.422	10
1,3,5-Trimethylbenzene	1.590	1.696	1.614			1.246	1.505	12.4
1,2,4-Trimethylbenzene	1.600	1.684	1.618			1.137	1.461	16.6
1,3-Dichlorobenzene	0.885	0.940	0.907			0.676	0.839	12.8
1,4-Dichlorobenzene	0.873	0.908	0.867			0.689	0.831	10.3
1,2-Dichlorobenzene	0.831	0.862	0.831			0.635	0.781	11.9
1,2,4-Trichlorobenzene	0.487	0.477	0.428			0.487	0.475	5.8
Hexachloro-1,3-Butadiene	0.498	0.514	0.484			0.453	0.463	12.6
1,3-Butadiene	0.823	0.601	0.493			0.794	0.671	20.5
Naphthalene	1.012	0.956	0.839			1.279	1.068	18
4-Ethyltoluene	1.572	1.648	1.564			1.283	1.498	9.7
1-Bromo-4-Fluorobenzene	0.811	0.840	0.832	0.890	0.969	0.839	0.889	9.6
Hexane	1.152	1.121	1.111			1.013	1.082	5.9
Allyl Chloride	1.017	0.668	0.706			0.860	0.779	20.3
1,4-Dioxane	60.037	62.593	76.143			75.484	67.626	11.2
Methyl Methacrylate	0.447	0.454	0.427			0.409	0.427	5.5

* Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG No.: G1083

Instrument ID: MSVOA_L Calibration Date/Time: 01/15/2015 12:38

Lab File ID: VL024513.D Init. Calib. Date(s): 12/29/2014 12/29/2014

Heated Purge: (Y/N) N Init. Calib. Time(s): 11:55 17:28

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Dichlorodifluoromethane	1.472	1.690		14.81	30
Chloromethane	0.734	0.745		1.5	30
Vinyl Chloride	0.657	0.658		0.15	30
Bromomethane	0.368	0.346		-5.98	30
Chloroethane	0.276	0.266		-3.62	30
Tetrahydrofuran	0.451	0.496		9.98	30
Trichlorofluoromethane	1.411	1.366		-3.19	30
1,1,2-Trichlorotrifluoroethane	0.837	0.755		-9.8	30
Dichlorotetrafluoroethane	1.457	1.333		-8.51	30
Bromoethene	0.426	0.389		-8.69	30
tert-Butyl alcohol	0.859	0.620		-27.82	30
Heptane	1.835	1.962		6.92	30
1,1-Dichloroethene	0.528	0.452		-14.39	30
Acetone	1.149	1.056		-8.09	30
Carbon Disulfide	0.880	0.867		-1.48	30
Methyl tert-Butyl Ether	2.108	2.025		-3.94	30
Methylene Chloride	0.462	0.375		-18.83	30
trans-1,2-Dichloroethene	0.657	0.651		-0.91	30
1,1-Dichloroethane	1.478	1.499		1.42	30
Cyclohexane	1.005	1.044		3.88	30
2-Butanone	0.816	0.868		6.37	30
Carbon Tetrachloride	0.604	0.629		4.14	30
cis-1,2-Dichloroethene	1.009	1.102		9.22	30
Chloroform	1.398	1.508		7.87	30
1,1,1-Trichloroethane	1.337	1.476		10.4	30
2,2,4-Trimethylpentane	1.896	1.923		1.42	30
Benzene	1.082	1.167		7.86	30
1,2-Dichloroethane	0.554	0.631		13.9	30
Trichloroethene	0.366	0.338		-7.65	30
1,2-Dichloropropane	0.417	0.450		7.91	30
Bromodichloromethane	0.739	0.825		11.64	30
4-Methyl-2-Pentanone	1.054	1.057		0.28	30
Toluene	1.369	1.351		-1.32	30
t-1,3-Dichloropropene	0.648	0.635		-2.01	30
cis-1,3-Dichloropropene	0.704	0.738		4.83	30
1,1,2-Trichloroethane	0.409	0.395		-3.42	30
Dibromochloromethane	0.554	0.561		1.26	30
1,2-Dibromoethane	1.178	1.087		-7.72	30
Tetrachloroethene	0.395	0.315		-20.25	30

All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G1083 SAS No.: G1083 SDG No.: G1083

Instrument ID: MSVOA_L Calibration Date/Time: 01/15/2015 12:38

Lab File ID: VL024513.D Init. Calib. Date(s): 12/29/2014 12/29/2014

Heated Purge: (Y/N) N Init. Calib. Time(s): 11:55 17:28

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Chlorobenzene	0.869	0.966		11.16	30
Ethyl Benzene	1.742	1.973		13.26	30
m/p-Xylene	1.388	1.514		9.08	30
o-Xylene	1.244	1.370		10.13	30
Styrene	1.050	1.231		17.24	30
Bromoform	0.524	0.476		-9.16	30
1,1,2,2-Tetrachloroethane	0.942	0.983		4.35	30
2-Chlorotoluene	1.422	1.639		15.26	30
1,3,5-Trimethylbenzene	1.505	1.713		13.82	30
1,2,4-Trimethylbenzene	1.461	1.585		8.49	30
1,3-Dichlorobenzene	0.839	0.891		6.2	30
1,4-Dichlorobenzene	0.831	0.891		7.22	30
1,2-Dichlorobenzene	0.781	0.833		6.66	30
1,2,4-Trichlorobenzene	0.475	0.472		-0.63	30
Hexachloro-1,3-Butadiene	0.463	0.336		-27.43	30
1,3-Butadiene	0.671	0.636		-5.22	30
Naphthalene	1.068	1.273		19.19	30
4-Ethyltoluene	1.498	1.750		16.82	30
1-Bromo-4-Fluorobenzene	0.889	0.967		8.77	30
Hexane	1.082	1.135		4.9	30
Allyl Chloride	0.779	0.669		-14.12	30
1,4-Dioxane	67.626	86.071		27.27	30
Methyl Methacrylate	0.427	0.472		10.54	30

All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

SHIPPING DOCUMENTS

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : G1083

Client Contact Information	Bottle Order ID : B1501015	Courier : UPS	1 of 5 COCs
Client ID : EAEN06 Project ID :	Frankford Arsenal Air	Sampler Name(s) : Caroline Newcombe	Analysis / Matrix
Customer Name : EA Engineering Science & Technology	Project Manager Denise wilt	AIR ANALYSIS CHAIN-OF-CUSTODY	
	Phone Number : 410-584-7000	Batch Certified	
Address : 225 Schilling Circle, Suite 400	Fax Number :		
	Site Details:		
City : Hunt Valley			
State : MD	Analysis Turnaround Time		
Zip Code : 21031	Standard : 15 business days OR	Data Package Type :	
Country :	Rush (Specify): ______ Days	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	Interior Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas		
B23-2-SG-01-12-2015	1/12-1/13/15	10:44	8:31	28.5	2.5			-30	-4.3	10545	10442	6 L	4.16	VL024292.D	X					X		

Temperature (Fahrenheit)

	Ambient	Maximum	Minimum	
Start	35°F			
Stop	~~35°F~~ 27°F			

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)

	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 1/8/15	Canisters Received by:	Date/Time:
Samples Relinquished by:	Date/Time: 1/13/15 14:00	Received by:	Date/Time:
Relinquished by: UPS	Date/Time: 1-14-15 10:20	Received by: Cassanova Perez	Date/Time: 1-14-15 10:20

B1501015 - 3

CHEMTECH
284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : G1083

Client Contact Information	Bottle Order ID : B1501015	Courier : UPS	4 of 5 COCs
Client ID : EAEN06 Project ID :	Frankford Arsenal Air	Sampler Name(s) : Caroline Newcombe	Analysis / Matrix
Customer Name : EA Engineering Science & Technology	Project Manager Denise wilt		
	Phone Number : 410-584-7000		
Address : 225 Schilling Circle, Suite 400	Fax Number :	AIR ANALYSIS CHAIN-OF-CUSTODY	
	Site Details:	Batch Certified	
City : Hunt Valley			
State : MD	Analysis Turnaround Time		
Zip Code : 21031	Standard : 15 business days OR	Data Package Type :	
Country :	Rush (Specify): ______ Days	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	Interior Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas		
SG-DUP-1-01-12-2015	1/12-1/13/15	10:12	8:36	730	4.5			-30	-5.1	10201	10490	6 L	4.16	VL024292.D	X					X		

Temperature (Fahrenheit)	Ambient	Maximum	Minimum	
Start	~60°F			
Stop	~60°F			

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 1/8/15	Canisters Received by:	Date/Time:
Samples Relinquished by:	Date/Time: 1/13/15 14:00	Received by:	Date/Time:
Relinquished by: UPS	Date/Time: 1-14-15 10:10	Received by: Cassavora	Date/Time: 1-14-15 10:20

B1501015 - 4

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : G1083

Client Contact Information	Bottle Order ID : B1501015	Courier : UPS	5 of 5 COCs
Client ID : EAEN06 Project ID :	Frankford Arsenal Air	Sampler Name(s) : Caroline Newcombe	
Customer Name : EA Engineering Science & Technology	Project Manager Denise wilt	AIR ANALYSIS CHAIN-OF-CUSTODY	
Address : 225 Schilling Circle, Suite 400	Phone Number : 410-584-7000	Batch Certified	
	Fax Number :		
	Site Details:		
City : Hunt Valley			
State : MD	Analysis Turnaround Time		
Zip Code : 21031	Standard : 15 business days OR	Data Package Type :	
Country :	Rush (Specify): ________ Days	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	Interior Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	Analysis: TO-15	Analysis	Analysis	Analysis	Matrix: Indoor/Ambinet Air	Matrix: Soil Gas	Matrix	Matrix
B23-1-SG_01_12_2015	1/12-1/13/15	10:12	10:12	>30	7.0			-30	-5.1	10110	10311	6 L	4.16	VL024292.D	X					X		

Temperature (Fahrenheit)

	Ambient	Maximum	Minimum	
Start	~60°F			
Stop	~60°F			

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)

	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low PID Readings:

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 1/8/15	Canisters Received by:	~~Date/Time:~~
Samples Relinquished by:	Date/Time: 1/13/15 14:00	Received by:	Date/Time:
Relinquished by: UPS	Date/Time: 1-14-15 10:20	Received by: Cassandra	Date/Time: 1-14-15 10:20

B1501015 - 1

DEP-077
Rev. 3/04

New Jersey Department of Environmental Protection

Internal Chain of Custody

Instructions: Use 1 form for each 20 samples of aliquot

Laboratory Person Breaking Field Seal on Sample Shuttle & Accepting Responsibility for Sample

Laboratory: Chemtech Location: 284 Sheffield Street, Mountainside,NJ 7092
Name: REGINALD Title: Sample Custodian
Field Sample Seal No.: G1083 Date Broken: 1/14/2015 Military Time Seal Broken: 10:20:00
Case No.: Frankford Arsenal Air Analytical Parameter/Fraction: TO-15

Sample No.	Aliquot/Extract No.	Sample No.	Aliquot/Extract No.
G1083-01	B23-2-SG-01-12-2015		
G1083-02	SG-DUP-1-01-12-2015		
G1083-03	B23-1-SG-01-12-2015		

Date	Time	Relinquished By	Received By	Purpose of Change of Custody
1/14/15	1204	Signature [signature] Printed Name RSJ	Signature [signature] Printed Name JCHARLINE	AIR LAB
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	

Distribution: White - Original (Sent With Report) Yellow - Contractor Archive Pink - Sample Custodian - Interim Copy

AIR SAMPLE PRESSURE & DILUTION LOGBOOK

Analyst Signature: [signature] Supervisor Signature: [signature]

METHOD: TO-15

Date	Sample Number	Canister #	Initial Pressure psia	Initial Pressure Hg	Final Pressure psia	Final Pressure Hg	Dilution Factor	Comment
01/08/15	G1040-01	10742	6.2	-17.7				SY
↓	G1040-02	10654	6.4	-17.7				↓
	G1040-03	10041	7.4	-14.9				↓
↓	G1040-04	10681	5.4		8.0		1.5X	SY
1/14/15	G1083-01	10442	12.6	-4.3				[initials]
	G1083-02	10490	12.2	-5.1				
⊥	G1083-03	10311	12.2	-5.1				⊥

10442_X2

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: B23-2-SG-1_12-2015
Client Name: EA Engineering
Project Name: Frankford Arsenal
Date: 1/13/15 Time: 8:29
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: G1083-G1083-01
Cust Sample: B23-2-SG-01-12-2015

10490_5.1

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: SG-DUP-1_1_12_2015
Client Name: EA Engineering
Project Name: EA Engineering
Date: 1/13/15 Time: 8:30
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: G1083-G1083-02
Cust Sample: SG-DUP-1-01-12-2015

10311_5.1

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)7

Client Sample ID #: B23-SG1-1_12_2015
Client Name: EA Engineering
Project Name: Frankford Arsenal
Date: 1/13/2015 Time: 10:12
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

StorageLocation: Air Lab
Sample: G1083-G1083-03
Cust Sample: B23-1-SG-01-12-2015

CHEMTECH 284 Sheffield Street Mountainside NJ 07092 Tel. 908-7898900

Laboratory Certification

State	License No.
New Jersey	20012
New York	11376
Connecticut	PH-0649
Florida	E87935
Louisiana	5035
Maryland	296
Massachusetts	M-NJ503
Pennsylvania	68-548
Rhode Island	LAO00259
Virginia	460220
Texas	T10470448-10-1

Other :

DOD ELAP Certified (L-A-B Accredited), ISO/IEC 17025	L2219
Soil Permit	P330-11-00012
CLP Inorganic Contract	EPW09038
CLP Organic Contract	EPW11030

QA Control Code: A2070148

CHEMTECH

284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

ANALYTICAL RESULTS SUMMARY

VOLATILE ORGANICS

PROJECT NAME : FRANKFORD ARSENAL AIR

EA ENGINEERING SCIENCE & TECHNOLOGY

225 Schilling Circle, Suite 400

Hunt Valley, MD - 21031

Phone No: 410-584-7000

ORDER ID : G3822

ATTENTION : Denise Wilt

DoD ELAP

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CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

1

Cover Page

Order ID : G3822

Project ID : Frankford Arsenal Air

Client : EA Engineering Science & Technology

Lab Sample Number	Client Sample Number
G3822-01	BZ3-3-SG

I certify that the data package is in compliance with the terms and conditions of the contract,both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the laboratory manager or his designee, as verified by the following signature.

Signature : _Mildred V Reyes

APPROVED Date: 10/5/2015

By Mildred V Reyes, QAQC Supervisor at 12:13 pm, Oct 06, 2015

NYDOH CERTIFICATION NO - 11376

NJDEP CERTIFICATION NO 20012

CHEMTECH
284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

CASE NARRATIVE

EA Engineering Science & Technology
Project Name: Frankford Arsenal Air
Project # N/A
Chemtech Project # G3822
Test Name: TO-15

A. Number of Samples and Date of Receipt:
1 Air sample was received on 09/24/2015.

B. Parameters
According to the Chain of Custody document, the following analyses were requested: TO-15. This data package contains results for TO-15.

C. Analytical Techniques:
The analysis performed on instrument MSVOA_L were done using GC column RTX-1, which is 60 meters, 0.32 mm id, 1.0 um df, Restek Cat. #10157. The Trap was supplied by Entech, glass bead and Tenax , Entech 7100A Preconcentrator.The analysis of TO-15 was based on method TO-15.

D. QA/ QC Samples:
The Holding Times were met for all analysis.
The Surrogate recoveries met the acceptable criteria.
The Internal Standards Areas met the acceptable requirements.
The Retention Times were acceptable for all samples.
The RPD for G3860-02DUP {MLC-02DUP} with File ID: VL026161.D recoveries met requirements for all parameters except for 1,2,4-Trimethylbenzene[28.6%].
The Blank Spike for {VL0929ABS01} with File ID: VL026153.D met requirements for all samples except for 1,1,2,2-Tetrachloroethane[69%] .
The Blank Spike Duplicate met requirements for all samples.
The Blank analysis indicated presence of Acetone [0.95 ug/m3] FileID: VL026152.D{VL0929ABL01} due to possible lab contamination.
The Initial Calibration met the requirements.
The Continuous Calibration met the requirements.
The Tuning criteria met requirements.
Sample BZ3-3-SG was diluted due to high concentration.

E. Additional Comments:
The not QT review data is reported in the Miscellaneous.

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The Manual Integrations are performed for the followings :

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Sequence	VL090415	Instrument	MSVOA_I

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDICCC010	VL026042.D	Chlorobenzene-d5	Feifei	9/8/2015 10:59:53 AM	sam	9/8/2015 11:41:50 AM	Peak Integrated by Software incorrectly
VSTDICC002	VL026043.D	1,4-Dioxane	Feifei	9/8/2015 10:59:55 AM	sam	9/8/2015 11:41:57 AM	Peak Integrated by Software incorrectly
VSTDICC002	VL026043.D	Ethanol	Feifei	9/8/2015 10:59:55 AM	sam	9/8/2015 11:41:57 AM	Peak Integrated by Software incorrectly
VSTDICC002	VL026043.D	m/p-Xylene	Feifei	9/8/2015 10:59:55 AM	sam	9/8/2015 11:41:57 AM	Peak Integrated by Software incorrectly
VSTDICC001	VL026044.D	1,4-Dioxane	Feifei	9/8/2015 10:59:57 AM	sam	9/8/2015 11:43:42 AM	Peak Integrated by Software incorrectly
VSTDICC001	VL026044.D	Ethanol	Feifei	9/8/2015 10:59:57 AM	sam	9/8/2015 11:43:42 AM	Peak Integrated by Software incorrectly
VSTDICC001	VL026044.D	m/p-Xylene	Feifei	9/8/2015 10:59:57 AM	sam	9/8/2015 11:43:42 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL026045.D	1,4-Dioxane	Feifei	9/8/2015 10:59:59 AM	sam	9/8/2015 11:42:02 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL026045.D	Ethanol	Feifei	9/8/2015 10:59:59 AM	sam	9/8/2015 11:42:02 AM	Peak Integrated by Software incorrectly
VSTDICC0.5	VL026045.D	Isopropyl Alcohol	Feifei	9/8/2015 10:59:59 AM	sam	9/8/2015 11:42:02 AM	Peak Integrated by

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							Software incorrectly
VSTDICC0.5	VL026045.D	m/p-Xylene	Feifei	9/8/2015 10:59:59 AM	sam	9/8/2015 11:42:02 AM	Peak Integrated by Software incorrectly

VSTDICC015	VL026048.D	Chlorobenzene-d5	Feifei	9/8/2015 11:00:01 AM	sam	9/8/2015 11:42:09 AM	Peak Integrated by Software incorrectly

Sequence	VL092915	Instrument	MSVOA_I

Sample ID	File ID	Parameter	Review By	Review On	Supervised By	Supervised On	Reason
VSTDCCC010	VL026151.D	1,4-Dioxane	Feifei	9/30/2015 12:12:17 PM	sam	9/30/2015 3:40:27 PM	Peak Integrated by Software incorrectly
VSTDCCC010	VL026151.D	Chlorobenzene-d5	Feifei	9/30/2015 12:12:17 PM	sam	9/30/2015 3:40:27 PM	Peak Integrated by Software incorrectly
VSTDCCC010	VL026151.D	Dichlorodifluoromethane	Feifei	9/30/2015 12:12:17 PM	sam	9/30/2015 3:40:27 PM	Peak Integrated by Software incorrectly
VL0929ABS01	VL026153.D	1,4-Dioxane	Feifei	9/30/2015 5:05:21 PM	MMDadoda	9/30/2015 5:08:15 PM	Peak Integrated by Software incorrectly
VL0929ABS01	VL026153.D	Chlorobenzene-d5	Feifei	9/30/2015 5:05:21 PM	MMDadoda	9/30/2015 5:08:15 PM	Incorrect baseline
G3822-01	VL026163.D	Chlorodifluoromethane	Feifei	9/30/2015 5:05:28 PM	sam	9/30/2015 5:30:15 PM	Peak Integrated by Software incorrectly
VSTDCCC010	VL026170.D	Chlorobenzene-d5	Feifei	9/30/2015 12:12:39 PM	sam	9/30/2015 3:41:01 PM	Peak Integrated by Software incorrectly

F. Manual Integration Comments:
Please refer to the Manual integration Report included with the Run Logs for information on the manual integrations performed.

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I certify that the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. The laboratory manager or his designee, as verified by the following signature has authorized release of the data contained in this hard copy data package.

Signature_____ Mildred V Reyes _

APPROVED

By Mildred V Reyes, QAQC Supervisor at 12:12 pm, Oct 06, 2015

DATA REPORTING QUALIFIERS- ORGANIC

For reporting results, the following " Results Qualifiers" are used:

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates the compound was analyzed for but was not detected. Report the minimum detection limit for the sample with the U, i.e. "10 U". This is not necessarily the instrument detection limit attainable for this particular sample based on any concentration or dilution that may have been required.
ND	Indicates the analyte was analyzed for, but not detected
J	Indicates an estimated value**.** This flag is used: (1) When estimating a concentration for a tentatively identified compound (library search hits, where a 1:1 response is assumed.) (2) When the mass spectral data indicated the identification, however the result was less than the specified detection limit greater than zero. If the detection limit was 10ug/L and a concentration of 3 ug/L was calculated report as 3 J. This is flag is used when similar situation arise on any organic parameter i.e. Pest, PCB and others.
B	Indicates the analyte was found in the blank as well as the sample report as "12 B".
E	Indicates the analyte 's concentration exceeds the calibrated range of the instrument for that specific analysis.
D	This flag identifies all compounds identified in an analysis at a secondary dilution factor.
P	This flag is used for Pesticide/PCB target analyte when there is >25% difference for detected concentrations between the two GC columns. The lower of the two values is reported on Form 1 and flagged with a "P".
N	This flag indicates presumptive evidence of a compound. This is only used for tentatively identified compounds (TICs), where the identification is based on a mass spectral library search. It applies to all TIC results. For generic characterization of a TIC, such as chlorinated hydrocarbon, the flag is not used.
A	This flag indicates that a Tentatively Identified Compound is a suspected aldol-condensation product.
Q	Indicates the LCS did not meet the control limits requirements

QA Control # A3040960

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APPENDIX A

QA REVIEW GENERAL DOCUMENTATION

Project #: G3822

	Completed
For thorough review, the report must have the following:	
GENERAL:	
Are all original paperwork present (chain of custody, record of communication,airbill, sample management lab chronicle, login page)	✓
Check chain-of-custody for proper relinquish/return of samples	✓
Is the chain of custody signed and complete	✓
Check internal chain-of-custody for proper relinquish/return of samples /sample extracts	✓
Collect information for each project id from server. Were all requirements followed	✓
COVER PAGE:	
Do numbers of samples correspond to the number of samples in the Chain of Custody on login page	✓
Do lab numbers and client Ids on cover page agree with the Chain of Custody	✓
CHAIN OF CUSTODY:	
Do requested analyses on Chain of Custody agree with form I results	✓
Do requested analyses on Chain of Custody agree with the log-in page	✓
Were the correct method log-in for analysis according to the Analytical Request and Chain of Castody	✓
Were the samples received within hold time	✓
Were any problems found with the samples at arrival recorded in the Sample Management Laboratory Chronicle	✓
ANALYTICAL:	
Was method requirement followed?	✓
Was client requirement followed?	✓
Does the case narrative summarize all QC failure?	✓
All runlogs and manual integration are reviewed for requirements	✓
All manual calculations and /or hand notations verified	✓

1st Level QA Review Signature: POONAM PATEL **Date:** 10/05/2015

REVIEWED

By kalpana, Data Reviewer at 4:12 pm, Oct 05, 2015

2nd Level QA Review Signature: ______ **Date:** ______

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LAB CHRONICLE

OrderID:	G3822	**OrderDate:**	9/24/2015 2:57:00 PM
Client:	EA Engineering Science & Technology	**Project:**	Frankford Arsenal Air
Contact:	Denise Wilt	**Location:**	Air Lab

LabID	ClientID	Matrix	Test	Method	Sample Date	Prep Date	Anal Date	Received
G3822-01	**BZ3-3-SG**	**Air**			**09/22/15**			**09/24/15**
			TO-15	TO-15			09/29/15	
G3822-01DL	**BZ3-3-SGDL**	**Air**			**09/22/15**			**09/24/15**
			TO-15	TO-15			09/29/15	

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A B C D E F G H

Hit Summary Sheet
SW-846

SDG No.: G3822

Client: EA Engineering Science & Technology

Sample ID	Client ID	Matrix	Parameter	Concentration	C	MDL	LOD	RDL	Units
Client ID:	**BZ3-3-SG**								
G3822-01	BZ3-3-SG	Air	Dichlorodifluoromethane	3.61		0.2	0.49	2.47	ug/m3
G3822-01	BZ3-3-SG	Air	Chloromethane	0.60	J	0.21	0.21	1.03	ug/m3
G3822-01	BZ3-3-SG	Air	Trichlorofluoromethane	46.10		0.22	0.56	2.81	ug/m3
G3822-01	BZ3-3-SG	Air	tert-Butyl alcohol	1.91		0.3	0.3	1.52	ug/m3
G3822-01	BZ3-3-SG	Air	Acetone	39.70	EB	0.24	0.24	1.19	ug/m3
G3822-01	BZ3-3-SG	Air	Carbon Disulfide	8.72		0.16	0.31	1.56	ug/m3
G3822-01	BZ3-3-SG	Air	Methylene Chloride	5.91		0.17	0.35	1.74	ug/m3
G3822-01	BZ3-3-SG	Air	2-Butanone	1.86		0.29	0.29	1.47	ug/m3
G3822-01	BZ3-3-SG	Air	Carbon Tetrachloride	1.57		0.19	0.19	0.19	ug/m3
G3822-01	BZ3-3-SG	Air	Chloroform	0.49	J	0.1	0.49	2.44	ug/m3
G3822-01	BZ3-3-SG	Air	Benzene	0.51	J	0.13	0.32	1.6	ug/m3
G3822-01	BZ3-3-SG	Air	Trichloroethene	0.54		0.11	0.16	0.16	ug/m3
G3822-01	BZ3-3-SG	Air	4-Methyl-2-Pentanone	0.53	J	0.2	0.41	2.05	ug/m3
G3822-01	BZ3-3-SG	Air	Toluene	1.13	J	0.19	0.38	1.88	ug/m3
G3822-01	BZ3-3-SG	Air	Tetrachloroethene	4.41		0.2	0.2	0.2	ug/m3
G3822-01	BZ3-3-SG	Air	1,2,4-Trimethylbenzene	0.49	J	0.49	0.49	2.46	ug/m3
			Total Voc :	118.08					
			Total Concentration:	118.08					
Client ID:	**BZ3-3-SGDL**								
G3822-01DL	BZ3-3-SGDL	Air	Trichlorofluoromethane	36.50	D	2.25	5.62	28.1	ug/m3
G3822-01DL	BZ3-3-SGDL	Air	Acetone	37.80	DB	2.38	2.38	11.9	ug/m3
G3822-01DL	BZ3-3-SGDL	Air	Carbon Disulfide	5.29	JD	1.56	3.11	15.6	ug/m3
			Total Voc :	79.59					
			Total Concentration:	79.59					

Chemical	CAS Number	Molecular Weight	Insert Results in ppbv	Q	Generates Results in ug/m3	QAS Decision	Foot-Notes
Dichlorodifluoromethane	75-71-8	120.9	0.73		3.61		
Chloromethane	74-87-3	50.49	0.29	J	0.6		
Vinyl Chloride	75-01-4	62.5	0.03	U	0.08		
Bromomethane	74-83-9	94.94	0.1	U	0.39		
Chloroethane	75-00-3	64.52	0.1	U	0.26		
Tetrahydrofuran	109-99-9	72.11	0.1	U	0.29		
Trichlorofluoromethane	75-69-4	137.4	8.2		46.1		
Dichlorotetrafluoroethane	76-14-2	170.9	0.1	U	0.7		
1,1,2-Trichlorotrifluoroethane	76-13-1	187.4	0.1	U	0.77		
Bromoethene	593-60-2	106.9	0.1	U	0.44		
tert-Butyl alcohol	75-65-0	74.12	0.63		1.91		
Heptane	142-82-5	100.2	0.1	U	0.41		
1,1-Dichloroethene	75-35-4	96.94	0.1	U	0.4		
Acetone	67-64-1	58.08	16.7	E	39.7		
Carbon Disulfide	75-15-0	76.14	2.8		8.72		
Methyl tert-Butyl Ether	1634-04-4	88.15	0.1	U	0.36		
Methylene Chloride	75-09-2	84.94	1.7		5.91		
trans-1,2-Dichloroethene	156-60-5	96.94	0.1	U	0.4		
1,1-Dichloroethane	75-34-3	98.96	0.1	U	0.4		
Cyclohexane	110-82-7	84.16	0.1	U	0.34		
2-Butanone	78-93-3	72.11	0.63		1.86		
Carbon Tetrachloride	56-23-5	153.8	0.25		1.57		
cis-1,2-Dichloroethene	156-59-2	96.94	0.1	U	0.4		
Chloroform	67-66-3	119.4	0.1	J	0.49		
1,1,1-Trichloroethane	71-55-6	133.4	0.03	U	0.16		
2,2,4-Trimethylpentane	540-84-1	114.2	0.1	U	0.47		
Benzene	71-43-2	78.11	0.16	J	0.51		
1,2-Dichloroethane	107-06-2	98.96	0.1	U	0.4		
Trichloroethene	79-01-6	131.4	0.1		0.54		
1,2-Dichloropropane	78-87-5	113	0.1	U	0.46		
Bromodichloromethane	75-27-4	163.8	0.1	U	0.67		
4-Methyl-2-Pentanone	108-10-1	100.2	0.13	J	0.53		
Toluene	108-88-3	92.14	0.3	J	1.13		
t-1,3-Dichloropropene	10061-02-6	111	0.1	U	0.45		
cis-1,3-Dichloropropene	10061-01-5	111	0.1	U	0.45		
1,1,2-Trichloroethane	79-00-5	133.4	0.1	U	0.55		
Dibromochloromethane	124-48-1	208.3	0.1	U	0.85		
1,2-Dibromoethane	106-93-4	187.9	0.1	U	0.77		
Tetrachloroethene	127-18-4	165.8	0.65		4.41		
Chlorobenzene	108-90-7	112.6	0.1	U	0.46		
Ethyl Benzene	100-41-4	106.2	0.1	U	0.43		
m/p-Xylene	179601-23-1	106.2	0.2	U	0.87		
o-Xylene	95-47-6	106.2	0.1	U	0.43		
Styrene	100-42-5	104.1	0.1	U	0.43		
Bromoform	75-25-2	252.8	0.1	U	1.03		
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.03	U	0.21		

2-Chlorotoluene	95-49-8	126.6	0.1	U	0.52		
1,3,5-Trimethylbenzene	108-67-8	120.2	0.1	U	0.49		
1,2,4-Trimethylbenzene	95-63-6	120.2	0.1	J	0.49		
1,3-Dichlorobenzene	541-73-1	147	0.1	U	0.6		
1,4-Dichlorobenzene	106-46-7	147	0.1	U	0.6		
1,2-Dichlorobenzene	95-50-1	147	0.1	U	0.6		
1,2,4-Trichlorobenzene	120-82-1	181.5	0.1	U	0.74		
Hexachloro-1,3-Butadiene	87-68-3	260.8	0.1	U	1.07		
Naphthalene	91-20-3	128.17	0.1	U	0.52		
1,3-Butadiene	106-99-0	54.09	0.1	U	0.22		
4-Ethyltoluene	622-96-8	120.2	0.1	U	0.49		
Hexane	110-54-3	86.17	0.1	U	0.35		
Allyl Chloride	107-05-1	76.53	0.1	U	0.31		
1,4-Dioxane	123-91-1	88.12	0.1	U	0.36		
Methyl Methacrylate	80-62-6	100.117	0.1	U	0.41		

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A B C D E F G H

Chemical	CAS Number	Molecular Weight	Insert Results in ppbv	Q	Generates Results in ug/m3	QAS Decision	Foot-Notes
Dichlorodif	75-71-8	120.9	1	UD	4.94		
Chloromet	74-87-3	50.49	1	UD	2.07		
Vinyl Chlor	75-01-4	62.5	0.3	UD	0.77		
Bromomet	74-83-9	94.94	1	UD	3.88		
Chloroetha	75-00-3	64.52	1	UD	2.64		
Tetrahydro	109-99-9	72.11	1	UD	2.95		
Trichloroflu	75-69-4	137.4	6.5	D	36.5		
Dichlorotet	76-14-2	170.9	1	UD	6.99		
1,1,2-Trich	76-13-1	187.4	1	UD	7.66		
Bromoethe	593-60-2	106.9	1	UD	4.37		
tert-Butyl a	75-65-0	74.12	1	UD	3.03		
Heptane	142-82-5	100.2	1	UD	4.1		
1,1-Dichlor	75-35-4	96.94	1	UD	3.96		
Acetone	67-64-1	58.08	15.9	D	37.8		
Carbon Dis	75-15-0	76.14	1.7	JD	5.29		
Methyl ter	1634-04-4	88.15	1	UD	3.61		
Methylene	75-09-2	84.94	1	UD	3.47		
trans-1,2-D	156-60-5	96.94	1	UD	3.96		
1,1-Dichlor	75-34-3	98.96	1	UD	4.05		
Cyclohexar	110-82-7	84.16	1	UD	3.44		
2-Butanon	78-93-3	72.11	1	UD	2.95		
Carbon Tet	56-23-5	153.8	0.3	UD	1.89		
cis-1,2-Dicl	156-59-2	96.94	1	UD	3.96		
Chloroform	67-66-3	119.4	1	UD	4.88		
1,1,1-Trich	71-55-6	133.4	0.3	UD	1.64		
2,2,4-Trime	540-84-1	114.2	1	UD	4.67		
Benzene	71-43-2	78.11	1	UD	3.19		
1,2-Dichlor	107-06-2	98.96	1	UD	4.05		
Trichloroet	79-01-6	131.4	0.3	UD	1.61		
1,2-Dichlor	78-87-5	113	1	UD	4.62		
Bromodich	75-27-4	163.8	1	UD	6.7		
4-Methyl-2	108-10-1	100.2	1	UD	4.1		
Toluene	108-88-3	92.14	1	UD	3.77		
t-1,3-Dichl	10061-02-6	111	1	UD	4.54		
cis-1,3-Dicl	10061-01-5	111	1	UD	4.54		
1,1,2-Trich	79-00-5	133.4	1	UD	5.46		
Dibromoch	124-48-1	208.3	1	UD	8.52		
1,2-Dibrom	106-93-4	187.9	1	UD	7.69		
Tetrachlor	127-18-4	165.8	0.3	UD	2.03		
Chloroben	108-90-7	112.6	1	UD	4.61		
Ethyl Benz	100-41-4	106.2	1	UD	4.34		
m/p-Xylene	179601-23	106.2	2	UD	8.69		
o-Xylene	95-47-6	106.2	1	UD	4.34		
Styrene	100-42-5	104.1	1	UD	4.26		
Bromoform	75-25-2	252.8	1	UD	10.3		
1,1,2,2-Tet	79-34-5	167.9	0.3	UD	2.06		

2-Chloroto	95-49-8	126.6	1	UD	5.18		
1,3,5-Trime	108-67-8	120.2	1	UD	4.92		
1,2,4-Trime	95-63-6	120.2	1	UD	4.92		
1,3-Dichlor	541-73-1	147	1	UD	6.01		
1,4-Dichlor	106-46-7	147	1	UD	6.01		
1,2-Dichlor	95-50-1	147	1	UD	6.01		
1,2,4-Trich	120-82-1	181.5	1	UD	7.42		
Hexachloro	87-68-3	260.8	1	UD	10.7		
1,3-Butadie	106-99-0	54.09	1	UD	2.21		
Naphthaler	91-20-3	128.17	1	UD	5.24		
4-Ethyltolu	622-96-8	120.2	1	UD	4.92		
Hexane	110-54-3	86.17	1	UD	3.52		
Allyl Chlori	107-05-1	76.53	1	UD	3.13		
1,4-Dioxan	123-91-1	88.12	1	UD	3.6		
Methyl Me	80-62-6	100.117	1	UD	4.09		

Matrix	CAS #	Compound Name	Molecular Wt	ppbv MDL	LOD ppbv	LOQ ppbv	ug/m3 MDL	LOD ug/m3	LOQ ug/m3
Air	71-55-6	1,1,1-Trichloroethane	133	0.03	0.03	0.03	0.163190184	0.163190184	0.16
Air	79-34-5	1,1,2,2-Tetrachloroethane	168	0.1	0.1	0.5	0.687116564	0.687116564	3.435582822
Air	79-00-5	1,1,2-Trichloroethane	133	0.1	0.1	0.5	0.54396728	0.54396728	2.719836401
Air	76-13-1	1,1,2-Trichlorotrifluoroethane	187	0.042	0.1	0.5	0.321226994	0.764826176	3.824130879
Air	75-34-3	1,1-Dichloroethane	99	0.039	0.1	0.5	0.15791411	0.404907975	2.024539877
Air	75-35-4	1,1-Dichloroethene	97	0.051	0.1	0.5	0.202331288	0.396728016	1.983640082
Air	120-82-1	1,2,4-Trichlorobenzene	181	0.039	0.1	0.5	0.288711656	0.740286299	3.701431493
Air	95-63-6	1,2,4-Trimethylbenzene	120	0.101	0.1	0.5	0.495705521	0.490797546	2.45398773
Air	106-93-4	1,2-Dibromoethane	188	0.1	0.1	0.5	0.768916155	0.768916155	3.844580777
Air	95-50-1	1,2-Dichlorobenzene	147	0.1	0.1	0.5	0.601226994	0.601226994	3.006134969
Air	107-06-2	1,2-Dichloroethane	99	0.1	0.1	0.5	0.404907975	0.404907975	2.024539877
Air	78-87-5	1,2-Dichloropropane	113	0.1	0.1	0.5	0.462167689	0.462167689	2.310838446
Air	108-67-8	1,3,5-Trimethylbenzene	120	0.1	0.1	0.5	0.490797546	0.490797546	2.45398773
Air	106-99-0	1,3-Butadiene	54	0.1	0.1	0.5	0.220858896	0.220858896	1.104294479
Air	541-73-1	1,3-Dichlorobenzene	147	0.1	0.1	0.5	0.601226994	0.601226994	3.006134969
Air	106-46-7	1,4-Dichlorobenzene	147	0.1	0.1	0.5	0.601226994	0.601226994	3.006134969
Air	123-91-1	1,4-Dioxane	88	0.1	0.1	0.5	0.3599182	0.3599182	1.799591002
Air	540-84-1	2,2,4-Trimethylpentane	114	0.044	0.1	0.5	0.205153374	0.466257669	2.331288344
Air	78-93-3	2-Butanone	72	0.1	0.1	0.5	0.294478528	0.294478528	1.472392638
Air	95-49-8	2-Chlorotoluene	126.6	0.1	0.1	0.5	0.517791411	0.517791411	2.588957055
Air	591-78-6	2-Hexanone	100	0.1	0.1	0.5	0.408997955	0.408997955	2.044989775
Air	622-96-8	4-Ethyltoluene	120	0.1	0.1	0.5	0.490797546	0.490797546	2.45398773
Air	108-10-1	4-Methyl-2-Pentanone	100	0.05	0.1	0.5	0.204498978	0.408997955	2.044989775
Air	67-64-1	Acetone	58	0.1	0.1	0.5	0.237218814	0.237218814	1.18609407
Air	107-05-1	Allyl Chloride	77	0.051	0.1	0.5	0.160613497	0.314928425	1.574642127
Air	71-43-2	Benzene	78	0.039	0.1	0.5	0.124417178	0.319018405	1.595092025
Air	100-44-7	Benzyl Chloride	141	0.1	0.1	0.5	0.576687117	0.576687117	2.883435583
Air	75-27-4	Bromodichloromethane	164	0.049	0.1	0.5	0.328670757	0.670756646	3.353783231
Air	593-60-2	Bromoethene	107	0.031	0.1	0.5	0.135664622	0.437627812	2.188139059
Air	75-25-2	Bromoform	253	0.047	0.1	0.5	0.486339468	1.034764826	5.173824131
Air	74-83-9	Bromomethane	95	0.031	0.1	0.5	0.120449898	0.388548057	1.942740286
Air	75-15-0	Carbon Disulfide	76	0.045	0.1	0.5	0.139877301	0.310838446	1.554192229
Air	56-23-5	Carbon Tetrachloride	154	0.03	0.03	0.03	0.188957055	0.188957055	0.19
Air	108-90-7	Chlorobenzene	113	0.1	0.1	0.5	0.462167689	0.462167689	2.310838446
Air	75-00-3	Chloroethane	65	0.1	0.1	0.5	0.265848671	0.265848671	1.329243354
Air	67-66-3	Chloroform	119	0.016	0.1	0.5	0.077873211	0.486707566	2.433537832
Air	74-87-3	Chloromethane	50	0.1	0.1	0.5	0.204498978	0.204498978	1.022494888
Air	156-59-2	cis-1,2-Dichloroethene	97	0.05	0.1	0.5	0.198364008	0.396728016	1.983640082
Air	10061-01-5	cis-1,3-Dichloropropene	111	0.1	0.1	0.5	0.45398773	0.45398773	2.26993865
Air	110-82-7	Cyclohexane	82	0.1	0.1	0.5	0.335378323	0.335378323	1.676891616
Air	124-48-1	Dibromochloromethane	208	0.05	0.1	0.5	0.425357873	0.850715746	4.253578732
Air	75-71-8	Dichlorodifluoromethane	121	0.036	0.1	0.5	0.178159509	0.494887526	2.474437628
Air	76-14-2	Dichlorotetrafluoroethane	171	0.038	0.1	0.5	0.265766871	0.699386503	3.496932515
Air	64-17-5	Ethanol	46.1	0.1	0.1	0.5	0.188548057	0.188548057	0.942740286
Air	141-78-6	Ethyl Acetate	88	0.1	0.1	0.5	0.3599182	0.3599182	1.799591002
Air	100-41-4	Ethyl Benzene	106	0.1	0.1	0.5	0.433537832	0.433537832	2.167689162
Air	142-82-5	Heptane	100	0.1	0.1	0.5	0.408997955	0.408997955	2.044989775
Air	87-68-3	Hexachloro-1,3-Butadiene	261	0.1	0.1	0.5	1.067484663	1.067484663	5.337423313
Air	110-54-3	Hexane	86	0.042	0.1	0.5	0.147730061	0.351738241	1.758691207
Air	67-63-0	Isopropyl Alcohol	60	0.1	0.1	0.5	0.245398773	0.245398773	1.226993865
Air	136777-61-2	m/p-Xylene	106	0.1	0.2	1	0.433537832	0.867075665	4.335378323
Air	80-62-6	Methyl methacrylate	100.1	0.1	0.1	0.5	0.409406953	0.409406953	2.047034765
Air	1634-04-4	Methyl tert-Butyl Ether	88	0.053	0.1	0.5	0.190756646	0.3599182	1.799591002
Air	75-09-2	Methylene Chloride	85	0.045	0.1	0.5	0.156441718	0.347648262	1.738241309
Air	95-47-6	o-Xylene	106	0.1	0.1	0.5	0.433537832	0.433537832	2.167689162
Air	115-07-1	Propene	42	0.102	0.1	0.5	0.175214724	0.171779141	0.858895706
Air	100-42-5	Styrene	104	0.1	0.1	0.5	0.425357873	0.425357873	2.126789366
Air	10061-02-6	t-1,3-Dichloropropene	111	0.1	0.1	0.5	0.45398773	0.45398773	2.26993865
Air	27975-78-6	tert-butyl alcohol	74.1	0.1	0.1	0.5	0.303067485	0.303067485	1.515337423
Air	127-18-4	Tetrachloroethene	166	0.03	0.03	0.03	0.203680982	0.203680982	0.2
Air	109-99-9	Tetrahydrofuran	72	0.1	0.1	0.5	0.294478528	0.294478528	1.472392638
Air	108-88-3	Toluene	92	0.053	0.1	0.5	0.199427403	0.376278119	1.881390593
Air	156-60-5	trans-1,2-Dichloroethene	97	0.05	0.1	0.5	0.198364008	0.396728016	1.983640082
Air	79-01-6	Trichloroethene	131	0.03	0.03	0.03	0.16	0.160736196	0.16
Air	75-69-4	Trichlorofluoromethane	137	0.039	0.1	0.5	0.218527607	0.560327198	2.801635992
Air	108-05-4	Vinyl Acetate	86	0.1	0.1	0.5	0.351738241	0.351738241	1.758691207
Air	75-01-4	Vinyl Chloride	62.5	0.03	0.03	0.03	0.076687117	0.076687117	0.08
Air	91-20-3	Naphthalene	128.17	0.04	0.1	0.5	0.209685072	0.52	2.621063395
Air	98-82-8	Isopropylbenzene	120.194	0.1	0.1	0.5	0.49	0.49	2.45795501
Air	103-65-1	n-propylbenzene	120.2	0.1	0.1	0.5	0.49	0.49	2.45807771
Air	98-06-6	tert-butyl benzene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	135-98-8	sec-butylbenzene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	99-87-6	p-isopropyltoluene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	104-51-8	n-butylbenzene	134.22	0.1	0.1	0.5	0.55	0.55	2.744785276
Air	630-20-6	1,1,1,2-Tetrachloroethane	168	0.1	0.1	0.5	0.69	0.69	3.43
		Acetonitrile							
		Acrolein							
		Acrylonitrile							

SAMPLE DATA

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	09/22/15
Project:	Frankford Arsenal Air	Date Received:	09/24/15
Client Sample ID:	BZ3-3-SG	SDG No.:	G3822
Lab Sample ID:	G3822-01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026163.D	1		09/29/15 20:10	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.73	3.61		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.29	0.6	J	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	8.2	46.1		0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.63	1.91		0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.1	0.41	U	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	16.7	39.7	EB	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	2.8	8.72		0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	1.7	5.91		0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.1	0.34	U	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	0.63	1.86		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	0.25	1.57		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.1	0.49	J	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.1	0.47	U	0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.16	0.51	J	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.1	0.54		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.13	0.53	J	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	0.3	1.13	J	0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	09/22/15
Project:	Frankford Arsenal Air	Date Received:	09/24/15
Client Sample ID:	BZ3-3-SG	SDG No.:	G3822
Lab Sample ID:	G3822-01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026163.D	1		09/29/15 20:10	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.65	4.41		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	0.2	0.87	U	0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	UQ	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.1	0.49	J	0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.1	0.52	U	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	0.1	0.35	U	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	U	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	12.6			65 - 135		126%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	762091		6.66				
540-36-3	1,4-Difluorobenzene	1871860		8.33				
3114-55-4	Chlorobenzene-d5	1558530		13.75				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	09/22/15
Project:	Frankford Arsenal Air	Date Received:	09/24/15
Client Sample ID:	BZ3-3-SGDL	SDG No.:	G3822
Lab Sample ID:	G3822-01DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026156.D	10		09/29/15 15:27	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	1	4.94	UD	1.98	4.94	24.7	ug/m3
74-87-3	Chloromethane	1	2.07	UD	2.07	2.07	10.3	ug/m3
75-01-4	Vinyl Chloride	0.3	0.77	UD	0.77	0.77	0.77	ug/m3
74-83-9	Bromomethane	1	3.88	UD	1.16	3.88	19.4	ug/m3
75-00-3	Chloroethane	1	2.64	UD	2.64	2.64	13.2	ug/m3
109-99-9	Tetrahydrofuran	1	2.95	UD	2.95	2.95	14.8	ug/m3
75-69-4	Trichlorofluoromethane	6.5	36.5	D	2.25	5.62	28.1	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	1	7.66	UD	3.07	7.66	38.3	ug/m3
76-14-2	Dichlorotetrafluoroethane	1	6.99	UD	2.8	6.99	35.0	ug/m3
593-60-2	Bromoethene	1	4.37	UD	1.31	4.37	21.9	ug/m3
75-65-0	tert-Butyl alcohol	1	3.03	UD	3.03	3.03	15.2	ug/m3
142-82-5	Heptane	1	4.1	UD	4.1	4.1	20.5	ug/m3
75-35-4	1,1-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-64-1	Acetone	15.9	37.8	DB	2.38	2.38	11.9	ug/m3
75-15-0	Carbon Disulfide	1.7	5.29	JD	1.56	3.11	15.6	ug/m3
1634-04-4	Methyl tert-Butyl Ether	1	3.61	UD	1.8	3.61	18.0	ug/m3
75-09-2	Methylene Chloride	1	3.47	UD	1.74	3.47	17.4	ug/m3
156-60-5	trans-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
75-34-3	1,1-Dichloroethane	1	4.05	UD	1.62	4.05	20.2	ug/m3
110-82-7	Cyclohexane	1	3.44	UD	3.44	3.44	17.2	ug/m3
78-93-3	2-Butanone	1	2.95	UD	2.95	2.95	14.8	ug/m3
56-23-5	Carbon Tetrachloride	0.3	1.89	UD	1.89	1.89	1.89	ug/m3
156-59-2	cis-1,2-Dichloroethene	1	3.96	UD	1.98	3.96	19.8	ug/m3
67-66-3	Chloroform	1	4.88	UD	0.98	4.88	24.4	ug/m3
71-55-6	1,1,1-Trichloroethane	0.3	1.64	UD	1.64	1.64	1.64	ug/m3
540-84-1	2,2,4-Trimethylpentane	1	4.67	UD	1.87	4.67	23.4	ug/m3
71-43-2	Benzene	1	3.19	UD	1.28	3.19	16.0	ug/m3
107-06-2	1,2-Dichloroethane	1	4.05	UD	4.05	4.05	20.2	ug/m3
79-01-6	Trichloroethene	0.3	1.61	UD	0.81	1.61	1.61	ug/m3
78-87-5	1,2-Dichloropropane	1	4.62	UD	4.62	4.62	23.1	ug/m3
75-27-4	Bromodichloromethane	1	6.7	UD	3.35	6.7	33.5	ug/m3
108-10-1	4-Methyl-2-Pentanone	1	4.1	UD	2.05	4.1	20.5	ug/m3
108-88-3	Toluene	1	3.77	UD	1.88	3.77	18.8	ug/m3
10061-02-6	t-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
10061-01-5	cis-1,3-Dichloropropene	1	4.54	UD	4.54	4.54	22.7	ug/m3
79-00-5	1,1,2-Trichloroethane	1	5.46	UD	5.46	5.46	27.3	ug/m3
124-48-1	Dibromochloromethane	1	8.52	UD	4.26	8.52	42.6	ug/m3
106-93-4	1,2-Dibromoethane	1	7.69	UD	7.69	7.69	38.4	ug/m3

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Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	09/22/15
Project:	Frankford Arsenal Air	Date Received:	09/24/15
Client Sample ID:	BZ3-3-SGDL	SDG No.:	G3822
Lab Sample ID:	G3822-01DL	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026156.D	10		09/29/15 15:27	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.3	2.03	UD	2.03	2.03	2.03	ug/m3
108-90-7	Chlorobenzene	1	4.61	UD	4.61	4.61	23.0	ug/m3
100-41-4	Ethyl Benzene	1	4.34	UD	4.34	4.34	21.7	ug/m3
179601-23-1	m/p-Xylene	2	8.69	UD	4.34	8.69	43.4	ug/m3
95-47-6	o-Xylene	1	4.34	UD	4.34	4.34	21.7	ug/m3
100-42-5	Styrene	1	4.26	UD	4.26	4.26	21.3	ug/m3
75-25-2	Bromoform	1	10.3	UD	5.17	10.3	51.7	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.3	2.06	UDQ	2.06	2.06	2.06	ug/m3
95-49-8	2-Chlorotoluene	1	5.18	UD	5.18	5.18	25.9	ug/m3
108-67-8	1,3,5-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
95-63-6	1,2,4-Trimethylbenzene	1	4.92	UD	4.92	4.92	24.6	ug/m3
541-73-1	1,3-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
106-46-7	1,4-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
95-50-1	1,2-Dichlorobenzene	1	6.01	UD	6.01	6.01	30.1	ug/m3
120-82-1	1,2,4-Trichlorobenzene	1	7.42	UD	2.97	7.42	37.1	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	1	10.7	UD	10.7	10.7	53.3	ug/m3
106-99-0	1,3-Butadiene	1	2.21	UD	2.21	2.21	11.1	ug/m3
91-20-3	Naphthalene	1	5.24	UD	2.1	5.24	26.2	ug/m3
622-96-8	4-Ethyltoluene	1	4.92	UD	4.92	4.92	24.6	ug/m3
110-54-3	Hexane	1	3.52	UD	1.41	3.52	17.6	ug/m3
107-05-1	Allyl Chloride	1	3.13	UD	1.57	3.13	15.6	ug/m3
123-91-1	1,4-Dioxane	1	3.6	UD	3.6	3.6	18.0	ug/m3
80-62-6	Methyl Methacrylate	1	4.09	UD	4.09	4.09	20.5	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10.7			65 - 135		107%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	898093		6.65				
540-36-3	1,4-Difluorobenzene	2445700		8.32				
3114-55-4	Chlorobenzene-d5	2876640		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

QC SUMMARY

Surrogate Summary

SDG No.: G3822

Client: EA Engineering Science & Technology

Analytical Method: SWTO-15

Lab Sample ID	Client ID	Parameter	Spike	Result	Recovery	Qual	Limits Low	Limits High
G3822-01	BZ3-3-SG	1-Bromo-4-Fluorobenzene	10	12.62	126		65	135
G3822-01DL	BZ3-3-SGDL	1-Bromo-4-Fluorobenzene	10	10.67	107		65	135
G3860-02DUP	MLC-02DUP	1-Bromo-4-Fluorobenzene	10	10.65	106		65	135
VL0929ABL01	VL0929ABL01	1-Bromo-4-Fluorobenzene	10	10.59	106		65	135
VL0929ABS01	VL0929ABS01	1-Bromo-4-Fluorobenzene	10	10.46	105		65	135

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Laboratory Control Sample/Laboratory Control Sample Duplicate Summary
SW-846

SDG No.: G3822
Client: EA Engineering Science & Technology
Analytical Method: SWTO-15 **Datafile :** VL026153.D

Lab Sample ID	Parameter	Spike	Result	Unit	Rec	RPD	Qual	Limits Low	Limits High	RPD
VL0929ABS01	Dichlorodifluoromethane	10	12.7	ppbv	127			70	130	
	Chloromethane	10	8.9	ppbv	89			70	130	
	Vinyl Chloride	10	8.5	ppbv	85			70	130	
	Bromomethane	10	10.1	ppbv	101			70	130	
	Chloroethane	10	9.3	ppbv	93			70	130	
	Tetrahydrofuran	10	8	ppbv	80			70	130	
	Trichlorofluoromethane	10	10.1	ppbv	101			70	130	
	1,1,2-Trichlorotrifluoroethane	10	9.8	ppbv	98			70	130	
	Dichlorotetrafluoethane	10	9.5	ppbv	95			70	130	
	Bromoethene	10	9.9	ppbv	99			70	130	
	tert-Butyl Alcohol	10	9.7	ppbv	97			70	130	
	Heptane	10	8.7	ppbv	87			70	130	
	1,1-Dichloroethene	10	9.7	ppbv	97			70	130	
	Acetone	10	8.4	ppbv	84			70	130	
	Carbon disulfide	10	10.5	ppbv	105			70	130	
	Methyl tert-butyl Ether	10	9.7	ppbv	97			70	130	
	Methylene Chloride	10	9	ppbv	90			70	130	
	trans-1,2-Dichloroethene	10	9.4	ppbv	94			70	130	
	1,1-Dichloroethane	10	9.1	ppbv	91			70	130	
	Cyclohexane	10	9.3	ppbv	93			70	130	
	2-Butanone	10	7.7	ppbv	77			70	130	
	Carbon Tetrachloride	10	9	ppbv	90			70	130	
	cis-1,2-Dichloroethene	10	9.2	ppbv	92			70	130	
	Chloroform	10	9.6	ppbv	96			70	130	
	1,1,1-Trichloroethane	10	9.6	ppbv	96			70	130	
	2,2,4-Trimethylpentane	10	7.8	ppbv	78			70	130	
	Benzene	10	8.2	ppbv	82			70	130	
	1,2-Dichloroethane	10	8.7	ppbv	87			70	130	
	Trichloroethene	10	7.5	ppbv	75			70	130	
	1,2-Dichloropropane	10	8	ppbv	80			70	130	
	Bromodichloromethane	10	9.1	ppbv	91			70	130	
	4-Methyl-2-Pentanone	10	8.3	ppbv	83			70	130	
	Toluene	10	8.6	ppbv	86			70	130	
	t-1,3-Dichloropropene	10	9.9	ppbv	99			70	130	
	cis-1,3-Dichloropropene	10	9.5	ppbv	95			70	130	
	1,1,2-Trichloroethane	10	8.5	ppbv	85			70	130	
	Dibromochloromethane	10	9.7	ppbv	97			70	130	
	1,2-Dibromoethane	10	8.6	ppbv	86			70	130	
	Tetrachloroethene	10	7.7	ppbv	77			70	130	
	Chlorobenzene	10	8.1	ppbv	81			70	130	
	Ethyl Benzene	10	8.2	ppbv	82			70	130	
	m/p-Xylene	20	16.2	ppbv	81			70	130	
	o-Xylene	10	8	ppbv	80			70	130	
	Styrene	10	9	ppbv	90			70	130	
	Bromoform	10	10.2	ppbv	102			70	130	
	1,1,2,2-Tetrachloroethane	10	6.9	ppbv	69		*	70	130	
	2-Chlorotoluene	10	8.3	ppbv	83			70	130	
	1,3,5-Trimethylbenzene	10	8.5	ppbv	85			70	130	
	1,2,4-Trimethylbenzene	10	8	ppbv	80			70	130	

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A B C D E F G H

Laboratory Control Sample/Laboratory Control Sample Duplicate Summary
SW-846

SDG No.: G3822

Client: EA Engineering Science & Technology

Analytical Method: SWTO-15 **Datafile :** VL026153.D

Lab Sample ID	Parameter	Spike	Result	Unit	Rec	RPD	Qual	Limits Low	Limits High	Limits RPD
VL0929ABS01	1,3-Dichlorobenzene	10	8.4	ppbv	84			70	130	
	1,4-Dichlorobenzene	10	8.4	ppbv	84			70	130	
	1,2-Dichlorobenzene	10	8.4	ppbv	84			70	130	
	1,2,4-Trichlorobenzene	10	7.6	ppbv	76			70	130	
	Hexachloro-1,3-butadiene	10	8.2	ppbv	82			70	130	
	Naphthalene	10	7.8	ppbv	78			70	130	
	1,3-Butadiene	10	8.9	ppbv	89			70	130	
	4-Ethyltoluene	10	8.6	ppbv	86			70	130	
	Hexane	10	8.9	ppbv	89			70	130	
	Allyl Chloride	10	9.2	ppbv	92			70	130	
	1,4-Dioxane	10	12.8	ppbv	128			70	130	
	Methyl methacrylate	10	8.9	ppbv	89			70	130	

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A B C D E F G H

Duplicate Sample Summary

Lab Sample Id :	G3860-02DUP		G3860-02
Client Id :	MLC-02DUP		MLC-02
DF :	1		1
Datafile :	VL026161.D		VL026160.D
Anal Date & Time :	09/29/2015	18:50	09/29/2015 18:09

Parameter	Result	Result	RPD
1,1,1-Trichloroethane	0	0	0
1,1,2,2-Tetrachloroethane	0	0	0
1,1,2-Trichloroethane	0	0	0
1,1,2-Trichlorotrifluoroethane	0	0	0
1,1-Dichloroethane	0	0	0
1,1-Dichloroethene	0	0	0
1,2,4-Trichlorobenzene	0	0	0
1,2,4-Trimethylbenzene	0.16	0.12	28.6 *
1,2-Dibromoethane	0	0	0
1,2-Dichlorobenzene	0	0	0
1,2-Dichloroethane	0	0	0
1,2-Dichloropropane	0	0	0
1,3,5-Trimethylbenzene	0	0	0
1,3-Butadiene	0	0	0
1,3-Dichlorobenzene	0	0	0
1,4-Dichlorobenzene	0	0	0
1,4-Dioxane	0	0	0
2,2,4-Trimethylpentane	0	0	0
2-Butanone	0.12	0.14	15.4
2-Chlorotoluene	0	0	0
4-Ethyltoluene	0	0	0
4-Methyl-2-Pentanone	0	0	0
Acetone	4.3	4	7.2
Allyl Chloride	0	0	0
Benzene	0	0	0
Bromodichloromethane	0	0	0
Bromoethene	0	0	0
Bromoform	0	0	0
Bromomethane	0	0	0
Carbon Disulfide	0	0	0

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Duplicate Sample Summary

Lab Sample Id :	G3860-02DUP	G3860-02
Client Id :	MLC-02DUP	MLC-02
DF :	1	1
Datafile :	VL026161.D	VL026160.D
Anal Date & Time :	09/29/2015 18:50	09/29/2015 18:09

Parameter	Result	Result	RPD
Carbon Tetrachloride	0.07	0.07	0
Chlorobenzene	0	0	0
Chloroethane	0	0	0
Chloroform	0	0	0
Chloromethane	0.47	0.46	2.2
cis-1,2-Dichloroethene	0	0	0
cis-1,3-Dichloropropene	0	0	0
Cyclohexane	0	0	0
Dibromochloromethane	0	0	0
Dichlorodifluoromethane	0.73	0.69	5.6
Dichlorotetrafluoroethane	0	0	0
Ethyl Benzene	0	0	0
Heptane	0	0	0
Hexachloro-1,3-Butadiene	0	0	0
Hexane	0	0	0
m/p-Xylene	0	0	0
Methyl Methacrylate	0	0	0
Methyl tert-Butyl Ether	0	0	0
Methylene Chloride	0.55	0.52	5.6
Naphthalene	0	0	0
o-Xylene	0	0	0
Styrene	0	0	0
t-1,3-Dichloropropene	0	0	0
tert-Butyl alcohol	0	0	0
Tetrachloroethene	0.03	0.03	0
Tetrahydrofuran	0	0	0
Toluene	0.8	0.75	6.5
trans-1,2-Dichloroethene	0	0	0
Trichloroethene	0	0	0
Trichlorofluoromethane	0.28	0.25	11.3
Vinyl Chloride	0	0	0

A B C D E F G H

Duplicate Sample Summary

Lab Sample Id :	G3860-02DUP		G3860-02
Client Id :	MLC-02DUP		MLC-02
DF :	1		1
Datafile :	VL026161.D		VL026160.D
Anal Date & Time :	09/29/2015	18:50	09/29/2015 18:09

Parameter	Result	Result	RPD

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VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VL0929ABL01

Lab Name: CHEMTECH   Contract: EAEN06

Lab Code: CHEM   Case No.: G3822   SAS No.: G3822   SDG NO.: G3822

Lab File ID: VL026152.D   Lab Sample ID: VL0929ABL01

Date Analyzed: 09/29/2015   Time Analyzed: 12:49

GC Column: RTX-1   ID: 0.32 (mm)   Heated Purge: (Y/N) N

Instrument ID: MSVOA_L

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
VL0929ABS01	VL0929ABS01	VL026153.D	09/29/2015
BZ3-3-SGDL	G3822-01DL	VL026156.D	09/29/2015
MLC-02DUP	G3860-02DUP	VL026161.D	09/29/2015
BZ3-3-SG	G3822-01	VL026163.D	09/29/2015

COMMENTS:

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VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG NO.: G3822

Lab File ID: VL026041.D BFB Injection Date: 09/04/2015

Instrument ID: MSVOA_L BFB Injection Time: 09:25

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: Y/N N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	20.7
75	30.0 - 66.0% of mass 95	51.1
95	Base Peak, 100% relative abundance	100
96	5.0 - 9.0% of mass 95	6.8
173	Less than 2.0% of mass 174	0.0 (0.0) 1
174	50.0 - 120.0% of mass 95	64.4
175	4.0 - 9.0% of mass 174	4.8 (7.4) 1
176	93.0 - 101.0% of mass 174	61.9 (96) 1
177	5.0 - 9.0% of mass 176	4.1 (6.5) 2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
VSTDICCC010	VSTDICCC010	VL026042.D	09/04/2015	10:55
VSTDICC002	VSTDICC002	VL026043.D	09/04/2015	11:37
VSTDICC001	VSTDICC001	VL026044.D	09/04/2015	12:15
VSTDICC0.5	VSTDICC0.5	VL026045.D	09/04/2015	12:53
VSTDICC0.1	VSTDICC0.1	VL026046.D	09/04/2015	13:31
VSTDICC0.03	VSTDICC0.03	VL026047.D	09/04/2015	14:10
VSTDICC015	VSTDICC015	VL026048.D	09/04/2015	14:51

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG NO.: G3822

Lab File ID: VL026150.D BFB Injection Date: 09/29/2015

Instrument ID: MSVOA_L BFB Injection Time: 09:53

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: Y/N N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	8.0 - 40.0% of mass 95	20.1
75	30.0 - 66.0% of mass 95	51.1
95	Base Peak, 100% relative abundance	100
96	5.0 - 9.0% of mass 95	6.8
173	Less than 2.0% of mass 174	0.0 (0.0) 1
174	50.0 - 120.0% of mass 95	65.2
175	4.0 - 9.0% of mass 174	5.2 (7.9) 1
176	93.0 - 101.0% of mass 174	62.8 (96.4) 1
177	5.0 - 9.0% of mass 176	4.1 (6.5) 2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
VSTDCCC010	VSTDCCC010	VL026151.D	09/29/2015	11:26
VL0929ABL01	VL0929ABL01	VL026152.D	09/29/2015	12:49
VL0929ABS01	VL0929ABS01	VL026153.D	09/29/2015	13:28
BZ3-3-SGDL	G3822-01DL	VL026156.D	09/29/2015	15:27
MLC-02DUP	G3860-02DUP	VL026161.D	09/29/2015	18:50
BZ3-3-SG	G3822-01	VL026163.D	09/29/2015	20:10
VSTDCCC010EC	VSTDCCC010	VL026170.D	09/30/2015	00:50

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VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG NO.: G3822

Lab File ID: VL026042.D Date Analyzed: 09/04/2015

Instrument ID: MSVOA_L Time Analyzed: 10:55

GC Column: RTX-1 ID: 0.32 (mm) Heated Purge: (Y/N) N

	IS1 AREA #	RT #	IS2 AREA #	RT #	IS3 AREA #	RT #
12 HOUR STD	768146	6.65	2105860	8.32	2363860	13.74
UPPER LIMIT	1536290	6.98	4211720	8.65	4727720	14.07
LOWER LIMIT	384073	6.32	1052930	7.99	1181930	13.41
EPA SAMPLE NO.						
BZ3-3-SG	762091	6.66	1871860	8.33	1558530	13.75
BZ3-3-SGDL	898093	6.65	2445700	8.32	2876640	13.74
VL0929ABL01	924792	6.65	2468590	8.32	2934060	13.74
VL0929ABS01	859968	6.65	2510480	8.33	2922540	13.75

IS1 = Bromochloromethane
IS2 = 1,4-Difluorobenzene
IS3 = Chlorobenzene-d5

AREA UPPER LIMIT = +40% of internal standard area
AREA LOWER LIMIT = -40% of internal standard area
RT UPPER LIMIT = +0.33 minutes of internal standard RT
RT LOWER LIMIT = -0.33 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

QC SAMPLE DATA

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0929ABL01	SDG No.:	G3822
Lab Sample ID:	VL0929ABL01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026152.D	1		09/29/15 12:49	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	0.1	0.49	U	0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	0.1	0.21	U	0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	0.03	0.08	U	0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	0.1	0.39	U	0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	0.1	0.26	U	0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	0.1	0.29	U	0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	0.1	0.56	U	0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	0.1	0.77	U	0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	0.1	0.7	U	0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	0.1	0.44	U	0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	0.1	0.3	U	0.3	0.3	1.52	ug/m3
142-82-5	Heptane	0.1	0.41	U	0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-64-1	Acetone	0.4	0.95	J	0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	0.1	0.31	U	0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	0.1	0.36	U	0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	0.1	0.35	U	0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	0.1	0.4	U	0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	0.1	0.34	U	0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	0.1	0.29	U	0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	0.03	0.19	U	0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	0.1	0.4	U	0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	0.1	0.49	U	0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	0.03	0.16	U	0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	0.1	0.47	U	0.19	0.47	2.34	ug/m3
71-43-2	Benzene	0.1	0.32	U	0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	0.1	0.4	U	0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	0.03	0.16	U	0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	0.1	0.46	U	0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	0.1	0.67	U	0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	0.1	0.41	U	0.2	0.41	2.05	ug/m3
108-88-3	Toluene	0.1	0.38	U	0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	0.1	0.45	U	0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	0.1	0.55	U	0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	0.1	0.85	U	0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	0.1	0.77	U	0.77	0.77	3.84	ug/m3

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0929ABL01	SDG No.:	G3822
Lab Sample ID:	VL0929ABL01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026152.D	1		09/29/15 12:49	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	0.03	0.2	U	0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	0.1	0.46	U	0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	0.2	0.87	U	0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	0.1	0.43	U	0.43	0.43	2.17	ug/m3
100-42-5	Styrene	0.1	0.43	U	0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	0.1	1.03	U	0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	0.03	0.21	U	0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	0.1	0.52	U	0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	0.1	0.6	U	0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	0.1	0.74	U	0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	0.1	1.07	U	1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	0.1	0.22	U	0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	0.1	0.52	U	0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	0.1	0.49	U	0.49	0.49	2.46	ug/m3
110-54-3	Hexane	0.1	0.35	U	0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	0.1	0.31	U	0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	0.1	0.36	U	0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	0.1	0.41	U	0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10.6			65 - 135		106%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	924792		6.65				
540-36-3	1,4-Difluorobenzene	2468590		8.32				
3114-55-4	Chlorobenzene-d5	2934060		13.74				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0929ABS01	SDG No.:	G3822
Lab Sample ID:	VL0929ABS01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026153.D	1		09/29/15 13:28	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
TARGETS								
75-71-8	Dichlorodifluoromethane	12.7	62.8		0.2	0.49	2.47	ug/m3
74-87-3	Chloromethane	8.9	18.4		0.21	0.21	1.03	ug/m3
75-01-4	Vinyl Chloride	8.5	21.7		0.08	0.08	0.08	ug/m3
74-83-9	Bromomethane	10.1	39.2		0.12	0.39	1.94	ug/m3
75-00-3	Chloroethane	9.3	24.5		0.26	0.26	1.32	ug/m3
109-99-9	Tetrahydrofuran	8	23.6		0.29	0.29	1.47	ug/m3
75-69-4	Trichlorofluoromethane	10.1	56.8		0.22	0.56	2.81	ug/m3
76-13-1	1,1,2-Trichlorotrifluoroethane	9.8	75.1		0.31	0.77	3.83	ug/m3
76-14-2	Dichlorotetrafluoroethane	9.5	66.4		0.28	0.7	3.49	ug/m3
593-60-2	Bromoethene	9.9	43.3		0.13	0.44	2.19	ug/m3
75-65-0	tert-Butyl alcohol	9.7	29.4		0.3	0.3	1.52	ug/m3
142-82-5	Heptane	8.7	35.6		0.41	0.41	2.05	ug/m3
75-35-4	1,1-Dichloroethene	9.7	38.5		0.2	0.4	1.98	ug/m3
67-64-1	Acetone	8.4	20.0		0.24	0.24	1.19	ug/m3
75-15-0	Carbon Disulfide	10.5	32.7		0.16	0.31	1.56	ug/m3
1634-04-4	Methyl tert-Butyl Ether	9.7	35.0		0.18	0.36	1.8	ug/m3
75-09-2	Methylene Chloride	9	31.3		0.17	0.35	1.74	ug/m3
156-60-5	trans-1,2-Dichloroethene	9.4	37.3		0.2	0.4	1.98	ug/m3
75-34-3	1,1-Dichloroethane	9.1	36.8		0.16	0.4	2.02	ug/m3
110-82-7	Cyclohexane	9.3	32.0		0.34	0.34	1.72	ug/m3
78-93-3	2-Butanone	7.7	22.7		0.29	0.29	1.47	ug/m3
56-23-5	Carbon Tetrachloride	9	56.6		0.19	0.19	0.19	ug/m3
156-59-2	cis-1,2-Dichloroethene	9.2	36.5		0.2	0.4	1.98	ug/m3
67-66-3	Chloroform	9.6	46.9		0.1	0.49	2.44	ug/m3
71-55-6	1,1,1-Trichloroethane	9.6	52.4		0.16	0.16	0.16	ug/m3
540-84-1	2,2,4-Trimethylpentane	7.8	36.4		0.19	0.47	2.34	ug/m3
71-43-2	Benzene	8.2	26.2		0.13	0.32	1.6	ug/m3
107-06-2	1,2-Dichloroethane	8.7	35.2		0.4	0.4	2.02	ug/m3
79-01-6	Trichloroethene	7.5	40.3		0.11	0.16	0.16	ug/m3
78-87-5	1,2-Dichloropropane	8	37.0		0.46	0.46	2.31	ug/m3
75-27-4	Bromodichloromethane	9.1	61.0		0.33	0.67	3.35	ug/m3
108-10-1	4-Methyl-2-Pentanone	8.3	34.0		0.2	0.41	2.05	ug/m3
108-88-3	Toluene	8.6	32.4		0.19	0.38	1.88	ug/m3
10061-02-6	t-1,3-Dichloropropene	9.9	44.9		0.45	0.45	2.27	ug/m3
10061-01-5	cis-1,3-Dichloropropene	9.5	43.1		0.45	0.45	2.27	ug/m3
79-00-5	1,1,2-Trichloroethane	8.5	46.4		0.55	0.55	2.73	ug/m3
124-48-1	Dibromochloromethane	9.7	82.6		0.43	0.85	4.26	ug/m3
106-93-4	1,2-Dibromoethane	8.6	66.1		0.77	0.77	3.84	ug/m3

CHEMTECH 284 Sheffield Street, Mountainside NJ 07092 (908)-789-8900 Fax : 908 789 8922

Report of Analysis

Client:	EA Engineering Science & Technology	Date Collected:	
Project:	Frankford Arsenal Air	Date Received:	
Client Sample ID:	VL0929ABS01	SDG No.:	G3822
Lab Sample ID:	VL0929ABS01	Matrix:	Air
Analytical Method:	TO-15	Test:	TO-15
Sample Wt/Vol:	400 Units: mL		

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
VL026153.D	1		09/29/15 13:28	VL092915

CAS Number	Parameter	Conc. ppbv	Conc. ug/M3	Qualifier	MDL	LOD	LOQ / CRQL	Units
127-18-4	Tetrachloroethene	7.7	52.2		0.2	0.2	0.2	ug/m3
108-90-7	Chlorobenzene	8.1	37.3		0.46	0.46	2.3	ug/m3
100-41-4	Ethyl Benzene	8.2	35.6		0.43	0.43	2.17	ug/m3
179601-23-1	m/p-Xylene	16.2	70.4		0.43	0.87	4.34	ug/m3
95-47-6	o-Xylene	8	34.8		0.43	0.43	2.17	ug/m3
100-42-5	Styrene	9	38.3		0.43	0.43	2.13	ug/m3
75-25-2	Bromoform	10.2	105		0.52	1.03	5.17	ug/m3
79-34-5	1,1,2,2-Tetrachloroethane	6.9	47.4		0.21	0.21	0.21	ug/m3
95-49-8	2-Chlorotoluene	8.3	43.0		0.52	0.52	2.59	ug/m3
108-67-8	1,3,5-Trimethylbenzene	8.5	41.8		0.49	0.49	2.46	ug/m3
95-63-6	1,2,4-Trimethylbenzene	8	39.3		0.49	0.49	2.46	ug/m3
541-73-1	1,3-Dichlorobenzene	8.4	50.5		0.6	0.6	3.01	ug/m3
106-46-7	1,4-Dichlorobenzene	8.4	50.5		0.6	0.6	3.01	ug/m3
95-50-1	1,2-Dichlorobenzene	8.4	50.5		0.6	0.6	3.01	ug/m3
120-82-1	1,2,4-Trichlorobenzene	7.6	56.4		0.3	0.74	3.71	ug/m3
87-68-3	Hexachloro-1,3-Butadiene	8.2	87.5		1.07	1.07	5.33	ug/m3
106-99-0	1,3-Butadiene	8.9	19.7		0.22	0.22	1.11	ug/m3
91-20-3	Naphthalene	7.8	40.9		0.21	0.52	2.62	ug/m3
622-96-8	4-Ethyltoluene	8.6	42.3		0.49	0.49	2.46	ug/m3
110-54-3	Hexane	8.9	31.4		0.14	0.35	1.76	ug/m3
107-05-1	Allyl Chloride	9.2	28.8		0.16	0.31	1.57	ug/m3
123-91-1	1,4-Dioxane	12.8	46.1		0.36	0.36	1.8	ug/m3
80-62-6	Methyl Methacrylate	8.9	36.4		0.41	0.41	2.05	ug/m3
SURROGATES								
460-00-4	1-Bromo-4-Fluorobenzene	10.5			65 - 135		105%	SPK: 10
INTERNAL STANDARDS								
74-97-5	Bromochloromethane	859968		6.65				
540-36-3	1,4-Difluorobenzene	2510480		8.33				
3114-55-4	Chlorobenzene-d5	2922540		13.75				

U = Not Detected
RL = Reporting Limit
MDL = Method Detection Limit
E = Value Exceeds Calibration Range
D = Dilution
J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
Q = indicates LCS control criteria did not meet requirements

CALIBRATION SUMMARY

5

Method Path : W:\HPCHEM1\MSVOA_L\METHODS\
Method File : VL090415AIR.M
Title : AIR ANALYSIS BY METHOD TO-15 Instrument: MSVOA_LFri Sep 04 15:41:31 2015
Last Update : Fri Sep 04 15:41:31 2015
Response Via : Initial Calibration

Calibration Files
0.03=VL026047.D 0.1 =VL026046.D 0.5 =VL026045.D 1 =VL026044.D 2 =VL026043.D 10 =VL026042.D 15 =VL026048.D

		Compound	0.03	0.1	0.5	1	2	10	15	Avg	%RSD
1)	I	Bromochloromethane	----------------	ISTD	--------------------						
2)	T	Dichlorodifluo...			1.795	1.878	1.385	1.052	1.067	1.435	27.20
3)		Chlorodifluoro...			1.260	1.229	1.196	0.980	1.070	1.147	10.30
4)		Chloromethane			0.698	0.680	0.692	0.643	0.683	0.679	3.18
5)	T	Vinyl Chloride	1.017	0.717	0.668	0.670	0.691	0.635	0.677	0.725	18.11
6)	T	Bromomethane			0.447	0.470	0.468	0.430	0.467	0.456	3.81
7)		Chloroethane			0.285	0.287	0.289	0.269	0.281	0.282	2.83
8)	T	Dichlorotetraf...			1.679	1.625	1.616	1.401	1.462	1.557	7.62
9)	T	Propene			0.605	0.590	0.597	0.551	0.573	0.583	3.71
10)	T	Heptane			2.061	2.065	2.129	1.918	1.934	2.021	4.51
11)	T	Trichlorofluor...			1.677	1.713	1.699	1.500	1.644	1.647	5.22
12)	T	1,1,2-Trichlor...			1.170	1.199	1.187	1.024	1.099	1.136	6.47
13)		Ethanol			0.062	0.091	0.074	0.058	0.068	0.071	18.17
14)	T	Bromoethene			0.482	0.493	0.504	0.462	0.481	0.484	3.26
15)	T	Acetone			1.395	1.373	1.362	1.006	1.074	1.242	15.01
16)	T	1,3-Butadiene			0.649	0.627	0.632	0.571	0.602	0.616	4.94
17)		tert-Butyl alc...			0.668	0.782	0.758	0.875	0.950	0.807	13.51
18)	T	1,1-Dichloroet...			0.529	0.549	0.551	0.497	0.528	0.531	4.05
19)	T	Isopropyl Alcohol			0.460	0.550	0.514	0.504	0.570	0.520	8.23
20)	T	Methylene Chlo...			0.577	0.573	0.539	0.461	0.491	0.528	9.61
21)	T	Allyl Chloride			0.875	0.883	0.859	0.804	0.864	0.857	3.66
22)	T	trans-1,2-Dich...			0.722	0.721	0.733	0.675	0.717	0.714	3.15
23)	T	Vinyl Acetate			2.128	2.405	2.402	2.387	2.452	2.355	5.48
24)	T	1,1-Dichloroet...			1.636	1.647	1.615	1.469	1.571	1.587	4.55
25)	T	Ethyl Acetate			2.677	2.723	2.737	2.538	2.518	2.639	3.93
26)	T	Hexane			1.266	1.320	1.317	1.217	1.202	1.264	4.35
27)	T	Carbon Disulfide			1.188	1.300	1.399	1.380	1.502	1.354	8.66
28)	T	Methyl tert-Bu...			1.835	1.933	1.957	1.933	1.963	1.924	2.68
29)	T	Chloroform			1.784	1.773	1.777	1.674	1.769	1.755	2.61
30)	T	Cyclohexane			1.226	1.209	1.219	1.179	1.205	1.208	1.49
31)	T	cis-1,2-Dichlo...			1.118	1.145	1.182	1.143	1.192	1.156	2.64
32)	T	1,1,1-Trichlor...	2.358	1.755	1.556	1.585	1.651	1.656	1.733	1.756	15.65
33)	I	1,4-Difluorobenzene	----------------	ISTD	--------------------						
34)	T	2-Butanone			0.654	0.670	0.679	0.605	0.601	0.642	5.65
35)	T	Carbon Tetrach...	0.940	0.625	0.605	0.637	0.656	0.612	0.618	0.671	17.92
36)	T	Benzene			1.109	1.117	1.105	0.995	0.960	1.057	7.00
37)	T	1,2-Dichloroet...			0.545	0.546	0.544	0.497	0.507	0.528	4.50

Method Path : W:\HPCHEM1\MSVOA_L\METHODS\
Method File : VL090415AIR.M

38)	T	Trichloroethene	0.675	0.499	0.444	0.442	0.446	0.375	0.354	0.462	22.86
39)	T	1,2-Dichloropr...			0.425	0.407	0.416	0.370	0.366	0.397	6.75
40)	T	1,4-Dioxane			0.035	0.076	0.063	0.054	0.062	0.058	26.34
41)	T	Tetrahydrofuran			0.360	0.379	0.394	0.375	0.372	0.376	3.29
42)	T	Bromodichlorom...			0.673	0.718	0.728	0.680	0.680	0.696	3.61
43)		Methyl Methacr...			0.345	0.377	0.399	0.379	0.378	0.376	5.23
44)	T	2,2,4-Trimethy...			1.936	1.992	1.977	1.583	1.468	1.791	13.77
45)	T	t-1,3-Dichloro...			0.395	0.444	0.518	0.548	0.554	0.492	14.13
46)	T	cis-1,3-Dichlo...			0.515	0.589	0.651	0.646	0.647	0.609	9.61
47)	T	1,1,2-Trichlor...			0.479	0.465	0.474	0.418	0.414	0.450	6.97
48)	T	Dibromochlorom...			0.541	0.592	0.656	0.627	0.631	0.610	7.28
49)	T	Bromoform			0.347	0.420	0.485	0.505	0.505	0.452	15.15
50)	T	4-Methyl-2-Pen...			0.824	0.870	0.929	0.848	0.828	0.860	4.96
51)	T	2-Hexanone			0.679	0.773	0.877	0.807	0.802	0.788	9.10
52)	T	Tetrachloroethene	0.744	0.492	0.454	0.438	0.452	0.401	0.383	0.481	25.31
53)	T	Toluene			1.355	1.397	1.436	1.255	1.234	1.335	6.58
54)	T	1,2-Dibromoethane			0.685	0.690	0.709	0.640	0.632	0.671	4.97
55)	I	Chlorobenzene-d5	----------------ISTD---------------------								
56)		1,1,1,2-Tetrac...			0.419	0.438	0.431	0.402	0.384	0.415	5.28
57)	T	Chlorobenzene			1.100	1.088	1.022	0.893	0.836	0.988	11.99
58)	T	Ethyl Benzene			1.711	1.782	1.719	1.586	1.503	1.660	6.80
59)	T	m/p-Xylene			1.406	1.416	1.374	1.200	1.131	1.305	10.03
60)	T	o-Xylene			1.479	1.497	1.441	1.217	1.141	1.355	12.13
61)	T	Styrene			0.513	0.580	0.602	0.614	0.598	0.582	6.89
62)		Isopropylbenzene			1.833	1.890	1.874	1.695	1.607	1.780	6.92
63)	T	1,1,2,2-Tetrac...	1.542	1.114	1.014	1.030	0.978	0.816	0.773	1.038	24.35
64)		n-propylbenzene			0.472	0.491	0.497	0.471	0.446	0.475	4.28
65)		tert-Butylbenzene			1.627	1.687	1.682	1.460	1.346	1.560	9.69
66)	T	Benzyl Chloride			0.265	0.327	0.418	0.562	0.551	0.424	31.15
67)		sec-Butylbenzene			2.205	2.343	2.373	2.127	1.971	2.204	7.45
68)	S	1-Bromo-4-Fluo...	0.736	0.753	0.737	0.726	0.713	0.755	0.748	0.738	2.08
69)		p-Isopropyltol...			1.731	1.870	1.930	1.748	1.635	1.783	6.58
70)		n-Butylbenzene			1.697	1.870	1.940	1.760	1.640	1.781	6.91
71)		2-Chlorotoluene			1.353	1.430	1.412	1.318	1.254	1.353	5.29
72)	T	4-Ethyltoluene			1.426	1.550	1.570	1.468	1.389	1.481	5.27
73)	T	1,3,5-Trimethy...			1.346	1.451	1.451	1.346	1.275	1.374	5.56
74)	T	1,2,4-Trimethy...			1.516	1.574	1.576	1.317	1.218	1.440	11.34
75)	T	1,3-Dichlorobe...			0.906	0.933	0.948	0.867	0.820	0.895	5.84
76)	T	1,4-Dichlorobe...			0.906	0.963	0.969	0.907	0.857	0.921	5.04
77)	T	1,2-Dichlorobe...			0.895	0.917	0.944	0.875	0.833	0.893	4.73
78)	T	Hexachloro-1,3...			0.359	0.371	0.383	0.352	0.323	0.358	6.25
79)	T	Naphthalene			1.055	1.124	1.228	1.128	1.060	1.119	6.25
80)	T	Naphthalene,2-...			0.224	0.259	0.281	0.203	0.345	0.262	21.00
81)	T	1,2,4-Trichlor...			0.524	0.545	0.575	0.546	0.504	0.539	4.96

(#) = Out of Range

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG No.: G3822

Instrument ID: MSVOA_L Calibration Date/Time: 09/29/2015 11:26

Lab File ID: VL026151.D Init. Calib. Date(s): 09/04/2015 09/04/2015

Heated Purge: (Y/N) N Init. Calib. Time(s): 10:55 14:51

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Dichlorodifluoromethane	1.435	1.863		29.83	30
Chloromethane	0.679	0.647		-4.71	30
Vinyl Chloride	0.725	0.662		-8.69	30
Bromomethane	0.456	0.469		2.85	30
Chloroethane	0.282	0.292		3.55	30
Tetrahydrofuran	0.376	0.322		-14.36	30
Trichlorofluoromethane	1.647	1.738		5.53	30
1,1,2-Trichlorotrifluoroethane	1.136	1.176		3.52	30
Dichlorotetrafluoroethane	1.557	1.543		-0.9	30
Bromoethene	0.484	0.519		7.23	30
tert-Butyl alcohol	0.807	0.874		8.3	30
Heptane	2.021	1.905		-5.74	30
1,1-Dichloroethene	0.531	0.562		5.84	30
Acetone	1.242	1.099		-11.51	30
Carbon Disulfide	1.354	1.541		13.81	30
Methyl tert-Butyl Ether	1.924	2.050		6.55	30
Methylene Chloride	0.528	0.515		-2.46	30
trans-1,2-Dichloroethene	0.714	0.725		1.54	30
1,1-Dichloroethane	1.587	1.520		-4.22	30
Cyclohexane	1.208	1.232		1.99	30
2-Butanone	0.642	0.530		-17.44	30
Carbon Tetrachloride	0.671	0.629		-6.26	30
cis-1,2-Dichloroethene	1.156	1.133		-1.99	30
Chloroform	1.755	1.741		-0.8	30
1,1,1-Trichloroethane	1.756	1.814		3.3	30
2,2,4-Trimethylpentane	1.791	1.481		-17.31	30
Benzene	1.057	0.932		-11.83	30
1,2-Dichloroethane	0.528	0.478		-9.47	30
Trichloroethene	0.462	0.369		-20.13	30
1,2-Dichloropropane	0.397	0.343		-13.6	30
Bromodichloromethane	0.696	0.673		-3.31	30
4-Methyl-2-Pentanone	0.860	0.771		-10.35	30
Toluene	1.335	1.220		-8.61	30
t-1,3-Dichloropropene	0.492	0.538		9.35	30
cis-1,3-Dichloropropene	0.609	0.623		2.3	30
1,1,2-Trichloroethane	0.450	0.409		-9.11	30
Dibromochloromethane	0.610	0.631		3.44	30
1,2-Dibromoethane	0.671	0.623		-7.15	30
Tetrachloroethene	0.481	0.398		-17.26	30

All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG No.: G3822

Instrument ID: MSVOA_L Calibration Date/Time: 09/29/2015 11:26

Lab File ID: VL026151.D Init. Calib. Date(s): 09/04/2015 09/04/2015

Heated Purge: (Y/N) N Init. Calib. Time(s): 10:55 14:51

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Chlorobenzene	0.988	0.901		-8.81	30
Ethyl Benzene	1.660	1.559		-6.08	30
m/p-Xylene	1.305	1.197		-8.28	30
o-Xylene	1.355	1.220		-9.96	30
Styrene	0.582	0.607		4.3	30
Bromoform	0.452	0.518		14.6	30
1,1,2,2-Tetrachloroethane	1.038	0.830		-20.04	30
2-Chlorotoluene	1.353	1.302		-3.77	30
1,3,5-Trimethylbenzene	1.374	1.357		-1.24	30
1,2,4-Trimethylbenzene	1.440	1.343		-6.74	30
1,3-Dichlorobenzene	0.895	0.898		0.34	30
1,4-Dichlorobenzene	0.921	0.941		2.17	30
1,2-Dichlorobenzene	0.893	0.911		2.02	30
1,2,4-Trichlorobenzene	0.539	0.565		4.82	30
Hexachloro-1,3-Butadiene	0.358	0.374		4.47	30
1,3-Butadiene	0.616	0.592		-3.9	30
Naphthalene	1.119	1.174		4.91	30
4-Ethyltoluene	1.481	1.474		-0.47	30
1-Bromo-4-Fluorobenzene	0.738	0.807		9.35	30
Hexane	1.264	1.201		-4.98	30
Allyl Chloride	0.857	0.871		1.63	30
1,4-Dioxane	58.106	71.342		22.78	30
Methyl Methacrylate	0.376	0.359		-4.52	30

All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG No.: G3822

Instrument ID: MSVOA_L Calibration Date/Time: 09/30/2015 00:50

Lab File ID: VL026170.D Init. Calib. Date(s): 09/04/2015 09/04/2015

Heated Purge: (Y/N) N Init. Calib. Time(s): 10:55 14:51

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Dichlorodifluoromethane	1.435	1.868		30.17	50
Chloromethane	0.679	0.641		-5.6	50
Vinyl Chloride	0.725	0.657		-9.38	50
Bromomethane	0.456	0.468		2.63	50
Chloroethane	0.282	0.283		0.35	50
Tetrahydrofuran	0.376	0.334		-11.17	50
Trichlorofluoromethane	1.647	1.788		8.56	50
1,1,2-Trichlorotrifluoroethane	1.136	1.203		5.9	50
Dichlorotetrafluoroethane	1.557	1.537		-1.28	50
Bromoethene	0.484	0.514		6.2	50
tert-Butyl alcohol	0.807	0.810		0.37	50
Heptane	2.021	1.806		-10.64	50
1,1-Dichloroethene	0.531	0.560		5.46	50
Acetone	1.242	1.113		-10.39	50
Carbon Disulfide	1.354	1.556		14.92	50
Methyl tert-Butyl Ether	1.924	2.005		4.21	50
Methylene Chloride	0.528	0.515		-2.46	50
trans-1,2-Dichloroethene	0.714	0.718		0.56	50
1,1-Dichloroethane	1.587	1.510		-4.85	50
Cyclohexane	1.208	1.152		-4.64	50
2-Butanone	0.642	0.556		-13.4	50
Carbon Tetrachloride	0.671	0.641		-4.47	50
cis-1,2-Dichloroethene	1.156	1.125		-2.68	50
Chloroform	1.755	1.761		0.34	50
1,1,1-Trichloroethane	1.756	1.728		-1.6	50
2,2,4-Trimethylpentane	1.791	1.481		-17.31	50
Benzene	1.057	0.932		-11.83	50
1,2-Dichloroethane	0.528	0.498		-5.68	50
Trichloroethene	0.462	0.371		-19.7	50
1,2-Dichloropropane	0.397	0.342		-13.85	50
Bromodichloromethane	0.696	0.685		-1.58	50
4-Methyl-2-Pentanone	0.860	0.768		-10.7	50
Toluene	1.335	1.213		-9.14	50
t-1,3-Dichloropropene	0.492	0.522		6.1	50
cis-1,3-Dichloropropene	0.609	0.623		2.3	50
1,1,2-Trichloroethane	0.450	0.408		-9.33	50
Dibromochloromethane	0.610	0.637		4.43	50
1,2-Dibromoethane	0.671	0.615		-8.35	50
Tetrachloroethene	0.481	0.388		-19.33	50

All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: CHEMTECH Contract: EAEN06

Lab Code: CHEM Case No.: G3822 SAS No.: G3822 SDG No.: G3822

Instrument ID: MSVOA_L Calibration Date/Time: 09/30/2015 00:50

Lab File ID: VL026170.D Init. Calib. Date(s): 09/04/2015 09/04/2015

Heated Purge: (Y/N) N Init. Calib. Time(s): 10:55 14:51

GC Column: RTX-1 ID: 0.32 (mm)

COMPOUND	RRF	RRF010	MIN RRF	%D	MAX%D
Chlorobenzene	0.988	0.850		-13.97	50
Ethyl Benzene	1.660	1.482		-10.72	50
m/p-Xylene	1.305	1.142		-12.49	50
o-Xylene	1.355	1.163		-14.17	50
Styrene	0.582	0.571		-1.89	50
Bromoform	0.452	0.505		11.73	50
1,1,2,2-Tetrachloroethane	1.038	0.799		-23.02	50
2-Chlorotoluene	1.353	1.246		-7.91	50
1,3,5-Trimethylbenzene	1.374	1.290		-6.11	50
1,2,4-Trimethylbenzene	1.440	1.259		-12.57	50
1,3-Dichlorobenzene	0.895	0.853		-4.69	50
1,4-Dichlorobenzene	0.921	0.883		-4.13	50
1,2-Dichlorobenzene	0.893	0.854		-4.37	50
1,2,4-Trichlorobenzene	0.539	0.480		-10.95	50
Hexachloro-1,3-Butadiene	0.358	0.313		-12.57	50
1,3-Butadiene	0.616	0.579		-6.01	50
Naphthalene	1.119	0.989		-11.62	50
4-Ethyltoluene	1.481	1.390		-6.14	50
1-Bromo-4-Fluorobenzene	0.738	0.773		4.74	50
Hexane	1.264	1.177		-6.88	50
Allyl Chloride	0.857	0.860		0.35	50
1,4-Dioxane	58.106	77.814		33.92	50
Methyl Methacrylate	0.376	0.360		-4.26	50

All other compounds must meet a minimum RRF of 0.010.
RRF of 1,4-Dioxane = Value should be divide by 1000.

SHIPPING DOCUMENTS

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 89

CHEMTECH Project No. : G3822

6.1

Client Contact Information	Bottle Order ID : **B1509075**	Courier : UPS	1 of ___ COCs
Client ID : **EAEN06** Project ID :	**Frankford Arsenal Air**	Sampler Name(s) : Denise W. H	
Customer Name : **EA Engineering Science & Technology**	Project Manager **Denise wilt**	AIR ANALYSIS CHAIN-OF-CUSTODY	
	Phone Number : **410-584-7000**		
Address : **225 Schilling Circle, Suite 400**	Fax Number :		
	Site Details: Soilvaporwell	Batch Certified	
City : **Hunt Valley**			
State : **MD**	Analysis Turnaround Time		
Zip Code : **21031**	Standard : **15 business days** **OR**	Data Package Type :	
Country :	Rush (Specify): ____ **Days**	EDD Type :	

Sample Identification	Sample Date(s)	Time Start (24 hr Clock)	Time Stop (24 hr Clock)	Can Vacuum in Field ("Hg) (Start)	Can Vacuum in Field ("Hg) (Stop)**	Interior Temp. (F) (Start)	Interior Temp. (F) (Stop)	Out going Can Pressure ("Hg)(Lab)	In coming Can Pressure ("Hg)(Lab)	Flow Reg. ID	Can ID	Can Size (L)	Flow Controller Readout	Can Cert ID	TO-15				Indoor/Ambinet Air	Soil Gas	
823-3-SG	~~9/21/15~~ 9/21/15 DW	1415	1415	29	4	71	78	-30	-7.5	10515	10268	6 L	4.16	VL025651.D	X					X	

9-21 to 9-22/ 2015

Temperature (Fahrenheit)

	Ambient	Maximum	Minimum	
Start	71			
Stop				

GC/MS Analyst Signature (TO-15)

Pressure (Inches of Hg)

	Ambient	Maximum	Minimum	
Start				
Stop				

** Submittal of this COC indicates approval of the analysis based on existing conditio

*DoD QSM Samples

Please follow the instructions on the back of this CO

Special Instructions/QC Requirements & Comments :

Suspected Contamination: High Medium Low — Although location had anomalously high vinyl chloride hit last winter

PID Readings: 0

Sampling site (State):

Quick Connector required : NO

Canisters Shiped by:	Date/Time: 9/21/15	Canisters Received by:	Date/Time: 9/21/15
Samples Relinquished by: Denise Wilt	Date/Time: 9/23/15 11am	Received by:	~~Date/Time:~~
Relinquished by: UPS	Date/Time: 9/24/15 1020	Received by:	Date/Time: 9/24/15 1020

B1509075 - 1

UPS CampusShip: View/Print Label

1. **Ensure there are no other shipping or tracking labels attached to your package.** Select the Print button on the print dialog box that appears. Note: If your browser does not support this function select Print from the File menu to print the label.

2. **Fold the printed label at the solid line below.** Place the label in a UPS Shipping Pouch. If you do not have a pouch, affix the folded label using clear plastic shipping tape over the entire label.

3. **GETTING YOUR SHIPMENT TO UPS**
Customers with a Daily Pickup
Your driver will pickup your shipment(s) as usual.

Customers without a Daily Pickup
Take your package to any location of The UPS StoreÂ®, UPS Access Point(TM) location, UPS Drop Box, UPS Customer Center, UPS Alliances (Office DepotÂ® or StaplesÂ®) or Authorized Shipping Outlet near you. Items sent via UPS Return Services(SM) (including via Ground) are also accepted at Drop Boxes. To find the location nearest you, please visit the Resources area of CampusShip and select UPS Locations.
Schedule a same day or future day Pickup to have a UPS driver pickup all your CampusShip packages.
Hand the package to any UPS driver in your area.

UPS Access Point™	UPS Access Point™	UPS Access Point™
THE UPS STORE	THE UPS STORE	THE UPS STORE
76 CRANBROOK RD	1810 YORK RD	722 DULANEY VALLEY RD
COCKEYSVILLE ,MD 21030	LUTHERVILLE TIMONIUM ,MD 21093	TOWSON ,MD 21204

FOLD HERE

D. WILT
4107714950
EA ENG SCIENCE TECH
225 SCHILLING CIRCLE
HUNT VALLEY MD 21031

9 LBS 1 OF 2

SHIP TO:
ATTN: SAMPLE RECEIPT
CHEMTECH
284 SHEFFIELD STREET
MOUNTAINSIDE NJ 07092-2319

NJ 078 9-61

UPS NEXT DAY AIR **1**
TRACKING #: 1Z 288 682 01 9063 2274

BILLING: P/P
UPS CARBON NEUTRAL SHIPMENT

Department Code: 2126
Project Phase AND Task: 6233017 0011 ****
GS 17.5.41. WNTNV50 66.0A 07/2015

JW 9/24/15 9020

UPS CampusShip: View/Print Label

1. **Ensure there are no other shipping or tracking labels attached to your package.** Select the Print button on the print dialog box that appears. Note: If your browser does not support this function select Print from the File menu to print the label.

2. **Fold the printed label at the solid line below.** Place the label in a UPS Shipping Pouch. If you do not have a pouch, affix the folded label using clear plastic shipping tape over the entire label.

3. **GETTING YOUR SHIPMENT TO UPS**
   Customers with a Daily Pickup
   Your driver will pickup your shipment(s) as usual.

   Customers without a Daily Pickup
   Take your package to any location of The UPS StoreÂ®, UPS Access Point(TM) location, UPS Drop Box, UPS Customer Center, UPS Alliances (Office DepotÂ® or StaplesÂ®) or Authorized Shipping Outlet near you. Items sent via UPS Return Services(SM) (including via Ground) are also accepted at Drop Boxes. To find the location nearest you, please visit the Resources area of CampusShip and select UPS Locations.
   Schedule a same day or future day Pickup to have a UPS driver pickup all your CampusShip packages.
   Hand the package to any UPS driver in your area.

UPS Access Point™	UPS Access Point™	UPS Access Point™
THE UPS STORE	THE UPS STORE	THE UPS STORE
76 CRANBROOK RD	1810 YORK RD	722 DULANEY VALLEY RD
COCKEYSVILLE ,MD 21030	LUTHERVILLE TIMONIUM ,MD 21093	TOWSON ,MD 21204

FOLD HERE

D. WILT
4107714950
EA ENG SCIENCE TECH
225 SCHILLING CIRCLE
HUNT VALLEY MD 21031

9 LBS

2 OF 2

SHIP TO:
ATTN: SAMPLE RECEIPT
CHEMTECH
284 SHEFFIELD STREET
MOUNTAINSIDE NJ 07092-2319

NJ 078 9-61

UPS NEXT DAY AIR **1**

TRACKING #: 1Z 288 682 01 9148 3488

BILLING: P/P
UPS CARBON NEUTRAL SHIPMENT

Department Code: 2126
Project Phase AND Task: 6233017 0011 ****
GS 17.5.41. WNTNV50 66.0A 07/2015

9/24/15
1020

CHEMTECH 284 Sheffield Street Mountainside NJ 07092 Tel. 908-7898900

Laboratory Certification

State	License No.
New Jersey	20012
New York	11376
Connecticut	PH-0649
Florida	E87935
Louisiana	5035
Maryland	296
Massachusetts	M-NJ503
Pennsylvania	68-548
Rhode Island	LAO00259
Virginia	460220
Texas	T10470448-10-1

Other :

DOD ELAP Certified (L-A-B Accredited), ISO/IEC 17025	L2219
Soil Permit	P330-11-00012
CLP Inorganic Contract	EPW09038
CLP Organic Contract	EPW11030

QA Control Code: A2070148

New Jersey Department of Environmental Protection

Internal Chain of Custody

Instructions: Use 1 form for each 20 samples of aliquot

Laboratory Person Breaking Field Seal on Sample Shuttle & Accepting Responsibility for Sample

Laboratory: Chemtech
REGINALD
Field Sample Seal No. G3822
Case No.: Frankford Arsenal Air

Location: 284 Sheffield Street, Mountainside,NJ 7092
Title: Sample Custodian
Date Broken 9/24/2015
Analytical Parameter/Fraction TO-15

Military Time Seal Broken: 10:20:00

Sample No.	Aliquot/Extract No.	Sample No.	Aliquot/Extract No.
G3822-01	BZ3-3-SG		

Date	Time	Relinquished By	Received By	Purpose of Change of Custody
9/24/15	1610	Signature [signature] Printed Name R SJ	Signature [signature] Printed Name [illegible]	TO JOE A.M
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	
		Signature Printed Name	Signature Printed Name	

Distribution: White - Original (Sent With Report) Yellow - Contractor Archive Pink - Sample Custodian - Interim Copy

AIR SAMPLE PRESSURE & DILUTION LOGBOOK

Analyst Signature: [signature]

Supervisor Signature: [signature]

METHOD: TO-15

Pressure Gauge ID: A255971

Date	Sample Number	Canister #	Initial Pressure psia	Initial Pressure Hg	Final Pressure psia	Final Pressure Hg	Dilution Factor	Comment
09/21/15	G3762-01 ~~G3762-01~~	10324	13.0	-3.5				SY
	G3762-02 ~~G3762-02~~	10321	12.8	-3.9				SY
	G3762-01	10132	0.5		15.0		30x	SY SY
	G3762-02	10790	0.5		15.0		30x	SY
9/24/15	G3822-01	10268	11.0	-7.5				

CHEMTECH

284 Sheffield Street, Mountainside, NJ 07092 P: (908) 789-8900 F: (908)78

Client Sample ID #: BZ3-3-SG
Client Name: EA Engineering
Project Name: Frankford Arsenal
Date: 9-20-15 Time: 1415
Analysis: TO-15
Comments:

CHEMTECH'S SAMPLE ID:
Date Received: Expiration Date: Date of Disposal:

10708

StorageLocation: Air Lab
Sample: G3822-G3822-01-A
Cust Sample: BZ3-3-SG

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Appendix B

Detailed Alternative Costing

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Appendix B

Alternative 1 Costing

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Assumptions for Alternative 1

No Action - All AOCs

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

General - Cost is $0

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Appendix B

Alternative 2 Costing

Cost Estimate Assumptions for Alternative 2 for AOC 1
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

2. Assume structural evaluation needed prior to excvation adjacent to buildings.

(2) Excavation of Lead Contaminated Soils

(a) Mobilization (General/equipment mobilization)

1. Mobilization includes office trailer, toilet, refrigerator, excavator, roller, and front-end loader. Also includes utility hookup and usage (1 month).

(b) Site preparation/erosion and sediment controls

1. Assumed placement of compost filter sock around perimeter of each excavation area.

2. Topographic survey will be performed by PA licensed surveyor across aerial extent of AOC (2.71 acres).

3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Excavation

1. Assumed a total excavation area of 64,605 sq. ft and excavation depths ranging up to 5 ft bgs in specified areas with a total excavation volume of 1,630 bank cubic yards.

2. Assumed that 80% of excavation volume will be live loaded with heavy machinery and 20% will be hand dug (due to underground utilities within excavation area).

3. Assumes total of 40 confirmatory samples (AOC1A=12 samples, AOC1B=12 samples, AOC1C=8 samples, and AOC1D=8 samples). Number of confirmatory samples based on estimated excavation volume using the PADEP Systematic Random Sampling Workbook. Follows requirements of PADEP Act 2 for post-excavation demonstration of attainment.

(d) Transport and Disposal

1. Assumed density of excavated soil (LCY) is 1.2 tons per cubic yard.

2. Assumed 80% of excavated soils will be disposed as non-hazardous waste and 20% of soils will be disposed as hazardous waste.

(e) Excavation Work Oversight

1. Assumed 1 sampling technician, 1 health and safety officer, and 1 site manager.

(f) Backfill Excavated Areas

1. Undisturbed soil (BCY) from site is adjusted by 1.25 to account for fluff/expansion (LCY) following excavation and hauling.

2. Imported common borrow (LCY) placed into excavation and compacted is adjusted by 0.72 to account for compaction (CCY).

3. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(g) Site Restoration

1. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(h) Pre- and Post-Construction Submittals

Cost Estimate Assumptions for Alternative 2 for AOC 1
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

Cost Estimate Assumptions for Alternative 2 for AOC 1
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(i) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. No costs associated with O&M. Assuming all impacted soils will be removed and no O&M will be necessary, including five year reviews.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 2 for AOC 1
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Structural evaluation	1	$20,000	LS	$20,000		
SUBTOTAL (1)				$20,000		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$6,666	LS	$6,666		
(b) Site preparation/erosion and sediment controls	1	$21,500	LS	$21,500		
(c) Excavation	1,630	$15.79	BCY	$25,741		
(d) Transportation and disposal lead-impacted soil	2,445	$79.72	TON	$194,927		
(e) Excavation oversight	1	$57,436	LS	$57,436		
(f) Backfill excavated area	482	$50	BCY	$24,007		
(g) Site Restoration	957	$50	BCY	$48,284		
(h) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(i) Air Monitoring and Decontamination	1	$3,387	LS	$3,387		
SUBTOTAL (2)				$391,947		
CONSTRUCTION SUBTOTAL				$411,947		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$61,792		
(b) Contractor Profit	10% of Construction Subtotal			$41,195		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$123,584		
CONSTRUCTION TOTAL				**$638,518**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$38,311		
(b) Engineering	12% of Construction Total			$76,622		
(c) Construction Services (Field Management)	8% of Construction Total			$51,081		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000		
TOTAL CAPITAL COSTS				**$831,533**		

Cost Estimate Summary for Alternative 2 for AOC 1

Excavation and Disposal

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost: Annual	O&M Cost: 30-Year (Present Worth)
O&M SUBTOTAL					$0	$0
O&M Project Management	5% of O&M Subtotal				$0	$0
O&M Contingency	30% of O&M Subtotal				$0	$0
TOTAL O&M COSTS					**$0**	**$0**
TOTAL ESTIMATED COST =				**$831,533**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Summary for Alternative 2 AOC-1

Excavation and Disposal

Frankford FS

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Structural evaluation	EA	1	$20,000	$20,000	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$20,000**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	1	$425.50	$430	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture.
	Field Office - delivery, setup, removal	LS	1	$1,000.00	$1,000	General estimate.
	Portable toilets (1)	LS	1	$200.00	$200	General estimate.
	Utilities hookup: Service, overhead feed, 400 Amp	EA	1	$2,850.00	$2,850	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050).
	Monthly utilities: Lights, HVAC, Water	MO	1	$236.50	$240	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160).
	Refrigerator for sample storage	EA	1	$250.00	$250	General estimate.
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$6,666**	**LS**

Cost Estimate Summary for Alternative 2 AOC-1

Excavation and Disposal

Frankford FS

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	4284	$3.00	$12,860	Vendor quote, Weaver Express Erosion Control Solutions.
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$4,650.00	$4,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$21,500**	**LS**
2 (c)	**Excavation**					
	Excavation of impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	1304	$2.40	$3,130	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200); Assume excavation depth of 0.5 FT and no non-impacted overburden soil.
	Live load onto trucks for disposal	BCY	1630	$0.36	$587	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0020);
	By hand with pick and shovel, light soil	BCY	326	$54.50	$17,769	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.13 1400);
	Confirmatory Samples	EA	40	$100.00	$4,000	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1014); Assume stockpile is in close proximity.
	SUBTOTAL				**$15.79**	**per BCY**
2 (d)	**Transport and Disposal**					
	Transport and disposal of soil (Haz)	TON	489	$135.00	$66,022	Vendor quote, Capital Environmental; sample required for treatability study.
	Transport and disposal of soil (Non-Haz)	TON	1956	$65.00	$127,154	Vendor quote, Capital Environmental.
	Fuel surcharge	GAL	200	$4.25	$850	Vendor quote, Capital Environmental.
	Testing of samples prior to disposal	EA	1	$900.00	$900	Vendor quote, Capital Environmental; TCLP metals, volatiles and PCB per 500 tons of soil.
	SUBTOTAL				**$79.72**	**per Ton**

Cost Estimate Summary for Alternative 2 AOC-1
Excavation and Disposal
Frankford FS

2 (e)	**Excavation Work Oversight**					
	Sampling Technician	DAY	24	$600.00	$14,400	One person at $60 per hour during excavation activities, 10 hours per day;
	Health and Safety Officer	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	1	$4,636.00	$4,636	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$57,436.00**	**LS**
2 (f)	**Backfill Excavated Areas (Common Borrow)**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	482	$17.80	$8,571	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	602	$7.75	$4,665	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread fill from stockpile with 2.5 CY F.E. loader	LCY	482	$3.50	$1,685	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 4 passes riding vibrating roller	CCY	347	$0.73	$253	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5040)
	Backfill narrow areas by hand, light soil	LCY	120	$31.00	$3,732	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Compact narrow areas w/ vibrating plate	CCY	87	$7.95	$689	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.

	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	13	$38.50	$501	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$49.86**	**per BCY**
2 (g)	**Site Restoration**					
	Borrow, loading and spreading, topsoil, front end loader, wheel mounted 1.5 CY bucket	BCY	957	$25.50	$24,407	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	1196	$7.75	$9,272	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	957	$3.50	$3,350	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Backfill narrow areas by hand, light soil	LCY	239	$31.00	$7,418	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Bluegrass, #4/M.S.F, hydro seeding w/ mulch and fertilizer	MSF	65	$52.00	$3,359	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$50.45**	**per BCY**
2 (h)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (i)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	MO	1.0	$1,082.00	$1,082	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Vendor quote; Capital Environmental
	Pressure washer: 3000 psi, gas, cold water	WK	4.0	$219.10	$876	Vendor quote; Sunbelt Rentals
	SUBTOTAL				**$3,386.65**	**LS**

Cost Estimate Summary for Alternative 2 AOC-1
Excavation and Disposal
Frankford FS

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

Cost Estimate Assumptions for Alternative 2 for AOC 6
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

2. Assume structural evaluation needed prior to excvation adjacent to buildings.

(2) Excavation of Lead Contaminated Soils

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, roller, and front-end loader.

(b) Site preparation/erosion and sediment controls

1. Assumed placement of compost filter sock around perimeter of each excavation area.

2. Topographic survey will be performed by PA licensed surveyor across aerial extent of AOC (2.71 acres).

3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

4. Assumed wooden deck will be demolished and rebuilt prior to site closeout.

(c) Excavation

1. Assumed a total excavation area of 447 sq. ft and excavation depths 3 ft bgs with at total excavation volume of 50 bank cubic yards.

2. Assumed that 80% of excavation volume will be live loaded with heavy machinery and 20% will be hand dug (due to underground utilities within excavation area).

3. Assumed a total of 8 confirmatory samples. Number of confirmatory samples based on estimated excavation volume using the PADEP Systematic Random Sampling Workbook. Follows requirements of PADEP Act 2 for post-excavation demonstration of attainment.

(d) Transport and Disposal

1. Assumed density of excavated soil (LCY) is 1.2 tons per cubic yard.

2. Assumed 80% of excavated soils will be disposed as non-hazardous waste and 20% of soils will be disposed as hazardous waste.

(e) Excavation Work Oversight

1. Assumed 1 health and safety officer, and 1 site manager.

(f) Backfill Excavated Areas

1. Undisturbed soil (BCY) from site is adjusted by 1.25 to account for fluff/expansion (LCY) following excavation and hauling.

2. Imported common borrow (LCY) placed into excavation and compacted is adjusted by 0.72 to account for compaction (CCY).

3. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(g) Site Restoration

1. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

2. Assumed only half of AOC-6 will require hydro seeding due to wood decking.

(h) Pre- and Post-Construction Submittals

1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

Cost Estimate Assumptions for Alternative 2 for AOC 6
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(i) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs
1. No costs associated with O&M. Assuming all impacted soils will be removed and no O&M will be necessary, including five year reviews.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 2 for AOC-6

Excavation and Disposal

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Structural evaluation	1	$5,000	LS	$5,000		
SUBTOTAL (1)				$5,000		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$1,919	LS	$1,919		
(b) Site preparation/erosion and sediment controls	1	$10,900	LS	$10,900		
(c) Excavation	50	$29.58	BCY	$1,469		
(d) Transportation and disposal lead-impacted soil	75	$102.49	TON	$7,636		
(e) Excavation oversight	1	$8,000	LS	$8,000		
(f) Backfill excavated area	46	$108	BCY	$4,956		
(g) Site Restoration	1	$276	LS	$276		
(h) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(i) Air Monitoring and Decontamination	1	$2,007	LS	$2,007		
SUBTOTAL (2)				$47,163		
CONSTRUCTION SUBTOTAL				$52,163		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$7,825		
(b) Contractor Profit	10% of Construction Subtotal			$5,216		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$15,649		
CONSTRUCTION TOTAL				**$80,853**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$4,851		
(b) Engineering	12% of Construction Total			$9,702		
(c) Construction Services (Field Management)	8% of Construction Total			$6,468		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000		
TOTAL CAPITAL COSTS				**$128,875**		

Cost Estimate Summary for Alternative 2 for AOC-6

Excavation and Disposal

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$0	$0
O&M Project Management	5% of O&M Subtotal				$0	$0
O&M Contingency	30% of O&M Subtotal				$0	$0
TOTAL O&M COSTS					**$0**	**$0**
TOTAL ESTIMATED COST =				**$128,875**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Summary for Alternative 2 AOC-6
Excavation and Disposal
Frankford FS

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Structural evaluation	EA	1	$5,000	$5,000	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$425.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	0	$1,000.00	$0	General estimate
	Portable toilets (1)	LS	1	$200.00	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$236.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250.00	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$1,919**	**LS**

Cost Estimate Summary for Alternative 2 AOC-6
Excavation and Disposal
Frankford FS

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	85	$3.00	$260	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Demolish, dispose, and rebuild wooden deck	LS	1	$5,000.00	$5,000	General estimate;
	Utility Clearance	LS	1	$1,650.00	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$10,900**	**LS**
2 (c)	**Excavation**					
	Excavation of impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	40	$2.40	$95	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200); Assume excavation depth of 0.5 FT and no non-impacted overburden soil.
	Live load onto to trucks for disposal	BCY	50	$0.36	$18	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0020);
	By hand with pick and shovel, light soil	BCY	10	$54.50	$541	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.13 1400);
	Confirmatory Samples	EA	8	$100.00	$800	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1014); Assume stockpile is in close proximity
	SUBTOTAL				**$29.58**	**per BCY**
2 (d)	**Transport and Disposal**					
	Transport and disposal of PCB (Haz)	TON	15	$135.00	$2,012	Vendor quote, Capital Environmental; sample required for treatability study
	Transport and disposal of PCB (Non-Haz)	TON	60	$65.00	$3,874	Vendor quote, Capital Environmental
	Fuel surcharge	GAL	200	$4.25	$850	Vendor quote, Capital Environmental
	Testing of samples prior to disposal	EA	1	$900.00	$900	Vendor quote, Capital Environmnetal; TCLP metals, volatiles and PCBs per 500 tons of soil.
	SUBTOTAL				**$102.49**	**per Ton**

Cost Estimate Summary for Alternative 2 AOC-6
Excavation and Disposal
Frankford FS

2 (e)	**Excavation Work Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 0days added to account for SCRIBE work.
	Health and Safety Officer	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	DAY	0	$1,715.36	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$8,000.00**	**LS**
2 (f)	**Backfill Excavated Areas (Common Borrow)**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	46	$17.80	$818	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	57	$7.75	$445	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread fill from stockpile with 2.5 CY F.E. loader	LCY	46	$3.50	$161	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 4 passes riding vibrating roller	CCY	33	$0.73	$24	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5040)
	Backfill narrow areas by hand, light soil	LCY	11	$31.00	$356	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Compact narrow areas w/ vibrating plate	CCY	8	$7.95	$66	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.

	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	5	$38.50	$193	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$1,810.00	$1,810	Laboratory quote, ALS Environmental; Less than 125 CY requires 6 samples analyzing metals, PCBs, & pesticides; 2 samples analyzing VOCs.
	SUBTOTAL				**$107.88**	**per BCY**
2 (g)	**Site Restoration**					
	Borrow, loading and spreading, topsoil, front end loader, wheel mounted 1.5 CY bucket	BCY	7	$25.50	$169	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	8	$7.75	$64	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	8	$3.50	$29	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Bluegrass, #4/M.S.F, hydro seeding w/ mulch and fertilizer	MSF	0	$52.00	$12	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$276.35**	**LS**
2 (h)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (i)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	1.0	$360.00	$360	EA equipment cost rate
	Decontamination (excavator, loader)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Vendor quote; Capital Environmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,007.34**	**LS**

Cost Estimate Summary for Alternative 2 AOC-6
Excavation and Disposal
Frankford FS

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014

Cost Estimate Assumptions for Alternative 2 for AOC 10
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Required to further delineate the verticle characteristics of the soil.

2. Assume structural evaluation needed prior to excvation adjacent to buildings.

(2) Excavation of Lead Contaminated Soils

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, roller, and front-end loader.

(b) Site preparation/erosion and sediment controls

1. Assumed placement of compost filter sock around perimeter of each excavation area.

2. Topographic survey will be performed by PA licensed surveyor across aerial extent of AOC (2.71 acres).

3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Excavation

1. Assumed a total excavation area of 2,417 sq. ft and excavation depths 5 ft bgs with at total excavation volume of 448 bank cubic yards.

2. Assumed that 80% of excavation volume will be live loaded with heavy machinery and 20% will be hand dug (due to underground utilities within excavation area).

3. Assumed a total of 8 confirmatory samples. Number of confirmatory samples based on estimated excavation volume using the PADEP Systematic Random Sampling Workbook. Follows requirements of PADEP Act 2 for post-excavation demonstration of attainment.

(d) Transport and Disposal

1. Assumed density of excavated soil (LCY) is 1.2 tons per cubic yard.

2. Assumed 80% of excavated soils will be disposed as non-hazardous waste and 20% of soils will be disposed as hazardous waste.

(e) Excavation Work Oversight

1. Assumed 1 sampling technician, 1 health and safety officer, and 1 site manager.

(f) Backfill Excavated Areas

1. Undisturbed soil (BCY) from site is adjusted by 1.25 to account for fluff/expansion (LCY) following excavation and hauling.

2. Imported common borrow (LCY) placed into excavation and compacted is adjusted by 0.72 to account for compaction (CCY).

3. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(g) Site Restoration

1. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(h) Pre- and Post-Construction Submittals

1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

Cost Estimate Assumptions for Alternative 2 for AOC 10
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(i) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs
1. No costs associated with O&M. Assuming all impacted soils will be removed and no O&M will be necessary, including five year reviews.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 2 for AOC-10
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost: Annual	O&M Cost: 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Geophysical, delineation, structural evaluation, reporting	1	$17,700	LS	$17,700		
SUBTOTAL (1)				$17,700		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$1,919	LS	$1,919		
(b) Site preparation/erosion and sediment controls	1	$6,300	LS	$6,300		
(c) Excavation	448	$15.12	BCY	$6,766		
(d) Transportation and disposal lead-impacted soil	671	$81.61	TON	$54,790		
(e) Excavation oversight	1	$12,545	LS	$12,545		
(f) Backfill excavated area	447	$50	BCY	$22,284		
(g) Site Restoration	36	$50	BCY	$1,806		
(h) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(i) Air Monitoring and Decontamination	1	$2,007	LS	$2,007		
SUBTOTAL (2)				$118,418		
CONSTRUCTION SUBTOTAL				$136,118		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$20,418		
(b) Contractor Profit	10% of Construction Subtotal			$13,612		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$40,835		
CONSTRUCTION TOTAL				**$210,983**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$12,659		
(b) Engineering	12% of Construction Total			$25,318		
(c) Construction Services (Field Management)	8% of Construction Total			$16,879		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000		
TOTAL CAPITAL COSTS				**$292,838**		

Cost Estimate Summary for Alternative 2 for AOC-10
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$0	$0
O&M Project Management	5% of O&M Subtotal				$0	$0
O&M Contingency	30% of O&M Subtotal				$0	$0
TOTAL O&M COSTS					**$0**	**$0**
TOTAL ESTIMATED COST =				**$292,838**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study*, EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Summary for Alternative 2 AOC-10

Excavation and Disposal

Frankford FS

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	1	$2,700.00	$2,700	General estimate
	Delineation Borings	EA	1	$8,000.00	$8,000	General estimate
	Structural	EA	1	$5,000.00	$5,000	
	Reporting	LS	1	$2,000.00	$2,000	General estimate
	SUBTOTAL				**$17,700**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$425.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	0	$1,000.00	$0	General estimate
	Portable toilets (1)	LS	1	$200.00	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$236.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250.00	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$1,919**	**LS**

Cost Estimate Summary for Alternative 2 AOC-10
Excavation and Disposal
Frankford FS

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	215	$3.00	$650	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650.00	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$6,300**	**LS**
2 (c)	**Excavation**					
	Excavation of impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	358	$2.40	$859	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200); Assume excavation depth of 0.5 FT and no non-impacted overburden soil.
	Live load onto to trucks for disposal	BCY	448	$0.36	$161	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0020);
	By hand with pick and shovel, light soil	BCY	90	$54.50	$4,879	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.13 1400);
	Confirmatory Samples	EA	8	$100.00	$800	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1014); Assume stockpile is in close proximity
	SUBTOTAL				**$15.12**	**per BCY**
2 (d)	**Transport and Disposal**					
	Transport and disposal of soil (Haz)	TON	134	$135.00	$18,128	Vendor quote, Capital Environmental; sample required for treatability study
	Transport and disposal of soil (Non-Haz)	TON	537	$65.00	$34,912	Vendor quote, Capital Environmental
	Fuel surcharge	GAL	200	$4.25	$850	Vendor quote, Capital Environmental
	Testing of samples prior to disposal	EA	1	$900.00	$900	Vendor quote, Capital Environmental; TCLP metals, volatiles and PCB per 500 tons of soil.
	SUBTOTAL				**$81.61**	**per Ton**

Cost Estimate Summary for Alternative 2 AOC-10
Excavation and Disposal
Frankford FS

2 (e)	**Excavation Work Oversight**					
	Sampling Technician	DAY	5	$600.00	$3,000	One person at $60 per hour during excavation activities, 10 hours per day;
	Health and Safety Officer	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	WK	1	$1,545.00	$1,545	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$12,545.00**	**LS**
2 (f)	**Backfill Excavated Areas**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	447	$17.80	$7,959	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	559	$7.75	$4,332	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread fill from stockpile with 2.5 CY F.E. loader	LCY	447	$3.50	$1,565	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 4 passes riding vibrating roller	CCY	322	$0.73	$235	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5040)
	Backfill narrow areas by hand, light soil	LCY	112	$31.00	$3,465	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Compact narrow areas w/ vibrating plate	CCY	80	$7.95	$640	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.

	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	5	$38.50	$193	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$49.84**	**per BCY**
2 (g)	**Site Restoration**					
	Borrow, loading and spreading, topsoil, front end loader, wheel mounted 1.5 CY bucket	BCY	36	$25.50	$913	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	45	$7.75	$347	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	36	$3.50	$125	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Backfill narrow areas by hand, light soil	LCY	9	$31.00	$278	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Bluegrass, #4/M.S.F, hydro seeding w/ mulch and fertilizer	MSF	2	$52.00	$126	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$50.45**	**per BCY**
2 (h)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (i)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	1.0	$360.00	$360	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Vendor quote; Capital Environmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,007.34**	**LS**

Cost Estimate Summary for Alternative 2 AOC-10
Excavation and Disposal
Frankford FS

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

Cost Estimate Assumptions for Alternative 2 for AOC 13
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

2. Assume structural evaluation needed prior to excvation adjacent to buildings.

(2) Excavation of Lead Contaminated Soils

(a) Mobilization (General/equipment mobilization)

1. Mobilization includes office trailer, toilet, refrigerator, excavator, roller, and front-end loader. Also includes utility hookup and usage (1 month).

(b) Site preparation/erosion and sediment controls

1. Assumed placement of compost filter sock around perimeter of each excavation area.

2. Topographic survey will be performed by PA licensed surveyor across aerial extent of AOC (2.71 acres).

3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Asphalt/ Concrete Removal

1. Assumed removal of 469 cu. yds of 6 in. thick asphalt and underlying 6 in. thick concrete layer. Asphalt/ concrete will be mechanically removed and hauled to disposal facility prior to soil removal. The combined density of ashpalt/concrete is assumed to be 2.025 tons per cubic yard.

(d) Excavation

1. Assumed a total excavation area of 12,655 sq. ft and excavation depths ranging up to 13 ft bgs in specified areas with a total excavation volume of 1,875 bank cubic yards.

2. Assumed that 80% of excavation volume will be live loaded with heavy machinery and 20% will be hand dug (due to underground utilities within excavation area).

3. Assumed a total of 12 confirmatory samples. Number of confirmatory samples based on estimated excavation volume using the PADEP Systematic Random Sampling Workbook. Follows requirements of PADEP Act 2 for post-excavation demonstration of attainment.

(e) Transport and Disposal

1. Assumed density of excavated soil (LCY) is 1.2 tons per cubic yard.

2. Assumed 80% of excavated soils will be disposed as non-hazardous waste and 20% of soils will be disposed as hazardous waste.

(f) Excavation Work Oversight

1. Assumed 1 sampling technician, 1 health and safety officer, and 1 site manager.

(g) Backfill Excavated Areas

1. Undisturbed soil (BCY) from site is adjusted by 1.25 to account for fluff/expansion (LCY) following excavation and hauling.

2. Imported common borrow (LCY) placed into excavation and compacted is adjusted by 0.72 to account for compaction (CCY).

3. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(h) Site Restoration

1. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(i) Pre- and Post-Construction Submittals

1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

Cost Estimate Assumptions for Alternative 2 for AOC 13
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(j) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. No costs associated with O&M. Assuming all impacted soils will be removed and no O&M will be necessary, including five year reviews.

General

2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 2 for AOC-13
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost	
					Annual	30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Structural evaluation	1	$5,000	LS	$5,000		
SUBTOTAL (1)				$5,000		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$6,666	LS	$6,666		
(b) Site preparation/erosion and sediment controls	1	$11,000	LS	$11,000		
(c) Asphalt/ concrete removal	1	$140,100	LS	$140,100		
(d) Excavation	2,344	$13.83	BCY	$32,408		
(e) Transportation and disposal lead-impacted soil	3,515	$80.01	TON	$281,257		
(f) Excavation oversight	1	$52,800	LS	$52,800		
(g) Backfill excavated area	2,601	$43	BCY	$111,955		
(h) Site Restoration	1	$36,924	LS	$36,924		
(i) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(j) Air Monitoring and Decontamination	1	$2,729	LS	$2,729		
SUBTOTAL (2)				$685,840		
CONSTRUCTION SUBTOTAL				$690,840		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$103,626		
(b) Contractor Profit	10% of Construction Subtotal			$69,084		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$207,252		
CONSTRUCTION TOTAL				**$1,070,803**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$64,248		
(b) Engineering	12% of Construction Total			$128,496		
(c) Construction Services (Field Management)	8% of Construction Total			$85,664		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000		
TOTAL CAPITAL COSTS				**$1,376,211**		

Cost Estimate Summary for Alternative 2 for AOC-13

Excavation and Disposal

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	**Quantity**	**Unit Cost**	**Units**	**Capital Cost**	**O&M Cost Annual**	**O&M Cost 30-Year (Present Worth)**
O&M SUBTOTAL					$0	$0
O&M Project Management	5% of O&M Subtotal				$0	$0
O&M Contingency	30% of O&M Subtotal				$0	$0
TOTAL O&M COSTS					**$0**	**$0**
			TOTAL ESTIMATED COST =	**$1,376,211**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Summary for Alternative 2 AOC-13
Excavation and Disposal
Frankford FS

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Structural Evaluation	EA	1	$5,000.00	$5,000	General estimate
	Delineation Borings	EA	0	$8,000.00	$0	General estimate
	Reporting	LS	0	$2,000.00	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	1	$425.50	$430	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	1	$1,000.00	$1,000	General estimate
	Portable toilets (1)	MO	1	$200.00	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	1	$2,850.00	$2,850	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	1	$236.50	$240	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	1	$250.00	$250	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$6,666**	**LS**

Cost Estimate Summary for Alternative 2 AOC-13
Excavation and Disposal
Frankford FS

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	462	$3.00	$1,390	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$7,900.00	$7,900	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650.00	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$11,000**	**LS**
2 (c)	**Asphalt/ Concrete Removal**					
	Asphalt removal, 4" to 6" thick	SY	1406	$9.20	$12,940	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 13.17 5050);
	Concrete removal, hydraulic hammer, 6" thick, rod reinforced	SY	1406	$19.40	$27,280	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 13.17 5200);
	Machine loading trucks and hauling to disposal facility	CY	469	$30.80	$14,435	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 19.19 3080/5100); Assume hauling distance approx. 10 miles
	Disposal facility fee	TON	949	$90.00	$85,415	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 19.20 0100);
	SUBTOTAL				**$140,100**	**LS**
2 (d)	**Excavation**					
	Excavation of non-impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	0	$2.40	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200); Assume non-impacted soils will be stockpiled onsite.
	Excavation of impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	1875	$2.40	$4,500	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200);
	Live load onto impacted soils to trucks for disposal	BCY	2344	$0.36	$844	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0020);
	By hand with pick and shovel, light soil	BCY	469	$54.50	$25,544	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.13 1400);
	Confirmatory Samples	EA	12	$100.00	$1,200	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1014); Assume stockpile is in close proximity
	SUBTOTAL				**$13.83**	**per BCY**
2 (e)	**Transport and Disposal**					
	Transport and disposal of soil (Haz)	TON	703	$135.00	$94,913	Vendor quote, Capital Environmental; sample required for treatability study
	Transport and disposal of soil (Non-Haz)	TON	2812	$65.00	$182,794	Vendor quote, Capital Environmental
	Fuel surcharge	GAL	200	$4.25	$850	Vendor quote, Capital Environmental

Cost Estimate Summary for Alternative 2 AOC-13
Excavation and Disposal
Frankford FS

	Testing of samples prior to disposal	EA	3	$900.00	$2,700	Vendor quote, Capital Environmental; TCLP metals, volatiles and PCB per 500 tons of soil.
SUBTOTAL					**$80.01**	**per Ton**

Cost Estimate Summary for Alternative 2 AOC-13
Excavation and Disposal
Frankford FS

2 (f)	**Excavation Work Oversight**					
	Sampling Technician	DAY	24	$600.00	$14,400	One person at $60 per hour during excavation activities, 10 hours per day;
	Health and Safety Officer	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$52,800.00**	**LS**
2 (g)	**Backfill Excavated Areas**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	2601	$17.80	$46,303	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	3252	$7.75	$25,200	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread fill from common earth stockpile with 2.5 CY F.E. loader	LCY	2601	$3.50	$9,105	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Spread fill from non-impacted stockpile with 2.5 CY F.E. loader	LCY	0	$3.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 4 passes riding vibrating roller	CCY	1873	$0.73	$1,367	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5040)
	Backfill narrow areas by hand, light soil	LCY	650	$31.00	$20,160	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Compact narrow areas w/ vibrating plate	CCY	468	$7.95	$3,722	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.

Cost Estimate Summary for Alternative 2 AOC-13
Excavation and Disposal
Frankford FS

	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	1	$255.00	$255	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	3	$135.00	$405	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	24	$38.50	$924	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$43.04**	**per BCY**
2 (h)	**Site Restoration**					
	Borrow, loading and spreading, topsoil, front end loader, wheel mounted 1.5 CY bucket	BCY	0	$25.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	0	$7.75	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	0	$3.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Bluegrass, #4/M.S.F, common, push spreader	MSF	0	$69.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	Re-pave parking area w/ plant-mix bituminous concrete, 6" thick	SY	1406	$26.00	$36,559	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$36,924.48**	**LS**
2 (i)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (j)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	MO	1.0	$1,082.00	$1,082	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Previous vendor quote; Capital Environmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Previous vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,729.34**	**LS**

Cost Estimate Summary for Alternative 2 AOC-13
Excavation and Disposal
Frankford FS

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

Cost Estimate Assumptions for Alternative 2 for AOC 20
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

2. Assume structural evaluation needed prior to excvation adjacent to buildings.

(2) Excavation of Lead Contaminated Soils

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, roller, and front-end loader.

(b) Site preparation/erosion and sediment controls

1. Assumed placement of compost filter sock around perimeter of each excavation area.

2. Topographic survey will be performed by PA licensed surveyor across aerial extent of AOC (2.71 acres).

3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Excavation

1. Assumed a total excavation area of 4,894 sq. ft and excavation depths 2 ft bgs with at total excavation volume of 363 bank cubic yards.

2. Assumed that 80% of excavation volume will be live loaded with heavy machinery and 20% will be hand dug (due to underground utilities within excavation area).

3. Assumed a total of 12 confirmatory samples. Number of confirmatory samples based on estimated excavation volume using the PADEP Systematic Random Sampling Workbook. Follows requirements of PADEP Act 2 for post-excavation demonstration of attainment.

(d) Transport and Disposal

1. Assumed density of excavated soil (LCY) is 1.2 tons per cubic yard.

2. Assumed 80% of excavated soils will be disposed as non-hazardous waste and 20% of soils will be disposed as hazardous waste.

(e) Excavation Work Oversight

1. Assumed 1 health and safety officer, and 1 site manager.

(f) Backfill Excavated Areas

1. Undisturbed soil (BCY) from site is adjusted by 1.25 to account for fluff/expansion (LCY) following excavation and hauling.

2. Imported common borrow (LCY) placed into excavation and compacted is adjusted by 0.72 to account for compaction (CCY).

3. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(g) Site Restoration

1. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(h) Pre- and Post-Construction Submittals

1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record

drawings, etc.

Cost Estimate Assumptions for Alternative 2 for AOC 20
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(i) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs
1. No costs associated with O&M. Assuming all impacted soils will be removed and no O&M will be necessary, including five year reviews.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 2 for AOC-20

Excavation and Disposal

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Structural evaluation	1	$5,000	LS	$5,000		
SUBTOTAL (1)				$5,000		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$1,919	LS	$1,919		
(b) Site preparation/erosion and sediment controls	1	$6,500	LS	$6,500		
(c) Excavation	363	$16.66	BCY	$6,038		
(d) Transportation and disposal lead-impacted soil	544	$82.22	TON	$44,708		
(e) Excavation oversight	1	$12,545	LS	$12,545		
(f) Backfill excavated area	302	$54	BCY	$16,233		
(g) Site Restoration	73	$50	BCY	$3,658		
(h) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(i) Air Monitoring and Decontamination	1	$2,007	LS	$2,007		
SUBTOTAL (2)				$103,608		
CONSTRUCTION SUBTOTAL				$108,608		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$16,291		
(b) Contractor Profit	10% of Construction Subtotal			$10,861		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$32,582		
CONSTRUCTION TOTAL				**$168,342**		
(4) Professional/Technical Services[1]:						
(a) Project Management	6% of Construction Total			$10,101		
(b) Engineering	12% of Construction Total			$20,201		
(c) Construction Services (Field Management)	8% of Construction Total			$13,467		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000		
TOTAL CAPITAL COSTS				**$239,111**		

Cost Estimate Summary for Alternative 2 for AOC-20
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$0	$0
O&M Project Management	5% of O&M Subtotal				$0	$0
O&M Contingency	30% of O&M Subtotal				$0	$0
TOTAL O&M COSTS					**$0**	**$0**
TOTAL ESTIMATED COST =				**$239,111**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Summary for Alternative 2 AOC-20

Excavation and Disposal

Frankford FS

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	structural evaluation	EA	1	$5,000.00	$5,000	General estimate
	Delineation Borings	EA	0	$8,000.00	$0	General estimate
	Reporting	LS	0	$2,000.00	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$425.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning,
	Field Office - delivery, setup, removal	LS	0	$1,000.00	$0	General estimate
	Portable toilets (1)	LS	1	$200.00	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$236.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250.00	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$1,919**	**LS**

Cost Estimate Summary for Alternative 2 AOC-20

Excavation and Disposal

Frankford FS

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	281	$3.00	$850	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650.00	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$6,500**	**LS**
2 (c)	**Excavation**					
	Excavation of impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	290	$2.40	$696	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200); Assume excavation depth of 0.5 FT and no non-impacted overburden soil.
	Live load onto to trucks for disposal	BCY	363	$0.36	$131	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0020);
	By hand with pick and shovel, light soil	BCY	73	$54.50	$3,951	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.13 1400);
	Confirmatory Samples	EA	12	$100.00	$1,200	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1014); Assume stockpile is in close proximity
	SUBTOTAL				**$16.66**	**per BCY**
2 (d)	**Transport and Disposal**					
	Transport and disposal of soil (Haz)	TON	109	$135.00	$14,682	Vendor quote, Capital Environmental; sample required for treatability study
	Transport and disposal of soil (Non-Haz)	TON	435	$65.00	$28,276	Vendor quote, Capital Environmental
	Fuel surcharge	GAL	200	$4.25	$850	Vendor quote, Capital Environmental
	Testing of samples prior to disposal	EA	1	$900.00	$900	Vendor quote, Capital Environmental; TCLP metals, volatiles and PCB per 500 tons of soil.
	SUBTOTAL				**$82.22**	**per Ton**

Cost Estimate Summary for Alternative 2 AOC-20

Excavation and Disposal

Frankford FS

2 (e)	**Excavation Work Oversight**					
	Sampling Technician	DAY	5	$600.00	$3,000	One person at $60 per hour during excavation activities, 10 hours per day;
	Health and Safety Officer	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	WK	1	$1,545.00	$1,545	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$12,545.00**	**LS**
2 (f)	**Backfill Excavated Areas**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	302	$17.80	$5,372	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	377	$7.75	$2,924	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread fill from stockpile with 2.5 CY F.E. loader	LCY	302	$3.50	$1,056	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 4 passes riding vibrating roller	CCY	217	$0.73	$159	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5040)
	Backfill narrow areas by hand, light soil	LCY	75	$31.00	$2,339	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Compact narrow areas w/ vibrating plate	CCY	54	$7.95	$432	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.

	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	3	$38.50	$116	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$53.79**	**per BCY**
2 (g)	**Site Restoration**					
	Borrow, loading and spreading, topsoil, front end loader, wheel mounted 1.5 CY bucket	BCY	73	$25.50	$1,849	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	91	$7.75	$702	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	73	$3.50	$254	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Backfill narrow areas by hand, light soil	LCY	18	$31.00	$562	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Bluegrass, #4/M.S.F, hydro seeding w/ mulch and fertilizer	MSF	5	$52.00	$254	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$50.45**	**per BCY**
2 (h)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (i)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	1.0	$360.00	$360	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Vendor quote; Capital Environmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,007.34**	**LS**

Cost Estimate Summary for Alternative 2 AOC-20

Excavation and Disposal

Frankford FS

Notes:

(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014

Cost Estimate Assumptions for Alternative 2 for AOC 21
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.
2. Assume structural evaluation needed prior to excvation adjacent to buildings.

(2) Excavation of Lead Contaminated Soils

(a) Mobilization (General/equipment mobilization)

1. Mobilization includes office trailer, toilet, refrigerator, excavator, roller, and front-end loader. Also includes utility hookup and usage (1 month).

(b) Site preparation/erosion and sediment controls

1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey will be performed by PA licensed surveyor across aerial extent of AOC (2.71 acres).
3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Asphalt/ Concrete Removal

1. Assumed removal of 122 cu. yds of 6 in. thick asphalt and underlying 6 in. thick concrete layer. Asphalt/ concrete will be mechanically removed and hauled to disposal facility prior to soil removal. The combined density of ashpalt/concrete is assumed to be 2.025 tons per cubic yard.

(d) Excavation

1. Assumed a total excavation area of 33,053 sq. ft and excavation depths ranging up to 5 ft bgs in specified areas with a total excavation volume of 6059 bank cubic yards.
2. Assumed that 80% of excavation volume will be live loaded with heavy machinery and 20% will be hand dug (due to underground utilities within excavation area).
3. Assumed a total of 24 confirmatory samples. Number of confirmatory samples based on estimated excavation volume using the PADEP Systematic Random Sampling Workbook. Follows requirements of PADEP Act 2 for post-excavation demonstration of attainment.

(e) Transport and Disposal

1. Assumed density of excavated soil (LCY) is 1.2 tons per cubic yard.
2. Assumed 80% of excavated soils will be disposed as non-hazardous waste and 20% of soils will be disposed as hazardous waste.

(f) Excavation Work Oversight
1. Assumed 1 sampling technician, 1 health and safety officer, and 1 site manager.

(g) Backfill Excavated Areas

1. Undisturbed soil (BCY) from site is adjusted by 1.25 to account for fluff/expansion (LCY) following excavation and hauling.
2. Imported common borrow (LCY) placed into excavation and compacted is adjusted by 0.72 to account for compaction (CCY).
3. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(h) Site Restoration
1. Assumed 80% backfill placed with mechanical equipment and 20% placed with manual equipment (e.g., shovels).

(i) Pre- and Post-Construction Submittals
1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

(j) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. No costs associated with O&M. Assuming all impacted soils will be removed and no O&M will be necessary, including five year reviews.

General

2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 2 for AOC-21
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Structural investigation	1	$5,000	LS	$5,000		
SUBTOTAL (1)				$5,000		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$6,666	LS	$6,666		
(b) Site preparation/erosion and sediment controls	1	$8,700	LS	$8,700		
(c) Asphalt/ concrete removal	1	$36,600	LS	$36,600		
(d) Excavation	6,060	$13.71	BCY	$83,090		
(e) Transportation and disposal lead-impacted soil	9,090	$79.29	TON	$720,726		
(f) Excavation oversight	1	$57,436	LS	$57,436		
(g) Backfill excavated area	6,115	$42	BCY	$256,291		
(h) Site Restoration	1	$31,876	LS	$31,876		
(i) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(j) Air Monitoring and Decontamination	1	$2,729	LS	$2,729		
SUBTOTAL (2)				$1,214,115		
CONSTRUCTION SUBTOTAL				$1,219,115		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$182,867		
(b) Contractor Profit	10% of Construction Subtotal			$121,911		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$365,734		
CONSTRUCTION TOTAL				**$1,889,628**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$113,378		
(b) Engineering	12% of Construction Total			$226,755		
(c) Construction Services (Field Management)	8% of Construction Total			$151,170		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000		
TOTAL CAPITAL COSTS				**$2,407,932**		

Cost Estimate Summary for Alternative 2 for AOC-21
Excavation and Disposal
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$0	$0
O&M Project Management	5% of O&M Subtotal				$0	$0
O&M Contingency	30% of O&M Subtotal				$0	$0
TOTAL O&M COSTS					**$0**	**$0**
TOTAL ESTIMATED COST =				**$2,407,932**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Summary for Alternative 2 AOC-21
Excavation and Disposal
Frankford FS

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Structural investigation	EA	1	$5,000.00	$5,000	General estimate
	Delineation Borings	EA	0	$8,000.00	$0	General estimate
	Reporting	LS	0	$2,000.00	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	1	$425.50	$430.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	1	$1,000.00	$1,000	General estimate
	Portable toilets (1)	MO	1	$200.00	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	1	$2,850.00	$2,850.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	1	$236.50	$240.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	1	$250.00	$250	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$6,666**	**LS**

Cost Estimate Summary for Alternative 2 AOC-21
Excavation and Disposal
Frankford FS

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	1006	$3.00	$3,020	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650.00	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$8,700**	**LS**
2 (c)	**Asphalt/ Concrete Removal**					
	Asphalt removal, 4" to 6" thick	SY	367	$9.20	$3,380	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 13.17 5050);
	Concrete removal, hydraulic hammer, 6" thick, rod reinforced	SY	367	$19.40	$7,130	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 13.17 5200);
	Machine loading trucks and hauling to disposal facility	CY	122	$30.80	$3,770	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 19.19 3080/5100); Assume hauling distance approx. 10 miles
	Disposal facility fee	TON	248	$90.00	$22,311	RSMeans, Site Work & Landscape Cost Data 2013 (02 41 19.20 0100);
	SUBTOTAL				**$36,600**	**LS**
2 (d)	**Excavation**					
	Excavation of impacted soils: excavator, hydraulic, crawler mtd, 1 CY cap.	BCY	4848	$2.40	$11,635	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0200);
	Live load impacted soils on to trucks for disposal	BCY	6060	$0.36	$2,181	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.42 0020);
	By hand with pick and shovel, light soil	BCY	1212	$54.50	$66,051	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 16.13 1400);
	Confirmatory Samples	EA	24	$100.00	$2,400	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1014); Assume stockpile is in close proximity
	SUBTOTAL				**$13.71**	**per BCY**
2 (e)	**Transport and Disposal**					
	Transport and disposal of soil (Haz)	TON	1818	$135.00	$245,419	Vendor quote, Capital Environmental; sample required for treatability study
	Transport and disposal of soil (Non-Haz)	TON	7272	$65.00	$472,658	Vendor quote, Capital Environmental
	Fuel surcharge	GAL	200	$4.25	$850	Vendor quote, Capital Environmental
	Testing of samples prior to disposal	EA	2	$900.00	$1,800	Vendor quote, Capital Environmental; TCLP metals, volatiles and PCB per 500 tons of soil.
	SUBTOTAL				**$79.29**	**per Ton**

Cost Estimate Summary for Alternative 2 AOC-21
Excavation and Disposal
Frankford FS

2 (f)	**Excavation Work Oversight**					
	Sampling Technician	DAY	24	$600.00	$14,400	One person at $60 per hour during excavation activities, 10 hours per day;
	Health and Safety Officer	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	1	$4,636.00	$4,636	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$57,436.00**	**LS**
2 (g)	**Backfill Excavated Areas**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	6115	$17.80	$108,844	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	7644	$7.75	$59,237	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread fill from common earth stockpile with 2.5 CY F.E. loader	LCY	6115	$3.50	$21,402	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 4 passes riding vibrating roller	CCY	4403	$0.73	$3,214	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5040)
	Backfill narrow areas by hand, light soil	LCY	1529	$31.00	$47,390	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Compact narrow areas w/ vibrating plate	CCY	1101	$7.95	$8,750	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	2	$255.00	$510	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.

	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	4	$135.00	$540	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	12	$38.50	$462	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$41.91**	**per BCY**
2 (h)	**Site Restoration**					
	Borrow, loading and spreading, topsoil, front end loader, wheel mounted 1.5 CY bucket	BCY	441	$25.50	$11,238	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	551	$7.75	$4,269	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	441	$3.50	$1,542	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Backfill narrow areas by hand, light soil	LCY	110	$31.00	$3,415	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0015)
	Bluegrass, #4/M.S.F, hydro seeding w/ mulch and fertilizer	MSF	30	$52.00	$1,547	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	Re-pave parking area w/ plant-mix bituminous concrete, 6" thick	SY	367	$26.00	$9,549	RSMeans, Site Work & Landscape Cost Data 2013 (32 11 26.13 0500)
	SUBTOTAL				**$31,876.45**	**LS**
2 (i)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (j)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	MO	1.0	$1,082.00	$1,082	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Vendor quote; Capital Environmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,729.34**	**LS**

Cost Estimate Summary for Alternative 2 AOC-21
Excavation and Disposal
Frankford FS

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

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Appendix B

Alternative 3 Costing

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Cost Estimate Assumptions for Alternative 3 for AOC 1
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

(2) Installation of Soil Cap

(a) Mobilization (General/equipment mobilization)
1. Mobilization includes office trailer, toilet, refrigerator, excavator, roller, and front-end loader. Also includes utility hookup and usage (1 month).

(b) Site preparation/erosion and sediment controls
1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey - Rate calculated from quote of $7,900/2.71acres.
3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Soil Cap Installation Oversight
1. Assumed 1 health and safety officer, and 1 site manager.

(d) Soil Cap Installation
1. Soil cap construction consists of a geosynthetic clay liner installed beneath 0.5 feet of "clean" compacted borrow material (11CY), followed by 0.5 feet of topsoil (11 CY).
2. Multiplied area of impact by 1.25 account for soil cap overlap.
3. Undisturbed soil (BCY) from borrow pit is adjusted by 1.25 to account for fluff/expansion (LCY) during hauling.
4. Imported common borrow (LCY) placed onto cap and compacted is adjusted by 0.72 to account for compaction (CCY).
5. Assumed 80% compacted with mechanical equipment and 20% compacted with manual equipment (e.g., shovels).

(e) Site Restoration
1. No additional assumptions.

(f) Pre- and Post-Construction Submittals
1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

(g) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. O&M wil include 5-year reviews and yearly inspections for a duration of 30-years. It assumed yearly inspections will not require landscape maintence (i.e. mowing, trimming, etc.), which is to be conducted by the property owner.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 3 for AOC-1
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Geophysical, delineation, reporting	1	$0	LS	$0		
SUBTOTAL (1)				$0		
(2) Installation of Soil Cap						
(a) Mobilization (General/equipment mobilization)	1	$6,666	LS	$6,666		
(b) Site preparation/erosion and sediment controls	1	$18,500	LS	$18,500		
(c) Soil cap installation oversight	1	$38,400	LS	$38,400		
(d) Soil cap installation	1	$255,440	LS	$255,440		
(e) Site Restoration	1	$3,393	LS	$3,393		
(f) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(g) Air Monitoring and Decontamination	1	$3,387	LS	$3,387		
SUBTOTAL (2)				$335,786		
CONSTRUCTION SUBTOTAL				$335,786		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$50,368		
(b) Contractor Profit	10% of Construction Subtotal			$33,579		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$100,736		
CONSTRUCTION TOTAL				**$520,469**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$31,228.11		
(b) Engineering	12% of Construction Total			$62,456.23		
(c) Construction Services (Field Management)	8% of Construction Total			$41,637.48		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000.00		
				$162,321.82		
(5) Site Restrictions:						
(a) Deed Restrictions	1	$25,000	LS	$25,000		
(b) Administrative Requirements						
(i) Five-Year Review reporting (30 years)	6	$30,000	EA		$6,000	$64,735
(ii) Yearly Inspections (30 years)	30	$2,000	EA		$2,000	$24,818
SUBTOTAL (6)				$25,000	$8,000	$89,553
TOTAL CAPITAL COSTS				**$707,790**		

Cost Estimate Summary for Alternative 3 for AOC-1
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$8,000	$89,553
O&M Project Management	5% of O&M Subtotal				$400	$4,478
O&M Contingency	30% of O&M Subtotal				$2,400	$26,866
TOTAL O&M COSTS					**$10,800**	**$120,896**
TOTAL ESTIMATED COST =				**$828,686**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 1 Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	0	$2,700	$0	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	1	$426	$430.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	1	$1,000	$1,000	General estimate
	Portable toilets (1)	LS	1	$200	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	1	$2,850	$2,850.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	1	$237	$240.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	1	$250	$250	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$6,666**	**LS**

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 1 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	4284	$3.00	$12,860	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$18,500**	**LS**
2 (c)	**Soil Cap Installation Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 4 days added to account for SCRIBE work.
	Health and Safety Officer	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$38,400.00**	**LS**
2 (d)	**Soil Cap Installation**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	1660	$17.80	$29,548	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Borrow, loading and spreading, top soil, front end loader, wheel mounted 1.5 CY bucket	BCY	1196	$18.80	$22,492	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	3570	$7.75	$27,671	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread common earth from stockpile with 2.5 CY F.E. loader	LCY	2075	$3.50	$7,262	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Spread common topsoil from stockpile with 2.5 CY F.E. loader	LCY	1495	$3.50	$5,234	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 2 passes riding vibrating roller	CCY	1195	$0.45	$538	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5000)
	Compact narrow areas w/ vibrating plate	CCY	299	$7.95	$2,375	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)

	Install anchor trench	LF	4284	$3.31	$15,932	RACER 2007;
	Geosynthetic clay liner	SF	80756	$1.52	$137,914	RACER 2007;

	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer anaylsis, &	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D	EA	7	$38.50	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standar	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$255,440.46**	**LS**
2 (e)	**Site Restoration**					
	Bluegrass, #4/M.S.F, hydroseeding w/ mulch and fertilizer	MSF	65	$52.00	$3,359	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$3,393.05**	**LS**
2 (f)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (g)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	MO	1.0	$1,082.00	$1,082	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Previous vendor quote; Capital Envrionmental
	Pressure washer: 3000 psi, gas, cold water	WK	4.0	$219.10	$876	Previous vendor quote; Sunbelt Rentals
	SUBTOTAL				**$3,386.65**	**LS**

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 1 Soil Capping with Environmental Covenant
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

5-Year Reviews

Cost = $30,000
Discount rate = 7.00%

Year	Present Value
1	--
2	--
3	--
4	--
5	$21,390
6	--
7	--
8	--
9	--
10	$15,250
11	--
12	--
13	--
14	--
15	$10,873
16	--
17	--
18	--
19	--
20	$7,753
21	--
22	--
23	--
24	--
25	$5,527
26	--
27	--
28	--
29	--
30	$3,941
TOTAL =	**$64,735**

Yearly Inspections

Cost = $2,000
Discount rate = 7.00%

Year	Present Value
1	$1,869
2	$1,747
3	$1,633
4	$1,526
5	$1,426
6	$1,333
7	$1,245
8	$1,164
9	$1,088
10	$1,017
11	$950
12	$888
13	$830
14	$776
15	$725
16	$677
17	$633
18	$592
19	$553
20	$517
21	$483
22	$451
23	$422
24	$394
25	$368
26	$344
27	$322
28	$301
29	$281
30	$263
TOTAL =	**$24,818**

Cost Estimate Assumptions for Alternative 3 for AOC 6
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

(2) Installation of Soil Cap

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, and front-end loader.

(b) Site preparation/erosion and sediment controls
1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey - Rate calculated from quote of $7,900/2.71acres.
3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Soil Cap Installation Oversight
1. Assumed 1 health and safety officer, and 1 site manager.

(d) Soil Cap Installation

1. Soil cap construction consists of a geosynthetic clay liner installed beneath 0.5 feet of "clean" compacted borrow material (11 CY), followed by 0.5 feet of topsoil (11 CY).

2. Multiplied area of impact by 1.25 account for soil cap overlap.

3. Undisturbed soil (BCY) from borrow pit is adjusted by 1.25 to account for fluff/expansion (LCY) during hauling.

4. Imported common borrow (LCY) placed onto cap and compacted is adjusted by 0.72 to account for compaction (CCY).

5. Assumed 100% compaction utilizing vibrating plate tamper due to small area of AOC.

(e) Site Restoration
1. No additional assumptions.

(f) Pre- and Post-Construction Submittals
1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

(g) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. O&M wil include 5-year reviews and yearly inspections for a duration of 30-years. It assumed yearly inspections will not require landscape maintence (i.e. mowing, trimming, etc.), which is to be conducted by the property owner.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 3 for AOC-6

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Geophysical, delineation, reporting	0	$0	LS	$0		
SUBTOTAL (1)				$0		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$1,313	LS	$1,313		
(b) Site preparation/erosion and sediment controls	1	$10,900	LS	$10,900		
(c) Soil cap installation oversight	1	$8,000	LS	$8,000		
(d) Soil cap installation	1	$4,937	LS	$4,937		
(e) Site Restoration	1	$23	LS	$23		
(f) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(g) Air Monitoring and Decontamination	1	$2,007	LS	$2,007		
SUBTOTAL (2)				$37,181		
CONSTRUCTION SUBTOTAL				$37,181		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$5,577		
(b) Contractor Profit	10% of Construction Subtotal			$3,718		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$11,154		
CONSTRUCTION TOTAL				**$57,631**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$3,457.84		
(b) Engineering	12% of Construction Total			$6,915.69		
(c) Construction Services (Field Management)	8% of Construction Total			$4,610.46		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000.00		
				$41,983.99		
(5) Site Restrictions:						
(a) Deed Restrictions	1	$25,000	LS	$25,000		
(b) Administrative Requirements						
(i) Five-Year Review reporting (30 years)	6	$30,000	EA		$6,000	$64,735
(ii) Yearly Inspections (30 years)	30	$2,000	EA		$2,000	$24,818
SUBTOTAL (6)				$25,000	$8,000	$89,553
TOTAL CAPITAL COSTS				**$114,599**		

Cost Estimate Summary for Alternative 3 for AOC-6
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	**Quantity**	**Unit Cost**	**Units**	**Capital Cost**	**O&M Cost Annual**	**O&M Cost 30-Year (Present Worth)**
O&M SUBTOTAL					$8,000	$89,553
O&M Project Management	5% of O&M Subtotal				$400	$4,478
O&M Contingency	30% of O&M Subtotal				$2,400	$26,866
TOTAL O&M COSTS					**$10,800**	**$120,896**
			TOTAL ESTIMATED COST =	**$235,495**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 6 Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	0	$2,700	$0	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$426	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	0	$1,000	$0	General estimate
	Portable toilets (1)	LS	1	$200	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$237	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	0	$538.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$1,313**	**LS**

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 6 Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	85	$3.00	$260	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Demolish, dispose, and rebuild wooden deck	LS	1	$5,000	$5,000.00	General estimate;
	Utility Clearance	LS	1	$1,650	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$10,900**	**LS**
2 (c)	**Soil Cap Installation Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 2 days added to account for SCRIBE work.
	Health and Safety Officer	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$8,000.00**	**LS**
2 (d)	**Soil Cap Installation**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	10	$17.80	$184	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Borrow, loading and spreading, top soil, front end loader, wheel mounted 1.5 CY bucket	BCY	8	$18.80	$156	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	23	$7.75	$180	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread common earth from stockpile with 2.5 CY F.E. loader	LCY	13	$3.50	$45	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Spread common topsoil from stockpile with 2.5 CY F.E. loader	LCY	10	$3.50	$36	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 2 passes riding vibrating roller	CCY	0	$0.45	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5000)
	Compact narrow areas w/ vibrating plate	CCY	9	$7.95	$74	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)

	Install anchor trench	LF	85	$3.31	$316	RACER 2007;
	Geosynthetic clay liner	SF	559	$1.52	$1,013	RACER 2007;

	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer anaylsis, & atterberg	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	1	$38.50	$39	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$1,810.00	$1,810	Laboratory quote, ALS Environmental; Less than 125 CY requires 6 samples analyzing metals, PCBs, & pesticides; 2 samples analyzing VOCs.
	SUBTOTAL				**$4,937.30**	**LS**
2 (e)	**Site Restoration**					
	Bluegrass, #4/M.S.F, hydroseeding w/ mulch and fertilizer	MSF	0	$52.00	$23	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$23.48**	**LS**
2 (f)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (g)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	1.0	$360.00	$360	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Vendor quote; Capital Envrionmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,007.34**	**LS**

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 6 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

5-Year Reviews

Cost = $30,000
Discount rate = 7.00%

Year	Present Value
1	--
2	--
3	--
4	--
5	$21,390
6	--
7	--
8	--
9	--
10	$15,250
11	--
12	--
13	--
14	--
15	$10,873
16	--
17	--
18	--
19	--
20	$7,753
21	--
22	--
23	--
24	--
25	$5,527
26	--
27	--
28	--
29	--
30	$3,941
TOTAL =	**$64,735**

Yearly Inspections

Cost = $2,000
Discount rate = 7.00%

Year	Present Value
1	$1,869
2	$1,747
3	$1,633
4	$1,526
5	$1,426
6	$1,333
7	$1,245
8	$1,164
9	$1,088
10	$1,017
11	$950
12	$888
13	$830
14	$776
15	$725
16	$677
17	$633
18	$592
19	$553
20	$517
21	$483
22	$451
23	$422
24	$394
25	$368
26	$344
27	$322
28	$301
29	$281
30	$263
TOTAL =	**$24,818**

Cost Estimate Assumptions for Alternative 3 for AOC 10
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

(2) Installation of Soil Cap

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, roller, and front-end loader.

(b) Site preparation/erosion and sediment controls
1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey - Rate calculated from quote of $7,900/2.71acres.
3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Soil Cap Installation Oversight
1. Assumed 1 health and safety officer, and 1 site manager.

(d) Soil Cap Installation
1. Soil cap construction consists of a geosynthetic clay liner installed beneath 0.5 feet of "clean" compacted borrow material (56 CY), followed by 0.5 feet of topsoil (56 CY).
2. Multiplied area of impact by 1.25 account for soil cap overlap.
3. Undisturbed soil (BCY) from borrow pit is adjusted by 1.25 to account for fluff/expansion (LCY) during hauling.
4. Imported common borrow (LCY) placed onto cap and compacted is adjusted by 0.72 to account for compaction (CCY).
5. Assumed 80% compacted with mechanical equipment and 20% compacted with manual equipment (e.g., shovels).

(e) Site Restoration
1. No additional assumptions.

(f) Pre- and Post-Construction Submittals
1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

(g) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. O&M wil include 5-year reviews and yearly inspections for a duration of 30-years. It assumed yearly inspections will not require landscape maintence (i.e. mowing, trimming, etc.), which is to be conducted by the property owner.

General
2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 3 for AOC-10

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Geophysical, delineation, reporting	1	$0	LS	$0		
SUBTOTAL (1)				$0		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$1,919	LS	$1,919		
(b) Site preparation/erosion and sediment controls	1	$6,300	LS	$6,300		
(c) Soil cap installation oversight	1	$8,000	LS	$8,000		
(d) Soil cap installation	1	$12,578	LS	$12,578		
(e) Site Restoration	1	$127	LS	$127		
(f) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(g) Air Monitoring and Decontamination	1	$2,007	LS	$2,007		
SUBTOTAL (2)				$40,931		
CONSTRUCTION SUBTOTAL				$40,931		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$6,140		
(b) Contractor Profit	10% of Construction Subtotal			$4,093		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$12,279		
CONSTRUCTION TOTAL				**$63,444**		
(4) Professional/Technical Services[1:]						
(a) Project Management	6% of Construction Total			$3,806.62		
(b) Engineering	12% of Construction Total			$7,613.24		
(c) Construction Services (Field Management)	8% of Construction Total			$5,075.49		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000.00		
				$43,495.36		
(5) Site Restrictions:						
(a) Deed Restrictions	1	$25,000	LS	$25,000		
(b) Administrative Requirements						
(i) Five-Year Review reporting (30 years)	6	$30,000	EA		$6,000	$64,735
(ii) Yearly Inspections (30 years)	30	$2,000	EA		$2,000	$24,818
SUBTOTAL (6)				$25,000	$8,000	$89,553
TOTAL CAPITAL COSTS				**$131,939**		

Cost Estimate Summary for Alternative 3 for AOC-10
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$8,000	$89,553
O&M Project Management	5% of O&M Subtotal				$400	$4,478
O&M Contingency	30% of O&M Subtotal				$2,400	$26,866
TOTAL O&M COSTS					**$10,800**	**$120,896**
TOTAL ESTIMATED COST =				**$252,835**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 10 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	0	$2,700	$0	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$426	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	0	$1,000	$0	General estimate
	Portable toilets (1)	LS	1	$200	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$237	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$1,919**	**LS**

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 10 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	214	$3.00	$650	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$6,300**	**LS**
2 (c)	**Soil Cap Installation Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 2 days added to account for SCRIBE work.
	Health and Safety Officer	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	5	$800.00	$4,000	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$8,000.00**	**LS**
2 (d)	**Soil Cap Installation**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	62	$17.80	$1,105	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Borrow, loading and spreading, top soil, front end loader, wheel mounted 1.5 CY bucket	BCY	45	$18.80	$841	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	134	$7.75	$1,035	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread common earth from stockpile with 2.5 CY F.E. loader	LCY	78	$3.50	$272	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	56	$4.50	$252	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 2 passes riding vibrating roller	CCY	45	$0.45	$20	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5000)
	Compact narrow areas w/ vibrating plate	CCY	11	$7.95	$89	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Install anchor trench	LF	214	$3.31	$796	RACER 2007;

	Geosynthetic clay liner	SF	3021	$1.52	$5,160	RACER 2007;

	natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer anaylsis, & atterberg limits ASTM D423	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	1	$38.50	$39	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$1,810.00	$1,810	Laboratory quote, ALS Environmental; Less than 125 CY requires 6 samples analyzing metals, PCBs, & pesticides; 2 samples analyzing VOCs.
	SUBTOTAL				**$12,578.13**	**LS**
2 (e)	**Site Restoration**					
	Bluegrass, #4/M.S.F, hydroseeding w/ mulch and fertilizer	MSF	2	$52.00	$126	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$126.94**	**LS**
2 (f)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (g)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	1.0	$360.00	$360	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Previous vendor quote; Capital Envrionmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Previous vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,007.34**	**LS**

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 10 Soil Capping with Environmental Covenant
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

5-Year Reviews

Cost = $30,000
Discount rate = 7.00%

Year	Present Value
1	--
2	--
3	--
4	--
5	$21,390
6	--
7	--
8	--
9	--
10	$15,250
11	--
12	--
13	--
14	--
15	$10,873
16	--
17	--
18	--
19	--
20	$7,753
21	--
22	--
23	--
24	--
25	$5,527
26	--
27	--
28	--
29	--
30	$3,941
TOTAL =	**$64,735**

Yearly Inspections

Cost = $2,000
Discount rate = 7.00%

Year	Present Value
1	$1,869
2	$1,747
3	$1,633
4	$1,526
5	$1,426
6	$1,333
7	$1,245
8	$1,164
9	$1,088
10	$1,017
11	$950
12	$888
13	$830
14	$776
15	$725
16	$677
17	$633
18	$592
19	$553
20	$517
21	$483
22	$451
23	$422
24	$394
25	$368
26	$344
27	$322
28	$301
29	$281
30	$263
TOTAL =	**$24,818**

Cost Estimate Assumptions for Alternative 3 for AOC 13
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

(2) Installation of Soil Cap

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, and front-end loader.

(b) Site preparation/erosion and sediment controls
1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey - Rate calculated from quote of $7,900/2.71acres.

3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Soil Cap Installation Oversight
1. Assumed 1 health and safety officer, and 1 site manager.

(d) Soil Cap Installation

1. Soil cap construction consists of a geosynthetic clay liner installed beneath 0.5 feet of "clean" compacted borrow material (11 CY), followed by 0.5 feet of topsoil (11 CY).

2. Multiplied area of impact by 1.25 account for soil cap overlap.

3. Undisturbed soil (BCY) from borrow pit is adjusted by 1.25 to account for fluff/expansion (LCY) during hauling.

4. Imported common borrow (LCY) placed onto cap and compacted is adjusted by 0.72 to account for compaction (CCY).

5. Assumed 100% compaction utilizing vibrating plate tamper due to small area of AOC.

(e) Site Restoration
1. No additional assumptions.

(f) Pre- and Post-Construction Submittals
1. No additional assumptions.

(g) Air Monitoring and Decontamination
1. No additional assumptions.

Cost Estimate Assumptions for Alternative 3 for AOC 13
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

O&M Costs

1. O&M wil include 5-year reviews and yearly inspections for a duration of 30-years. It assumed yearly inspections will not require landscape maintence (i.e. mowing, trimming, etc.), which is to be conducted by the property owner.

General

2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Assumptions for Alternative 3 for AOC 13

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Cost Estimate Summary for Alternative 3 for AOC-13

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost	
					Annual	30-Year (Present Worth)
(1) Pre-Design Investigation						
(a) Geophysical, delineation, reporting	0	$0	LS	$0		
SUBTOTAL (1)				$0		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	0	$0	LS	$0		
(b) Site preparation/erosion and sediment controls	0	$6,300	LS	$0		
(c) Soil cap installation oversight	0	$0	LS	$0		
(d) Soil cap installation	0	$0	LS	$0		
(e) Site Restoration	0	$0	LS	$0		
(f) Contractor Submittals (pre- and post-construction)	0	$0	LS	$0		
(g) Air Monitoring and Decontamination	0	$0	LS	$0		
SUBTOTAL (2)				$0		
CONSTRUCTION SUBTOTAL				$0		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$0		
(b) Contractor Profit	10% of Construction Subtotal			$0		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$0		

Cost Estimate Summary for Alternative 3 for AOC-13

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

					O&M Cost	
Item	**Quantity**	**Unit Cost**	**Units**	**Capital Cost**	**Annual**	**30-Year (Present Worth)**
CONSTRUCTION TOTAL				**$0**		
(4) Professional/Technical Services[1]:						
(a) Project Management	6% of Construction Total			$0.00		
(b) Engineering	12% of Construction Total			$0.00		
(c) Construction Services (Field Management)	8% of Construction Total			$0.00		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$0.00		
				$0.00		
(5) Site Restrictions:						
(a) Deed Restrictions	1	$25,000	LS	$25,000		
(b) Administrative Requirements						
(i) Five-Year Review reporting (30 years)	6	$30,000	EA		$6,000	$64,735
(ii) Yearly Inspections (30 years)	30	$2,000	EA		$2,000	$24,818
SUBTOTAL (6)				$25,000	$6,000	$89,553
TOTAL CAPITAL COSTS				**$25,000**		
O&M SUBTOTAL					$0	$89,553
O&M Project Management	5% of O&M Subtotal				$0	$4,478
O&M Contingency	30% of O&M Subtotal				$0	$26,866
TOTAL O&M COSTS					**$0**	**$120,896**
TOTAL ESTIMATED COST =				**$145,896**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 13 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Total Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	0	$2,700	$0	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (b)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$426	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	0	$1,000	$0	General estimate
	Portable toilets (1)	MO	0	$200	$0	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$237	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	0	$538.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	0	$538.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	0	$538.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$0**	**LS**

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 13 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2 (c)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	214	$3.00	$650	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$6,300**	**LS**
2 (d)	**Soil Cap Installation Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 2 days added to account for SCRIBE work.
	Health and Safety Officer	DAY	0	$800.00	$0	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	0	$800.00	$0	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$0.00**	**LS**
2 (e)	**Soil Cap Installation**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	0	$17.80	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Borrow, loading and spreading, top soil, front end loader, wheel mounted 1.5 CY bucket	BCY	0	$18.80	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	0	$7.75	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread common earth/ topsoil from stockpile with 2.5 CY F.E. loader	LCY	0	$3.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 2 passes riding vibrating roller	ECY	0	$0.45	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5000)

	Compact narrow areas w/ vibrating plate	ECY	0	$7.95	$0	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Install anchor trench	LF	0	$3.31	$0	RACER 2007;
	Geosynthetic clay liner	SF	0	$1.52	$0	RACER 2007;
	Construction Testing - borrow source (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	Representative Samples - delivered materials (common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer anaylsis, &	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	0	$135.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM I	EA	0	$38.50	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standa	LS	0	$1,810.00	$0	Laboratory quote, ALS Environmental; Less than 125 CY requires 6 samples analyzing metals, PCBs, & pesticides; 2 samples analyzing VOCs.
	SUBTOTAL				**$0.00**	**LS**
2 (f)	**Site Restoration**					
	Bluegrass, #4/M.S.F, hydroseeding w/ mulch and fertilizer	MSF	0	$52.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$0.00**	**LS**
2 (h)	**Pre- and Post-Construction Submittals**	LS	0.0	$10,000.00	**$0**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$0.00**	**LS**

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 13 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2 (h)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	0.0	$360.00	$0	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	0	$714.12	$0	Previous vendor quote; Capital Envrionmental
	Pressure washer: 3000 psi, gas, cold water	WK	0.0	$219.10	$0	Previous vendor quote; Sunbelt Rentals
	SUBTOTAL				**$0.00**	**LS**

Notes:

(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 13 Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

5-Year Reviews

Cost = $30,000
Discount rate = 7.00%

Year	Present Value
1	--
2	--
3	--
4	--
5	$21,390
6	--
7	--
8	--
9	--
10	$15,250
11	--
12	--
13	--
14	--
15	$10,873
16	--
17	--
18	--
19	--
20	$7,753
21	--
22	--
23	--
24	--
25	$5,527
26	--
27	--
28	--
29	--
30	$3,941
TOTAL =	**$64,735**

Yearly Inspections

Cost = $2,000
Discount rate = 7.00%

Year	Present Value
1	$1,869
2	$1,747
3	$1,633
4	$1,526
5	$1,426
6	$1,333
7	$1,245
8	$1,164
9	$1,088
10	$1,017
11	$950
12	$888
13	$830
14	$776
15	$725
16	$677
17	$633
18	$592
19	$553
20	$517
21	$483
22	$451
23	$422
24	$394
25	$368
26	$344
27	$322
28	$301
29	$281
30	$263
TOTAL =	**$24,818**

Cost Estimate Assumptions for Alternative 3 for AOC 20
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

(2) Installation of Soil Cap

(a) Mobilization (General/equipment mobilization)

1. Short duration of work anticipated. Mobilization will include a toilet, excavator, roller, and front-end loader.

(b) Site preparation/erosion and sediment controls
1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey - Rate calculated from quote of $7,900/2.71acres.
3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Soil Cap Installation Oversight
1. Assumed 1 health and safety officer, and 1 site manager.

(d) Soil Cap Installation
1. Soil cap construction consists of a geosynthetic clay liner installed beneath 0.5 feet of "clean" compacted borrow material (114 CY), followed by 0.5 feet of topsoil (114 CY).
2. Multiplied area of impact by 1.25 account for soil cap overlap.
3. Undisturbed soil (BCY) from borrow pit is adjusted by 1.25 to account for fluff/expansion (LCY) during hauling.
4. Imported common borrow (LCY) placed onto cap and compacted is adjusted by 0.72 to account for compaction (CCY).
5. Assumed 80% compacted with mechanical equipment and 20% compacted with manual equipment (e.g., shovels).

(e) Site Restoration
1. No additional assumptions.

(f) Pre- and Post-Construction Submittals
1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

(g) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. O&M wil include 5-year reviews and yearly inspections for a duration of 30-years. It assumed yearly inspections will not require landscape maintence (i.e. mowing, trimming, etc.), which is to be conducted by the property owner.

General

Cost Estimate Assumptions for Alternative 3 for AOC 20
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 3 for AOC-20

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	**Quantity**	**Unit Cost**	**Units**	**Capital Cost**	**O&M Cost Annual**	**O&M Cost 30-Year (Present Worth)**
(1) Pre-Design Investigation						
(a) Geophysical, delineation, reporting	1	$0	LS	$0		
SUBTOTAL (1)				$0		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$1,919	LS	$1,919		
(b) Site preparation/erosion and sediment controls	1	$6,500	LS	$6,500		
(c) Soil cap installation oversight	1	$16,000	LS	$16,000		
(d) Soil cap installation	1	$22,750	LS	$22,750		
(e) Site Restoration	1	$321	LS	$321		
(f) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(g) Health and Safety/Decontamination	1	$2,367	LS	$2,367		
SUBTOTAL (2)				$59,858		
CONSTRUCTION SUBTOTAL				$59,858		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$8,979		
(b) Contractor Profit	10% of Construction Subtotal			$5,986		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$17,957		
				$32,922		
CONSTRUCTION TOTAL				**$92,779**		
(4) Professional/Technical Services[1]:						
(a) Project Management	6% of Construction Total			$5,566.77		
(b) Engineering	12% of Construction Total			$11,133.53		
(c) Construction Services (Field Management)	8% of Construction Total			$7,422.35		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000.00		
(5) Site Restrictions:						
(a) Deed Restrictions	1	$25,000	LS	$25,000		
(b) Administrative Requirements						
(i) Five-Year Review reporting (30 years)	6	$30,000	EA		$6,000	$64,735
(ii) Yearly Inspections (30 years)	30	$2,000	EA		$2,000	$24,818
SUBTOTAL (6)				$25,000	$8,000	$89,553

Cost Estimate Summary for Alternative 3 for AOC-20

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost	
					Annual	30-Year (Present Worth)
TOTAL CAPITAL COSTS				**$168,902**		

Cost Estimate Summary for Alternative 3 for AOC-20

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost	
					Annual	**30-Year (Present Worth)**
O&M SUBTOTAL					$8,000	$89,553
O&M Project Management	5% of O&M Subtotal				$400	$4,478
O&M Contingency	30% of O&M Subtotal				$2,400	$26,866
TOTAL O&M COSTS					**$10,800**	**$120,896**
TOTAL ESTIMATED COST =				**$289,798**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 20 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	0	$2,700	$0	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	0	$426	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	0	$1,000	$0	General estimate
	Portable toilets (1)	LS	1	$200	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	0	$2,850	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	0	$237	$0.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	0	$250	$0	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$1,919**	**LS**

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	281	$3.00	$850	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$6,500**	**LS**
2 (c)	**Soil Cap Installation Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 2 days added to account for SCRIBE work.
	Health and Safety Officer	DAY	10	$800.00	$8,000	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	10	$800.00	$8,000	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$16,000.00**	**LS**
2 (d)	**Soil Cap Installation**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	126	$17.80	$2,238	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Borrow, loading and spreading, top soil, front end loader, wheel mounted 1.5 CY bucket	BCY	91	$18.80	$1,704	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	270	$7.75	$2,096	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread common earth from stockpile with 2.5 CY F.E. loader	LCY	157	$3.50	$550	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Spread topsoil from stockpile with 2.5 CY F.E. loader	LCY	113	$4.50	$510	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 2 passes riding vibrating roller	CCY	91	$0.45	$41	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5000)
	Compact narrow areas w/ vibrating plate	CCY	23	$7.95	$180	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)

	Install anchor trench	LF	281	$3.31	$1,045	RACER 2007;
	Geosynthetic clay liner	SF	6118	$1.52	$10,447	RACER 2007;

	natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer anaylsis, & atterberg limits ASTM D423	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D29	EA	1	$38.50	$39	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$22,750.07**	**LS**
2 (e)	**Site Restoration**					
	Bluegrass, #4/M.S.F, hydroseeding w/ mulch and fertilizer	MSF	6	$52.00	$318	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$321.29**	**LS**
2 (f)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (g)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	WK	2.0	$360.00	$720	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Previous vendor quote; Capital Envrionmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Previous vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,367.34**	**LS**

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 20 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

5-Year Reviews

Cost = $30,000
Discount rate = 7.00%

Year	Present Value
1	--
2	--
3	--
4	--
5	$21,390
6	--
7	--
8	--
9	--
10	$15,250
11	--
12	--
13	--
14	--
15	$10,873
16	--
17	--
18	--
19	--
20	$7,753
21	--
22	--
23	--
24	--
25	$5,527
26	--
27	--
28	--
29	--
30	$3,941
TOTAL =	**$64,735**

Yearly Inspections

Cost = $2,000
Discount rate = 7.00%

Year	Present Value
1	$1,869
2	$1,747
3	$1,633
4	$1,526
5	$1,426
6	$1,333
7	$1,245
8	$1,164
9	$1,088
10	$1,017
11	$950
12	$888
13	$830
14	$776
15	$725
16	$677
17	$633
18	$592
19	$553
20	$517
21	$483
22	$451
23	$422
24	$394
25	$368
26	$344
27	$322
28	$301
29	$281
30	$263
TOTAL =	**$24,818**

Cost Estimate Assumptions for Alternative 3 for AOC 21
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

(1) Pre-Design Investigation

1. Assumed not needed due to delineation conducted during Remedial Investigation and 2014 supplemental investigation.

(2) Installation of Soil Cap

(a) Mobilization (General/equipment mobilization)

1. Mobilization includes office trailer, toilet, refrigerator, excavator, roller, and front-end loader. Also includes utility hookup and usage (1 month).

(b) Site preparation/erosion and sediment controls
1. Assumed placement of compost filter sock around perimeter of each excavation area.
2. Topographic survey - Rate calculated from quote of $7,900/2.71acres.
3. Utility clearnance will utilize Ground Penetrating Radar, TW-6 Metal Detector, and Precision Utility Locator.

(c) Soil Cap Installation Oversight
1. Assumed 1 health and safety officer, and 1 site manager.

(d) Soil Cap Installation

1. Soil cap construction consists of a geosynthetic clay liner installed beneath 0.5 feet of "clean" compacted borrow material (688 CY), followed by 0.5 feet of topsoil (688 CY).

2. Multiplied area of impact by 1.25 account for soil cap overlap.

3. Undisturbed soil (BCY) from borrow pit is adjusted by 1.25 to account for fluff/expansion (LCY) during hauling.

4. Imported common borrow (LCY) placed onto cap and compacted is adjusted by 0.72 to account for compaction (CCY).
5. Assumed 80% compacted with mechanical equipment and 20% compacted with manual equipment (e.g., shovels).

(e) Site Restoration
1. No additional assumptions.

(f) Pre- and Post-Construction Submittals
1. Submittals will include certifications, material testing data, closure reports, as-built drawings, record drawings, etc.

(g) Air Monitoring and Decontamination
1. No additional assumptions.

O&M Costs

1. O&M wil include 5-year reviews and yearly inspections for a duration of 30-years. It assumed yearly inspections will not require landscape maintence (i.e. mowing, trimming, etc.), which is to be conducted by the property owner.

General

Cost Estimate Assumptions for Alternative 3 for AOC 21
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2014 Inflation Rate (http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=237&year1=2013&year2=2014)

Cost Estimate Summary for Alternative 3 for AOC-21

Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	**Quantity**	**Unit Cost**	**Units**	**Capital Cost**	**O&M Cost Annual**	**O&M Cost 30-Year (Present Worth)**
(1) Pre-Design Investigation						
(a) Geophysical, delineation, reporting	0	$0	LS	$0		
SUBTOTAL (1)				$0		
(2) Excavation of lead Contaminated Soils						
(a) Mobilization (General/equipment mobilization)	1	$6,666	LS	$6,666		
(b) Site preparation/erosion and sediment controls	1	$8,700	LS	$8,700		
(c) Soil cap installation oversight	1	$38,400	LS	$38,400		
(d) Soil cap installation	1	$116,678	LS	$116,678		
(e) Site Restoration	1	$1,953	LS	$1,953		
(f) Contractor Submittals (pre- and post-construction)	1	$10,000	LS	$10,000		
(g) Health and Safety/Decontamination	1	$2,729	LS	$2,729		
SUBTOTAL (2)				$185,126		
CONSTRUCTION SUBTOTAL				$185,126		
(3) Additional Construction Costs[1]:						
(a) Contractor Overhead	15% of Construction Subtotal			$27,769		
(b) Contractor Profit	10% of Construction Subtotal			$18,513		
(c) Contingency (Scope + Bid)	30% of Construction Subtotal			$55,538		
CONSTRUCTION TOTAL				**$286,945**		
(4) Professional/Technical Services[1]:						
(a) Project Management	6% of Construction Total			$17,216.72		
(b) Engineering	12% of Construction Total			$34,433.43		
(c) Construction Services (Field Management)	8% of Construction Total			$22,955.62		
(d) Planning documents (SAP, FSP, QAPP, HSP)	1	$27,000	LS	$27,000.00		
				$101,605.77		
(5) Site Restrictions:						
(a) Deed Restrictions	1	$25,000	LS	$25,000		
(b) Administrative Requirements						
(i) Five-Year Review reporting (30 years)	6	$30,000	EA		$6,000	$64,735
(ii) Yearly Inspections (30 years)	30	$2,000	EA		$2,000	$24,818
SUBTOTAL (6)				$25,000	$8,000	$89,553
TOTAL CAPITAL COSTS				**$413,551**		

Cost Estimate Summary for Alternative 3 for AOC-21
Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Item	Quantity	Unit Cost	Units	Capital Cost	O&M Cost Annual	O&M Cost 30-Year (Present Worth)
O&M SUBTOTAL					$8,000	$89,553
O&M Project Management	5% of O&M Subtotal				$400	$4,478
O&M Contingency	30% of O&M Subtotal				$2,400	$26,866
TOTAL O&M COSTS					**$10,800**	**$120,896**
TOTAL ESTIMATED COST =				**$534,447**		

NOTES:

[1] Based on guidance provided in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* , EPA 540-R-00-002; OSWER 9355.0-75, July 2000.

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 21 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

Line Item	*Description*	*Unit*	*Estimated Quantity*	*Unit Cost*	*Estimated Cost*	*Cost Basis/Reference*
1 (a)	**Pre-Design Investigation**					
	Geophysical Investigation - EM-61	EA	0	$2,700	$0	General estimate
	Delineation Borings	EA	0	$8,000	$0	General estimate
	Reporting	LS	0	$2,000	$0	General estimate
	SUBTOTAL				**$0**	**LS**
2 (a)	**Mobilization**					
	Field Office - 50'x12' (Rent One Unit-Construction)	MO	1	$426	$430.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 52 13.20 0550/0700); includes air conditioning, furniture
	Field Office - delivery, setup, removal	LS	1	$1,000	$1,000	General estimate
	Portable toilets (1)	MO	1	$200	$200	General estimate
	Utilities hookup: Service, overhead feed, 400 Amp	EA	1	$2,850	$2,850.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.50 0050)
	Monthly utilities: Lights, HVAC, Water	MO	1	$237	$240.00	RSMeans, Site Work & Landscape Cost Data 2013 (01 51 13.80 0700, 01 52 13.40 0160)
	Refrigerator for sample storage	EA	1	$250	$250	General estimate
	Mobilize/Demobilize equipment					
	Excavator (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Roller (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	Front End Loader (1)	EA	1	$538.00	$538	RSMeans, Site Work & Landscape Cost Data 2013 (01 54 36.50 0020);
	SUBTOTAL				**$6,666**	**LS**

Cost Estimate Frankford Arsenal

Alternative 3 for AOC 21 Capping and Future Use Restrictions

Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

2 (b)	**Site Preparation/Erosion and Sediment Controls**					
	Compost filter sock w/ installation, 12-inch diameter	LF	1006	$3.00	$3,020	Vendor quote, Weaver Express Erosion Control Solutions
	Topographic Survey	LS	1	$3,950.00	$3,950	Vendor quote, Site Design Concepts; Includes pre/post construction surveys.
	Utility Clearance	LS	1	$1,650	$1,650	Estimate from Delta Geophysics Inc.; Cost includes site map with findings.
	SUBTOTAL				**$8,700**	**LS**
2 (c)	**Soil Cap Installation Oversight**					
	Sampling Technician	DAY	0	$600.00	$0	One person at $60 per hour during excavation activities, 10 hours per day; Additional 2 days added to account for SCRIBE work.
	Health and Safety Officer	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	Site Manager	DAY	24	$800.00	$19,200	One person at $80 per hour during excavation activities, 10 hours per day;
	X-Ray Fluorescence machine	MO	0	$4,636.00	$0	Post-excavation in-field screening; EA equipment cost rate
	SUBTOTAL				**$38,400.00**	**LS**
2 (d)	**Soil Cap Installation**					
	Borrow, loading and spreading, common earth, front end loader, wheel mounted 1.5 CY bucket	BCY	764	$17.80	$13,605	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 4060);
	Borrow, loading and spreading, top soil, front end loader, wheel mounted 1.5 CY bucket	BCY	551	$18.80	$10,357	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.15 7060);
	Truck haul from borrow pit; 12 CY truck, cycle 10 miles, 50 MPH ave, 25 min. wait/load/unload	LCY	1644	$7.75	$12,741	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.20 1506);
	Spread common earth from stockpile with 2.5 CY F.E. loader	LCY	955	$3.50	$3,344	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Spread common topsoil from stockpile with 2.5 CY F.E. loader	LCY	689	$4.50	$3,099	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.17 0170)
	Compaction: 6-inch lifts; 2 passes riding vibrating ro	ECY	550	$0.45	$248	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.23 5000)
	Compact narrow areas w/ vibrating plate	ECY	138	$7.95	$1,094	RSMeans, Site Work & Landscape Cost Data 2013 (31 23 23.13 0600)
	Install anchor trench	LF	1006	$3.31	$3,741	RACER 2007;

	Geosynthetic clay liner	SF	37185	$1.52	$63,503	RACER 2007;

	borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer analysis, & atterberg limits ASTM D423	EA	3	$255.00	$765	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Assumed 3 test required from borrow source.
	(common borrow); natural moisture content ASTM D2216, particle size analysis ASTM D421, hydrometer anaylsis, & atterberg limits ASTM	EA	0	$255.00	$0	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4400, 4600, 4750, 4510); Additional samples required every 3,000 CY.
	Compaction testing; proctor compaction, 4-inch mold, ASTM D 698	EA	2	$135.00	$270	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4900); Assumed 2 test required from borrow and 1 test required every 3,000 CY.
	Compaction testing; soil density, nuclear method, ASTM D2922	EA	3	$38.50	$116	RSMeans, Site Work & Landscape Cost Data 2013 (01 45 23.50 4735); Assumed in-field density testing will be required every 6" lift & every 10,000 SF.
	Backfill (topsoil/common earth) testing per PADEP standards	LS	1	$2,640.00	$2,640	Laboratory quote, ALS Environmental; Greater than 125 CY requires 9 samples analyzing metals, PCBs, & pesticides; 3 samples analyzing VOCs.
	SUBTOTAL				**$116,677.71**	**LS**
2 (e)	**Site Restoration**					
	Bluegrass, #4/M.S.F, hydroseeding w/ mulch and fer	MSF	37	$52.00	$1,934	RSMeans, Site Work & Landscape Cost Data 2013 (32 92 19.14 0800)
	SUBTOTAL				**$1,952.94**	**LS**
2 (f)	**Pre- and Post-Construction Submittals**	LS	1.0	$10,000.00	**$10,000**	General estimate; Includes any subcontractor pre/post construction submittals.
	SUBTOTAL				**$10,000.00**	**LS**
2 (g)	**Air Monitoring and Decontamination**					
	Work Area Monitoring					
	MiniRam Dust Monitor	MO	1.0	$1,082.00	$1,082	EA equipment cost rate
	Decontamination (excavator, loader, roller)					
	Disposal (hazwaste) per drum	EA	2	$714.12	$1,428	Previous vendor quote; Capital Envrionmental
	Pressure washer: 3000 psi, gas, cold water	WK	1.0	$219.10	$219	Previous vendor quote; Sunbelt Rentals
	SUBTOTAL				**$2,729.34**	**LS**

Notes:
(1) Costs based on RSMeans Cost Data 2013 were adjusted by factor of 1.01 for Year 2014.

Cost Estimate Frankford Arsenal
Alternative 3 for AOC 21 Capping and Future Use Restrictions
Former Frankford Arsenal Area II, Philadelphia, Pennsylvania

5-Year Reviews

Cost = $30,000
Discount rate = 7.00%

Year	Present Value
1	--
2	--
3	--
4	--
5	$21,390
6	--
7	--
8	--
9	--
10	$15,250
11	--
12	--
13	--
14	--
15	$10,873
16	--
17	--
18	--
19	--
20	$7,753
21	--
22	--
23	--
24	--
25	$5,527
26	--
27	--
28	--
29	--
30	$3,941
TOTAL =	**$64,735**

Yearly Inspections

Cost = $2,000
Discount rate = 7.00%

Year	Present Value
1	$1,869
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9	$1,088
10	$1,017
11	$950
12	$888
13	$830
14	$776
15	$725
16	$677
17	$633
18	$592
19	$553
20	$517
21	$483
22	$451
23	$422
24	$394
25	$368
26	$344
27	$322
28	$301
29	$281
30	$263
TOTAL =	**$24,818**