Picatinny Arsenal Installation Restoration Program

Picatinny Arsenal is an Official Hawk Watch Site

PICATINNY ARSENAL
FORMER SKEET RANGE (CC-057)
REMEDIAL INVESTIGATION REPORT

MAY 2012

U.S. Army Corps of Engineers
Baltimore District

FINAL

Architect Engineering Contract
Number W912DR-05-D-0026

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LIST OF ACRONYMS AND ABBREVIATIONS

amsl ..... above mean sea level
ALM..... Adult Lead Model
ADAF ..... Age-Dependent Adjustment Factors
ATSDR..... Agency for Toxic Substances Disease Registry
AE ..... Architect-Engineer
AUF..... Area Use Factor
ANL..... Argonne National Laboratory
AEDB-R ..... Army Environmental Database – Restoration Module
ARCS..... Assessment and Remediation of Contaminated Sediment
BTV..... Background Threshold Values
BRAC..... Base Realignment and Closure
bgs ..... below ground surface
BAFs ..... Bioaccumulation Factors
BCFs..... Bioconcentration Factors
CCME ..... Canadian Council of Ministers of the Environment
CSF..... Carcinogenic Slope Factors
CDI..... Chronic Daily Intake
CFR..... Code of Federal Regulations
CERCLA ..... Comprehensive Environmental Response, Compensation, and Liability Act
CSM..... Conceptual Site Model
CEQ ..... Council on Environmental Quality
COPCs..... Contaminant of Potential Concern
DSERTS/PICA . Defense Site Environmental Restoration Tracking System/Picatinny Arsenal
DOD..... Department of Defense
DA..... Dose absorbed per unit area per event
ERAGS ..... Ecological Risk Assessment Guidance for Superfund
ESLs ..... Ecological Screening Levels
ER-L..... Effects Range-Low
ER-M..... Effects Range-Medium
EDDs ..... Electronic Data Deliverables
EEQ ..... Ecological Effects Quotient
EPCs..... Exposure Point Concentrations
DO..... Dissolved Oxygen
FS ..... Feasibility Study
FFA ..... Federal Facility Agreement
HQ..... Hazard Quotient
HRS ..... Hazard Ranking Score
HEAST..... Health Effects Assessment Summary Tables
HHRA..... Human Health Risk Assessment
ICFKE ..... ICF Kaiser Engineers
IUR..... Inhalation Unit Risks
IEUBK..... Integrated Exposure Update Biokenetic
IRIS..... Integrated Risk Information System
ITRC..... Interstate Technical Regulatory Council
LUCs..... Land Use Controls
LOC..... Level of Concern
LOAEL ..... Lowest Observed Adverse Effects Level
MCL ..... Maximum Contaminant Level
MCLG ..... Maximum Contaminant Level Guide
MDCs..... Maximum Detected Concentrations
MDL ..... Method Detection Limit
µg/dL..... micrograms per deciliter
µg/L..... micrograms per liter

mg/cm^2 ..... milligrams per cubic centimeter
mg/kg ..... milligrams per kilogram
mg/L ..... milligrams per liter
MRL ..... Minimum Risk Level
MW..... Monitoring Well
NAWQC ..... National Ambient Water Quality Criteria
NEPA ..... National Environmental Policy Act
NOAA..... National Oceanic and Atmospheric Administration
NPL ..... National Priorities List
NSSF ..... National Sports Shooting Foundation
NJDEP ..... New Jersey Department of Environmental Protection
NJGWQC..... New Jersey Groundwater Quality Criteria
NJSWQC ..... New Jersey Surface Water Quality Criteria
NYSDEC..... New York State Department of Environmental Conservation
NYSDOH ..... New York State Department of Health
NOAEL..... No Observable Adverse Effects Level
NRDCSRS..... Non-Residential Direct Contact Soil Remediation Standard
ORNL ..... Oak Ridge National Laboratory
ONJSC..... Office of the New Jersey State Climatologist
ORP ..... Oxidation-Reduction Potential
PEF ..... Particulate Emission Factor
PTA ..... Picatinny Arsenal
PAH..... Polynuclear Aromatic Hydrocarbons
PQL..... Practical Quantitation Level
PEC..... Probable Effects Concentration
PEL ..... Probable Effects Level
PPRTVs ..... Provisional Peer Reviewed Toxicity Values
QC..... Quality Control
RDA ..... Recommended Daily Allowance
ROD ..... Record of Decision
RFCs..... Reference Concentrations
RFDs..... Reference Doses
RSL ..... Regional Screening Level
RI..... Remedial Investigation
RI/FS..... Remedial Investigation/Feasibility Study
RIR..... Remedial Investigation Report
RDCSRS ..... Residential Direct-Contact Soil Remediation Standard
R-SLs ..... Residential-Screening Levels
RAGS..... Risk Assessment Guidance for Superfund
SLs..... Screening Levels
SLERA ..... Screening Level Ecological Risk Assessment
SD ..... Sediment Sample
Shaw..... Shaw Environmental & Infrastructure
SARA ..... Superfund Amendments and Reauthorization Act
SS ..... Surface Sample
SW ..... Surface Water
TW-SLs..... Tapwater-Screening Levels
TAL ..... Target Analyte List
TBC..... Target Based Concentration
TEC..... Threshold Effects Concentration
TOC ..... Total Organic Carbon
TRV..... Toxicity Reference Values
USACE ..... United States Army Corps of Engineers
USEPA..... United States Environmental Protection Agency
USFWS..... United States Fish and Wildlife Service
USGS..... United States Geological Survey

UCL..... Upper Confidence Limit
VDEQ..... Virginia Department of Environmental Quality
VOC ..... Volatile Organic Compound
VRP..... Voluntary Remediation Program

EXECUTIVE SUMMARY

The United States Army Corps of Engineers (USACE) tasked Shaw Environmental & Infrastructure (Shaw) to perform a Remedial Investigation (RI) of the former Skeet Range (CC-057) located to the north of Site 180 at Picatinny Arsenal (PTA), Dover, New Jersey. The former Skeet Range is located at the southern end of PTA on the eastern side of Green Pond Brook in a swampy portion of PTA (**Figure 1-1**). The RI work order was performed under the Architect-Engineer (AE) contract number W912DR-05-D-0026, Task Order 04.

The former Skeet Range is located within Picatinny Arsenal's Phase I group of sites. The Phase I group of sites has undergone extensive investigation since 1991. Area C within the Phase I group of sites includes the land area occupied by the former Skeet Range. However, during investigations of Area C, the former Skeet Range was not specifically targeted. Refer to **Section 1.2** for a discussion of the former Skeet Range background and surrounding site investigation details.

The RI at the former Skeet Range was conducted because soil and sediment sampling from 2002 through 2010 indicated lead and polynuclear aromatic hydrocarbon (PAH) contamination in and around the former Skeet Range. The investigation focused on the nature and extent of contaminants to assess the risk for future land uses. The investigation also monitored groundwater and surface water in the area to ensure elevated concentrations of metals and/or PAHs did not leach into surrounding surface water bodies or the underlying aquifer.

Remedial Investigation Field Activities and Analytical Results Summary

Field activities performed as part of the RI at the former Skeet Range included the collection of 23 surface soil, five subsurface soil, nine sediment, six surface water, and six groundwater samples in order to better characterize impacts from the operations of the former Skeet Range. A Human Health Risk Assessment (HHRA) and Screening Level Ecological Risk Assessment (SLERA) were also conducted following collection of samples and analysis of sampling results.

Results of the soil and sediment sampling indicated concentrations of PAHs and metals in excess of levels of concern (LOCs), including arsenic and lead in surface soil, lead in subsurface soil, and antimony, arsenic, copper, lead, and zinc in sediment samples. Lead is scattered within and around the former Skeet Range in soil and sediment at concentrations exceeding LOCs with the highest concentrations located within the maximum shot fall zone. Arsenic was only detected above LOCs in one surface soil and two sediment samples and these exceedances may be related to former landfilling. Other metal exceedances in sediment were not widespread and deemed only to cause potential ecological impacts. Only minor PAH exceedances were found in one surface soil sample, two subsurface soil samples, and one sediment soil sample. These minor exceedances were attributed to the accumulation of clay targets or nearby asphalt roads. For the most part, horizontal delineation of soil and sediment has been achieved. Complete vertical delineation of some metals and PAHs in sediment has not been achieved within the maximum shot fall zone.

Results of the groundwater sampling indicated concentrations of iron and arsenic in excess of the LOCs for groundwater. Arsenic exceedances are attributed to historic landfilling operations or contamination from other sites. Iron concentrations are attributed to local geologic conditions.

Results of the surface water sampling indicated concentrations of antimony, arsenic, iron, and lead in excess of LOCs; all of which may be attributed to the operation of the former Skeet Range. Arsenic and antimony were detected above the LOC within and adjacent to the impact fan at locations proximal to sediment exceedances of these metals. Iron was detected at concentrations well above the PTA background concentration. Lead was detected above the LOC at locations proximal to soil and sediment exceedances of lead.

Remedial Investigation Risk Assessment Results Summary

Results of the HHRA indicated the risk for current worker exposure scenarios are within the acceptable risk range. However, the current hazard is above the threshold value of 1.0 for the current routine worker with the hazard driver being antimony in sediment. It is important to note that there are no current workers at the site and no future plans to develop the site. Future routine workers and

hypothetical future resident exposures scenarios exceeded the upper level of the acceptable risk range of 1.0E-04. COPCs having estimated cancer risks greater than 1.0E-6 are PAHs in surface soil and arsenic in surface water, sediment and groundwater. The future hazard levels exceeded the threshold level of 1.0 with the hazard drivers being antimony in sediment and surface water and arsenic in groundwater.

Lead model results demonstrated that lead in surface soil and sediment at the former Skeet Range exceeded, by a considerable amount, safe exposure levels. The probability that lead in surface soil would result in unacceptable future child blood lead levels was 98.9 percent, and 99.9 percent for sediment, while the probability that lead in surface soil would result in unacceptable adult worker fetal blood lead levels was up to 44 percent, and up to 99 percent for sediment. As all these probability estimates exceed the 5 percent threshold of concern, potential lead exposure at the Site is unacceptable.

Results of the SLERA indicated the food chain assessment suggests potential adverse impacts to all modeled wildlife (marsh wrens, short-tailed shrews, American woodcocks, meadow voles, raccoons, and northern bobwhites) particularly for modeled contact with the hazard driver lead in soil and sediment.

The direct contact assessment results suggest a potential reduction in wildlife food supply due to lead in surface soil; antimony, arsenic, copper, lead, and zinc in sediment; and copper, iron, and lead in surface water. Given the relatively large size of the Site (approximately 11 acres of soil and 12 acres of sediment), while some wildlife may forage in nearby areas that are not contaminated, other wildlife species, especially those with home ranges less than 11 to 12 acres, such as the marsh wren, short-tailed shrew, and meadow vole, may be adversely affected as a result of a reduced food supply. In addition, copper, iron, and lead concentrations in surface water exceeded promulgated state and/or federal water quality criteria for the protection of aquatic life.

There is a potential concern that large lead particles, or lead shot, may be present at the former Skeet Range, and therefore may be adversely impacting certain species of birds (such as the northern bobwhite quail) that intentionally ingest grit to aid their digestion.

Overall Summary and Recommendations

Since 2008, three investigations have been conducted to characterize the former Skeet Range. Numerous soil, sediment, surface water, and groundwater samples have been collected as a result of these investigations. Lead has exceeded the soil or sediment LOC in nearly half of the soil and sediment samples collected at the site. Lead has exceeded the surface water LOC in 8 of 9 samples collected at the site. No exceedances of lead have been detected in groundwater. Distribution patterns of lead suggest the primary source of lead in soil, sediment, and surface water is the former operation of the Skeet Range. However, the lack of lead exceedances in groundwater indicates that lead is not leaching into the groundwater. It should be noted that groundwater depth at the site is as shallow as 1.0 ft bgs.

Arsenic, antimony, and iron have also been detected in surface water above LOCs since 2008. These exceedances are attributed to the former operation of the Skeet Range, especially given the fact that soil and sediment exceedances of these metals were detected above LOCs proximal to these locations.

Arsenic, aluminum, iron, manganese, and vanadium have been detected above LOCs in groundwater since 2008. However, these detections are attributed to historic landfilling in the area or background geologic conditions.

Five PAHs and arsenic were detected above LOCs in soil since 2008. Six PAHs, arsenic, copper, and zinc were detected above LOCs in sediment since 2008. Arsenic was detected above the LOC in three soil/sediment samples which may be attributed to former landfilling operations in the area. Copper and zinc were only detected above the LOC in sediment samples collected in 2011. These detections show no distinct pattern but may be related to the former operations of the Skeet Range. Only minor exceedances of PAHs have been found in soil and sediment samples within and around the former Skeet Range since 2008. Vertical delineation of these impacts has shown decreasing concentrations with depth. Horizontal impacts have been delineated in most directions from the former Skeet Range. One minor exceedance in surface soil remains to the west of the impact fan which is attributed to a nearby asphalt road and telephone stockpiling in the area. While the full extent of lead impacts has not

been determined, additional delineation is not deemed necessary at this time, based on the lead model results that are well above the threshold of concern.

A Feasibility Study (FS) is recommended to evaluate remedial alternatives for the impacts found during investigations of the former Skeet Range. The FS should evaluate potential remedial alternatives to determine which option is deemed best suited for current and future uses of the site, while protective of human health and the environment. Existing institutional controls, as well as existing State regulations will preclude the installation of a potable well at the site or conversion of the marsh/wetlands into residential housing.

1.0 INTRODUCTION

The United States Army Corps of Engineers (USACE) tasked Shaw Environmental & Infrastructure (Shaw) to perform a Remedial Investigation (RI) of the former Skeet Range (CC-057) located to the north of Site 180 at Picatinny Arsenal (PTA), Dover, New Jersey. The RI work order was performed under the Architect-Engineer (AE) contract number W912DR-05-D-0026, Task Order 04.

PTA was added to the National Priorities List (NPL) in March 1990 with a Hazard Ranking Score (HRS) of 42.92. As required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and amended by the Superfund Amendments and Reauthorization Act (SARA), the U.S. Army initiated a RI. A Federal Facility Agreement (FFA) was signed between the U.S. Army and the United States Environmental Protection Agency (USEPA), which incorporated the requirements of the New Jersey Department of Environmental Protection (NJDEP). The FFA provided the terms, list of documents to be generated, and established target dates for deliverables generated as part of this process.

A list of the potentially contaminated sites at PTA was developed in a Remedial Investigation/Feasibility Study (RI/FS) Concept Plan, prepared by Argonne National Laboratory (ANL, 1991). This Concept Plan was developed based upon an evaluation of data gathered during previous investigations at PTA. The concept plan defined 16 study areas, designated Area A through Area P, each consisting of different study sites prioritized for RI/FS and/or closure activities. The study areas were placed into three groups: Phase I (Areas B through G), Phase II (Areas H through K), and Phase III (Areas L through P). These groupings of sites were designed to investigate the sites with the greatest potential for contamination first. Area A, the Burning Ground, was separated from the Phases because it was considered the highest risk. The Phase I group of sites was perceived to have the highest probability of contamination and the Phase III group the lowest. The Phase I group of sites has undergone extensive investigation since 1991. Area C within the Phase I group of sites includes the land area occupied by the former Skeet Range. However, during investigations of Area C, the former Skeet Range was not specifically targeted.

The former Skeet Range (also known as Site CC-057) overlaps Site 19 (to the north) and is located adjacent to Site 34 (to the southwest). Site 180 (also known as PICA-093 and the "Waste Burial Area near Sites 19 and 34") is located approximately 150 feet to the southeast of the former Skeet Range. Green Pond Brook is located to the west of the former Skeet Range (**Figure 1-1**). Site 19 was originally investigated in 1993 as part of the Phase I RI. Metals and polynuclear aromatic hydrocarbons (PAHs) were detected in the soil at Site 19 but were deemed related to telephone stockpiling adjacent to the site. Site 19 is currently inactive with institutional controls being implemented as the remedial alternative. Site 34 is the location of the former burning grounds and has been investigated thoroughly due to the long-term open burning of waste. Open burning operations at Site 34 ceased on June 1, 2011. A Remedial Action for Site 34 has been established and a remedial design is currently being developed.

Large portions of the southern end of PTA (Areas B and C) were subject to landfilling to increase the amount of usable land primarily to convert the original swampy land for more useful purposes. A review of aerial photography confirmed that extensive landfilling activities occurred in this area including Site 180 and the former Skeet Range. Historic landfilling activities at Site 180 included stockpiling of various debris, mainly attributed to the dumping of unburned waste from Site 34. This area was extensively investigated from 1991 to 2007. Site 180's boundaries eventually extended into the former Skeet Range boundaries at which point a separate investigation was undertaken. Site 180 is currently under a Record Of Decision (ROD) with land use controls (LUCs). For a more detailed discussion of the former Skeet Range background and the aforementioned surrounding sties, please refer to **Section 1.2**.

This RI Report (RIR) was prepared to characterize the extent and magnitude of possible environmental contamination at the former Skeet Range at PTA. This project conforms to all relevant USEPA and NJDEP guidance and criteria. This project also conforms to the rules and guidance specific to projects performed under CERCLA.

The operations of the Picatinny Arsenal former Skeet Range are far from atypical. There are approximately 9,000 trap and skeet ranges in the United States which have operated for many years, some of which have known impacts from metals and PAHs. While numerous active and former ranges

have been investigated, not all ranges need to be investigated for the potential health effects they may pose to wildlife receptors. For example, recent studies have shown that potential bird ingestion of lead shot is less of a concern than previously thought (Kerr et al., 2010, 2011). The RI at the Picatinny Arsenal former Skeet Range was conducted because soil and sediment sampling from 2002 through 2010 indicated lead and PAH contamination in and around the former Skeet Range. The investigation focused on the nature and extent of contaminants to assess the risk for future land uses. The investigation also monitored groundwater and surface water in the area to ensure elevated concentrations of metals and/or PAHs did not leach into surrounding surface water bodies or the underlying aquifer. This RIR provides a summary of the site description, site history/background, previous sampling results, RI sampling methods and procedures, RI sampling results, analysis of RI sampling results, risk assessment results, and summary and conclusions. Refer to **Figure 1-2** for the sampling locations discussed within this RIR.

1.1 PURPOSE OF REPORT

The purpose of this report is to document the technical approach for field sampling activities, present the results of the field investigation, perform a contamination assessment for the site, and provide recommendations for the site. In addition, quantitative results of a human health risk assessment (HHRA) are presented for the site. Ecological risk assessment results are also incorporated into the report. The data generated as part of this RI will be used to identify and quantify sources of contamination at the site, determine the nature and extent of contamination at the site, perform a complete risk assessment, and, if necessary, support the selection of future remedial alternatives in order to mitigate risks in accordance with the requirements of CERCLA.

All RI-related activities were performed in accordance with the USEPA guidance documents developed for activities performed under CERCLA, SARA, the National Environmental Policy Act of 1969 (NEPA), the President's Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations [CFR] 1500-1508), and NJDEP guidance documents (2005a, 2005b). The documents included *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988). In addition, the procedures used in this RI are consistent with the U.S. Army policy toward integrating the NEPA and CERCLA/SARA processes. The field investigation portion of this RI was performed under the purview of the U.S. Army, USEPA Region 2, and the NJDEP from March 2011 to April 2011.

1.2 PICATINNY ARSENAL/FORMER SKEET RANGE BACKGROUND

PTA, located in Morris County, New Jersey, near the City of Dover, is listed on USEPA's Superfund NPL. The CERCLIS identification number is NJ3210020704. The Army is the lead agency for the remedial actions at the former Skeet Range at PTA, and USEPA Region 2 is the support agency with oversight responsibilities. Plans and activities are also coordinated with the appropriate New Jersey State agencies, including the NJDEP.

PTA is located approximately four miles north of the City of Dover in Morris County, New Jersey. Some of the nearby populous areas are Morristown, Morris Plains, Parsippany, Troy Hills, Randolph Township, and Sparta Township. The PTA land area consists of 6,491 acres of improved and unimproved land. PTA is situated in an elongated classic U-shaped glacial valley, trending northeast-southwest between Green Pond Mountain and Copperas Mountain on the northwest and an unnamed hill on the southeast. Most of the buildings and other facilities at PTA are located on the narrow valley floor or on the slopes along the southeast side.

PTA is owned and operated by the U.S. Army. The facility was a major source of munitions for World War I, the Korean War, and the Vietnam Conflict. During those periods, PTA was involved in the production of explosives, rocket and munition propellants, pyrotechnic signals and flares, fuses, and metal components. Currently, the primary mission of PTA is research, development, and engineering of munitions and weapons.

1.2.1 Former Skeet Range Description/Location

The former Skeet Range (also known as Site CC-057) overlaps Site 19 (to the north) and is located adjacent to Site 34 (to the southwest). Site 180 (also known as PICA-093 and the "Waste Burial Area near Sites 19 and 34") is located approximately 150 feet to the southeast of the former Skeet Range. Green Pond Brook is located to the west of the former Skeet Range (**Figure 1-1**). Site 19 was originally investigated in 1993 as part of the Phase I RI. Metals and polynuclear aromatic hydrocarbons (PAHs) were detected in the soil at Site 19 but were deemed related to telephone stockpiling adjacent to the site. Site 19 is currently inactive with institutional controls being implemented as the remedial alternative. Site 34 is the location of the former burning grounds and has been investigated thoroughly due to the long-term open burning of waste. Operations at Site 34 ceased on June 1, 2011. A Remedial Action for Site 34 has been established in the form of an impervious cover, groundwater monitoring, and LUCs. This is slated to go in effect on October 1, 2012.

Large portions of the southern end of PTA (Areas B and C) were subject to landfilling to increase the amount of usable land primarily to convert the original swampy land for more useful purposes. A review of aerial photography confirmed that extensive landfilling activities occurred in this area including Site 180 and the former Skeet Range. Historic landfilling activities at Site 180 included stockpiling of various debris, mainly attributed to the dumping of unburned waste from Site 34. This area was extensively investigated from 1991 to 2007. Site 180's boundaries eventually extended into the former Skeet Range boundaries at which point a separate investigation was undertaken. Site 180 is currently under a ROD with LUCs.

Portions of PTA's land have been classified as wetlands. This includes portions of the former Skeet Range. Wetlands encompass approximately 1,250 acres of the 5,853 acres at PTA. Wetlands at PTA include forested wetlands and shrub lands. Approximately 92% of the wetlands are maple swamp forest, lakes and ponds, and their associated woody scrub-shrub wetlands. The largest portion of wetlands is located within the southern portion of PTA, which includes the former Skeet Range. This is an area laced with drainage ditches.

Hydric soils are defined as soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper portion of the soil horizon and support the growth and regeneration of hydrophytic vegetation. These soils generally are poorly drained, have a water table less than or equal to 1.0 feet bgs, and are frequently flooded or ponded during the growing season. Hydric soils comprise 26% of PTA's land. Approximately 50% of the former Skeet Range consists of hydric soils. The entire former Skeet Range has been mapped as NJDEP wetlands (USAEC, 2001).

1.2.2 Former Skeet Range History

The range was constructed in the 1950s and was used for recreational trap and skeet shooting into the 1990s. The range consists of several asphalt walkways through an open grassy area where the shooting occurred. As part of the Phase I RI, a detailed site inspection was conducted of the range (Dames and Moore, 1995). At the time, Buildings 1181 and 1182 were used to launch the traps and to store cases of targets. Building 1181A contained several barbeque grills and site maintenance equipment such as a wheelbarrow, rakes, and plywood. The shooters faced north and shot towards a heavily wooded area. Dames and Moore noted that the range contained accumulated bulk lead shot and clay fragments from the historical use of the range. There was concern that the accumulated lead shot may represent an ecological concern. However, no further investigation was recommended due to the ongoing activities at the range.

From 1991 to 2007, Site 180 was investigated which included the northeastern push-out boundary toward the area of the former Skeet Range. Buried debris was found along this push-out boundary in 2005 and subsequently additional environmental sampling and debris removal were performed. After sampling from 2005 to 2007, ARCADIS issued a letter to the Army suggesting that the lead identified in Sample 180SS-15 is outside the boundary of Site 180, is related to the historical use of the former Skeet Range, and therefore should be addressed as a separate site. Thus, the Army agreed to further investigate the lead contamination to identify the potential source of the elevated lead levels.

In June 2008, Shaw performed an investigation of the area to characterize potential impacts from the former Skeet Range. Analytical results from soil, sediment, and surface water sampling indicated several surface soil samples exceeded the soil level of concern (LOC) for lead (Shaw, 2008). A subsurface soil sample collected in the area also contained a lead concentration above the soil LOC. Furthermore, sediment and surface water samples collected from a drainage ditch in the area revealed concentrations of lead above the sediment and surface water LOCs. Previous surface soil sampling in the area performed by IT Corporation in October 2002 also found elevated concentrations of PAHs above applicable LOCs in the area of the former Skeet Range (Shaw, 2004).

As a result of the 2008 investigation findings and in response to regulatory comments regarding findings during previous investigations in the area, Shaw performed additional investigation within and around the former Skeet Range impact fan to further characterize impacts from lead concentrations in soil and sediment, to evaluate levels of PAHs in the soil and sediment, and evaluate metals and PAH concentrations in shallow groundwater (Shaw, 2010a).

Based on the results of the 2010 investigation of the former Skeet Range, Shaw developed a RI Work Plan to delineate the extent of contamination and characterize the risks posed by the contamination (Shaw, 2011). The RI activities performed at the site are summarized within the body of this report. The following sections provide greater detail of the historical site data prior to RI activities.

1.2.3 Previous Investigations

Several investigations were performed within and around the former Skeet Range prior to the RI activities. These included investigations of Site 180, Site 19, Green Pond Brook, and the former Skeet Range. The following sections present an overview of the findings of these investigations.

1.2.4 Historical Site 180 Investigation Results

According to the Army Environmental Database-Restoration Module (AEDB-R) database, Site 180 (PICA-093) is described as follows: "The waste burial area situated in a low marshy area formerly containing several debris piles of drums, concrete rubble, scrap, metal, lumber, railroad ties, and trees. Extensive landfilling operations have taken place in this portion of Area C over the years. Materials were disposed of in large burial pits and in surface piles. The proximity of Site 180 to the burning grounds made it a convenient location to dispose of and store items that could not be burned or did not require burning." More detailed information about Site 180 and associated investigations can be found in the following paragraphs.

In 1991, the Site 180 boundaries were defined by ANL as a 300 foot by 300 foot area (ANL, 1991); however, these boundaries did not correlate with any physical or natural features. The original Site 180 included several piles of debris containing railroad ties, concrete rubble, scrap metal and tires (Dames and Moore, 1998). The lateral extent of Site 180 has been increased since the completion of the Phase I RI Report to include additional piles of debris and waste material in the vicinity of the original site. During an investigation of Site 180 in October 2002, two surface soil samples were collected within the former Skeet Range (Shaw, 2004). Refer to **Section 1.2.6.1** below for additional discussion of this investigation. On November 1, 2005 during an Army tour of the site with the regulators, NJDEP, USEPA and United States Fish and Wildlife Service (USFWS) representatives expressed concern over the potential contamination and risk associated with buried debris identified along the boundary of Site 180. In November 2005, 12 surface soil samples were collected along the push-out boundary between Site 180 and the marsh. All samples were located near partially buried debris including some drums. The drums were in poor condition and decomposed by rust. Sample 180SS-15A located at the northeastern end of Site 180 exceeded the sediment LOCs for cadmium, copper, lead, mercury, nickel, zinc and several PAHs. Subsequent to the sampling event, all of the drum remnants and other surface debris were removed and disposed by Shaw in 2006. Additional delineation sampling was conducted around (Samples 180SS-15N, S, E, W) and beneath (Sample 180SS-15B) Sample 180SS-15A in March 2006. Lead levels exceeded the sediment LOC of 38.8 milligrams per kilogram (mg/kg) in all five samples with concentrations ranging from 293 mg/kg to 2,830 mg/kg.

In February 2007, ARCADIS issued a letter to the Army suggesting that the lead identified in Sample 180SS-15 is outside the boundary of Site 180, is related to the historical use of the adjacent former Skeet Range, and therefore should be addressed as a separate site. The 180SS-15 soil samples

were collected approximately 400 feet from the shooting pad of the former Skeet Range and within the maximum shot fall zone for trap and skeet ranges of 375 feet to 600 feet from the firing line (ITRC, 2005; NSSF, 1997). Thus, the Army agreed to further investigate the lead contamination to identify the potential source of the elevated lead levels. Based on the ROD issued for Site 180 in 2007, site access control measures include a fence surrounding the entire base and 24-hour police patrol to prevent trespassing.

1.2.5 Historical Site 19 and Green Pond Brook Investigation Results

In order to assess the lead contamination identified during the Site 180 investigation, data from other sites in proximity to Site 180 and the former Skeet Range were reviewed. The two sites that were evaluated are Site 19 and Green Pond Brook (**Figure 1-1**).

In 1993 as part of the Phase I RI at Site 19, five surface soil, five subsurface soil, one surface water, one sediment, and 11 groundwater samples from four monitoring wells were collected. PAHs and metals were detected in the soil samples. The PAH concentrations did not exceed the comparison criteria and are believed to be related to the telephone poles stockpiled in the area or open burning activities at Site 34. The PAHs were deemed unlikely to be associated with the skeet targets due to the distance from the range and the trap house. Metals exceedances were reported for arsenic and beryllium. The maximum lead concentration in the 10 samples was 43.2 mg/kg (Dames and Moore, 1998).

The surface water and sediment samples were collected from an area of intermittent ponded water at the center of the site and not one of the drainage channels that traverse the area. PAHs and lead were detected in the surface water sample. The PAH and lead concentrations identified in the sediment sample were below the appropriate comparison criteria used at that time, the Effects Range-Low (ER-L) and Effects Range-Medium (ER-M) sediment concentrations as outlined in a National Oceanic and Atmospheric Administration (NOAA) technical memorandum dated August 1991 (NOAA, 1991).

Arsenic and lead were detected above the comparison criteria in the unfiltered groundwater samples collected from the site wells and one upgradient well (C-1B). Arsenic concentrations ranged up to 13.8 micrograms per liter [(µg/l); LOC = 3 µg/L] and lead concentrations ranged up to 32.9 µg/l (LOC = 5 µg/l). Arsenic concentrations in filtered groundwater samples also exceeded the LOC; however, lead was not detected in the filtered samples at a detection limit of 5 µg/l.

One surface water sample and one sediment sample were collected from Green Pond Brook upgradient of the former Skeet Range and the associated impact fan. Sample SW/SDGP-16 was collected at the intersection of South Brook Road and Shinkle Road. The surface water sample did not contain detectable levels of PAHs or lead. The sediment sample contained elevated levels of several PAHs and a lead concentration of 1,250 mg/kg. Several surface water and sediment samples have been collected from Green Pond Brook downgradient of the former Skeet Range adjacent to Site 34. Similar concentrations of lead and PAHs were detected in the downgradient sediment samples. It is unclear whether the elevated PAHs and lead concentrations in the sediment are related to open burning activities at Site 34, fill used in this marshy portion of the base, activities at the former Skeet Range, or base operations upgradient of this area.

1.2.6 Historical Skeet Range Investigation Results

1.2.6.1 October 2002 Investigation

In October 2002, IT Corporation collected seven surface soil samples (34SS-24 through 34SS-30) as part of an investigation of Sites 34 and 180 (Shaw, 2004). Samples 34SS-29 and 34SS-30, collected at the former Skeet Range, were the only samples collected at the range prior to Shaw's investigations. The samples were analyzed for PAHs and Target Analyte List (TAL) Metals. Lead concentrations in the two samples were well below the LOC of 600 mg/kg (the LOC at the time of this 2002 investigation) with concentrations of 13.1 mg/kg and 76.7 mg/kg. The only LOC exceedances reported in the two samples were arsenic and PAHs. Sample 34SS-29, located upgradient of the actual range had an arsenic concentration of 38.8 mg/kg (LOC = 20 mg/kg). Sample 34SS-30, located within the firing zone of the Skeet Range, had an arsenic concentration of 25.6 mg/kg. The arsenic contamination may be related to runoff from Site 34, Site 180, or the former Skeet Range. Seven PAHs

were detected in excess of their respective LOCs in Sample 34SS-30. The LOC exceedances ranged from 17 mg/kg for dibenz(a,h)anthracene (LOC = 0.66 mg/kg) to 94 mg/kg for chrysene (LOC = 40 mg/kg). The benzo(a)pyrene concentration of 90 mg/kg exceeded the LOC of 0.66 mg/kg by more than two orders of magnitude. The elevated PAH levels are most likely the result of the clay targets used at the former Skeet Range (Shaw, 2004).

1.2.6.2 2007 and 2008 Investigation

In July 2007, Shaw personnel performed a site walk-over in preparation of future investigations and observed similar findings to Dames and Moore's site inspection in 1994. Most of the surface debris was clay fragments and spent shells.

In order to determine the source and extent of the lead contamination, a sampling approach was developed based on guidance documents from the NJDEP (NJDEP, 2005a,b), the Interstate Technical Regulatory Council (ITRC, 2003; ITRC, 2005); and the National Sports Shooting Foundation (NSSF, 1997). Guidance was also provided by the U.S. Army Environmental Center. As part of the "Lead Investigation Report" by Shaw in 2008, a total of 14 surface soil samples were collected every 50 feet from previous sample locations 180SS-15N,S,E,W up to 200 feet from the original sample. A subsurface soil sample (180SS-E/C) was collected from 2.0 to 2.5 feet below ground surface (bgs) at former sample location 180SS-15E, which had the highest lead concentration (2,830 mg/kg) for vertical delineation. Sample analyses were limited to lead.

Additionally, Shaw personnel collected samples within the boundaries of the former Skeet Range. At shotgun ranges such as trap and skeet, shot is widely distributed. When a shotgun target is hit by a well-centered shot, only a relatively few of the several hundred pellets in the shot string actually strike the target. These may be deformed or deflected and fall to the ground nearby. Most of the pellets in the load continue beyond where the target was hit. According to guidance developed for small arms ranges, the positions of the shooters and the angles at which trap and skeet targets are thrown result in a fan-shaped shot fall zone. Depending on the load, the angle at which the shot was fired, and wind direction, typical lead skeet loads can reach about 680 feet from the shooter (NSSF, 1997). However, most skeet shot typically tends to fall roughly 375 to 600 feet from the shooter (NSSF, 1997). At the PTA former Skeet Range, this shot fall zone is heavily vegetated with wetland and upland woody species. The shot fall zone is also very wet and marshy.

Fourteen surface soil samples (B1181SS-1 to B1181SS-14) were collected along transect lines through the shooting fan including the center line of the fan (**see Figure 3 in Appendix F**). Since this investigation was not intended to be a characterization of the former range, only a portion of the shot fall zone was sampled. An additional seven surface soil samples (B1181SS-15 to B1181SS-21) were collected along two transects from the range located outside the shooting fan. Samples were spaced approximately 150 to 100 feet apart along the transects depending on the proximity of other samples and any physical obstructions. Sample analyses were limited to lead.

Lead was detected in the 36 surface soil (SS) samples and the one subsurface soil sample. The lead concentrations ranged from 82.4 mg/kg to 209,000 mg/kg. The LOC for lead in soil at the time of this investigation was 800 mg/kg. Twenty-five of the 37 samples exceeded the soil LOC.

The subsurface soil sample 180SS-15E/C, collected from 2.0 to 2.5 feet bgs, had a lead concentration of 6,930 mg/kg. The lead concentration exceeds the lead concentration detected in the surface soil sample (180SS-15E) collected at this location in 2006. The increased lead concentration in the subsurface soil sample may be the result of the fill used in the area or the leaching of the lead from the surface soil.

Twenty-one (21) of the 37 soil samples had percent solids levels below 50%. Many of these samples could be considered sediment samples based on the percent solids levels and their location within a wetland. Solid samples with greater than 50% solids are generally deemed soil samples, while samples below 50% are deemed sediment samples. However, other factors should be considered in the designation such as the type of vegetation, the height of the water table, and whether the soils are considered hydric. The underlying significance for this distinction is the associated LOC. Due to the magnitude of the lead concentrations detected in the samples, most samples exceed both the sediment LOC of 38.8 mg/kg and the soil LOC. Lead concentrations in the previous samples collected in 2005 and

2006 have been compared to the sediment LOC despite most samples exceeding 50% solids, because they are located within the wetlands portion of the sampled area. Sample 1181SS-1 with a percent solids content of 37 was not deemed a sediment sample because it is located on a maintained grass cover at the front of the former Skeet Range.

Three surface water and sediment samples (Samples 1181SW/SD-1 to 1181SW/SD-3) were collected from the drainage ditch located to the north of the range within the shot fall zone. These samples were also analyzed for lead.

The sediment concentrations ranged from 104 mg/kg to 21,500 mg/kg. All three concentrations exceed the sediment LOC of 38.8 mg/kg. Lead concentrations in the surface water samples ranged from 35.8 µg/L to 354 µg/l. All these concentrations exceed the surface water LOC of 3.2 µg/l. The highest surface water and sediment concentrations were located in the area of the highest soil concentrations. The surface water concentrations decreased downstream toward the confluence of the drainage ditch with Green Pond Brook (Shaw, 2008).

1.2.6.3 June 2010 Investigation

Shaw performed an additional investigation at the former Skeet Range in June 2010, which consisted of the installation of two monitoring wells (B1181MW-1 and B1181MW-2), sampling the newly installed wells and three existing monitoring wells (C-1A, C-1B, and DM19-3), soil sampling, and sediment sampling. The new monitoring wells were installed to determine the groundwater flow direction and to assess potential impacts to shallow groundwater proximal to and within the former Skeet Range. Evaluation of the groundwater elevations measured in the monitoring wells indicated the general groundwater flow direction is northwest toward Green Pond Brook.

A total of six groundwater samples were collected from the three existing monitoring wells and the two new wells. A duplicate groundwater sample was collected from monitoring well B1181MW-2. Arsenic was detected in two of the six groundwater samples at concentrations of 7.55 µg/l (C-1B) and 13.2 µg/l (DM19-3), both of which exceeded the arsenic LOC of 3.0 µg/l. Aluminum was detected in all six groundwater samples at concentrations ranging from 298 µg/l to 1,110 µg/l all of which exceeded the aluminum LOC of 200 µg/l. Iron was detected in all six groundwater samples at concentrations ranging from 1,380 µg/l to 18,300 µg/l, all of which exceeded the iron LOC of 300 µg/l. Manganese was detected in all six groundwater samples at concentrations ranging from 1,400 µg/l to 3,350 µg/l, all of which exceeded the manganese LOC of 50 µg/l. Vanadium was detected in four of the six groundwater samples at concentrations ranging from 6.93 µg/l to 18.2 µg/l, all of which exceeded the vanadium LOC of 2.0 µg/l.

Arsenic is a known groundwater contaminant in the area and is likely from historic landfilling operations or contamination from other sites. Vanadium may also be related to historic landfilling operations in the area. While it is possible that the arsenic detections in groundwater could be related to former Skeet Range ammunition, it is unlikely the arsenic and vanadium detections in groundwater are related to the historic operation of the former Skeet Range (Shaw, 2005; Shaw, 2009; Shaw, 2010c; Shaw, 2010d). Aluminum, iron, and manganese concentrations in groundwater are consistent with concentrations detected in wells throughout the base and are due to local geologic conditions. Despite the high concentrations of lead in the soil and given the shallow groundwater level, lead was not detected above the LOC in the groundwater, suggesting that the lead is absorbed to the soil and organic carbon, and it is not leaching into the groundwater or moving in solution. PAHs were not detected in the groundwater samples collected.

A total of 16 surface soil/sediment samples were collected within the boundaries of the former Skeet Range and the associated impact fan in June 2010. Twelve of these samples (B1181SS-22 through B1181SS-33) were collected along the central and western transect lines within the boundaries of the shooting range fan. Sample B1181SS-35 was collected near the trap house where remnants of clay targets have accumulated. Samples B1181SS-36 and B1181SS-37 and sample B1181SS-38 were collected in the central and eastern portion of the shooting fan within the maximum shot fall zone to delineate the downgradient extent of the lead contamination. It should be noted that these “soil/sediment” samples were analyzed for percent solids in order to evaluate the samples as a soil or sediment when comparing to applicable LOCs. A discussion of these results is found below. Refer to the “*Picatinny*

Arsenal Former Skeet Range Investigation Data Report" from 2010 for additional clarification as to what samples were considered sediment and what samples were considered soil (Shaw, 2010b).

Five PAHs were detected in one or more surface soil/sediment samples at concentrations greater than their respective LOCs. Benzo(a)anthracene (LOC = 2.0 mg/kg) was detected above the LOC in three samples at concentrations ranging from 3.61 mg/kg to 27.6 mg/kg. Benzo(a)pyrene (LOC = 0.2 mg/kg) was detected in 13 of 14 samples above the LOC at concentrations ranging from 0.301 mg/kg to 21.6 mg/kg. Benzo(b)fluoranthene (LOC = 2.0 mg/kg) was detected above the LOC in four samples at concentrations ranging from 3.79 mg/kg to 27.1 mg/kg. Dibenz(a,h)anthracene (LOC = 0.2 mg/kg) was detected in eight of 14 samples above the LOC at concentrations ranging from 0.289 mg/kg to 4.88 mg/kg. Indeno(1,2,3-cd)pyrene (LOC = 2.0 mg/kg) was detected above the LOC in three samples at concentrations ranging from 2.66 mg/kg to 16.5 mg/kg.

Lead was detected in six surface soil samples at concentrations exceeding the lead soil LOC of 800 mg/kg. Lead concentrations exceeding the LOC ranged from 923 mg/kg to 84,700 mg/kg.

In addition to the surface soil/sediment samples, two sediment samples were also collected during this investigation from drainage channels within and adjacent to the northeastern Skeet Range impact fan. Five PAHs, benzo(b)fluoroanthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, fluoroanthene, and pyrene, were found at concentrations exceeding their respective sediment LOCs. Benzo(b)fluoroanthene (LOC = 0.0272 mg/kg) was detected above the LOC in sample B1181SD-4 DUP at a concentration of 0.227 mg/kg. Benzo(g,h,i)perylene (LOC = 0.17 mg/kg) was detected above the LOC in sample B1181SD-5 at a concentration of 1.69 mg/kg. Benzo(k)fluoroanthene (LOC = 0.0272 mg/kg) was detected above the LOC in sample B1181SD-4 DUP at a concentration of 0.287 mg/kg. Fluoranthene (LOC = 0.06423 mg/kg) was detected above the LOC in sample B1181SD-4 DUP at a concentration of 0.113 mg/kg. Pyrene (LOC = 0.053 mg/kg) was detected above the LOC in two samples at concentrations of 0.155 mg/kg and 0.467 mg/kg. Lead was also detected above the LOC (38.8 mg/kg) in sediment sample B1181SD-5 at a concentration of 387 mg/kg.

The highest lead concentrations in the soil/sediment samples collected during the 2010 investigation were primarily found within the maximum shot fall zone. However, concentrations of lead above the LOC were still detected in soil samples outside of the maximum shot fall zone and in sediment samples collected near the maximum extent of the northeastern shot fall zone. Refer to **Figure 1-3** for the pattern/distribution of elevated lead concentrations in the area of the former Skeet Range. Refer to **Appendix F** for historical site figures from previous Skeet Range submittals.

Based on the results of the 2010 investigation, a RI was recommended to further delineate lead concentrations in the soil and sediment both horizontally and vertically, including outside the shot fall zone. The RI was proposed to also delineate the extent of PAH contamination in the soil and sediment. In addition, the RI was proposed to include a risk assessment to quantify risks associated with the contamination identified at the site and to determine whether remedial action will be needed due to historic operations of the former Skeet Range.

1.3 REPORT ORGANIZATION

The former Skeet Range RIR is organized as follows:

Executive Summary: A summary of the site background, important details, and findings are presented.

Section 1.0 – Introduction: The purpose and organization of the report are presented, as well as an installation description and history (including a summary of previous investigations).

Section 2.0 – Physical Characteristics of the Installation: Climatology and physical setting, including regional topography, physiography, land use, geology, and hydrogeology are discussed.

Section 3.0 – Nature and Extent of Contamination: This section summarizes the field investigation activities and chemical results.

Section 4.0 – Contaminant Fate and Transport: This section describes contaminant sources, physical and chemical properties of contaminants, potential routes of migrations, and contaminant persistence.

Section 5.0 – Human Health Risk Assessment: This section summarizes the human health risk assessment results based on chemical results from field activities.

Section 6.0 – Screening Level Ecological Risk Assessment: This section summarizes the ecological risk assessment results based on chemical results from field activities.

Section 7.0 – Summary and Conclusions: This section summarizes all the information gathered during this assessment and makes recommendations based on field results and interpretations.

Section 8.0 – References

In addition, appendices are provided at the end of the report, which include HHRA data summary tables, ecological risk assessment data summary tables, and site photographs.

2.0 PHYSICAL CHARACTERISTICS OF THE INSTALLATION AND THE FORMER SKEET RANGE

2.1 PHYSIOGRAPHY AND TOPOGRAPHY

PTA is located in the New Jersey Highlands physiographic province, which ranges from 12 to 18 miles wide and is located between the Appalachian Piedmont physiographic province to the southeast and the Valley and Ridge province to the northwest. The New Jersey Highlands is the southernmost extension of the New England sub-province (Reading Prong) of the Appalachian Highland physiographic province (Gill and Vecchioli, 1965). The area is characterized by broad, rounded, or flat-topped northeast-southwest trending ridges, and deep and generally narrow valleys that are controlled by the northeast-trending folds and faults of the underlying bedrock.

The valley in which PTA resides has a broad and relatively flat floor, which slopes gently to the southwest. Elevations within the valley floor range from approximately 800 feet above mean sea level (amsl) at the northeastern boundary to approximately 700 feet amsl at the southwestern boundary. The valley varies from 1,000 to 4,000 feet in width. The main valley of PTA is bounded to the northwest by Green Pond and Copperas Mountains and to the southeast by an unnamed ridge. Green Pond and Copperas Mountains are rugged and steeply sloped with a maximum elevation of about 1,250 feet amsl. The southeastern ridge is less steep with a maximum elevation of about 1,150 feet amsl and contains small elevated plateaus. Marshy areas at the southern end of PTA and north of Lake Denmark are very flat with minor relief. The former Skeet Range is located within the southern end of PTA and is notably flat with minor relief. Marshy areas cover the majority of the former Skeet Range.

2.2 CLIMATOLOGY AND METEOROLOGY

PTA is located within the northwestern section of New Jersey. Northwestern New Jersey has a humid continental climate, which consists of noted seasonal changes and seasonal fluctuations in temperatures and precipitation. PTA is also located within the New Jersey Northern Climate Zone. This climate zone consists mainly of elevated highlands and valleys which are part of the Appalachian Uplands. The highlands and mountains in this climate zone increase precipitation chances due to orographic lifting and subsidence [Office of the New Jersey State Climatologist (ONJSC), 2010].

Based on data obtained from the ONJSC at Rutgers University, the closest weather station reporting substantial climatic data is the Boonton weather station. For the period from 1971 through 2000, average monthly temperatures ranged from 27.4 degrees Fahrenheit in January to 73.6 degrees Fahrenheit in July. Average maximum temperatures (1971-2000) range from 36.1 degrees Fahrenheit in January to 84.5 degrees Fahrenheit in July. Average minimum temperatures for the same time period range from 18.7 degrees Fahrenheit in January to 62.7 degrees Fahrenheit in July. For the time period 1971 through 2000, the mean annual total precipitation was 50.94 inches, with the driest average month being February (3.05 inches) and the wettest average month being September (5.08 inches; ONJSC, 2010).

2.3 SURFACE WATER HYDROLOGY

PTA is located in the upper part of the Passaic River drainage basin. Green Pond Brook, which is the primary drainage feature of PTA, joins the Rockaway River approximately one mile south of PTA. From this confluence, the Rockaway River flows east through the Boonton Reservoir, an 8.5-billion gallon water source for Jersey City. The Rockaway River then flows southeast, merging with the Passaic River, which discharges into Newark Bay at Elizabeth, New Jersey.

At PTA, surface water generally flows down to the valley axis via a number of small, unnamed streams and ditches, and then to the southwest via Burnt Meadow Brook and Green Pond Brook. The northeast portion of PTA is drained by Burnt Meadow Brook, which has an average width of three to four feet and a maximum depth of one foot. Burnt Meadow Brook discharges into Lake Denmark in the northeastern portion of the installation (USATHAMA, 1976). Lake Denmark discharges by a continuation of Burnt Meadow Brook into Green Pond Brook, the principal drainage feature for PTA. Green Pond Brook then flows southwestward into Picatinny Lake. Located in the geographic center of PTA, Picatinny Lake is approximately 5,300 feet long, an average of 1,000 feet wide (108 acres), with a maximum depth

of 20 feet (165 million gallons) (USATHAMA, 1976). Green Pond Brook, with a width of 10 to 30 feet and a maximum depth of five feet, continues southwestward from Picatinny Lake through the center of the valley, and discharges into the Rockaway River about one mile southeast of PTA.

Three gauging stations are located on Green Pond Brook: just north of Picatinny Lake, at the Picatinny Lake outfall, and approximately 100 feet upstream of the southwestern border of PTA. Base flow discharge data indicate that Green Pond Brook is a gaining stream (Vowinkel et al., 1985).

Bear Swamp Brook, with a width of three to seven feet and a maximum depth of two feet, is a tributary to Green Pond Brook. Bear Swamp Brook starts as a spring on Green Pond Mountain on the western side of PTA. This brook drains the area southwest of Picatinny Lake and south of Green Pond Mountain before entering Green Pond Brook approximately one mile south of Picatinny Lake. The flat valley bottom near the southern portion of PTA is drained by a network of engineered drainage ditches that discharge into Green Pond Brook.

Green Pond Brook flows along the western periphery of the former Skeet Range site. It should be noted that miles of Green Pond Brook traverse PTA land at locations upgradient of the former Skeet Range. Green Pond Brook drains several small streams and man-made reservoirs which are located within the former Skeet Range and adjacent areas. Numerous other small ponds and reservoirs which serve as collection basins also influence local drainage patterns at PTA.

2.4 GEOLOGY

A majority of the environmental investigations at PTA to date have focused on hydrogeologic studies of the stratified drift (unconsolidated overburden). The U.S. Geological Survey (USGS) conducted most of the work that has been done to characterize the bedrock formations and their weathered zones. Many of the geologic descriptions contained herein are based on previous work conducted by Richard A. Volkert of the USGS including a geologic mapping project conducted at PTA in 2002.

Because boulder beds have been encountered in the lower portions of the drift, bedrock elevations and overburden thicknesses determined by drilling refusal may be locally uncertain (Vowinkel et al., 1985). Finally, the thickness of the bedrock formations is both erosionally and fault controlled, and varies widely both at PTA and regionally.

2.4.1 Bedrock

2.4.1.1 Lithologic Characteristics

Four bedrock formations underlie PTA: Precambrian Basement and three lower Paleozoic sedimentary formations – the Hardyston Quartzite, the Leithsville Formation, and the Green Pond Conglomerate. The overlying valley fill is composed of Pleistocene glacial deposits and minor amounts of recent alluvium.

The Precambrian section is composed of rocks of Middle Proterozoic age that are highly metamorphosed meta-sedimentary and intrusive igneous rocks that are categorized as the Byram intrusive suite (Drake, 1984), Losee metamorphic suite (Drake, 1984; Volkert and Drake, 1999), Lake Hopatcong Intrusive suite (Drake and Volkert, 1991) and a suite of unnamed metasedimentary rocks. The oldest basement unit is a meta-sedimentary sequence of biotite-quartz-plagioclase gneiss and amphibolite, which crops out in a band extending northeast from Lake Denmark (Sims, 1958). This unit is also found throughout the ridge that runs along the southeastern side of the installation. The majority (~75%) of the basement complex consists of gneissic pyroxene/hornblende granite and alaskite that are primarily composed of microperthite, quartz, hornblende or pyroxene, and plagioclase and contain abundant xenoliths and pegmatites. The alaskite facies (granite lacking mafic minerals) is closely associated with large magnetite ore deposits (Sims, 1958). These metamorphosed intrusive rocks show a strong gneissic structure and have been mapped in the past as gneiss (Sims, 1958).

The Early Cambrian age Hardyston Quartzite unconformably overlies the Precambrian basement bedrock. It is composed of well-cemented thin- to medium-bedded feldspathic quartzite with interbeds of arkose, quartz-pebble conglomerate, and silty shale, becoming more calcareous in the upward direction. The Hardyston Formation has a maximum thickness of 30 feet and underlies a narrow ridge on the

eastern flank of the valley, southwest of Picatinny Lake without outcropping on the Arsenal (Lytle and Epstein, 1987).

The Leithsville Formation is an Early to Middle Cambrian age dolomite that underlies the western part of Picatinny Lake and much of the valley fill sediments to the southwest. It gradationally overlies the Hardyston Quartzite (Harte, 1986). The Leithsville Formation has also been referred to as the Kittatinny Dolomite (Barnett, 1976). The Leithsville Formation has three members: the (basal) Califon member, which consists of about 100 feet of dolomite; the Hamburg member, which consists of 35 to 100 feet of interbedded sandstone, siltstone, shale, and dolomite; and the (upper) Wallkill member, which consists of 350 to 500 ft of dark gray, patchy dolomite (Markewicz and Dalton, 1980).

The Green Pond Conglomerate is a Silurian age conglomerate that makes up most of Green Pond and Copperas Mountains. It is composed of medium to coarse grained quartz-pebble conglomerate, quartzitic arkose and orthoquartzite, and thin to thick bedded reddish-brown siltstone. It grades downward into less abundant gray, very dark red, or grayish-purple, medium to coarse-grained, thin to very thick bedded pebble to cobble-conglomerate containing clasts of red shale, siltstone, sandstone, and chert; yellowish-gray sandstone and chert; dark-gray shale and chert; and white-gray and pink milky quartz. At PTA, the lower contact of the Green Pond Conglomerate has been cut out by the Tanners Brook-Green Pond Fault, which places the Green Pond Conglomerate over the Leithsville.

2.4.2 Glacial Sediments

Overburden materials overlie the Precambrian and lower Paleozoic age bedrock at PTA. The overburden glacial materials consist mostly of till and stratified drift deposited during the Wisconsin glacial event. There are also minor amounts of recent alluvium. The terminal moraine of the Wisconsin glaciation, a 25- to 40-foot-high mound of tightly packed till consisting of unsorted particles ranging in size from clay to boulders, roughly coincides with the southwest boundary of PTA (Harte, 1986). A smaller recessional moraine is located just south of Picatinny Lake. Stratified drift, consisting of interbedded layers of sand, silt, and clay, were deposited behind these moraines as the glaciers retreated. Following deglaciation, Holocene deposits of silt, clay and finally peat formed in floodplains and ice-blocked depressions along Green Pond Brook (USGS, 1993).

The nature and thickness of the glacial deposits vary substantially at PTA. Relatively impermeable till is found both in the moraines and in patches against the sides and bottom of the valley. Stratified drift, deposited by the retreating glaciers behind the moraines, fills the valley underlying PTA. The drift is thickest above the axis of the valley, and thins rapidly off axis, pinching out against the valley slopes. Seismic studies indicate that the maximum drift thickness (along the valley axis) varies from about 50 feet near Picatinny Lake to over 300 feet near the southwestern boundary of PTA (Lacombe et al., 1986).

Classification of the glacial deposits into separate and homogeneous units is complex at PTA. The USGS (1993) reported the glacial deposits as five permeable layers represented as aquifers and three low permeability layers represented as confining units in the southern portion (Phase I area which includes the former Skeet Range) of the Arsenal, south of Picatinny Lake. In contrast, Dames and Moore (1995) reported three permeable layers in the Phase I area (Areas A through G).

2.5 SOILS

The soils at PTA can be categorized into two major types: (1) soils highly disturbed by human influence; and (2) soils exhibiting characteristics of past glacial activity. The Soil Survey of Morris County, New Jersey identifies 27 different soil types at PTA (Eby, 1976). Four of the soils identified on the Arsenal – Made Land (Ma), Pits (Ps), Urban Land (Ua), and Urban Land-Rockaway Complex (UrD) are classified as disturbed areas as a result of human activities. The majority of these soils are mapped in the central and southwestern portion of the Arsenal where extensive filling activities have occurred in areas previously somewhat poorly to very poorly drained.

The remainder of the soils mapped at PTA are closely related to the underlying geologic formations and past glacial influences. The Hibernia (HbC, HiD), Netcong (NtB), Ridgebury (RgA, RiB), Rockaway (RoB, RpC, RrD, RsC, RsD, RsE) and Whitman (Wm) soils were formed from glacial till

deposits and contain a high amount of stone and/or gravel. The remaining glaciated soils mapped at PTA are derived either from organic and mineral deposition of proglacial lakes and kettles or glacial outwash.

Hydric soils mapped at PTA include the Adrian muck (Ad), Carlisle muck (Cm), Preakness (PvA, Pw), Ridgebury (RgA, RiB), and Whitman (Wm) soils. The hydric soils present at PTA are derived either from organic or mineral deposition. The organic hydric soils (Adrian Muck, Carlisle Muck) commonly occupy the position of former depressions where the deposition of organic and mineral sediment have completely or partially filled in lakes and ponds. The hydric mineral soils (PvA, Pw, RgA, RlB, Wm) commonly occur in various landscape positions including outwash plains, kettles, and undrained depressions. The Hibernia and Pompton soils are considered non-hydric with hydric inclusions, indicating that small areas of hydric soils are included in the mapping units. Based on the Morris County Soil Survey of 1976, soils within and around the former Skeet Range appear to be classified as a mixture of Ad, Cm, and Ma.

Based on observations during sampling and monitoring well installation in 2010/2011, soils at the site vary dependent on location. Within the marshy areas of the former Skeet Range, soils are typically saturated with a mixture of clay, silt, and rocks. Along the western and southwestern portions of the former Skeet Range, a mixture of sands, silts, and clays were found from the surface to approximately 20 feet bgs.

2.6 HYDROGEOLOGY

The principal source of groundwater in the Green Pond Valley is local precipitation. The low-permeability and the steep slopes of Green Pond Mountain and Copperas Mountain to the northwest and the unnamed ridge to the southeast restrict the infiltration of precipitation into these mountains. Most of the precipitation that falls on the mountains flows overland to their bases and into the highly permeable glacial sediments. The small amount of precipitation that enters these ridges flows down through shallow fractures to the glacial sediments in the valley. Effectively, all discharge from the groundwater system flows to surface water bodies, primarily the Rockaway River and Green Pond Brook (USGS, 1991).

Groundwater occurs in both the valley glacial materials and in the bedrock at PTA. South of Picatinny Lake, where the hydrogeology has been studied in detail, the bedrock and glacial sediments at PTA were divided into a sequence of six permeable layers and five intervening, low-permeability layers on the basis of the general hydraulic properties of the sediments (USGS, 1991). Sand units exceeding 10 feet in thickness can act as pathways for contaminants and, therefore, were designated as permeable layers. Confining units, such as thick clay units, are not present at PTA; however, units containing clay and/or silt that impede the flow of groundwater are present. The designation of a layer as a low-permeability or permeable layer was made solely on the basis of the layer's ability to transmit water, and thus may not correspond to time- or rock-stratigraphic designations.

The thickness of the weathered zone of the bedrock ranges from 24 feet at well 27-84 near Picatinny Lake to 136 feet at well 27-250 near the southern boundary of the Arsenal. The bedrock beneath the glacial sediments at PTA weathers to a clay, which fills the fractures in the bedrock and impedes the flow of water. Therefore, the weathered zone of the bedrock was designated as a low-permeability layer.

Groundwater data from within and around the former Skeet Range indicates a gradual groundwater flow to the west toward Green Pond Brook. Depth to first groundwater during the April 2011 sampling event occurred between 1.11 feet bgs and 6.00 feet bgs.

2.7 LAND USE

Picatinny is owned and operated by the Army. Currently, the primary mission and land use of Picatinny is research, development, and engineering of munitions and weapons. The remaining land is used for outdoor recreation or unimproved, wooded land. The former Skeet Range is currently unused land. Historically, the former Skeet Range has been used for recreational purposes.

3.0 NATURE AND EXTENT OF CONTAMINATION

3.1 SUMMARY OF RI PROGRAM

The former Skeet Range RI sampling activities were conducted in March and April 2011. The former Skeet Range RI sampling included:

1. Collection of 6 groundwater samples from 5 monitoring wells, including a duplicate.
2. Collection of 23 surface soil samples from 21 locations, including duplicates;
3. Collection of 6 surface water samples from 5 locations, including a duplicate;
4. Collection of 5 subsurface soil samples from 5 locations; and
5. Collection of 9 sediment samples from 8 locations, including a duplicate.

Table 3-1 provides a list of all the samples that were collected, including a summary of sample locations and analyses performed, during the RI. Analytical results for the samples are presented in **Tables 3-2 through 3-6**. Compounds detected above their associated LOC are indicated with bold font and shading. Sample designations are explained in **Section 3.2**.

All laboratory analyses were performed by NJDEP- and Department of Defense (DOD)- certified laboratories using certified methods. All analytical data from the 2010 investigation and the 2011 RI were validated using the USEPA National Functional Guidelines (USEPA, 1994, 2004) prior to use in the risk assessment. Validation reports are included in **Appendix A**. Electronic Data Deliverables (EDDs) have been submitted to the NJDEP along with the RIR.

3.2 SAMPLE NUMBERING SCHEME

This section describes the sample numbering system for environmental field samples and field quality control (QC) samples. The sample numbering system is applicable to all CERCLA Definitive Data samples.

3.2.1 Field Samples

There are two basic notations used for the identification of field samples: Site Identification and Field Sample Number. The Site Identification corresponds to the site from which the samples was collected (e.g., Site 19) or building number associated with the site (e.g., Building 1181) and is inclusive of the media type from which the field sample was collected. For example, the sample collected at the same boring would have the same Site Identification but would have unique Field Sample Numbers, which would correspond to the depth of the sample collected. Since this investigation was performed an area which does not specifically correspond to a site number, the majority of the Site Identification Numbers are associated with a building. The sequence of digits, which comprise both the Site Identification and the Field Sample Number are as follows:

123 AB – 34A

where:

123: Corresponds to the site number as given in the *1991 ANL RI Concept Plan* and the *2002 Installation Action Plan* (ARDEC, 2002). RI Concept Plan site numbers were not established for some Defense Site Environmental Restoration Tracking System/Picatinny Arsenal (DSERTS/PICA) sites. As indicated previously, the majority of the Site Identification Numbers are associated with a building for purposes of this investigation. Only samples collected from nearby monitoring wells are associated with historical sites [e.g., C1-A and C1-B (Area C) and DM19-3 (Site 19)]. For newly installed monitoring wells and all soil, surface water, and sediment samples collected, the Site Identification are associated with Building 1181 (i.e., B1181).

AB: Corresponds to the media type sampled at the site. The following are the sample media codes that were used during the RI:

- SS: Soil sampling as described in **Sections 3.5 and 3.6;**

- SD: Sediment sampling as described in **Section 3.8**;
- SW: Surface water sampling as described in **Section 3.7**;
- MW: Monitoring well sampling as described in **Section 3.4**. Note: only used for newly installed monitoring wells.

34: Corresponds to sequential samples collected from the same area, as defined by the previous five digits. The sequence number is from 01 through 99.

A: This letter represents the same depth (e.g., C indicates a sample collected from 2.0-2.5 feet bgs).

In the event of sampling multiple depths or conditions at the same location, sequential letters are used to denote the sample depths or conditions. For example, surface soil samples collected during RI sampling are denoted by no letter following the sample (0 to 0.5 feet bgs), C (2.0 to 2.5 feet bgs), or D (4.0 to 4.5 feet bgs).

3.2.2 Field Quality Control Samples

The field QC samples collected during the RI include rinse/equipment blanks, aqueous trip blanks, and duplicate samples. The sample numbering system for the field QC samples is described in the following subsections.

3.2.2.1 Rinse/Equipment Blanks

Rinse blanks are collected at a rate of one per type of equipment per decontamination event. A consistent volume of analyte-free water is poured over the equipment, with the rinse water collected in the appropriate sample containers. The Rinse/Equipment Blank sample number is identified by the following 10-digit sequence:

GW012300R1

Where GW designates the media (groundwater) to be sampled; 012300 designates the month (01), day (23), and year (00) of the creation of the rinse blank; R designates a rinse blank QC sample; 1 designates the number of rinse blank samples collected for that day for the designated media. This sample identification number is cross-referenced to the field parameter logbook to determine the associated environmental samples.

3.2.2.2 Aqueous Trip Blanks

Aqueous trip blanks are created onsite each day of aqueous volatile organic compound (VOC) sampling, using analyte-free water. Trip blanks accompany associated environmental VOC samples and are shipped with the collected field samples. The Aqueous Trip Blank sample number is identified by the following 10-digit sequence:

GW012400T1

Where GW designates the media (groundwater) to be samples; 012400 designates the month (01), day (24), and year (00) of the creation of the aqueous trip blank; T designates an aqueous trip blank QC sample; 1 designates the number of aqueous trip blank samples collected for that day for the designated media. This sample identification number is cross-referenced to the field parameter logbook to determine the associated environmental samples.

3.2.2.3 Field Duplicate Samples

Field duplicate samples provide information on sampling precision as well as analytical precision. Duplicate samples are collected at a rate of one field duplicate per 20 samples per matrix, or 5% of all samples. The Site Identification/Building Number and the field Sample Number have the same sequence with the exception of adding “Dup” to the duplicate sample. For example,

	Site Identification/Building Number	Field Sample Number
Sample ID:	B1181	B1181MW-1

Duplicate Sample ID: B1181 B1181MW-1 DUP

3.3 IDENTIFICATION OF LEVELS OF CONCERN

Chemical data generated from the analysis of site samples collected from the various media and presented in this report are compared to regulatory values or PTA background concentrations. LOCs have been selected for individual contaminants of concern. Comparison criteria are presented by media in **Tables 3-7 to 3-10**. The development of LOCs for each media is discussed below.

3.3.1 Groundwater Criteria

The comparison criteria for PTA groundwater were based on the lower of the following values: (1) Federal maximum contaminant level (MCL), (2) New Jersey State MCLs, (3) New Jersey Groundwater Quality Criteria (NJGWQC) or practical quantitation level (PQL) (whichever is higher) (NJDEP, 2010a), and (4) any non-zero Federal maximum contaminant level guide (MCLG). If none of the above criteria were available, the groundwater comparison criteria were based on the lower of the following target based concentration (TBC) criteria: Federal Drinking Water Standards and Health Advisories or USEPA Region III Tap Water (10^{-6}) Regional Screening Levels (RSLs). **Table 3-7** lists the LOCs selected for analytes in groundwater.

3.3.2 Surface and Subsurface Soil Criteria

Soil samples were evaluated by comparing the detected concentration to the NJDEP Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) (NJDEP, 2009). When NJDEP NRDCSRS were not available, EPA Industrial RSLs were used. **Table 3-8** lists the LOCs selected for analytes in soil.

3.3.3 Surface Water Criteria

Analytical results of surface water samples were evaluated by comparing the detected concentration first to the NJDEP Surface Water Quality Criteria (NJSWQC) (NJDEP, 2010c). If no NJSWQC was available, then the result compared to the USEPA Water Quality Criteria. In the absence of this, the result was compared to the USEPA Region III Tap Water RSLs. Once the above value was established, it was compared to the PTA surface water background, if available, and the higher of the two was selected as the LOC. **Table 3-9** lists the LOCs selected for analytes in surface water.

3.3.4 Sediment Criteria

Sediment samples were evaluated by comparing the detected concentration to the following criteria:

- NJDEP Ecological Screening Criteria (NJDEP, 2010b), utilizing the Freshwater Lower Effects Levels.
- Toxicological Benchmarks for Screening Contaminants of Potential for Effects on Sediment-Associated Biota: 1997 Revision (ES/ER/TM-95/R4), Department of Energy, 1997.
- Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment, 2001.
- New York State Department of Environmental Conservation's (NYSDEC) *Technical Guidance for Screening Contaminated* Sediments (NYDEC, 1999).
- Oak Ridge National Laboratory Sediment Quality Benchmarks (ORNL, 1997).

Subsequently, the lowest value taken from the above was compared to the PTA background concentration, if available. The final LOC chosen was the higher of the two values.

In the event a value could not be determined utilizing the above sources, the following were utilized in the order presented:

- New Jersey NRDCSRS.
- USEPA Soil Industrial RSLs.
- New Jersey Residential Direct-Contact Soil Remediation Standard (RDCSRS).

- USEPA Soil residential RSL.

Table 3-10 lists the LOCs selected for analytes in sediment.

3.4 GROUNDWATER SAMPLING METHODS AND RESULTS

Six groundwater samples were collected from five monitoring wells in and around the former Skeet Range on April 28, 2011. Groundwater sampling methods and results of laboratory analyses are presented in the following sections.

3.4.1 Groundwater Sampling Methods

Prior to groundwater sampling, synoptic water level measurements were conducted at monitoring wells C-1A, C-1B, DM19-3, B1181MW-1, and B1181MW-2. These wells were purged and sampled by the USEPA Region 2 low-flow methodology using decontaminated Grundfos submersible pumps (USEPA, 1998). Decontamination of the submersible pumps was conducted in accordance with the approved PTA field sampling procedures (ICFKE, 1998) and NJDEP's *Field Sampling Procedures Manual* (NJDEP, 2005a). During groundwater purging and sampling, groundwater quality parameters were measured using a calibrated multimeter. Temperature, pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity were recorded during purging (**Appendix B**). All groundwater samples collected were analyzed for munitions metals (lead, antimony, arsenic, copper, zinc, and iron) and PAHs. All sample analyses were performed by a laboratory certified by the NJDEP for the selected methods.

3.4.2 Groundwater Chemical Results

No PAH compounds were detected in the groundwater samples collected from monitoring wells C-1A, C-1B, DM19-3, B1181MW-1, and B1181MW-2.

Arsenic was detected in two of the six samples which were analyzed for arsenic. Both of these detections exceeded the LOC of 3.0 µg/l. Arsenic was detected in the groundwater samples collected from monitoring wells C-1B and DM19-3 at concentrations of 4.0 µg/l and 10.3 µg/l, respectively, both which exceed the LOC. Well C-1B is located hydraulically upgradient in relation to the former Skeet Range and well DM19-3 is located hydraulically downgradient in relation to the former Skeet Range.

Iron was detected in all six samples analyzed for iron. Five of these six detections exceeded the LOC of 300 µg/l. Iron was detected in the groundwater samples collected from monitoring wells C-1B, B1181MW-2, DM19-3, and B1181MW-1 (including duplicate sample) at concentrations of 624 µg/l, 16,900 µg/l, 2,050 µg/l, 15,300 µg/l, and 14,600 µg/l (duplicate), respectively. Iron was also detected in the groundwater sample collected from monitoring well C-1A at a concentration of 209 µg/l, which is below the LOC. Iron concentrations are elevated due to local geologic conditions and are not site related. Copper, lead, antimony, and zinc were not detected in any of the groundwater samples collected.

Based on a review of the groundwater data, minor exceedances of arsenic and iron were detected in some of the groundwater samples above LOCs. The detections of arsenic above LOCs are located both upgradient and downgradient of the former Skeet Range and could be related to known landfilling within the southern portions of PTA historically. The detections of iron are likely associated with local geologic conditions.

A summary of the groundwater results can be found in **Table 3-2**. Groundwater sampling locations and results can be found on **Figure 3-1**. A groundwater elevation map based on the 2011 data can be found on **Figure 3-2**.

3.5 SURFACE SOIL SAMPLING METHODS AND RESULTS

Twenty-three (23) surface soil samples were collected from 21 sample locations in and around the former Skeet Range on March 16 and 19, 2011. Surface soil sampling methods and results of laboratory analyses are presented in the following sections.

3.5.1 Surface Soil Sampling Methods

The surface soil samples were collected using decontaminated stainless-steel trowels. Decontamination of the trowels was conducted in accordance with the approved PTA field sampling procedures (ICFKE, 1998) and *NJDEP's Field Sampling Procedures Manual* (NJDEP, 2005a). A sufficient amount of soil from the surface interval was placed on a decontaminated stainless-steel tray for mixing. After any rocks or organic matter was removed, the soil was homogenized using the coning and quartering method. Once the soil was homogenized, the required soil volume was placed into the sample bottles at each sample location. Fifteen of the surface soil samples collected were analyzed for munitions metals and PAHs, seven of the surface soil samples collected were analyzed for lead only, and one of the surface soil samples collected was analyzed for munitions metals only.

The surface soil samples were collected in accordance with the approved Standard Operating Procedure for soil sampling as presented in the *Picatinny Arsenal Facility-Wide Field Sampling Plan* (ICFKE, 1998). The surface soil samples were also collected in accordance with the *Technical Requirements for Site Remediation* (NJDEP, 2005b) which included collection of samples in discrete six-inch intervals. All analyses were conducted by a laboratory certified by the NJDEP to perform the necessary analyses.

3.5.2 Surface Soil Chemical Results

Benzo(a)anthracene was detected in three surface soil samples. Only one of the surface soil sampling locations, B1181SS-54 (including duplicate), had concentrations above the LOC of 2.0 mg/kg. The average concentration of benzo(a)anthracene at this sample location was 4.05J mg/kg.

Benzo(b)fluoranthene was detected in four surface soil samples. Only one of the surface soil sampling locations, B1181SS-54 (including duplicate), had concentrations above the LOC of 2.0 mg/kg. The average concentration on benzo(b)fluoranthene at this sample location was 4.4J mg/kg.

Benzo(a)pyrene was detected in three surface soil samples. Only one of the surface soil sampling locations, B1181SS-54 (including duplicate), had concentrations above the LOC of 0.2 mg/kg. The average concentration of benzo(a)pyrene at this sample location was 2.95J mg/kg. Benzo(a)pyrene was detected at the LOC at surface sampling location B1181SS-42.

Dibenz(a,h)anthracene was detected in two surface soil samples. This included sample B1181SS-54 and its associated duplicate sample. The average concentration of 0.475J mg/kg exceeds the LOC of 0.2 mg/kg.

Additional PAHs detected in one or more surface soil samples included indeno(1,2,3-cd)pyrene, fluoranthene, pyrene, chrysene, naphthalene, acenaphthene, fluorene, phenanthrene, anthracene, benzo(k)fluoranthene, and benzo(g,h,i)perylene. These additional detections were found below applicable LOCs.

Arsenic was detected in 16 surface soil samples. However, only one of the surface soil sampling locations had a concentration above the LOC of 19 mg/kg. Arsenic was detected at a concentration of 24.1 mg/kg at surface soil sampling location B1181SS-42.

Lead was detected in all 23 surface soil samples where it was analyzed. Of these, four samples were found at concentrations above the LOC of 800 mg/kg. Lead was above the LOC in samples B1181SS-54 (896 mg/kg), B1181SS-54 DUP (1,080J mg/kg), B1181SS-45 (1,330 mg/kg), and B1181SS-46 (8,650 mg/kg). The average concentration of lead in the samples collected at location B1181SS-54 is 988 mg/kg, which is still greater than the LOC.

Additional metals detected in one or more of the surface soil samples included antimony, copper, iron, and zinc. These additional detections were found below applicable LOCs.

Based on a review of surface soil data, lead is scattered within and around the former Skeet Range at concentrations exceeding the LOC. The highest concentrations appear to be within the eastern and northeastern portions of the maximum shot fall zone. It appears horizontal delineation has been achieved to the north, south, and west of the former Skeet Range. This delineation is evident to the north in sample numbers B1181SS-43, B1181SS-44, B1181SS-50, B1181SS-51, B1181SS-52, and B1181SS-53, to the south in sample numbers B1181SS-20, B1181SS-21, B1181SS-22, 180SS-12A, and 180SS-

13A, and to the west in sample numbers B1181SS-24, B1181SS-39, B1181SS-56, and B1181SS-57. The majority of samples collected to the east of the former Skeet Range found lead concentrations below LOCs; however, two samples remained at concentrations above LOCs located due east of the maximum shot fall zone. While the full extent of lead impacts has not been determined, additional delineation to the east of the former Skeet Range is not deemed necessary at this time based on the lead model results that are well above the threshold of concern. Refer to **Section 5.0** for additional details on the risk assessment performed as a part of this investigation.

The location of the surface soil sample with an arsenic concentration detected above the LOC is on the western edge of the former Skeet Range impact fan. Given this was the only location with arsenic exceeding the LOC and the fact it was a marginal exceedance, arsenic in soil impacts seem to be localized and not representative of an area impacted from the former operation of the skeet range. A summary of the surface soil results can be found in **Table 3-3**.

Only minor exceedances of PAHs were detected in one surface soil sample located to the west of the former Skeet Range impact fan. As stated in the 2010 data report, these exceedances may be related to nearby asphalt roads or from debris stockpiled at Site 34 (e.g., telephone poles).

3.6 SUBSURFACE SOIL SAMPLING METHODS AND RESULTS

Five subsurface soil samples were collected from five sample locations in and around the former Skeet Range on March 16, 2011. Subsurface soil sampling methods and results of laboratory analyses are presented in the following sections.

3.6.1 Subsurface Soil Sampling Methods

The subsurface soil samples were collected using decontaminated stainless-steel augers. Decontamination of the augers was conducted in accordance with the approved Picatinny field sampling procedures (ICFKE, 1998) and NJDEP's *Field Sampling Procedures Manual* (NJDEP, 2005a). A sufficient amount of soil from the specified soil interval was placed on a decontaminated stainless-steel tray for mixing. After any rocks or organic matter was removed, the soil was homogenized using the coning and quartering method. Once the soil was homogenized, the required soil volume was placed into the sample bottles at each sample location. Three of the subsurface soil samples were analyzed for lead only, while the remaining two subsurface soil samples were analyzed for PAHs only.

The subsurface soil samples were collected in accordance with the approved Standard Operating Procedure for soil sampling as presented in the *Picatinny Arsenal Facility-Wide Field Sampling Plan* (ICFKE, 1998). The subsurface soil samples were also collected in accordance with the *Technical Requirements for Site Remediation* (NJDEP, 2005b) which included collection of samples in discrete six-inch intervals. All analyses were conducted by a laboratory certified by the NJDEP to perform the necessary analyses.

3.6.2 Subsurface Soil Chemical Results

Benzo(a)anthracene was detected in two of two subsurface soil samples analyzed for PAHs. Both of these detections were at concentrations exceeding the LOC of 2.0 mg/kg. Benzo(a)anthracene was detected in subsurface soil samples B1181SS-23C and B1181SS-35C at concentrations of 8.0 and 5.4 mg/kg, respectfully. Both samples were collected from 2.0 to 2.5 feet below grade at former sampling locations that had elevated PAH levels in the surface soil.

Benzo(b)fluoranthene was detected in two of two subsurface soil samples analyzed for PAHs. Both of these detections were found at concentrations exceeding the LOC of 2.0 mg/kg. Benzo(b)fluoranthene was detected in subsurface soil samples B1181SS-23C and B1181SS-35C at concentrations of 8.6 and 3.1J mg/kg, respectfully.

Benzo(a)pyrene was detected in two of two subsurface soil samples analyzed for PAHs. Both of these detections were found at concentrations exceeding the LOC of 0.2 mg/kg. Benzo(a)pyrene was detected in subsurface soil samples B1181SS-23C and B1181SS-35C at concentrations of 6.8 and 7.1 mg/kg, respectfully.

Dibenz(a,h)anthracene was detected in two of two subsurface soil samples analyzed for PAHs. Both of these detections were found at concentrations exceeding the LOC of 0.2 mg/kg. Dibenz(a,h)anthracene was detected in subsurface soil samples B1181SS-23C and B1181SS-35C at concentrations of 1.0J and 1.1J mg/kg, respectfully.

Indeno(1,2,3-cd)pyrene was detected in two of two subsurface soil samples analyzed for PAHs. However, only one of these subsurface soil sampling locations found a concentration above the LOC of 2.0 mg/kg. Indeno(1,2,3-cd)pyrene was detected at a concentration of 2.7 mg/kg at subsurface soil sampling location B1181SS-23C.

Additional PAHs detected in one or more subsurface soil samples included fluoranthene, pyrene, chrysene, naphthalene, acenaphthene, fluorene, phenanthrene, anthracene, benzo(k)fluoranthene, and benzo(g,h,i)perylene. These additional detections were found below applicable LOCs.

Lead was detected at three of three subsurface sampling locations analyzed for lead. Lead was detected in soil samples B1181SS-25C (82.5 mg/kg), B1181SS-14C (3,060 mg/kg), and B1181SS-10D (273 mg/kg). Of these, only the sample collected from soil sampling location B1181SS-14C was detected above the LOC of 800 mg/kg.

Based on a review of subsurface soil data, vertical delineation of lead impacts appears to be achieved in most locations. This delineation is evident at sample locations B1181SS-10D and B1181SS-25C. Only at location B1181SS-14, there remains an elevated detection of lead in subsurface soil. This area is located within the northeastern maximum shot fall zone. While the full extent of lead impacts has not been determined, additional vertical delineation is not deemed necessary at this time based on the lead model results that are well above the threshold of concern. Refer to **Section 5.0** for additional details on the risk assessment performed as a part of this investigation.

Only minor exceedances of five PAHs were detected in one or two of the subsurface soil samples. When compared to the surface soil sampling results from 2010 at these locations, concentrations of contaminants decrease significantly with depth. As stated in the 2010 data report, these exceedances may be related to nearby asphalt roads (B1181SS-23) or accumulation of clay pigeons (B1181SS-35). Although the vertical extent of PAHs has not been defined, it is important to note that the PAH contamination has not impacted the groundwater.

A summary of the subsurface soil results can be found in **Table 3-4**. The historical and current lead soil sampling results are summarized in **Figure 1-3**. The 2011 soil sampling arsenic data are shown in **Figure 3-3**. The 2011 soil sampling PAH data are presented in **Figure 3-4**.

3.7 SURFACE WATER SAMPLING METHODS AND RESULTS

Six surface water samples were collected from five sample locations in and around the former Skeet Range from March 16 to March 21, 2011. Surface water and sediment samples were not collected from Green Pond Brook (Site 34) because this site has already been characterized and a ROD has been signed for the site (Shaw, 2009). The ROD requires annual chemical and biological sampling for the lower portion of Green Pond Brook, which includes Area C. Surface water sampling methods and results of laboratory analyses are presented in the following sections.

3.7.1 Surface Water Sampling Methods

The surface water samples were collected using a decontaminated stainless-steel pitcher and were transferred directly to pre-preserved sample bottles for shipping to the laboratory. Prior to sampling, surface water parameters were measured using a calibrated multimeter, and temperature, pH, conductivity, ORP, DO, and turbidity were recorded. All five surface water samples collected were analyzed for munitions metals and PAHs.

The surface water samples were collected in accordance with the approved Standard Operating Procedure for surface water sampling as presented in the *Picatinny Arsenal Facility-Wide Field Sampling Plan* (ICFKE, 1998). The surface water samples were also collected in accordance with the *Technical Requirements for Site Remediation* (NJDEP, 2005b).

3.7.2 Surface Water Chemical Results

Antimony was detected in four surface water samples. Three of these detections were at concentrations exceeding the LOC of 5.6 µg/l, including one duplicate sample. These exceedances included both samples collected at B1181SW-6 (average of 10.6J µg/l) and sample B1181SW-10 (73.4 µg/l).

Arsenic was detected in two surface water samples. Both of these detections were at concentrations exceeding the LOC of 1.38 µg/l. These exceedances included sample B1181SW-6 (1.40J µg/l) and sample B1181SW-10 (23J µg/l).

Iron was detected in all six surface water samples. The only exceedance was at sample B1181SW-10 where a concentration of 8,340 µg/l exceeded the LOC of 1,790 µg/l.

Lead was detected in all six surface water samples. Five of these detections were at concentrations exceeding the LOC of 5.0 µg/l, including one duplicate sample. These exceedances included both samples collected at B1181SW-6 (average of 874J µg/l), sample B1181SW-7 (18.8 µg/l), sample B1181SW-9 (70.6 µg/l), and sample B1181SW-10 (7,530 µg/l).

Copper was not detected in the surface water samples at concentrations exceeding the LOC. No PAH compounds were detected in the surface water samples. A summary of the surface water results can be found in **Table 3-5**. Surface water sampling locations and results can be found on **Figure 3-1**.

Based on a review of surface water data, the greatest impacts from metals was found at the surface water sample collected within the central portion of the skeet range maximum shot fall zone. Lead was detected above the LOC in five of six samples which is likely attributed to the former operation of the skeet range. The surface water samples which detected lead below the LOC were outside of the shot fall zone at a location upgradient of the remaining surface water samples. The remaining metals detected above LOCs may be related to the high turbidity of the samples, landfilling within the area, or weathering of the shot used at the former Skeet Range. Upgradient surface water sample B1181SW-8 shows delineation of metal impacts to surface water. The surface water collected within the ditches at the site is either stagnant or drains to Green Pond Brook. Green Pond Brook is monitored annually for impacts to ecological receptors.

3.8 SEDIMENT SAMPLING METHODS AND RESULTS

Nine sediment samples were collected from eight sample locations in and around the former Skeet Range from March 16 to March 21, 2011. Sediment sampling methods and results of laboratory analyses are presented in the following sections.

3.8.1 Sediment Sampling Methods

The sediment samples were collected using decontaminated stainless-steel trowels or augers. Decontamination of the trowels or augers was conducted in accordance with the approved Picatinny field sampling procedures (ICFKE, 1998) and NJDEP's Field Sampling Procedures Manual (NJDEP, 2005a). A sufficient amount of sediment from the specified interval was placed on a decontaminated stainless-steel tray for mixing. After any rocks or organic matter was removed, the sediment was homogenized using the coning and quartering method. Once the sediment was homogenized, the required sediment volume was placed in the sample bottles at each sample location. Seven of the sediment samples collected were analyzed for munitions metals and PAHs while the remaining two sediment samples collected were analyzed for lead only.

The sediment samples were collected in accordance with the approved Standard Operating Procedure for sediment sampling as presented in the *Picatinny Arsenal Facility-Wide Field Sampling Plan* (ICFKE, 1998). The sediment samples were also collected in accordance with the Technical Requirements for Site Remediation (NJDEP, 2005b) which included collection of samples in discrete six-inch intervals.

3.8.2 Sediment Chemical Results

The only PAH compound detected in the sediment samples was fluoranthene. Fluoranthene (LOC = 0.06423 mg/kg) was detected at a concentration of 0.29J mg/kg in sample B1181SD-3C, which is above the LOC. PAHs were not detected in the remaining sediment samples.

Antimony was detected in three sediment samples. Two of these detections were at concentrations exceeding the LOC of 450 mg/kg. These exceedances included sample B1181SD-9 (4,190 mg/kg) and sample B1181SD-10 (6,250 mg/kg). It should be noted that antimony was also detected above the LOC in sample B1181SD-6 DUP; however, this exceedance was rejected after data validation due to laboratory error. Therefore, the detection of antimony at this sample location will not be used for purposes of this investigation.

Arsenic was detected in five sediment samples. Two of these detections were at concentrations exceeding the LOC of 16 mg/kg. These exceedances included sample B1181SD-9 (851 mg/kg) and sample B1181SD-10 (175 mg/kg). It should be noted that arsenic was also detected above the LOC at sediment sample location B1181SD-6 (including duplicate); however, these exceedances were rejected after data validation due to laboratory error. Therefore, the detection of arsenic at this sample location will not be used for purposes of this investigation.

Copper was detected in seven sediment samples. Five of these detections were at concentrations exceeding the LOC of 28 mg/kg, including one duplicate sample. These exceedances included both samples collected at B1181SD-6 (average of 236.5J mg/kg), sample B1181SD-3C (213 mg/kg), sample B1181SD-9 (238 mg/kg), and sample B1181SD-10 (514 mg/kg).

Lead was detected in seven sediment samples. Five of these detections were at concentrations exceeding the LOC of 38.8 mg/kg. These exceedances included sample B1181SD-3C (18,000 mg/kg), sample B1181SD-9 (71,000 mg/kg), sample B1181SD-10 (186,000 mg/kg), sample B1181SD-11 (780J mg/kg), and sample B1181SD-12 (2,220 mg/kg). It should be noted that lead was also detected above the LOC at sediment sample location B1181SD-6 (including duplicate); however, these exceedances were rejected after data validation due to laboratory error. Therefore, the detection of lead at this sample location will not be used for purposes of this investigation.

Zinc was detected in seven sediment samples. Two of these detections were at concentrations exceeding the LOC of 171 mg/kg. These exceedances included sample B1181SD-3C (629 mg/kg) and sample B1181SD-9 (211 mg/kg).

Iron was not detected in the sediment samples at concentrations exceeding the LOC. A summary of the sediment results can be found in **Table 3-6**. The 2011 sediment sampling munitions metals and PAH data is summarized in **Figure 3-5**.

Based on a review of sediment sampling data, only one PAH was detected above the LOC, and at a relatively low concentration. This detection was found at a sampling location within the maximum shot fall zone and may be related to the historical use of clay pigeons associated with skeet range operations. Several metals were detected at concentrations exceeding their respective LOCs in at least one sediment sample. Lead was detected in five samples above the LOC and appears to be distributed throughout the former skeet range with the highest concentration located at a central location with the maximum shot fall zone. The remaining metals were for the most part found within the maximum shot fall zone, with the highest concentrations found in this zone. These metals may be related to the former operation of the skeet range or landfilling within the area.

Based on known impacts to soils and sediments at small arms firing ranges, the concentrations of antimony, arsenic, copper, and zinc could also be related to munitions used at the former Skeet Range. According to information obtained from the ITRC document entitled *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges*, lead is the primary constituent of a projectile (e.g., shotgun ammunition). Antimony is commonly present in shotgun ammunition to increase hardness. Arsenic is present within the lead shot since it increases the surface tension of lead which improves shot roundness. Copper and zinc are commonly present in shotgun ammunition as a jacket alloy metal (ITRC, 2003).

Horizontal delineation of sediment is evident to the east of the maximum shot fall zone at sampling locations B1181SD-7 and B1181SD-8. At least one metal or PAH remains at concentrations

exceeding sediment LOCs in the remaining sediment sampling locations which are located within or adjacent to the maximum shot fall zone. This includes a lack of vertical delineation of copper, lead, zinc, and fluoranthene at sediment sampling location B1181SD-3C and a lack of horizontal delineation of lead (B1181SD-11) and copper (B1181SD-6). Although the elevated metals concentrations in the sediment of the drainage channel may be a continuing source of contamination to Green Pond Brook, additional delineation at these sample locations is not deemed necessary because additional samples would be collected below the biologically active zone and ecological impacts are typically assessed between the 0 to 1 foot interval. Additional vertical delineation sediment samples would be collected below this depth interval. Potential future risks from sediment exposures below 1 ft bgs would be minimal based on current land use and the site's swampy nature. In addition, additional horizontal delineation of lead and copper at these locations within the sampled drainage channel would extend into Green Pond Brook. Potential impacts to Green Pond Brook have been evaluated in a RI (Dames and Moore, 1998), FS (IT, 2001), and ROD (Shaw, 2004). The remedial alternative for this portion of Green Pond Brook includes annual chemical and biological sampling to assess the impacts to ecological receptors. No additional characterization of the drainage channel at the former Skeet Range or Green Pond Brook is warranted.

4.0 CONTAMINANT FATE AND TRANSPORT

The concentrations and distribution of contaminants at the former Skeet Range were described in detail in the preceding sections of the report. The potential risks associated with exposure to these chemicals also are presented in this report. Based on the results of the HHRA and screening criteria outlined in Section 5.0, lead was identified as the primary health concern in soil and sediment. PAHs and arsenic are also identified as risk factors in soil. Therefore, these metals and PAHs were included for fate and transport evaluation.

4.1 LEAD

Lead was detected above the LOC of 800 mg/kg in four surface and one subsurface soil samples collected at the former Skeet Range. Lead was detected above the LOC in surface soil samples B1181SS-54 (896 mg/kg), B1181SS-54 DUP (1,080J mg/kg), B1181SS-45 (1,330 mg/kg), and B1181SS-46 (8,650 mg/kg). Lead was detected above the LOC in subsurface soil sample B1181SS-14C at a concentration of 3,060 mg/kg. Lead was detected above the LOC of 38.8 mg/kg in sediment samples B1181SD-3C (18,000 mg/kg), sample B1181SD-9 (71,000 mg/kg), sample B1181SD-10 (186,000 mg/kg), sample B1181SD-11 (780J mg/kg), and sample B1181SD-12 (2,220 mg/kg).

The leaching of lead from soil or sediment to groundwater is very slow under most natural conditions, except for highly acidic situations. The conditions that include leaching are the presence of lead in soil and sediment at concentrations that either approach or exceed the cation exchange capacity of the soil or sediment, the presence of materials in the soil or sediment that are capable of forming soluble chelates with lead, and a decrease in the pH of the leaching solutions (for example, acid rain). Based on the absence of elevated lead concentrations in groundwater, it appears that lead is not leaching from the soil or sediment into the groundwater. In addition, positively charged metal cations tend to bind to negatively charged particles in soil such as clays and to a lesser extent to silt and soil organic matter. Given the fact that the former Skeet Range soils are primarily clays and silts, this further reinforces reasoning behind the lack of leaching of lead from soils and sediment to groundwater across the site.

4.2 POLYNUCLEAR AROMATIC HYDROCARBONS

PAHs are a group of more than a hundred organic compounds of two or more aromatic rings. PAH compounds benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, benzo(a)anthracene, and indeno(1,2,3-cd)pyrene were identified as the primary COPCs with estimated cancer risks greater than 1.0E-6 in surface soil at the former Skeet Range and the majority were detected at concentrations exceeding their respective LOCs. Indeno(1,2,3-cd)pyrene was not detected above the LOC and therefore is not considered for fate and transport evaluation. Benzo(a)pyrene was detected above the LOC of 0.2 mg/kg at sampling location B1181SS-54 (including duplicate) at an averaged concentration of 2.95 mg/kg. Benzo(b)fluoranthene was detected above the LOC of 2.0 mg/kg at sampling location B1181SS-54 (including duplicate) at an averaged concentration of 4.4 mg/kg. Dibenz(a,h)anthracene was detected above the LOC of 0.2 mg/kg at sampling location B1181SS-54 (including duplicate) at an averaged concentration of 0.475 mg/kg. Benzo(a)anthracene was detected above the LOC of 2.0 mg/kg at sampling location B1181SS-54 (including duplicate) at an averaged concentration of 4.05 mg/kg.

As a general rule, when PAH compounds grow in molecular weight, their solubility in water decreases, solubility in fat tissues increases, and their melting and boiling points increase (Environment Canada, 1997). The solubility and vapor pressures of the PAHs identified above indicate they are not soluble in water and do not readily volatilize to the atmosphere. In addition, the organic carbon/water partition coefficient's (K_{OC}) for the PAHs of concern indicate the compounds will not tend to leach in groundwater or surface water runoff. Site data indicate LOC exceedances for these compounds in one surface soil sampling location. A subsurface soil sample was not collected at this location (B1181SS-54); therefore, the lack of subsurface soil samples from this location limits the site-specific evaluation of PAH transport. However, in general, PAHs are likely to sorb to the surface soil and will minimally migrate vertically into groundwater. PAHs were not detected in the groundwater or surface water samples collected at the former Skeet Range.

PAHs are slow to degrade in the environment. Therefore, PAHs will tend to remain in the soil at the former Skeet Range with surface water runoff being the primary means of contaminant transport. However, as indicated above, surface water samples collected at the Site did not indicate evidence of PAH impacts.

4.3 ARSENIC

Arsenic was detected above the LOC of 19 mg/kg in one surface soil sample, B1181SS-42, at a concentration of 24.1 mg/kg. Arsenic was not detected above the LOC in subsurface soil samples collected in and around the former Skeet Range. Arsenic was detected above the LOC of 16 mg/kg in two sediment samples, B1181SD-9 and B1181SD-10, at concentrations of 851 mg/kg and 175 mg/kg, respectively. The most common forms of arsenic found in nature (As^{+5} and As^{+3}) are typically found in aqueous solution as arsenate (AsO_4^{-3}) and arsenite (AsO_2^{-1}), respectively. However, the metallic (0 state) and -3 state may also occur. Both arsenate and arsenite are toxic; however, arsenite is the more toxic form, and arsenate is the most common form. Arsenate is relatively immobile in the environment due to its formation of insoluble complexes with iron, aluminum, and calcium. The presence of iron is the most effective in controlling the mobility of arsenate. In contrast, arsenite compounds are 4 to 10 times more soluble than arsenate compounds. Redox reactions can influence arsenic concentrations through reduction of arsenate to arsenic. Given arsenic was only found in one soil sample exceeding the LOC and the fact it was a marginal exceedance, arsenic in soil impacts seem to be localized and not representative of an area impacted from the former operation of the Skeet Range. The soil arsenic exceedance, along with the two sediment exceedances, may be related to former landfilling in this area of PTA.

Arsenic was detected above the LOC of 1.38 µg/l in surface water samples B1181SW-6 (1.40 µg/l) and B1181SW-10 (23 µg/l). Given that arsenic was also detected above the LOC in sediment sample B1181SD-9, which is located in the general vicinity of surface water sample B1181SW-6, it is possible that arsenic in the sediment has partitioned to the surface water.

Arsenic was also detected above the LOC of 3.0 µg/l in groundwater samples collected from monitoring wells C-1B and DM19-3 at concentrations of 4.0 µg/l and 10.3 µg/l, respectively. The detections of arsenic in groundwater above LOCs are located both upgradient and downgradient of the former Skeet Range and may be related to known historic landfilling in the area. Given this and the difficulty of arsenic transport from the soil or sediment into groundwater at the concentrations detected, it is unlikely these detections are related to the historic operation of the former Skeet Range.

5.0 HUMAN HEALTH RISK ASSESSMENT

The former Skeet Range HHRA evaluates the probability and magnitude of potential adverse effects on human health associated with exposure to site-related chemicals in soil, surface water, sediment and groundwater.

The HHRA is consistent with the *Final Picatinny Arsenal Former Skeet Range RI Work Plan* (Shaw, 2011), *Response to USEPA and BTAG Region II and NJDEP Comments* (Shaw, 2010e), guidance included in USEPA's Interim Final Risk Assessment Guidance for Superfund (RAGS), and other current USEPA/USEPA Region II resources and guidance documents as noted throughout this section and on the RAGS Part D tables provided in **Appendix C**. Additional information regarding the site background can be found in **Section 1.2**. This HHRA consists of the following six sections:

- **Section 5.1**: Data Summary and Selection of chemicals of potential concern (COPCs): Relevant site data are gathered, examined, and discussed. Basic constituent statistics and screening levels (SLs) are summarized. COPCs are identified by comparison to screening criteria as discussed in **Section 5.1.2**.
- **Section 5.2**: Exposure Assessment: Potentially exposed populations (e.g., receptors) and exposure routes are identified, and exposure point concentrations (EPCs) are calculated for COPCs. Standard exposure factors and health-protective assumptions are used to assess the magnitude, frequency, and duration of exposure for each exposure route.
- **Section 5.3**: Toxicity Assessment: Toxicity criteria for COPCs are compiled and presented.
- **Section 5.4**: Risk Characterization: Quantitative risks and hazards are estimated and summarized by combining toxicity criteria with intakes for each exposure route.
- **Section 5.5**: Uncertainties Analysis: Uncertainties, "including uncertainties in the physical setting definition for the site, in the models used, in the exposure parameters, and in the toxicity assessment" (USEPA, 1989) are discussed.
- **Section 5.6**: Summary and Conclusions: The results of the HHRAs are summarized.

The tabulated risk assessment results are presented in accordance with USEPA guidance described in RAGS: Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (USEPA, 2001a). RAGS D requires the risk assessment results to be presented in a series of standardized tables, which are presented in **Appendix C**.

5.1 DATA SUMMARY AND SELECTION OF COPCS

5.1.1 Data Summary

Table 5-1 identifies the soil, surface water, sediment, and groundwater samples used in the HHRA for the former Skeet Range. For purposes of this risk assessment, only data from the June 2010 investigation and the 2011 RI were used. The sampling date for each sample used in the HHRA is also provided in **Table 5-1** to indicate the associated investigation. The complete data tables for detected analytes for each media are provided under the Tables tab. Additional information regarding the data used in the HHRAs is summarized below:

- If a constituent was measured by two methods, results from the more robust analytical method were used.
- J-flagged data (estimated concentration) were considered detections and were used without modification.
- The qualification and validation of the analytical data included a comparison of the site data to corresponding blank (laboratory, equipment rinse, field, and trip) concentration data. If the detected concentration in a site sample was less than ten times (for common laboratory contaminants) or five times (for other compounds) the concentration in the corresponding blank sample, the sample was qualified with a "B." According to USEPA Region II data validation

guidance (USEPA, 1994, 2004), confirmed blank-related sample results were flagged as nondetect or detect during the data validation, depending on what type of blank sample the analyte was detected in, concentrations exceeding the five times or ten times blank concentrations (see above) were used "as is" in the HHRAs.

- Rejected results (R-flagged) were not used.
- Data from duplicate sample pairs were averaged and treated as one result. If an analyte was detected in one of the sample pair, one half the detection limit of the non-detect was averaged with the detected result and the result was considered detected.

Additional information regarding specific soil, sediment, surface water, and groundwater samples used in the HHRA is provided in **Section 5.1.1.1**.

5.1.1.1 Former Skeet Range

Surface Soil and Total Soil

The soil samples used for COPC screening of the former Skeet Range were collected during the RI. As presented in **Table 5-1**, the soil samples for the Site were divided into surface soil (0 to 1.0 ft bgs) and total soil (0 to 10 ft bgs). The total soil data grouping was assembled by combining the surface and subsurface soil data sets to address mixing of potential soil contamination during construction or land development activities. A total of 40 surface soil samples including duplicates and 45 total soil samples including duplicates were used in the HHRA for the former Skeet Range. Note, not every chemical was analyzed in every soil sample.

Groundwater

Sample results from groundwater monitoring wells were considered representative of the former Skeet Range and these results were used in the HHRA. A total of 12 groundwater samples (including duplicates) were collected at the Site via monitoring wells and used in the HHRA. These sample locations are listed in **Table 5-1**.

Surface Water

Surface water samples collected during the RI were used for the COPC screening for former Skeet Range surface water. A total of six surface water samples, including duplicates, were collected from the Site. Note, not every chemical was analyzed in every surface water sample. These sample locations are listed in **Table 5-1**.

Sediment

Sediment samples collected during the RI were used for the COPC screening for former Skeet Range sediment. A total of 12 sediment samples, including duplicates, were collected from the Site. Note, not every chemical was analyzed in every sediment sample. These sample locations are listed in **Table 5-1**.

5.1.2 Identification of COPCs

COPCs were identified for the Sites by comparing the maximum detected concentration (MDC) with the following risk-based screening levels (SLs) for each media: USEPA residential (r)-SLs (surface soil, total soil and sediment) and USEPA tapwater (tw)-SLs (surface water and groundwater) as presented in the June 2011 USEPA Regional Screening Table (USEPA, 2011a). In accordance with USEPA regional guidance, SLs for non-carcinogenic chemicals were adjusted downward to a hazard quotient (HQ) of 0.1 to ensure that chemicals with additive effects were not prematurely eliminated during screening. Although current and future land uses at former Skeet Range are most likely to remain industrial in nature, r-SLs (rather than industrial) were used for comparisons with soil concentrations. Because the residential scenario is evaluated for this HHRA, r-SLs were used to screen chemicals in soil as a conservative measure. In addition, a lead action level of 400 mg/kg for residential receptors was used in the COPC identification since toxicity criteria were not available for lead, and an action level of 0.015 mg/L was used for groundwater and surface water (USEPA, 1994).

For some COPCs without screening levels, the values used for screening were based on surrogate chemicals with similar structures and properties. The surrogates for this HHRA were based on proxy compounds as identified on each COPC selection table. Virginia's Department of Environmental Quality (VDEQ's) Risk Assessment Guidance, Risk-Based Screening Levels Proxy Values (VDEQ, 2010) was also used as a guide.

The essential nutrients calcium, magnesium, potassium and sodium were eliminated as COPCs. Although iron is also an essential nutrient, there is an SL available for iron. If iron concentrations in soil, sediment, or water resulted in an HQ of 1.0 or greater, a "margin of exposure" evaluation was also performed. If needed, risks from exposure to iron were characterized by comparing estimated iron intake to the Recommended Daily Allowance (RDA) and concentrations known to cause effects in children (USEPA, 1996a).

Analytes detected at a maximum concentration greater than the corresponding adjusted SL or screening values identified above for iron and lead were selected as COPCs. Analytes for which no screening criteria exist were also selected as COPCs if toxicity data are known or suspected to exist. COPC screening tables for the former Skeet Range are presented as follows in **Appendix C**:

- Table 2.1: Surface Soil
- Table 2-2: Total Soil
- Table 2.3: Groundwater
- Table 2.4: Surface Water
- Table 2.5: Sediment

A summary of former Skeet Range COPCs, by media, are presented in **Table 5-2**, with the number of selected COPCs presented below:

- 11 COPCs were selected in surface soil,
- 11 COPCs were selected in total soil,
- Four COPCs were selected in groundwater,
- Four COPCs were selected in surface water, and
- Six COPCs were selected in sediment.

5.2 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate "the type and magnitude of exposures to chemicals of potential concern" (USEPA, 1989). When combined with chemical-specific toxicity information (summarized in the toxicity assessment), these exposures produce estimations of potential risks.

5.2.1 Conceptual Site Model/Receptor Characterization

A conceptual site model (CSM) for the former Skeet Range is presented on **Figure 5-1** for current and future exposure scenarios. Table 1 (**Appendix C**) presents the rationale for the selection of current and future receptor populations quantified in the HHRA.

The general land use at the former Skeet Range is commercial/industrial. Currently, no Picatinny Arsenal workers are employed at the Site. The marshy condition of the Site limits the potential land use. However, future land use may include residential development, if Picatinny undergoes Base Realignment and Closure (BRAC), thus future residential adults and children are evaluated as potential receptors to former Skeet Range media.

As the former Skeet Range will likely remain in its current commercial/industrial status, the most likely receptors at the former Skeet Range are routine workers, who work at the adjacent sites such as the former Burning Ground on a regular basis. As a result, routine workers are evaluated in the HHRA. Other receptors include construction workers that may perform intrusive work to repair underground

utilities or construct future buildings. Although other receptors, such as caretakers, maintenance workers, trespassers, or on-site adult visitors, may be present at the former Skeet Range, they are not quantified in the HHRA as compelling information does not exist to suggest these receptors would be more exposed to Skeet Range constituents, (e.g., the COPC dose would not be greater than for the routine worker or the construction worker). Since the Site may become BRAC in the future, and the area could become residential, future child and adult residents are evaluated as potential receptors in the HHRA.

Potential exposure pathways associated with groundwater at the former Skeet Range are considered for evaluation in the HHRA. Currently, impacted groundwater beneath the former Skeet Range is not used as a drinking water source, and drinking water used at Picatinny is obtained from treated on-base supply wells. As a result, there are no complete direct exposure pathways for groundwater under current land-use conditions. Although groundwater is not expected to be used at the former Skeet Range, future exposure scenarios (including ingestion, dermal contact, and inhalation) for potential residential and routine worker exposures is quantified, as appropriate for the selected COPCs. It should be noted that the closest water supply well to the former Skeet Range is located approximately 7,000 feet upgradient of the Skeet Range.

Groundwater inhalation exposure for a construction worker in a trench could occur under the current/future timeframe, and this exposure pathway was to be quantified (as stated in the Work Plan; Shaw, 2011) using the VDEQ (2008) Trench Model (as NJDEP does not currently recommend a Trench Model of their own). However, as no volatile organic compounds (VOCs) were selected in ground water (**Table 5-2**), this pathway is considered incomplete. Offgassing of VOCs from groundwater through the vadose zone to outdoor ambient air is also an incomplete pathway, as no groundwater VOC COPCs were selected.

Potential exposure pathways associated with surface soil at the former Skeet Range are considered under both current and future land-use conditions. The major exposure pathways by which routine workers could be exposed to surface soil contamination are via incidental ingestion and dermal absorption. Accordingly, these pathways are evaluated for routine workers in the HHRA. Exposures due to inhalation of airborne contaminants released from soil are also evaluated.

For potential exposure to sediment and surface water for the future adult and child resident, it is assumed contact occurs twice a week for the warmer months of the year (spring, summer, and fall; 39 weeks x 2 times per week), for a total of 78 days per year.

Ground-intrusive or excavation activities may infrequently take place at the former Skeet Range under current land-use conditions and may occur more frequently in the future if development occurs. Therefore, potential construction/excavation worker exposures to chemicals in total soil (surface plus subsurface soil) could occur via incidental ingestion, dermal absorption, and inhalation and these pathways are quantified in the HHRA.

In summary, the following pathways are quantitatively evaluated in the HHRA:

- Incidental ingestion, dermal absorption and inhalation of chemicals in surface soil (0-1 feet) by current and future routine workers;
- Incidental ingestion, dermal absorption and inhalation of chemicals in total soil (surface plus subsurface soil, 0-10 feet) by future adult and child residents;
- Incidental ingestion, dermal absorption, and inhalation of chemicals in total soil (surface plus subsurface soil, 0-10 feet) by current and future construction workers;
- Ingestion and dermal absorption of chemicals in groundwater by potential on-site future adult and child receptors and potential future routine workers; and
- Ingestion and dermal absorption of chemicals in surface water and sediment by current and future routine workers, and future adult and child residents.

As indicated on **Figure 5-1**, the potential human receptors evaluated in the HHRA were as follows:

- **Current and Future Routine Base Worker**. Exposure scenario represents upper bound exposure for all general office and other industrial personnel whose exposure is primarily limited to surface soil, but for many years duration. Surface water and sediment exposures were also evaluated, as well as exposure to groundwater, assuming groundwater is developed as a drinking water supply in the future.
- **Current and Future Construction Worker**. Exposure scenario represents upper bound exposure for those personnel that may involve more intensive, deeper soil exposure (up to 10 ft bgs) for periods up to 1 year. Although the depth to groundwater at the former Skeet Range is generally between approximately one and five ft bgs, incidental exposure to groundwater in a trench via dermal contact and incidental ingestion was not included, as groundwater is not expected to infiltrate into the bottom of a trench due to pre-construction groundwater dewatering that would typically be required for safe subsurface construction activities.
- **Future Adult/Child Resident**. Exposure scenario represents upper bound exposures for hypothetical adult and child residents whose exposures were assessed for surface soil (0-1 ft bgs) and total soil (0-10 feet bgs). Surface water and sediment exposures were also evaluated, as well as exposure to groundwater. Exposure to surface soil was quantified in the Risk Characterization of the HHRA, while potential exposure to total soil was assessed in the Uncertainty Section of the HHRA. This approach was taken because exposures to surface soil are more likely than exposures to total soil; although exposures to total soil are possible if the Site is redeveloped for residential purposes.

5.2.2 Identification of Exposure Pathways

The potential receptors identified for the Site include routine base workers, construction workers, adult residents, and child residents. It should be noted that lifetime resident's cancer risk is estimated by adding together the estimated cancer risks for adult residents and child residents. Site Table 1 (**Appendix C**) summarizes the selection of exposure pathways for each receptor listing the rationale for the inclusion or exclusion of each pathway at the former Skeet Range, while **Figure 5-1** illustrates which receptors are exposed to Site media.

5.2.3 Calculation of EPCs

To calculate intakes, a 95% upper confidence limit of the mean concentration (95% upper confidence limit; UCL) for each COPC is used as a conservative estimate of the average concentration in a given environmental medium to which a receptor would be exposed. The 95% UCL estimate is referred to as the EPC. The 95% UCL is used rather than the mean concentration, to account for uncertainty when estimating EPCs from sample data (USEPA, 1989). Methods used to calculate 95% UCLs are based on guidance provided in the documents Calculating UCLs for EPCs at Hazardous Waste Sites (USEPA, 2002a) and ProUCL Version 4.00.100 Technical Guide (USEPA, 2010a).

In general, the method used to calculate a 95% UCL depends on: 1) the prevalence of non-detects, 2) the data distribution (e.g., normal, gamma, lognormal, or nonparametric), and 3) number of samples. Non-detect results introduce uncertainty in the data set because the true concentration may be between zero to just below the detection limit. Therefore, distributional assumptions are difficult to ascertain for COPCs with a high rate of non-detects. EPA's (2010a) ProUCL 4.00.100 statistical program was used to estimate 95% UCL values for nearly all the COPC data sets. For data sets with non-detects with multiple detection limits, ProUCL uses the Kaplan-Meier estimation method to derive a recommended 95% UCL (USEPA, 2010a). Where ProUCL recommends the results of more than one statistical approach, the most conservative (highest) 95% UCL value was used in the HHRA. In some cases where fewer than approximately one to two samples had detected values, ProUCL does not recommend a 95% UCL value. For these cases, as a conservative approach, the MDC was used as the EPC.

EPCs for soil (surface and total), groundwater, surface water, and sediment COPCs are presented in Tables 3.1 through 3.5 (**Appendix C**). The output from ProUCL 4.00.100 is provided for the former Skeet Range in Attachment A to **Appendix C**).

Modeling of concentrations of COPCs in indoor air from household use of groundwater, and modeling concentrations of COPCs in trench air from *in-situ* groundwater were not needed, as no organics were selected as COPCs in groundwater (**Table 5-2**).

5.2.4 Quantification of Exposure: Calculation of Daily Intakes

For each receptor and pathway, chronic daily intake (CDI, expressed as milligrams of COPC per kilogram body weight per day) for each COPC is estimated by combining the EPC with exposure parameters such as ingestion rate, frequency of contact, duration, and frequency of exposure. In addition, intake parameters are selected so the combination of intake variables results in an estimate of the reasonable maximum exposure for that pathway (USEPA, 1989). Intake formulas, exposure parameters, and chemical-specific parameters for each of the receptors for the Site is provided in Tables 4.1 through 4.16 (**Appendix C**). Intake equations shown in **Appendix C** Tables 4.1 through 4.16 are all from RAGS A (USEPA, 1989), except the dermal equations that are from RAGS-E (USEPA, 2004) and the inhalation equations that are from RAGS-F (USEPA, 2009d).

The particulate emission factor (PEF) used to calculate an inhalation daily intake associated with soil was calculated in accordance with the Supplemental Guidance for Developing Soil SLs for Superfund Sites (USEPA, 2002b). The PEF for the Site is provided in Attachment B **(Appendix C**).

For exposures to surface water and groundwater via dermal contact, the amount of chemical in water absorbed through the skin must be estimated in order to calculate the dose used in the intake formula. The dose absorbed per unit area per event (DA) is a function of the chemical concentration in water, the permeability coefficient for that chemical from water through the skin, and exposure time. Following USEPA (2004) guidance, receptor-specific DA values were calculated for surface water and groundwater using USEPA's worksheet (2001b) and chemical-specific parameters. The DA values for the Site are described in Attachment C **(Appendix C**).

In the event that excavation work is performed at the Site, the construction worker may be exposed to volatile emissions from groundwater in the bottom of a trench. While USEPA does not have a standardized model for estimating concentrations of airborne VOCs in a trench or a pit, the VDEQ provides such a model on their Voluntary Remediation Program (VRP) web site (VDEQ, 2010). However, as no organics were selected as COPCs in groundwater (**Table 5-2**), this transport model was not required.

Similarly, the EPCs for VOCs in air due to volatilization from Site groundwater were to be estimated for the household use of groundwater, using the volatilization factor (K) from Andelman (1990), as cited in USEPA (1991c). However, as no VOCs were selected as COPCs in groundwater (**Table 5-2**), this transport model was not required.

5.3 TOXICITY ASSESSMENT

The methodology used for classifying health effects from exposure to chemicals followed that recommended by USEPA (2011a). The health effects analysis considers chronic (long-term) exposures. Using the following hierarchy (USEPA, 2003a), the chronic toxicity criteria were obtained from:

- Tier 1 – Integrated Risk Information System (IRIS) (USEPA, 2011b).
- Tier 2 – Provisional Peer Reviewed Toxicity Values (PPRTVs) - as developed on a chemical-specific basis by the Office of Superfund Remediation and Technology Innovation (USEPA, 2011c), and as summarized on the USEPA Regional SL Table (USEPA, 2011a).
- Tier 3 – Other Toxicity Values – including additional USEPA and non-USEPA sources of toxicity information, such as the Agency for Toxic Substances Disease Registry (ATSDR) Minimum Risk Levels (MRLs), California Environmental Protection Agency, and the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a).

Toxicity criteria used to quantify non-carcinogenic hazards (reference doses – RfDs and reference concentrations - RfCs) and carcinogenic risks (slope factors – CSFs and inhalation unit risks - IURs) are presented for the Site in Tables 5.1, 5.2, 6.1, and 6.2 (**Appendix C**).

Dermal toxicity factors were estimated from oral toxicity data using chemical-specific oral to dermal adjustment factors recommended in USEPA (2011a), as presented for the Site Tables 5.1 and 6.1 (**Appendix C**).

5.3.1 Calculations for COPCs with Mutagenic Mode of Action

Six PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenzo[ah]anthracene, and indeno[123cd]-pyrene) were COPCs in soil at the Site, and benzo[b]fluoranthene was a COPEC in sediment. USEPA has determined that these compounds have a mutagenic mode of action (USEPA 2005, 2008, 2011a). Adjusting for early life susceptibility would result in higher risk estimates; therefore, this adjustment was performed.

The adult/lifetime cancer risks for the six mutagenic PAHs were calculated using USEPA cancer slope factors that ranged from 7.3E-2 to 7.3E+0 $(mg/kg\text{-}day)^{-1}$ (**Appendix C** Table 6.1), with benzo(a)pyrene and dibenzo(ah)anthracene having the highest slope factor of 7.3E+0 $(mg/kg\text{-}day)^{-1}$. Mutagenic PAH cancer risks were quantified by applying age-dependent adjustment factors (ADAFs). The following ADAFs were applied: 10 for ages 0-2, 3 for ages 2-16, and 1 (i.e., no adjustment) for years 16 and older. In the following example calculations, cancer risks associated with benzo(a)pyrene in surface soil at the Site are shown for the ingestion and dermal exposure pathways. Calculation details for all mutagenic PAHs are presented in **Appendix C** Attachment F.

<u>Benzo(a)pyrene Soil Ingestion Exposure</u>

- Ages 0-2

$$\frac{7.1 mg/kg\ x\ 0.0002 kg/day\ x\ 350 days/yr\ x\ 2 yr}{365 days/yr\ x\ 70 yr\ x\ 15 kg}\ x\ \frac{7.3}{mg/kg/day}\ x\ 10 = 1.9E-04$$

- Ages 2-6

$$\frac{7.1 mg/kg\ x\ 0.0002 mg/day\ x\ 350 days/yr\ x\ 4 yr}{365 days/yr\ x\ 70 yr\ x\ 15 kg}\ x\ \frac{7.3}{mg/kg/day}\ x\ 3 = 1.1E-04$$

- Ages 6-16

$$\frac{7.1 mg/kg\ x\ 0.0001 mg/day\ x\ 350 days/yr\ x\ 10 yr}{365 days/yr\ x\ 70 yr\ x\ 70 kg}\ x\ \frac{7.3}{mg/kg/day}\ x\ 3 = 3.0E-05$$

- Ages 16-30

$$\frac{7.1 mg/kg\ x\ 0.0001 mg/day\ x\ 350 days/yr\ x\ 14 yr}{365 days/yr\ x\ 70 yr\ x\ 70 kg}\ x\ \frac{7.3}{mg/kg/day}\ x\ 1 = 1.4E-05$$

<u>Total Benzo(a)pyrene Soil Ingestion Risk</u>

(1.9 E-04) + (1.1 E-04) + (3.0 E-05) + (1.4 E-05) = 3.4 E-04

<u>Benzo(a)pyrene Soil Dermal Exposure</u>

- Ages 0-2

$$\frac{7.1 \text{mg/kg x } 0.2 \text{ mg/cm}^2 \text{ x } 0.13 \text{ x } 2800 \text{ cm}^2\text{/day x 1E - 6 kg/mg x } 350 \text{ days / yr x } 2 \text{ yr}}{365 \text{ days / yr x } 70 \text{ yr x } 15 \text{ kg}}\ \text{x}\ \frac{7.3}{\text{mg / kg / day}}\ \text{x}\ 10 = 6.9\text{E} - 05$$

- Ages 2-6

$$\frac{7.1 \text{mg/kg x } 0.2 \text{ mg/cm}^2 \text{ x } 0.13 \text{ x } 2800 \text{ cm}^2\text{/day x 1E - 6 kg/mg x } 350 \text{ days / yr x } 4 \text{ yr}}{365 \text{ days / yr x } 70 \text{ yr x } 15 \text{ kg}}\ \text{x}\ \frac{7.3}{\text{mg / kg / day}}\ \text{x}\ 3 = 4.1\text{E} - 05$$

- Ages 6-16

$$\frac{7.1\text{mg/kg x } 0.07\text{ mg/cm}^2 \text{ x } 0.13 \text{ x } 3300\text{ cm}^2\text{/day x1E - 6 kg/mg x } 350\text{ days/ yr x } 10\text{ yr}}{365\text{ days/ yr x } 70\text{ yr x } 70\text{ kg}} \text{ x } \frac{7.3}{\text{mg / kg / day}} \text{ x } 3 = 9.1\text{E} - 06$$

- Ages 16-30

$$\frac{7.1\text{ mg/kg x } 0.07\text{ mg/cm}^2 \text{ x } 0.13 \text{ x } 3300\text{ cm}^2\text{/day x 1E - 6 kg/mg x } 350\text{ days / yr x } 14\text{ yr}}{365\text{ days / yr x } 70\text{ yr x } 70\text{ kg}} \text{ x } \frac{7.3}{\text{mg / kg / day}} \text{ x } 1 = 4.3\text{E} - 06$$

Total Benzo(a)pyrene Soil Dermal Risk

(6.9 E-05) + (4.1 E-05) + (9.1 E-06) + (4.3 E-06) = 1.2 E-04

Summary of PAH Mutagenic Mode of Action

The mutagenic mode of action for relevant PAHs in soil and sediment was quantitatively assessed for cancer risks in the HHRA. As mentioned previously, calculation details are presented in **Appendix C** Attachment F, and **Appendix C** RAGS-D Tables include mutagenic cancer risks.

5.3.2 Evaluation of Lead

Quantitative oral toxicity criteria are not available for lead. The potential risks associated with residential child exposures to lead are addressed using the Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model for Windows®, (USEPA, 1994, 2002c, 2010b). The IEUBK model was designed to provide predictions of the probability of elevated blood lead levels for children. This model addresses three components of environmental risk assessments: the multimedia nature of exposures to lead, lead pharmacokinetics, and significant variability in exposure and risk, through estimation of probability distributions of blood lead levels for children exposed to similar environmental concentrations. The model output includes probability distribution and density plots, predicted geometric mean blood lead levels, and the percentages of the population potentially experiencing concentrations above 10 µg/dL (below which adverse manifestations are not expected). The lead risks are considered unacceptable if the child-blood lead level for more than 5 percent of children is estimated to equal or exceed the Centers for Disease Control and Prevention concern threshold of 10 micrograms per deciliter (µg/dL).

USEPA's Adult Lead Model (ALM) (USEPA, 2003b), is typically used to evaluate risks associated with nonresidential adult exposures to lead in soil. This model assesses potential lead exposures for an adult pregnant female, and estimates the probability that fetal blood lead exceeds the Centers for Disease Control and Prevention concern threshold of 10 µg/dL.

Lead was selected as a COPC in the following Site media, with EPCs and arithmetic mean concentrations as follows:

- Surface soil: EPC = 25,200 mg/kg; mean = 5,883 mg/kg (**Appendix C**, Table 3.1)
- Total soil: EPC = 23,300 mg/kg; mean = 5,510 mg/kg (**Appendix C**, Table 3.2)
- Sediment: EPC = 186,000 mg/kg; mean = 30,900 mg/kg (**Appendix C**, Table 3.5)

When applying the IEUBK Model and the ALM, the input value for the lead concentration is typically based on the arithmetic mean concentration for lead in the medium of interest. As the mean surface soil lead concentration in soil is greater than the mean concentration in total soil, the surface soil concentration is used. A separate assessment for lead in sediment is performed.

Based on the results of the IEUBK Model (**Appendix C** Attachment E-1), the estimated geometric mean blood lead level is 29.4 µg/dL for child exposure to surface soil, with an estimated 98.9 percent probability that the potentially exposed population would have a blood lead level that exceeds the Centers for Disease Control and Prevention concern threshold of 10 µg/dL.

Based on the results of the IEUBK Model (**Appendix C** Attachment E-2), the estimated geometric mean blood lead level is 76.4 µg/dL for child exposure to sediment, with an estimated 99.9 percent probability that the potentially exposed population would have a blood lead level that exceeds the

Centers for Disease Control and Prevention concern threshold of 10 µg/dL. It should be noted that environmental exposures associated with blood lead levels above 30 µg/dL are above the range of values that have been used in the calibration and empirical validation of the model; therefore, these results have an elevated component of uncertainty.

To evaluate exposure of adults to lead in surface soil and sediment, the ALM was used. This model assesses potential lead exposures for an adult pregnant female, and estimates the probability that fetal blood lead exceeds the Centers for Disease Control and Prevention concern threshold of 10 µg/dL. Based on the results of the ALM (**Appendix C** Attachment E-3), the estimated 95th percentile fetal blood lead level is 22 to 30 µg/dL for adult exposure to surface soil, with an estimated 39 to 44 percent probability that the potentially exposed fetal population would have a blood lead level that exceeds the Centers for Disease Control and Prevention concern threshold of 10 µg/dL.

Based on the results of the ALM (**Appendix C** Attachment E-4), the estimated 95th percentile fetal blood lead level is 108 to 140 µg/dL for adult exposure to sediment, with an estimated 97 to 99 percent probability that the potentially exposed fetal population would have a blood lead level that exceeds the Centers for Disease Control and Prevention concern threshold of 10 µg/dL.

These lead model results, summarized in **Table 5-3**, demonstrate that lead in surface soil and sediment at the former Skeet Range exceed, by a considerable amount, safe exposure levels associated with blood lead levels less than 10 µg/dL. The probability that lead in surface soil would result in unacceptable child blood lead levels is 98.9 percent, and 99.9 percent for sediment, while the probability that lead in surface soil would result in unacceptable adult worker fetal blood lead levels is up to 44 percent, and up to 99 percent for sediment. As all these estimates exceed the 5 percent threshold, potential lead exposure is unacceptable, per Centers for Disease Control and Prevention recommendations.

5.3.3 Evaluation of Chromium

As chromium speciation data were not collected at the Site, it is not know if hexavalent chromium is actually present. Chromium was conservatively assessed in the selection of COPCs (**Section 5.1.2**) by assuming total chromium analytical results were hexavalent chromium. For the risk characterization, however, total chromium was assumed to be trivalent chromium and chemical-specific toxicity data for trivalent chromium were used in the risk and hazard calculations. This approach was taken because there is no documentation of hexavalent chromium being used or released at the former Skeet Range.

5.4 RISK CHARACTERIZATION

Quantitative risks and hazards due to exposure to COPCs are estimated and summarized by combining toxicity criteria (presented in the Toxicity Assessment) with CDIs (calculated in the Exposure Assessment). Methods used to calculate risks and hazards are taken from USEPA (1989).

For exposures to potential carcinogens, the individual upper-bound excess lifetime cancer risk was calculated by multiplying the estimated CDI by the CSF. In order to assess the individual excess lifetime cancer risks associated with simultaneous exposure to COPCs, the risks derived from the individual chemicals are summed within each exposure pathway. For the residential scenario, carcinogenic risk was evaluated for the lifetime resident by adding together estimated cancer risks for adult and child residential receptors.

Non-carcinogenic adverse health effects were calculated by dividing the CDI of each COPC by its RfD, resulting in a HQ. HQs with a value greater than one (1.0) indicate the potential for adverse health effects. To estimate non-carcinogenic adverse health effects due to simultaneous exposure to several COPCs, HQs for individual COPCs were summed within each exposure pathway that resulted in a HI. As with HQs, HIs that are greater than 1.0 indicate potential adverse health effects. In such cases, COPCs were divided into categories based on the target organ affected (e.g., liver, kidney) and target organ-specific HIs were recalculated. Non-carcinogenic hazards were evaluated for both child and adult residents independently.

Excess lifetime cancer risks derived in this report were compared with USEPA's acceptable risk range for Superfund sites of 1.0E-06 to 1.0E-04 (USEPA, 1989), where the threshold of 1.0E-6 is considered by USEPA to be the point of departure for *de minimis* risk. In addition, USEPA's Office of

Solid Waste and Emergency Response has issued a directive (USEPA, 1991a) clarifying the role of HHRA in the Superfund process. The directive states that, if the cumulative carcinogenic risk to a receptor (based on reasonable maximum exposure for both current and future land use) is less than 1.0E-04 and the non-carcinogenic HI is equal to or less than 1, action generally is not warranted unless adverse environmental effects are likely.

Calculation of risks and hazards due to exposure to COPCs are provided for the former Skeet Range in Tables 7.1 through 7.9 (**Appendix C**). A summary of risks and HIs for each receptor, using RAGS-D table format, is presented for the Site in Tables 9.1 through 9.4 (**Appendix C**). It should be noted that no Tables 8s are presented in **Appendix C** because no radiological COPCs were selected for the former Skeet Range, and RAGS-D Table 8s are only used for radiological COPCs. The former Skeet Range risks and hazards are summarized in **Table 5-3**.

As presented in **Table 5-3** for the former Skeet Range, the total cancer risk for the current routine worker (8.8E-5) is within the acceptable risk range of 1.0E-6 to 1.0E-4, with the COPCs with estimated cancer risks greater than 1.0E-6 being benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, and benzo(a)anthracene in surface soil, and arsenic in surface water and sediment (groundwater is not an exposure medium for the current worker, as on-site groundwater is not used as a drinking water supply). The total HI of 1.7 is above the threshold of concern, with the hazard driver being antimony in sediment. For the future routine worker, the total cancer risk (2.0E-4) is above the acceptable risk range of 1.0E-6 to 1.0E-4, due primarily to benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, and benzo(a)anthracene in surface soil, and arsenic in surface water, sediment, and groundwater. The total HI of 5.2 is above the threshold of concern, primarily due to antimony in sediment and manganese in groundwater. For the current/future construction worker, the total cancer risk (2.0E-6) is within the acceptable risk range of 1.0E-6 to 1.0E-4, with no individual risk drivers identified. The total HI of 0.2 is below the threshold of concern. For the future hypothetical adult resident exposed over a lifetime, the total cancer risk (1.5E-3) exceeds the acceptable risk range of 1.0E-6 to 1.0E-4, due primarily to benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, benzo(a)anthracene, and indeno(123cd)pyrene in surface soil, and arsenic in surface water, sediment, and groundwater. The total HI for a future hypothetical adult resident is 13 primarily due to antimony in surface water and sediment, and manganese and arsenic in groundwater. For the future hypothetical child resident, the total cancer risk (1.1E-3) is above the acceptable risk range of 1.0E-6 to 1.0E-4, due primarily to benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, benzo(a)anthracene, and indeno(123cd)pyrene in surface soil, and arsenic in surface water, sediment, and groundwater. The total HI for a future hypothetical child resident is 76, primarily due to antimony in surface water, antimony and arsenic in sediment, and manganese, arsenic, and iron in groundwater.

A refinement of the HIs based on target organs was conducted by calculating HIs on a target organ-specific basis, as shown in the noncarcinogenic table columns for the Site in Tables 9.1 through 9.5 (**Appendix C**). However, refinement by target organ did not reduce the estimated hazard below 1.

In addition, Tables 10.1 through 10.4 for the Site (**Appendix C**) present the summarized risks and hazards for risk and hazard drivers (i.e., those COPCs having a risk greater than 1.E-6 or a total hazard greater than 1.0).

5.4.1 Iron Margin of Exposure Evaluation

Because the iron concentration in groundwater at the former Skeet Range resulted in an HQ of 0.5 or higher for the child resident, a “margin of exposure evaluation” was conducted. This evaluation consisted of a comparison of estimated intake of iron to the RDA and concentrations known to cause adverse health effects in children. The calculated intake of iron via the route of ingestion was compared with amounts that are associated with an RDA of 10 mg/day (0.36 to 1.11 mg/kg-day) for children from 6 months to 10 years of age (USEPA, 1996a).

For the Site, the calculated child intake of iron via hypothetical ingestion of surface soil, groundwater, surface water and sediment was approximately 1.4 mg/kg-day (**Appendix C** Table 7.8). Thus, the calculated iron intake at the former Skeet Range (mostly from groundwater ingestion) was above the RDA of 10 mg/day (0.36 to 1.11 mg/kg-day).

5.4.2 Background

Statistical evaluations were conducted to compare metal and PAH concentrations (for risk and/or hazard drivers) in soil, surface water, sediment, and groundwater at the former Skeet Range with site-specific background concentrations (IT Corporation, 2002), or if unavailable from IT (2002), using 95th percentile background threshold values (BTVs) from NJDEP (2002, 2003). It should be noted that no site-specific or regional groundwater background concentrations are available.

The metal and PAH COPCs identified as having an estimated cancer risk greater than 1.0E-6 or a hazard greater than 1.0 in soil, surface water, sediment, and groundwater were selected for the background evaluation, as listed in **Table 5-4**.

As a first step in the background evaluation, maximum Site concentrations were compared with BTVs from IT (2002) for metals in soil, sediment, and surface water, and using 95th percentile BTVs from NJDEP (2002, 2003) for PAHs in soil. If MDCs exceeded the BTVs by only a moderate amount, than a refined background statistical evaluation was considered. This refined evaluation, if performed, would follow the procedures outlined in the USEPA Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (USEPA, 2002d) and would be conducted using USEPA's ProUCL 4.00.100 statistical program. Statistical analyses could include distribution testing of Site data sets and background data sets, evaluation of data using descriptive summary statistics, and comparisons of Site data to background.

For the former Skeet Range metal and PAH COPCs that were risk and/or hazard drivers, the MDCs were compared with BTVs in **Table 5-4**. It should be noted that dibenzo(ah)anthracene was not detected in the NJDEP (2002,2003) background data base, therefore comparisons with this PAH could not be made, and antimony was not analyzed in the IT (2002) site-specific background data base for surface water, therefore comparisons with this metal in surface water could not be made.

Based on comparisons presented in **Table 5-4**, the only COPC risk drivers found to be related to background were iron in sediment, and benzo(b)fluoranthene in sediment when the soil BTV was used as a surrogate for sediment.

A more refined background statistical analysis was not performed for the Site-related PAH and metal COPCs shown on **Table 5-4** due to the finding that the MDCs of these COPCs were considerably above the BTVs.

In conclusion, except for iron and benzo(b)fluoranthene in sediment, the rest of the Site risk driver PAHs and metals are expected to be related to the former Skeet Range.

5.5 UNCERTAINTIES

Risk assessments involve the use of assumptions, judgments, and incomplete data to varying degrees that contribute to the uncertainty of the final estimates of risk. Uncertainties result both from the use of assumptions or models in lieu of actual data and from the error inherent in the estimation of risk related parameters and may cause risk to be overestimated or underestimated. Based on the uncertainties described below, this risk assessment should not be construed as presenting an absolute estimate of risk to persons potentially exposed to COPCs.

Consideration of the uncertainty attached to various aspects of the risk assessment allows better interpretation of the risk assessment results and understanding of the potential adverse effects on human health. In general, the primary sources of uncertainty were associated with environmental sampling and analysis, selection of chemicals for evaluation, toxicological data, exposure assessment, and background. The effects of these uncertainties on the risk estimates are discussed below.

5.5.1 Environmental Sampling and Analysis

If the samples do not adequately represent media at the former Skeet Range, hazard/risk estimates could be overestimated or underestimated. The sampling and analysis plan was designed to investigate known or anticipated areas of contamination and delineate area(s) of concern. Therefore, there was less chance that the hazard/risk estimates were biased low. Also, if the analytical methods used do not apply to some chemicals that are present at each area, risk could be underestimated. Because the analytical methods at the Site were selected to address all chemicals that are known or

suspected to be present on the basis of the history of each area, the potential for not identifying a COPC was reduced.

Uncertainty in environmental chemical analysis can stem from several sources including errors inherent in the sampling or analytical procedures. Analytical accuracy errors or sampling errors can result in rejection of data, which decreases the available data for use in the HHRA, or in the qualification of data, which increases the uncertainty in the detected chemical concentrations. There is uncertainty associated with chemicals reported in samples at concentrations below the method reporting limit but still included in data analysis and with those chemicals qualified "J" indicating that the concentrations are estimated. Another issue involves the amount of blank related (i.e., B-qualified) data in the data set. However, as discussed in Section 4.1, B-qualified data were used in the HHRA, either as is, or treated as a nondetect, per USEPA Region 2 Data Validation guidelines.

Another uncertainty associated with sampling and analysis concerns the inclusion of chemicals that are potentially present in the environment due to anthropogenic sources. For example, PAHs are considered ubiquitous in soil from anthropogenic sources, such as combustion. If such chemicals are not site-related, the risks associated with the site may be overestimated. This uncertainty may have a low-to-moderate effect on overestimating risks. However, based on comparison with NJ Highlands background soil data, PAHs at the former Skeet Range surface soil were determined to be above background (**Table 5-4)**.

5.5.2 Selection of Chemicals for Evaluation

A comparison of maximum detected chemical concentrations with USEPA Regional SLs was conducted for surface soil, total soil, surface water, sediment, and groundwater. Chemicals with maximum concentrations below their respective SLs were not carried through the assessment. It is unlikely that this risk-based screening excluded chemicals that should be included, based on the conservative exposure assumptions and conservatively derived toxicity criteria that are the basis of the SLs. Although following this methodology does not provide a quantitative risk estimate for every chemical, it focuses the assessment on the chemicals accounting for the greatest risks (i.e., chemicals whose maximum concentrations are greater than their respective SLs) and the cumulative risk estimates would not be expected to be significantly greater.

Background concentrations of PAHs and metals in soil at the Site have been characterized and were used in statistical comparisons with Site soil to evaluate whether concentrations of some PAHs and metals detected at the former Skeet Range were greater than BTVs. Uncertainties associated with the use of these data may lead to a low-to-moderate overestimation or underestimation of surface and total soil risks due to metals and/or PAHs.

For some COPCs without screening levels, the values used for screening were based on surrogate chemicals with similar structures and properties. The surrogates for this HHRA were generally based on proxy compounds as recommended in VDEQ's Risk Assessment Guidance, Risk-Based Screening Levels Proxy Values (VDEQ, 2010).

5.5.3 Exposure Assessment

The primary areas of uncertainty affecting exposure parameter estimation involved the assumptions regarding exposure pathways, the estimation of EPCs, and the exposure parameters used to estimate chemical doses. An underlying assumption in the HHRA was that individuals at the Site would engage in activities that would result in exposures via each selected pathway. For example, it was assumed that construction workers engage in regular activities (125 days per year) under current and future land use conditions resulting in exposure to COPCs. This assumption is likely conservative, in that it is more likely that construction activities occur less than 125 days per year.

In establishing EPCs, the concentrations of chemicals in the media evaluated are assumed to remain constant over time. Depending on the properties of the chemical and the media in which it was detected, this assumption could overestimate or underestimate risks, based on the degree of chemical transport to other media or the rate and extent a chemical degrades over time.

When calculating EPCs from sample data using ProUCL, non-detect results are coded as "zeroes." As indicated in the ProUCL output for the Site (Attachment A in **Appendix C**), summary

statistics, such as the arithmetic mean, were based on detected values only. For calculation of the 95% UCL of the mean, the program substitutes surrogate values for the detection limits. Approaches which substitute values for non-detected chemical concentrations are associated with uncertainty, because chemicals that were not detected at the specified sample MDL may be absent from the medium or may be present at a concentration below the sample MDL. Furthermore, only the detected concentrations in each data set are used to determine the distribution of the data. For data sets with non-detects, the uncertainty associated with the distribution of the data could result in an over-estimation of the EPC.

The 95% UCL was used as the EPC for each medium if an EPC was estimated by ProUCL. Generally, at least eight to ten samples are recommended for the calculation of an EPC. The ProUCL software typically gives a warning when data sets are too small (sample size < 10), which suggests that the 95% UCL values could be unreliable. If the 95% UCL exceeds the maximum detected value or if fewer than five samples are available, the maximum was conservatively used as a default EPC in this HHRA. Using a value that is based on one sampling location (i.e., the maximum) has associated uncertainty and it adds a great deal of conservatism to the assessment. Using the maximum value, however, was deemed less uncertain than using potentially unreliable results.

The 95% UCLs (not the maximum) were used as the EPCs for most chemicals in surface soil, total soil, surface water, sediment, and groundwater. Therefore, the cancer risk/non-cancer hazard estimates were not likely to be biased high. However, the EPC for benzo(b)fluoranthene in sediment risk was based on a maximum value, as only one sample had a detected result, which resulted in USEPA's ProUCL program not generating a 95% UCL. In this case, the MDC was used, which likely resulted in an overestimation of risk and/or hazard.

The exposure parameters used to describe the extent, frequency, and duration of exposure are associated with uncertainty. Actual risks for individuals within an exposed population may differ from those predicted, depending upon their actual intake rates (e.g., soil ingestion rates), nutritional status, or body weight. Exposure assumptions were selected to produce an upper bound estimate of exposure in accordance with USEPA guidelines regarding evaluation of potential exposures at Superfund sites. For example, the exposure frequency for the routine worker was assumed to be 250 days/year for 25 years.

In addition, many USEPA (1991b) default exposure parameters are highly conservative and are based on risk management interpretations of limited data. For example, although current USEPA guidance recommends default soil ingestion rates of 100 mg/day for individuals over 6 years of age, other studies, such as Calabrese et al. (1990), have shown that the USEPA default soil ingestion rate of 100 mg/day is likely to greatly overestimate adult exposures and risks. In addition, chemicals in soil are assumed 100% bioavailable; this assumes that ingested chemicals present in a soil matrix are absorbed through the GI tract, which is unlikely due to the affinity of contaminants for soil particles. Therefore, based on the conservative exposure assumptions used in the HHRA, exposures and estimated potential risks were likely to be overestimated for the ingestion of soil pathways.

Evaluation of the dermal absorption exposure pathway is affected by uncertainties in dermal exposure parameters. For example, there is uncertainty associated with the exposed skin surface areas used, since the choice of exposed body parts could slightly overestimate or underestimate risks. Uncertainties that are more significant are associated with the selection and use of dermal absorption factors. For this HHRA, the dermal absorption factors and calculations were based on dermal absorption factors recommended in the USEPA RSL Table (USEPA, 2011a) from USEPA's RAGS: Part E, Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004). These soil dermal absorption factors were summarized in the Site Attachment D (**Appendix C**). Very limited information is available on dermal absorption of chemicals from contacted soil under environmental conditions. In fact, there are no actual human epidemiological data to support the hypothesis that absorption of soil-bound compounds under exposure conditions is a complete route of exposure. For example, the Public Health Statements from the (ATSDR, 1992, 2000, 2004, 2006, 2007) indicate that metals such as aluminum, arsenic, cobalt, manganese, and vanadium, are not known to result in human health effects by dermal absorption because very little can enter the body through the skin under normal circumstances (i.e., without exposure to very high concentrations for long periods or exposure to skin that is damaged). Therefore, using the dermal absorption factors to evaluate dermal absorption exposures to soil may have resulted in an overestimation of risks.

The surface area (SA) used for the adult resident exposed to surface soil was 3,300 cm^2 for exposed face, forearms, and hands, and assumes long pants are worn (RAGS-D Table 4.3 in **Appendix C**). Although the recommended SA in RAGS E Exhibit 3-5 (USEPA, 2004) is 5,700 cm^2, this assumes shorts are worn, so that the lower legs are exposed (in addition to the head, hands, and forearms). It is unlikely that shorts would be worn year-round by a future resident at the Skeet Range (if it were redeveloped for residential use), due to the Arsenal's location in north central New Jersey. Based on this, it is inappropriate to assume year-round exposure to lower legs via dermal contact with soil.

The soil-to-skin adherence factors that were applied at the Site are consistent with factors that are recommended in Exhibit 3-3 (Activity Specific-Surface Area Weighted Soil Adherence Factors) of U.S. EPA's Risk Assessment Guidance for Superfund Part E, Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004). The guidance provides different adherence factors for dry and wet soil conditions. For this HHRA, it was assumed that exposure scenarios involving wading activities would result in direct exposure to sediment. All sediment exposures were treated as "wet soil" to be conservative. An adherence factor of 0.2 milligrams per cubic centimeter (mg/cm^2) was applied for the routine base worker, and adult and child resident. These factors are conservative because some of the sediment would likely wash off during wading rather than adhere to the skin surface. Therefore, dermal exposures to sediment are likely to be over-estimated.

Although the dermal adherence factor (AF) for worker exposure to soil is 0.1 mg/cm^2 (RAGS-D Table 4.1 in **Appendix C**), as the soil is somewhat marshy, there is some uncertainty in this value, and it might have been more reasonable for the AF to be 0.2 mg/cm^2 (the same as for sediment; RAGS-D Table 4.8 in **Appendix C**). However, as the total surface soil cancer risk for the routine worker is 4.3E-5 including ingestion, dermal, and inhalation exposure pathways, and the dermal pathway only contributes a risk of 1.2E-5 (**Appendix C** Table 9.1), doubling of the AF for the dermal pathway would only increase the total risk to 5.5E-5. This would not appreciably change the total routine worker estimated cancer risk of 2E-4. Total cancer risk would still exceed 1E-4 and risk from soil alone would still exceed 1E-5. It should also be noted that if on-site soil had been treated as sediment, a lower exposure frequency would have been used and overall risks would have been lower.

There is some uncertainty in the use of the soil AF of 0.2 mg/cm^2 for a future residential child exposed to sediment (RAGS-D Table 4.10 in **Appendix C)**. The 95th percentile soil AF for a "child playing in wet soil" is 3.3 mg/cm^2 (USEPA, 2004). However, given the other conservative RME assumptions used in the HHRA (i.e., 95% UCL EPC COPC concentrations, a sediment ingestion rate of 200 mg/day, the assumption that a small child aged 1 to 6 would be playing in wetland sediment, and an exposure duration of 6 years), the use of a 95th percentile wet soil AF would result in an unrealistically high exposure, Given current and future land use information for Picatinny Arsenal, as well as existing institutional controls and State regulations, a future residential scenario within a marsh/wetlands is very unlikely. The use of RME values for each exposure variable would likely result in a cumulative cancer risk that is above the high-end of the plausible risk for an individual at the upper end of the risk distribution (USEPA 1992).

For exposures to COPCs in groundwater and surface water via dermal absorption, the USEPA's dermal guidance (USEPA, 2004) cautions that the procedures for estimating dermal dose from water contact are new. The dermal permeability estimates are probably the most uncertain of the parameters in the dermal dose equation. The guidance (USEPA, 2004) notes that particulate-bound chemicals in aqueous medium (e.g., suspended soil particles) would be considered much less bioavailable for dermal absorption due to inefficient adsorption of suspended particles onto the skin surface and a slower rate of absorption into the skin. Because phthalates, PAHs, and pesticides likely adsorb to soil, if these compounds were detected in surface water samples, then they may be attributable to the presence of particulates. Therefore, risks due to dermal absorption could potentially be overestimated for phthalates, PAHs, and/or pesticides. Conversely, the permeability coefficients for the halogenated compounds are likely to be underestimated. Because halogenated chemicals have a lower ratio of molar volume relative to their molecular weight than hydrocarbons (due to the relatively weighty halogen atom), the Kp correlation based on molecular weight of hydrocarbons would tend to underestimate permeability coefficients for halogenated organic chemicals (USEPA, 2004). However, as organics were not selected as COPCs in former Skeet Range surface water or groundwater, these uncertainties are less of a concern.

5.5.4 Receptor Exposure to Media

Resident Exposure to Surface and Subsurface Soil

The HHRA completed for the former Skeet Range used COPCs in surface soil (as well as EPCs for these COPCs), to quantify risks and hazards for hypothetical future residential adult and child exposure. However, if the Site undergoes BRAC and is developed for residential land use in the future, it is possible that subsurface soil may be brought to the surface during future home and utility line construction activities. Therefore, to address this uncertainty, surface soil EPCs were compared with total soil EPCs to estimate whether or not risks and hazards would increase if the residential HHRA had quantified exposure to total soil (surface plus subsurface soil).

As shown in **Table 5-5**, two soil COPCs at the former Skeet Range (out of 11 comparable COPC EPCs) had greater EPCs in total soil compared with surface soil, summarized as follows:

- Benzo(a)anthracene: 5% greater EPC in total soil
- Chrysene: 7% greater EPC in total soil
- Indeno(1,2,3-cd)pyrene: 92% greater EPC in total soil

As two of these three COPC EPC increases were less than ten percent, impacts on the hypothetical future residential HHRA conclusions may be minor. In addition, for the three COPCs listed above, only benzo(a)anthracene and indeno(1,2,3-cd)pyrene were identified as COPCs having estimated cancer risks greater than 1.0E-6 in surface soil (**Table 5-4**). Overall, estimated risks would be expected to be slightly greater for future residential exposure to total soil, compared with surface soil. For example, the total adult cancer risk for exposure to soil would be expected to increase from 6.91E-4 to approximately 7.1E-4.

5.5.5 Toxicological Data

The HHRA relies on USEPA derived dose response criteria. These health effects criteria are conservative and are designed to be protective of sensitive subpopulations. The health criteria used to evaluate long-term exposures, such as RfDs or CSFs, are based on concepts and assumptions that bias an evaluation in the direction of overestimation of health risk. As USEPA notes in its Guidelines for Carcinogenic Risk Assessment (USEPA, 1986), there are major uncertainties in extrapolating both from animals to humans and from high to low doses. There are important species differences in uptake, metabolism, and organ distribution of carcinogens, as well as species and strain differences in target site susceptibility, human populations are variable with respect to genetic constitution, diet, occupational and home environment, activity patterns, and other cultural factors.

To compensate for these uncertainties, upper bound 95% UCLs for CSFs (carcinogens), and uncertainty factors for RfDs (non-carcinogens) were used. The assumptions used here provide a rough but plausible estimate of the upper limit of risk; in other words, it is not likely that the true risk would be much more than the estimated risk, but it could very well be considerably lower, even approaching zero. More refined modeling in the area of dose response calculation (e.g., using maximum likelihood dose response values rather than the 95% UCL) would be expected to substantially lower the final risk.

For dermal absorption exposure pathways, the absence of dermal toxicity criteria necessitates the use of oral toxicity data. To calculate risk estimates for the dermal absorption pathway, absorbed dermal absorption doses are combined with oral toxicity values (also discussed previously in **Section 5.3**). Oral toxicity values, which are typically expressed in terms of potential (or administered) doses, should be adjusted when assessing dermal absorption doses, which are expressed as internal (or absorbed) doses. In this assessment, absolute oral absorption factors that reflect the toxicity study conditions were used to modify the oral toxicity criteria. For those chemicals lacking sufficient information, a default oral absorption factor of 1.0 was used. The risk estimates for the dermal absorption pathways may be overestimated or underestimated, depending on how the values used in the HHRA reflect the difference between the oral and dermal routes.

Inhalation toxicity criteria are unavailable for many of the COPCs. For some COPCs, however, oral-based toxicity criteria were used to estimate risks from inhalation exposure through route-to-route

extrapolation. For example, some of the inhalation RfCs are based on dietary studies (CalEPA, 2000). The following uncertainties were associated with such a substitution:

- Many contaminants show portal-of-entry toxicity - that is, adverse health effects occur primarily at the tissue site at which the chemical is introduced into the body (e.g., GI tract, lung, or skin).
- Physiological and anatomical differences between the GI tract and respiratory systems invalidate a cross-route quantitative risk extrapolation. The small intestine of humans contains a very large surface area that readily absorbs most compounds by passive diffusion (Klaasen et al., 1986). The oral absorption of a few compounds, such as iron, is an energy-dependent (active-transport) process, wherein; the absorption rate is proportional to the body's current need for iron.
- The rate and extent of pulmonary absorption are much more complex and depend on such factors as particle size distribution of the airborne toxicant and blood-gas solubility of the toxicant (Klaasen et al., 1986). Particles with median aerodynamic diameters of approximately 1 micrometer or less are absorbed by the alveolar region of the human lung. Larger particles deposit in the tracheobronchial or nasopharyngeal regions where they are cleared by mucociliary mechanisms and subsequently swallowed or physically removed and exhaled. Therefore, pulmonary absorption is more highly dependent on the physiochemical properties of the material than oral absorption.
- Human inhalation risk estimates based on oral toxicity data in subhuman species are distorted by both route-to-route extrapolation and interspecies extrapolation. For example, the rodent GI tract, which includes a structurally unique fore stomach, is anatomically and functionally distinct from the human lung, which contains a very large alveolar surface area for extensive absorption. The rate and extent of absorption across these distinct physiological systems are not alike.

In general, the lack of toxicity values for the inhalation pathway could result in an underestimation of risk or hazard. However, risks and hazards associated with dusts and particulates are typically small relative to the ingestion and dermal pathways.

In addition, for inhalation exposure to substances present as dusts, vapors, gases, or airborne particulate matter, dose extrapolation is far more complex, and therefore associated with uncertainty. The major confounding factors that prohibit a direct dose extrapolation of an inhaled toxicant are the following:

- Over 40 functionally different cell types in the lung - the distribution, consequent metabolic reactions, and air exchange rates vary widely across species.
- Differential concentration and activity of the detoxifying protein glutathione.
- Interspecies and intraspecies differences in the ability to repair pulmonary cell damage, and to clear toxic contaminants and immune complexes from the respiratory tract. For example, species vary in the ability to activate macrophages - nonspecific immune cells that can both protect the inner lining of the respiratory system and, at high concentrations, damage healthy tissues.
- Anatomical variations in the respiratory pathway, which affect both absorption rates and time to reach steady-state blood levels.
- Sensitivity to solubility and concentration variables; because of metabolic saturation (i.e., the exhaustion of normal metabolic activity caused by exposure to high concentrations), highly soluble contaminants deviate from first-order kinetics - which makes it difficult to predict the rates and extent of biotransformation and detoxification reactions. Furthermore, intermittent inhalation exposure to highly blood-soluble chemicals results in bioaccumulation in fat tissue because of the insufficient time between exposure sessions for complete clearance of the contaminant. Such slow release from the fat compartment to other body tissues can result in toxicological and metabolic effects that are difficult to assess and vary across species.

For chemicals without IRIS toxicity criteria, provisional toxicity criteria were used where available (Tables 5.1, 5.2, 6.1, and 6.2 in **Appendix C**). Provisional toxicity criteria (i.e., PPRTVs) present a source

of uncertainty, since USEPA has evaluated the compound, but consensus has not been established on the toxicity criteria. PPRTVs or other oral toxicity provisional values were used for aluminum, cobalt, and iron. Provisional inhalation toxicity values were used for aluminum and cobalt. For this assessment, use of provisional toxicity criteria was preferable to not evaluating the chemical in order to limit data gaps. However, because these toxicity criteria have not been formally accepted by USEPA, there is uncertainty with these values and, therefore, with the risks and hazards calculated using these toxicity criteria.

It is noted that the Supplemental SSL Guidance (USEPA, 2002b) recommends that toxicity values for subchronic exposures be used to calculate the HQs for exposures by the construction worker. The general lack of readily-available subchronic toxicity values for the COPCs at the Site contributes to the uncertainty of the HIs. Typically, subchronic toxicity values are 10-fold greater than chronic toxicity values and, therefore, would result in lower HQs. Because chronic toxicity values were used for all COPCs, the calculated hazards for the construction worker are likely to be overestimated.

No soil samples for chromium speciation (i.e., hexavalent and trivalent chromium) were collected at the former Skeet Range. However, there is no reason to believe total chromium results should be considered to have a significant component of hexavalent chromium. Based on this, toxicity values for trivalent chromium were used for all risk and hazard calculations for total chromium results for Site media. There is some uncertainty in this approach, however, as hexavalent chromium use or disposal at the former Skeet Range has not been documented, this uncertainty is deemed low.

5.5.6 Site Specific Background

No site-specific Picatinny background data exist for PAHs in soil or for any PAH or inorganic concentrations in groundwater. Therefore, regional PAH concentrations in soil were used for the background comparison, and no background comparisons could be performed for groundwater (**Section 5.4.2**). This resulted in HHRA uncertainty, as some estimated risks and hazards may be attributable to site-specific background concentrations.

5.5.7 Risk Characterization

Minor uncertainty is associated with rounding of the risk and hazard estimates. Thus, the actual risk or hazard may be slightly greater or less than the presented values. A related issue is that rounding results in differences between summed risk and hazard values, depending on how the summing is performed. For example, the RAGS Table 7 spreadsheets in Tables 7.1 through 7.9 for the Site (**Appendix C**) present risks and hazards that were summed for exposure route, exposure point, exposure medium, and medium total. The individual chemical-specific risks and hazards were summed only for the initial exposure route in deriving the total. For the subsequent summations (exposure point, exposure medium, and medium total), each was the summation of the preceding sums. For this reason, there can also be rounding-related differences between the “same” values presented in the Site Table 9 and 10 spreadsheets (**Appendix C**, Tables 9.1 through 9.4 and Tables 10.1 through 10.4, respectively).

5.6 HHRA SUMMARY AND CONCLUSIONS

The HHRA was performed to evaluate the potential human health effects associated with contamination at the former Skeet Range. Receptors evaluated for these Sites included current/future routine workers, current/future construction workers and future adult and child residents.

5.6.1 Summary

As presented in **Table 5-3** for the former Skeet Range, although the total cancer risk for the current routine worker (8.8E-5) was within the acceptable risk range of 1.0E-6 to 1.0E-4, chemicals having an estimated cancer risk greater than 1E-6 were benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, and benzo(a)anthracene in surface soil, and arsenic in surface water and sediment (groundwater is not an exposure medium for the current worker, as on-site groundwater is not used as a drinking water supply). The total HI of 1.7 was above the threshold of concern, with the hazard driver being antimony in sediment. For the future routine worker, the total cancer risk (2.0E-4) was above the acceptable risk range of 1.0E-6 to 1.0E-4, due primarily to benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, and benzo(a)anthracene in surface soil, and arsenic in surface water, sediment, and groundwater. The total HI of 5.2 was above the threshold of concern, primarily due to antimony in sediment and manganese in groundwater. For the current/future

construction worker, the total cancer risk (2.0E-6) was within the acceptable risk range of 1.0E-6 to 1.0E-4, with no individual risk drivers identified. The total HI of 0.2 was below the threshold of concern. For the future hypothetical adult resident exposed over a lifetime, the total cancer risk (1.5E-3) exceeded the acceptable risk range of 1.0E-6 to 1.0E-4, due primarily to benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, benzo(a)anthracene, benzo(k)fluoranthene, and indeno(123cd)pyrene in surface soil, and arsenic in surface water, sediment, and groundwater. The total HI for a future hypothetical adult resident was 13 primarily due to antimony in surface water and sediment, and manganese and arsenic in groundwater. For the future hypothetical child resident, the total cancer risk (1.1E-3) was above the acceptable risk range of 1.0E-6 to 1.0E-4, due primarily to benzo(a)pyrene, arsenic, benzo(b)fluoranthene, dibenzo(ah)anthracene, benzo(a)anthracene, benzo(k)fluoranthene, and indeno(123cd)pyrene in surface soil, and arsenic in surface water, sediment, and groundwater. The total HI for a future hypothetical child resident was 76, primarily due to antimony in surface water, antimony and arsenic in sediment, and manganese, arsenic, and iron in groundwater.

Lead model results demonstrated that lead in surface soil and sediment at the former Skeet Range exceeded, by a considerable amount, safe exposure levels associated with blood lead levels less than 10 µg/dL for future child blood lead levels, and for adult worker blood lead levels (**Table 5-3**). The probability that lead in surface soil would result in unacceptable future child blood lead levels was 98.9 percent, and 99.9 percent for sediment, while the probability that lead in surface soil would result in unacceptable adult worker fetal blood lead levels was up to 44 percent, and up to 99 percent for sediment. Since these probability estimates exceed the 5 percent threshold of concern (recommended by the Centers for Disease Control and Prevention), potential lead exposure at the Site is unacceptable. It should be noted that environmental exposures associated with blood lead levels above 30 µg/dL (e.g., for Skeet Range sediment, but not soil) are above the range of values that have been used in the calibration and empirical validation of the model; therefore, these results have an elevated component of uncertainty. It is also very important to note that under current conditions individuals are not likely to be exposed to lead residue at the Site because impacted areas are 400 feet or more from where the trap and skeet shooters stood, and the wetland environment is not conducive to easy site access, and people generally are not expected to be able to walk through the lead-impacted areas without difficulty.

Based on background comparisons presented in **Table 5-4**, the only COPCs having an estimated cancer risk greater than 1.0E-6 or a hazard greater than 1.0 that were found to be related to background were iron and benzo(b)fluoranthene in sediment at the former Skeet Range.

6.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

A SLERA was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases at the PTA former Skeet Range. The results of the SLERA contribute to the overall characterization of the Site and the scientific/management decision point reached for the SLERA includes one of the following:

- There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the Site on the basis of ecological risk.
- The information is not adequate to make a decision at this point and further refinement of data is needed to augment the ecological risk screening.
- The information collected and presented indicates that a more thorough assessment is warranted.

The SLERA was performed following guidelines provided by the *Tri-Service Procedural Guidelines for Ecological Risk Assessments* (Wentsel et al., 1996) and Steps 1, 2 and 3a of the *Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997b). Steps 1, 2 and 3a were completed as part of the SLERA. The addition of Step 3a focuses the outcome of the SLERA, streamlines the review process, and allows one assessment to function as the initial forum for ecological risk management decision making at the Site.

The primary objective of the SLERA is to assess whether there is enough information to state that there is the potential for unacceptable risks to ecological receptors as a result of potential hazardous substance releases. Characterizing the ecological communities in the vicinity of the former Skeet Range, assessing the particular hazardous substances being released, identifying pathways for receptor exposure, and estimating the magnitude and likelihood of potential risk to identified receptors meets this objective. The SLERA addresses the potential for adverse effects to vegetation, the soil and sediment invertebrate communites, wildlife, endangered and threatened species, and wetlands or other sensitive habitats that may be associated with the former Skeet Range.

Concentrations of chemicals were measured in surface soil, sediment and surface water, which were the relevant environmental media at the former Skeet Range.

Using available soil, surface water, and sediment analytical data, the SLERA was performed by following Steps 1 and 2 of USEPA (1997b). Step 1 includes a screening-level problem formulation and ecological effects evaluation, and Step 2 includes an SL preliminary exposure estimate and risk calculation. The SLERA is organized as follows: Site Characterization (**Section 6.1**); Methodologies for the Identification of COPECs and Concentration Statistics (**Section 6.2**); Identification of Exposure Pathways and Potential Receptors for Analysis (**Section 6.3**); Identification of Assessment and Measurement Endpoints (**Section 6.4**); Exposure Estimation (**Section 6.5**); Ecological Effects Assessment (**Section 6.6**); Risk Characterization (**Section 6.7**); and Uncertainty Analysis (**Section 6.8**).

6.1 SITE CHARACTERIZATION

The following section summarizes site information detailed in the Picatinny Arsenal Former Skeet Range Remedial Investigation Work Plan (USACE, 2011) and Picatinny Arsenal Real Property Master Plan: Long Range Component (Parsons, 2007). It includes a discussion of the general site characteristics, aquatic habitat, vegetative communities, wildlife communities, and a discussion on threatened and endangered species.

6.1.1 General Site Characterization

The former Skeet Range is located approximately 150 feet northwest of Site 180 on the southern end of PTA on the eastern side of Green Pond Brook. The former Skeet Range is bounded by Site 19 to the north-northwest, Site 180 to the south and southeast, Site 34 to the southwest, and the Green Pond Brook to the west (**Figure 1-1**). Large portions of the southern end of PTA were subject to landfilling to increase the amount of usable land.

Analytical results from soil, sediment, and surface water sampling, performed in June 2008 by Shaw, indicated several surface soil samples exceeded the soil LOC for lead. A subsurface soil sample collected in the area also contained a lead concentration above the soil LOC. Furthermore, sediment and surface water samples collected from a drainage ditch in the area revealed concentrations of lead above the sediment and surface water LOCs. Previous surface soil sampling in the area performed by IT Corporation in October 2002 also found elevated concentrations of PAHs above applicable LOCs in the area of the former Skeet Range.

As a result of the 2008 investigation findings and in response to regulatory comments regarding findings during previous investigations in the area, Shaw performed additional investigation within and around the former Skeet Range impact fan to further characterize impacts from lead concentrations in soil and sediment, to evaluate levels of PAHs in the soil and sediment, and evaluate metals and PAH concentrations in shallow groundwater.

Approximately 11 acres of soil and 12 acres of sediment exist at the Site, based on the overall areas sampled for chemical concentrations. However, areas of elevated concentrations of lead and PAH contamination are considerably smaller than these area estimates. As a conservative approach, these area estimates of 11 and 12 acres, respectively, were used in the SLERA for the area use factor approach for the Tier 2 assessment for terrestrial and aquatic receptors (**Section 6.5.1**).

6.1.2 Surface Water and Sediment

Surface water and sediment present at the Site includes small drainage ditches that are stagnant and highly turbid (**Appendix E**). The ditches are very shallow and do not support fish populations.

6.1.3 Wetlands

Portions of PTA's land have been classified as wetlands and encompass approximately 1,250 acres. Wetlands at PTA include forested wetlands and shrub lands. Approximately 92% of the wetlands are maple swamp forest, lakes and ponds, and their associated woody scrub-shrub wetlands. The largest portion of wetlands is located within the southern portion of PTA, which includes the former Skeet Range. This is an area laced with drainage ditches. Hydric soils comprise 26% of PTA's land. Approximately 50% of the former Skeet Range consists of hydric soils. The entire former Skeet Range has been mapped as NJDEP wetlands (USACE, 2001).

6.1.4 Vegetative Communities

The vegetative communities at PTA are primarily forest (approximately 70 percent) consisting of mixed oak, northern hardwood, red maple, hemlock, red/white pine, aspen/gray birch, and hemlock wetland; palustrine shrublands consisting of smooth alder, swamp azalea, mulberry, high bush blueberry, swamp loosestrife, buttonbush, meadowsweet, and swamp rose. Non-forested portions of PTA are improved land use areas that have been vegetated with grasses, shrubs, and ornamental trees. The former Skeet Range and surrounding area are in a low-lying region within PTA and consist of mixed forest and unmaintained grasses and shrublands that are occasionally inundated with standing water.

6.1.5 Wildlife Communities

PTA supports a diversity of habitats and provides resources for a variety of plants, fish, and other wildlife species including 208 bird species, 41 mammals, 19 reptiles, 21 amphibians, and 26 fish species (Parsons, 2007). When combined with adjacent public natural areas, PTA forests constitute more than 11,000 acres of contiguous wildlife habitat.

6.1.6 Threatened, Rare, and Endangered Species Information

Two federally- and state-listed threatened, rare, and/or endangered species (Indiana bat and bog turtle) have been identified at PTA (Parsons, 2007). Although no threatened, rare, and/or endangered species have been identified at the former Skeet Range, the Indiana bat and bog turtle have the potential to be in the vicinity. Details of threatened, rare, and endangered species are presented in **Table 6-1**.

6.2 IDENTIFICATION OF COPECS AND CONCENTRATION STATISTICS

Using the chemical results from environmental media samples collected at the former Skeet Range, a subset of the chemicals detected having data of good quality and that were not a result of non-

site sources are identified. Lists of samples used for the SLERA, including field duplicates, are presented in **Table 6-2**. The COPEC selection process is described in more detail in the following subsections; however, screening results are presented in **Section 6.2.2**.

6.2.1 Data Organization

The data for each chemical have been sorted by medium. To assess potential ecological impacts, sediment data from 0-1.0 and 2.0-3.0 ft bgs, surface soil from 0-0.5 ft bgs (no samples were collected from 0.5 – 1.0 ft bgs), and surface water data, have been considered. Due to the fact that only two sediment samples were collected from depth (between 1.0 and 3.0 ft bgs) and the likelihood that boggy sediments are readily accessible to ecological receptors due to their soft consistency, sediment sample results from 0 – 3.0 ft bgs have been used in this SLERA.

Chemicals that were not detected at least once in a medium are not included in the risk assessment, although non-detected constituents are discussed in the Uncertainty Analysis section (**Section 6.8.2**).

The analytical data may have qualifiers from the analytical laboratory QC or from the data validation process that reflect the level of confidence in the data. Although the HHRA additionally evaluated subsurface soil (2.0-3.0 and 4.0-5.0 ft bgs) and groundwater; otherwise, the methodology for data summation was identical between the SLERA and the HHRA.

6.2.2 Descriptive Statistical Calculations

Because of the uncertainty associated with characterizing contamination in environmental media, the 95% UCL of the mean has been estimated for chemicals selected as COPECs in sediment, sediment, and surface water samples. The calculation of EPCs follows the same procedure used for the HHRA (**Section 5.2.3**). EPC statistical output from USEPA's ProUCL program is presented in **Appendix C**, Attachment A (along with HHRA COPC EPCs).

6.2.3 Frequency of Detection

Chemicals that are detected infrequently (<5%) have been included in the risk evaluation as a conservative approach. Therefore, a low frequency of detection was not used to exclude COPECs.

6.2.4 Natural Site Constituents (Essential Nutrients) and Total Organic Carbon

As a conservative step, the essential nutrients calcium, magnesium, potassium, and sodium were assessed in the SLERA. Total organic carbon (TOC) (the total measurable amount of carbon found in a sample) was not evaluated in the SLERA for potential toxicity.

6.2.5 Selection of COPECs

All detected chemicals in an environmental medium were assessed for the direct contact exposure pathway, and only detected important bioaccumulative constituents (USEPA, 2000) were selected for assessment via food chain modeling. An initial screening step comparing the MDCs of chemicals with available toxicity benchmarks was not performed.

Tables 6-3 and **6-4** (soil), **Tables 6-5** and **6-6** (sediment), and **Tables 6-7** and **6-8** (surface water) have been prepared for detected constituents with the following information:

- CAS number.
- Chemical name.
- Range of detected concentrations, and associated qualifiers.
- Concentration units.
- Location of MDC.
- Frequency of detection.
- Range of detection limits.

- COPEC selection conclusion: YES or NO.
- Rationale for selection or rejection of the COPEC.

COPECs were selected as shown in **Tables 6-3** through **6-8**. In general, COPECs were selected as a concern for the direct contact exposure pathway if the constituent was detected in an environmental medium (**Tables 6-3**, **6-5**, and **6-7**). For food chain exposure pathways, detected COPECs were selected if they were identified as important bioaccumulative constituents (**Tables 6-4**, **6-6**, and **6-8**).

- Twenty-three COPECs have been selected for surface soil direct contact exposure (**Table 6-3**).
- Nineteen COPECs have been selected for surface soil food chain exposure (**Table 6-4**).
- Eleven COPECs have been selected for sediment direct contact exposure (**Table 6-5**).
- Nine COPECs have been selected for sediment food chain exposure (**Table 6-6**).
- Six COPECs have been selected for surface water direct contact exposure (**Table 6-7**).
- Four COPECs have been selected for surface water food chain exposure (**Table 6-8**).

EPCs were calculated based on the statistical procedures discussed in the HHRA (**Section 5.2.3**). The MDCs and EPCs were determined or calculated for surface soil (**Table 6-9**), sediment (**Table 6-10**), and surface water (**Table 6-11**) using USEPA's ProUCL software.

6.3 IDENTIFICATION OF EXPOSURE PATHWAYS AND POTENTIAL RECEPTORS FOR ANALYSIS

The former Skeet Range wildlife may be exposed to COPECs by several pathways, including: 1) the ingestion of impacted surface soil, sediment, surface water, or food while foraging; 2) dermal absorption of chemicals from sediment or surface water; and 3) inhalation of chemicals that have been wind-eroded from dried soil or sediment or have volatilized from soil, sediment, or water. Among these potential exposure pathways, the greatest potential for exposure to chemicals is likely to result from the ingestion of chemicals in food and surface water. The incidental ingestion of impacted soil or sediment (during foraging) is typically a less important exposure route. The ingestion of food, soil, sediment, and surface water, however, are viable exposure pathways and were quantified in the SLERA.

Receptor-specific exposures via inhalation or dermal absorption were not selected for further evaluation because of a lack of appropriate exposure data and the expectation that these pathways would be insignificant in comparison to the other exposure pathways quantified. Inhalation exposure would be expected to be minimal due to dilution of airborne COPECs in ambient air. Dermal exposure would also be expected to be minimal due to the expectation that wildlife fur or feathers would act to impede the transport the COPECs to the dermal layer.

Appropriate assessment receptors have been selected for evaluation in the SLERA which represent terrestrial and wetland communities. In order to narrow the exposure characterization portion of the SLERA on species or components that are the most likely to be affected, the SLERA has focused the selection process on species, groups of species, or functional groups, rather than higher organization levels such as communities or ecosystems. Site biota are organized into major functional groups. The major groups are flora and fauna, including vertebrates (e.g., mammals and birds), invertebrates and aquatic plants.

Primary criteria for selecting appropriate assessment receptors included, but were not limited to, the following:

- The assessment receptor will have a relatively high likelihood of contacting chemicals via direct or indirect exposure.
- The assessment receptor will exhibit marked sensitivity to the COPECs given their mode of toxicity, propensity to bioaccumulate, etc.

- The assessment receptor will be a key component of ecosystem structure or function (e.g., importance in the food web, ecological relevance).

6.3.1 Receptors

Six representative receptor species that may be possibly found at the former Skeet Range area were selected as indicator species for the potential effects of COPECs, based on conversations and agreements with stakeholders (USACE and USEPA) during preparation of the RI workplan (USACE, 2011). These indicator species represent two classes of vertebrate wildlife (mammals and birds), a range of body sizes and home ranges, a variety of food habits (herbivore, omnivore, and insectivore), and varying degrees of soil and sediment exposure (incidental ingestion). The six animal species selected include the American woodcock (*Scolopax minor*), Bobwhite quail (*Colinus virginianus*), short-tailed shrew (*Blarina brevicauda*), meadow vole (*Microtus pennsylvanicus*), marsh wren (*Cistothorus palustris*), and raccoon (*Procyon lotor*). Data used to model exposure for these species are summarized in **Appendix D, Table D-1**.

These receptors are presented in **Figure 6-1**, with the food web illustrated in **Figure 6-2**. Several of these species have limited home ranges, particularly the shrew, vole, and wren, which make them particularly vulnerable to potential exposure from Site constituents. These selected receptor species are potentially present at the Site, and sufficient toxicological information (with the exception of some bird species) is available in the literature for comparative and interpretive purposes. These species (as representative surrogate species) are considered important to the stability of the local ecological food chain and biotic community. It is important to note that relatively low densities of some of these selected receptor species would mitigate exposure and result in limited population effects (even if exposure to isolated COPEC hotspots occur), given the small site areas with elevated COPEC concentrations. This is discussed in more detail in the Uncertainty Section (**Section 6.8.3**).

It should be noted that potential impacts to plants and other biota are assessed by comparing measured surface soil, sediment, and surface water COPEC concentrations with readily-available direct-contact criteria (see **Section 6.7.3**).

Larger species such as the white-tailed deer, bald eagle, peregrine falcon, and osprey were not selected as sensitive receptors due to their large home ranges. The potential risk to species with larger home ranges is generally included within the predicted risks to the selected indicator receptors. Receptor profiles for the six selected species are presented in the following paragraphs.

American woodcock. The American woodcock is an invertivore that feeds primarily on earthworms and other soil dwelling invertebrates, but plant material also account for approximately ten percent of the woodcock diet. Body weight ranges from 176 to 218 grams, and averages 197 grams (**Appendix D, Table D-1**). The woodcock inhabits woodlands and fields with a home range of approximately 59 acres. This species is present throughout most of eastern and North America, and winter primarily in the southeastern United States. Woodcock nest on the ground, usually near the base of a tree or shrub with the female caring for the brood.

Short-Tailed shrew. The short-tailed shrew is an insectivore that feeds largely on soil (or sediment) invertebrates. It would be potentially exposed to COPECs through prey items and have a relatively high rate of incidental ingestion of soil (sediment) while foraging on earthworms. This short-tailed shrew is the largest shrew found in North America. It is solid gray above and below, with a short tail, and weighs between 15 and 29 grams (Whitaker, 1995). Total length of this shrew is 76 to 102 mm (Burt and Grossenheider, 1980), and weight ranges from 12.5 to 22.5 grams, and averages 15 grams (**Appendix D, Table D-1**). The range of this shrew extends from southeastern Canada and the northeastern U.S. to Nebraska, Missouri, Kentucky, and in the mountains to Alabama (Whitaker, 1995). Preferable habitat for the shrew includes forests, grasslands, marshes, and brushy areas. It will make a nest of dry leaves, grass, and hair beneath logs, stumps, rocks, or debris (Burt and Grossenheider, 1980). This mammal has a voracious appetite, and will consume earthworms, other terrestrial invertebrates, and sometimes young mice (Whitaker, 1995). Mean population densities range from 5.7, in the winter, to 28 per acre in the summer (USEPA, 1993). Their home range varies from 0.5 to 1 acre (Burt and Grossenheider, 1980) and an average value of 0.96 acres has been used in this SLERA.

Longevity is typically around 20 months (USEPA, 1993), with 5 to 8 young born to each of 2 to 3 litters (Burt and Grossenheider, 1980).

Meadow vole. The meadow vole inhabits grassy areas (upland and wetland) and is expected to obtain a significant portion of its herbivorous diet from the Site. The vole resides in every area of the United States and Canada where there is good grass cover, ranges in size from about 9 to 13 centimeters in length, and weighs between 17 and 52 grams (**Appendix D, Table D-1**). The meadow vole has a limited foraging range, increasing its potential to be exposed (directly or indirectly) to COPECs in on-site surface soil. The vole has an average home range of 0.09 acres, with summer ranges larger than winter ranges. The vole does not hibernate and is active year-round. Population densities can range up to several hundred per hectare (USEPA, 1993).

Northern bobwhite quail. The northern bobwhite quail is primarily an herbivore feeding on seeds, fruits, and forage plants, but invertebrates may also account for up to 20 percent of the bobwhite diet. The most common foraging mode is walking on the ground, gleaning seeds from the ground and low vegetation. They are poor flyers so they seldom leave the ground and do not migrate. Body weight ranges from 154 to 194 grams, and averages 175 grams (**Appendix D, Table D-1**). Bobwhites gather in coveys and the home range averages about 25 acres. It is the most widespread of the North American quail and ranges from southeastern Wyoming, east to southern Minnesota, and across to southern Maine, south through central and eastern United States, to Florida and eastern New Mexico. Dust bathing is common, which consists of quail scratching soil or dirt and rubbing the dust in their feathers, and then shaking the dust from their plumage. Quail construct nests in open woodlands or near open fields. Nests are formed in small depressions dug into the soil and are lined with grasses.

Raccoon. The raccoon is the most abundant and widespread medium-sized omnivore in North America. It feeds on fruits, nuts, acorns, corn, grains, insects, frogs, crayfish, eggs, and most any animal and vegetable matter. Average body weight ranges from 3.67 to 6.76 kg, and averages 5.1 kg overall, and the raccoon has an average home range of 128 acres, based on coastal island data (**Appendix D, Table D-1**). They are found near virtually any aquatic habitat, including hardwood swamps, mangroves, floodplain forests, and freshwater and saltwater marshes. They are also common in suburban residential areas, and cultivated and abandoned farmlands. From central U.S. into Canada raccoons undergo a winter dormancy lasting up to four months. It is not a true hibernation; however, they can be easily awakened. Population densities depend on the quality and quantity of food resources and den sites, and rang between 0.005 and 1.5 raccoons per hectare, although 0.1 to 0.2 per hectare is more common (USEPA, 1993). It should be noted that surface water at the Site consists of small drainage ditches that are stagnant and highly turbid and are not expected to support fish populations of sufficient mass to serve as prey. Therefore, even though a small portion (approximately 2%) of the raccoon's diet consists of fish (**Appendix D, Table D-1**), fish consumption will not be evaluated as a potential pathway. In addition, it is assumed that small mammals consumed by the raccoon, are terrestrial prey items (e.g., rodents) that are primarily exposed to soil and not sediment.

Marsh Wren. The marsh wren is an insectivore that feeds on insects, spiders, snails, and aquatic insects (Cornell BNA, 2010). They have long slender bills adapted for gleaning insects from the ground and vegetation. They generally feed near or at the surface of the water in freshwater cattail marshes and salt marshes, and also forage on insects taken from stems and leaves of cattails or other vegetation. Body weight ranges from 9 to 13.5 grams, and averages 11 grams (**Appendix D, Table D-1**). Home ranges are small and average 0.5 acres (USEPA, 1993). Standing water from several centimeters to nearly a meter is typical for habitat areas selected for use. Breeding nests are woven of cattails, reeds, and grasses and lashed to standing vegetation. Population densities as high as 120 adult birds per hectare have been recorded (USEPA, 1993). Most species are migratory, although some southern and coastal maritime populations are year-round residents. Marsh wrens bred throughout most of the northern half of the U.S., and in coastal areas as far south as Florida, and winter in southern U.S. and into Mexico.

6.4 IDENTIFICATION OF ASSESSMENT AND MEASUREMENT ENDPOINTS

The protection of ecological resources, such as habitats and species of plants and animals, is a principal motivation for conducting the SLERA. To assess whether the protection of these resources are

met at the Site, assessment and measurement endpoints have been formulated to define the specific ecological values to be protected and to define the degree to which each may be protected.

Unlike the HHRA process, which focuses on individual receptors, a SLERA focuses on populations or groups of interbreeding nonhuman, non-domesticated receptors. In the SLERA process, the risks to individuals are generally assessed if they are protected under the Endangered Species Act.

Selected assessment endpoints reflect environmental values that are protected by law, are critical resources, and/or have relevance to ecological functions that may be impaired. Both the entity and attribute are identified for each assessment endpoint (Suter, 1993).

Assessment endpoints are inferred from effects to one or more measurement endpoints. The measurement endpoint is a measurable response to a stressor that is related to the valued attribute of the chosen assessment endpoint. It serves as a surrogate attribute of the ecological entity of interest (or of a closely related ecological entity) that can be used to draw a predictive conclusion about the potential for effects to the assessment endpoint.

Measurement endpoints for the SLERAs are based on toxicity values from the available literature. When possible, receptors and endpoints have been concurrently selected by identifying those that are known to be adversely affected by chemicals at the Site based on published literature.

6.4.1 Assessment Endpoints

ERAGS (USEPA, 1997b) states: "For the screening-level ecological risk assessment, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments. Adverse effects on populations can be inferred from measures related to impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure or function. Adverse effects on habitats can be inferred from changes in composition and characteristics that reduce the habitats' ability to support plant and animal populations and communities."

The selected assessment endpoints for the former Skeet Range are stated as the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous, piscivorous, and carnivorous birds. The corresponding null hypothesis (H_o) for each of the assessment endpoints is stated as: the presence of site contaminants within surface soil, surface water, sediment, vegetation, and prey will have no adverse effect on the survival or reproductive capabilities of populations of herbivorous, insectivorous, and omnivorous mammals and birds. In addition, assessment endpoints for the base of the food chain are stated as the protection of long-term survival and reproduction of plants and invertebrates. Assessment endpoints are summarized in **Table 6-12**.

The food web model (**Figure 6-2**) was developed to illustrate how the selected receptor guilds are ecologically linked. For invertebrates, small prey items and plants, partitioning coefficients and simple empirical uptake models were employed to estimate COPEC concentrations within tissues (see **Section 6.5**). These tissue concentrations were then used as input values for exposure to higher trophic level receptors through the dietary route of exposure.

6.4.2 Measurement Endpoints

Measurement endpoints are frequently numerical expressions of observations (e.g., toxicity test results or community diversity indices) that can be compared to detect adverse responses to a site contaminant (USEPA, 1997b). In this SLERA, however, measurement endpoints consist primarily of calculated HQs for the selected COPECs.

As five of the selected receptor species (American woodcock, bobwhite, marsh wren, short-tailed shrew, and raccoon) feed on invertebrates, a reduction in the abundance of this food source could potentially result in an adverse impact due to food shortages. Therefore, the direct contact toxicity of COPECs to invertebrates (**Section 6.7.3**) was selected as a measurement endpoint for protection of long-term survival and reproductive capabilities for populations of insectivorous and omnivorous mammals and birds. Measurement endpoints are summarized in **Table 6-12**.

6.5 EXPOSURE ESTIMATION

This section includes a discussion of how COPEC exposures were quantified, including intake (**Section 6.5.1**) and bioaccumulation (**Section 6.5.2**).

An estimate of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the Site was developed, considering both current and reasonably plausible future use scenarios.

Ecological routes of exposure for biota may be direct (bioconcentration) or through the food web via the consumption of contaminated organisms (bioaccumulation). Food web exposure can occur when fauna consume contaminated biota. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated sediment; animals ingesting surface water; plants absorbing contaminants by uptake from contaminated soil or sediment; and the dermal contact of organisms with contaminated surface soil, sediment, or surface water. As discussed in **Section 6.3**, dermal contact and inhalation exposures are considered insignificant compared to other quantified routes of exposure. Direct exposure and plant uptake of chemicals from contaminated soil or sediment is discussed in **Section 6.5.2**, with uptake factors presented in **Appendix D Table D-15**. Modeled chemical concentrations in plants, followed by modeled wildlife ingestion, were used to estimate herbivorous and omnivorous wildlife HQs (with details presented in **Appendix D Tables D-2** through **D-14**).

Bioavailability of a chemical is an important contaminant characteristic that influences the degree of chemical-receptor interaction. For purposes of the SLERA, bioavailability is conservatively assumed to be 100%.

For faunal receptors, calculation of exposure rates relies upon determination of an organism's exposure to COPECs found in surface water or sediment, and on transfer factors used for food chain exposure. Exposure rates for terrestrial and aquatic wildlife receptors in this SLERA are based solely upon ingestion of contaminants from these media and from consumption of other organisms.

6.5.1 Intake

The first step in estimating exposure rates for terrestrial and aquatic wildlife involves the calculation of food ingestion and drinking water intake rates for Site receptors. USEPA (1993) includes a variety of exposure information for a number of avian and mammalian species. Information regarding feeding rates, watering rates and dietary composition are available for many species, or may be estimated using allometric equations (Nagy, 2001). Data have also been gathered on incidental ingestion of sediment and/or soil, and are incorporated for the receptor species. This information is summarized in **Appendix D**, **Table D-1**. For the SLERA, conservative Tier 1 exposures are based on maximum dietary intake, maximum incidental sediment intake, minimum body weight, 100% Site exposure (i.e., area use factor [AUF] set equal to unity), and the use of COPEC MDCs as EPCs. Less conservative more realistic Tier 2 exposures are based on average dietary and incidental sediment intake, average body weight, calculated AUF based on Site area and home range of the receptor species, and COPEC EPCs set equal to 95% UCLs. These Tier 2 exposures may be considered as a portion of Step 3a of the ERAGS 8-step process.

Algorithms have been evaluated for calculating exposure for vertebrates that account for exposure via ingestion of contaminated water, incidental ingestion of contaminated soil or sediment, ingestion of plants grown in contaminated soil sediment, and prey items. Results for these algorithms are presented in **Appendix D, Tables D-2** through **D-13**. An example calculation is presented in **Appendix D, Table D-14**.

The basic equation for estimating dose through the dietary pathway is:

$$E_j = \left(\frac{A}{HR}\right)\left[\sum_{i=1}^{m}\left((IR_i \times C_{ij}) / BW\right)\right]$$

Where:

E_j	=	Total exposure to chemical j (mg/kg-day)
A	=	Site Area (acres)
HR	=	Home Range of receptor (acres), with A/HR = Area Use Factor (≤ 1)
m	=	Total number of ingested media
i	=	Counter for media (e.g., plants = 1, fish = 2, invertebrates = 3, mammal prey = 4, bird prey = 5, sediment = 6, surface water = 7)
IR_i	=	Consumption rate for medium (kg/day), receptor specific
C_{ij}	=	Chemical concentration j in the ith food (media) type (mg/kg dry weight)
BW	=	Body weight of the receptor (kg wet weight).

And:

IR_i	=	Ingestion Rate (medium) x Diet Fraction (medium), e.g., shrew food ingestion rate (0.002 kg/day) x 0.104 (10.4% diet fraction) = 0.00021 kg/day
C_{ij}	=	Concentration in soil, sediment or surface water x bioaccumulation factor (BAF), e.g., arsenic concentration in soil (10.9 mg/kg) x soil-to- plant BAF (0.03752) = 0.41 mg/kg estimated arsenic concentration in terrestrial plants

6.5.2 Bioaccumulation and Bioconcentration Factors

For the current SLERA, BAFs and bioconcentration factors (BCFs) for soil/sediment-to-plants, soil-to-terrestrial invertebrates (earthworms), soil-to-small mammals and birds, and sediment-to-aquatic invertebrates are presented in **Appendix D**, **Tables D-15** through **D-18**, respectively. BAFs and/or BCFs were not available for every COPEC, but were estimated as described in the footnotes to these tables. For each BAF/BCF pathway, both a Tier 1 and Tier 2 value is presented. The Tier 1 BAF/BCF is generally the upper bound value found in the literature, to represent a worst-case exposure scenario, while the Tier 2 BAF/BCF represents a conservative, yet more realistic exposure value.

Soil/sediment-to-plant BAF/BCF values (**Appendix D**, **Table D-15**) are based on information from USEPA (2007) and Efroymson et al. (2001). BAF values are based on regression equations, if available, that produce a BAF value that scales in a non-linear fashion with soil COPEC concentrations. If a regression equation is not available or not recommended for a particular COPEC, a USEPA recommended value is used. An example of how a regression equation is used is presented as follows (for copper):

Natural log (Plant Cu concentration) = 0.394 x natural log [soil Cu concentration]) + 0.668

Thus, for a soil copper concentration of 57.25 mg/kg, the estimated natural log concentration in plant tissue is 2.265, and the inverse of the natural log is 9.6 mg/kg, for an estimated concentration-specific BAF of 0.17, (9.6/57.25).

Soil-to-earthworm BAF values (**Appendix D**, **Table D-16**) are based on information from USEPA (2007), Sample et al. (1998a), and Sample et al. (1999). Earthworms are used as a surrogate species to represent terrestrial invertebrates including insects. BAF values are based on regression equations, if available, that produce a BAF value that scales in a non-linear fashion with soil COPEC concentrations. If a regression equation is not available or not recommended for a particular COPEC, a USEPA recommended value is used. It should be noted that as the regression equation predicts COPEC concentrations in earthworms, the actual BAF value is estimated by dividing the earthworm COPEC concentration by the soil COPEC concentration.

For the organic COPECs at the Site, an equation from USEPA (2007) is used to estimate the soil-to-earthworm BAF, if no other literature value is available, along with COPEC-specific Kow and fraction of organic carbon information. The approach for estimating soil pore water to earthworm bioaccumulation for organic chemicals is based on laboratory and field studies (Jager, 1998). This approach uses the same method proposed by Connell and Markwell (1990) for the soil solution-earthworm system which was used in the USEPA (2007) guidance, but uses a more realistic earthworm lipid fraction of 4 to 6% (Jager, 1998).

The regression equation from Jager (1998) is as follows:

$$Log\ BAF = 0.87 * \log K_{ow} - 2.00\ (r^2 = 0.84,\ n = 69)$$

This relationship is then used in USEPA (2007) as follows:

$$BAF = \frac{10^{(0.87 \log Kow - 2.00)}/0.16}{F_{oc} * K_{oc}}$$

where:

Log K_{ow}	=	log octanol-water partition coefficient;
0.16	=	Conversion from wet weight to dry weight assuming 16% solids (Jager, 1998);
F_{oc}	=	fraction of organic carbon; and
K_{oc}	=	soil organic carbon to water partitioning coefficient.

Earthworms are used as a surrogate species to represent terrestrial invertebrates including insects. Values are based on Eco-SSL uptake values or regression equations, if available. If a regression equation or recommended uptake value is not available for a particular COPEC, an alternative value is used. It should be noted that as the regression equation predicts COPEC concentrations in earthworms, the actual BAF value is estimated by dividing the earthworm COPEC concentration by the soil COPEC concentration.

Soil-to-small mammal and small bird BAF/BCF values (**Appendix D**, **Table D-17**) are based on information from USEPA (2007), Sample et al. (1998), and Brandt et al. (2002). Values are based on regression equations (USEPA, 2007), Brandt et al (2002) or alternative BAF values if no regression equation is available.

Sediment-to-aquatic invertebrate BAF/BCF values (**Appendix D**, **Table D-18**) are based on information from Bechtel Jacobs (1998). If no uptake value was available, the Tier 2 soil-to-terrestrial invertebrate uptake values were used.

6.6 ECOLOGICAL EFFECTS CHARACTERIZATION

This ecological effects characterization section presents the selection of literature benchmark values and the development of reference toxicity values.

6.6.1 Selection of Literature Benchmark Values

Appropriate sources for literature benchmark values have been consulted, such as EcoSSLs (USEPA, 2011); Benchmarks for Wildlife (Sample et al., 1996); and the PAH Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review (Eisler, 1987).

6.6.2 Development of Toxicology Reference Values

TRVs were selected from available data for use in the former Skeet Range SLERA. These TRVs focus on the growth, survival, and reproduction of species and/or populations. Empirical data are available for the specific receptor-endpoint combinations in some instances. However, for some COPECs, data on surrogate species and/or on endpoints other than the No Observable Adverse Effects Level (NOAEL) and Lowest Observable Adverse Effects Level (LOAEL) had to be used. The NOAEL is a dose of each COPEC that will produce no known adverse effects in the test species, while the LOAEL is the lowest dose of a COPEC that has been shown to produce an adverse effect. The NOAEL was judged to be an appropriate toxicological endpoint for the Tier 1 approach since it would provide the greatest degree of protection to the receptor species; however, both NOAELs and LOAELs are used for informational purposes in the Tier. Both the NOAEL and the LOAEL were also used in the Tier 2 approach; however, the LOAEL is recommended as a point of comparison for decision-making for risk management purposes. In general, LOAELs for growth, reproduction and/or developmental endpoints are thought to be protective at the population level of biological organization. In addition, in instances where data are unavailable for a site-associated COPEC, toxicological information for surrogate chemicals had to be used. Safety factors are used to adjust for these differences and extrapolate risks to the Site's receptors at the NOAEL and/or LOAEL endpoint. This process is described below and the values are presented in **Appendix D, Tables D-19** and **D-20** for NOAEL and LOAEL TRVs, respectively.

Toxicity information pertinent to identified receptors has been gathered for those analytes identified as COPECs. Because the measurement endpoint ranges from the NOAEL to the LOAEL, preference was given to chronic studies noting concentrations at which no adverse effects were observed and ones for which the lowest concentrations associated with adverse effects were observed.

As recommended by Hull et al. (2007), allometric dose scaling using body mass was not performed for chronic TRVs because this approach is not scientifically defensible and interclass toxicity extrapolations were not performed as physiological differences between classes are too great to be addressed with the use of simplistic safety factors. Safety factors (Wentsel et al., 1996) were used to account for extrapolation to the no effects or lowest-effects endpoints, and for differences in study duration as shown in **Appendix D, Table D-19 and D-20**. Although additional safety factors may be employed for endangered species, no endangered species were selected as representative receptors and these additional safety factors were not required.

TRVs provide a reference point for the comparison of toxicological effects upon exposure to a contaminant. To complete this comparison, receptor exposures to Site contaminants are calculated.

6.7 RISK CHARACTERIZATION

The risk characterization phase integrates information on exposure, exposure-effects relationships, and defined or presumed target populations. The result is a determination of the likelihood, severity, and characteristics of adverse effects to environmental stressors present at a site. Qualitative and semi quantitative approaches have been taken to estimate the likelihood of adverse effects occurring as a result of exposure of the selected site receptors to COPECs.

For this assessment, TRVs and exposure rates have been calculated and are used to generate HQs (Wentsel et al., 1996), by dividing the receptor exposure rate for each contaminant by the calculated TRV. Ecological Effects Quotients (EEQs) or HQs are a means of estimating the potential for adverse effects to organisms at a contaminated site, and for assessing the potential that toxicological effects will occur among site receptors.

6.7.1 Plant Impact Assessment

To assess the potential impact of COPEC concentrations in soil and sediment on upland and wetland plant species, visual qualitative observations were made during Site reconnaissance prior to and during sample collections. The overall health of the plant community at the former Skeet Range appeared to be generally comparable to the plant community in the surrounding area; however, elevated concentrations of metals in some areas would be expected to be toxic to plants, assuming these metals are bioavailable (**Section 6.7.3.1**).

6.7.2 Predictive Risk Estimation for Wildlife

The potential wildlife risks associated with the former Skeet Range are estimated in the SLERA. The risk estimation has been performed through a series of quantitative HQ calculations that compare receptor-specific exposure doses with TRVs. The EEQs (or HQs) are compared to HQ guidelines for assessing the risk posed from contaminants. It should be noted that HQs are not measures of risk, are not population-based statistics, and are not linearly-scaled statistics, and therefore an HQ above 1, even exceedingly so, does not guarantee that there is even one individual expressing the toxicological effect associated with a given chemical to which it was exposed (Allard et al., 2007; Tannenbaum, 2001; Bartell, 1996).

The simple HQ ratios are summed to provide conservative HI estimates for chemicals and exposure pathways for a given receptor. Whether or not HQ summation was appropriate and scientifically defensible is based on whether the chemicals have a similar mode of toxicological action While individual contaminants may affect distinct target organs or systems within an organism, classes of chemicals may act in similar ways, thus being additive in effect.

Tier 1 and Tier 2 individual COPEC EEQs and HIs (summed EEQs) for receptors at the former Skeet Range are presented in risk characterization tables for the six selected receptor species.

The summation of HQs into an HI was performed in this SLERA as a conservative approach. To assess whether or not individual COPEC HQs should be segregated based on dissimilar modes of toxicological action, individual COPEC effects were evaluated. However, as risk drivers resulted in HQs ranging from 12 to 30,877 (see following paragraphs), segregation of COPECs by mode of toxicological action was not performed.

Tier 1 and Tier 2 individual COPEC EEQs and HIs (summed EEQs) for receptors at the former Skeet Range are presented in risk characterization tables (**Appendix D, Tables D-2** through **D-13**) for the six selected receptor species. These summed EEQs are presented in **Table 6-13**, along with the hazard driver (COPEC[s] contributing the majority of the total estimated EEQ) and the exposure pathway of concern (the pathway contributing the most to the total estimated EEQ).

As shown in **Table 6-13**, Tier 1 total EEQs ranged from approximately 105 to 30,877 for the six receptor species, using TRVs based on either NOAEL or LOAEL values. The marsh wren was predicted to be the most impacted, followed by the American woodcock, short-tailed shrew, raccoon, meadow vole, and northern bobwhite. The inorganic constituent lead contributed the most to the estimated total EEQs. Exposure pathways of most concern, based on the results of the Tier 1 food chain modeling, were aquatic invertebrate, terrestrial invertebrate, soil, and sediment ingestion.

More realistic Tier 2 total EEQs were also elevated, especially values based on NOAEL TRVs, which ranged from 12 to 5,213 (**Table 6-13**). However, Tier 2 total EEQs were much lower than Tier 1 total EEQs. The specific results of the Tier 2 risk estimation for the six receptor species are discussed below.

American woodcock. The total EEQs for both NOAEL and LOAEL TRVs exceeded 1 (66 and 55, respectively). One COPEC had an individual NOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (66). One COPEC had an individual LOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (55). The primary exposure pathway was the ingestion of terrestrial invertebrates and soil. The results of the Tier 2 risk evaluation for American woodcock are presented in **Appendix D, Table D-3**.

Northern bobwhite. The total EEQs for both NOAEL and LOAEL TRVs exceeded 1 (15 and 12, respectively). One COPEC had an individual NOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (14). One COPEC had an individual LOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (12). The primary exposure pathway was the ingestion of terrestrial invertebrates and soil. The results of the Tier 2 risk evaluation northern bobwhite quail are presented in **Appendix D, Table D-5**.

Marsh wren. The total EEQs for both NOAEL and LOAEL TRVs exceeded 1 (5,213 and 4,375, respectively). Four COPECs had individual NOAEL-based EEQs that exceeded 1 (EEQ in parenthesis): lead (5,146), copper (39), arsenic (24), and zinc (4.8). Four COPECs had individual LOAEL-based EEQs that exceeded 1 (EEQ in parenthesis): lead (4,323), copper (32), arsenic (15), and zinc (4.8). The

primary exposure pathway was the ingestion of aquatic invertebrates. The results of the Tier 2 risk evaluation for marsh wrens are presented in **Appendix D, Table D-7**.

Short-tailed shrew. The total EEQs for both NOAEL and LOAEL TRVs exceeded 1 (191 and 155, respectively). Ten COPECs had individual NOAEL-based EEQs that exceeded 1 (EEQ in parenthesis): lead (157), fluoranthene (12), benzo(b)fluoranthene (7.5), pyrene (2.7), benzo(k)fluoranthene (2.4), chrysene (2.0), indeno(1,2,3-cd)pyrene (1.7), benzo(a)anthracene (1.4), benzo(ghi)perylene (1.4), and benzo(a)pyrene (1.4). Three COPECs had individual LOAEL-based EEQs that exceeded 1 (EEQ in parenthesis) when rounded to one significant figure: lead (147), fluoranthene (2.4), and benzo(b)fluoranthene (1.5). The primary exposure pathway was the ingestion of terrestrial invertebrates and soil. The results of the short-tailed shrew Tier 2 risk evaluation are presented in **Appendix D, Table D-9**.

Meadow vole. The total EEQs for both NOAEL and LOAEL TRVs exceeded 1 (42 and 33, respectively). Four COPECs had individual NOAEL-based EEQs that exceeded 1 (EEQ in parenthesis): lead (33), fluoranthene (3.4), pyrene (1.8), and benzo(b)fluoranthene (1.6). One COPEC had an individual LOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (31). The primary exposure pathway was the ingestion of soil. The results of the Tier 2 risk evaluation for meadow voles are presented in **Appendix D, Table D-11**.

Raccoon. The total EEQs for both NOAEL and LOAEL TRVs exceeded 1 (14 and 13, respectively). One COPEC had an individual NOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (13.4). One COPEC had an individual LOAEL-based EEQ that exceeded 1 (EEQ in parenthesis): lead (12.6). The primary exposure pathway was the ingestion aquatic invertebrates and sediment. The results of the Tier 2 risk evaluation for raccoons are presented in **Appendix D, Table D-13**.

6.7.3 Approach for the Evaluation of Direct Contact Toxicity

For direct contact exposure for invertebrates to COPECs in soil, sediment and surface water, measured COPEC concentrations were simply compared with direct contact benchmarks appropriate for these communities. COPEC media concentrations are compared with a variety of direct contact benchmarks. Intake is not calculated because potential adverse effects are assessed by evaluating the COPEC concentrations in soil, sediment and surface water. The results are presented below and summarized in **Tables 6-14** (surface soil), **6-15** (sediment) and **6-16** (surface water).

6.7.3.1 Surface Soil

As there are no promulgated soil screening criteria for terrestrial organisms potentially exposed to COPECs in soil collected from the former Skeet Range, a weight-of-evidence approach was used, where the more soil benchmarks exceeded by the COPEC concentration, the greater the potential for adverse effects. As most soil dwelling biota are relatively non-mobile, maximum detected surface soil concentrations are used. In addition, an exposure concentration more representative of potential community-level effects is also used in the evaluation, expressed as the 95% UCL. Soil benchmarks used to assess direct contact exposure include the following:

- New Jersey DEP Ecological Screening Criteria;
  - Soil screening values (for plants and invertebrates only) compiled from: USEPA Region 5 ESLs (USEPA, 2003c), USEPA EcoSSLs (USEPA, 2007), and Oak Ridge National Laboratory Screening Benchmarks for Plants from ORNL (ORNL, 1997), lowest of the relevant benchmarks from each source used as a screening value.
- Dutch Intervention Value (Netherland Ministry of Housing, 2000);
- Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guideline values (CCME, 2003);
  - Conservative value based on agricultural land use.
- Lowest EcoSSL for invertebrate or plant toxicity (USEPA, 2007) (if not used by NJDEP – see above); and

- ORNL Benchmarks for Soil Invertebrates (ORNL, 1997) (if not used by NJDEP – see above).

Based on the results of the soil screening evaluation for direct contact, seventeen COPECs detected in surface soil had maximum concentrations that exceeded at least one benchmark, however, only seven of these COPECs (antimony, arsenic, copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene) had more than 50 percent of the available benchmarks exceeded (**Table 6-14**). When 95% UCL soil concentrations are used in the screening assessment, only fifteen COPECs detected in surface soil had concentrations that exceeded at least one benchmark, and only lead had more than 50 percent of the available benchmarks exceeded. Detailed results of the surface soil direct contact assessment for COPEC MDCs that exceeded the 50 percent threshold are discussed below.

There was no available surface soil benchmark for iron.

- The antimony MDC exceeded three of the four available benchmarks for antimony. When the EPC was compared to the same screening benchmarks, one of the four benchmark values was exceeded. However, this benchmark is based on plant toxicity; therefore, potential for direct contact toxicity is not significant enough to recommend further action at the Site.
- The arsenic MDC exceeded four of the six available benchmarks. When the EPC for arsenic was compared to the same screening benchmarks, only two of the six benchmark values were exceeded. It is worth noting that the two exceeded benchmarks are based on plant toxicity. As less than 50% of the arsenic benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.
- The copper MDC exceeded four of the six available benchmarks. When the EPC for copper was compared to the same screening benchmarks, only one of the screening values was exceeded. As less than 50% of the copper benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.
- The lead MDC and EPC exceeded all of the five available benchmarks. Based on this finding, it is possible that organisms inhabiting the soil at the Site may be adversely impacted by levels of lead.
- The benzo(a)anthracene MDC exceeded two of the three available benchmarks. When the EPC for benzo(a)anthracene was compared to the same screening benchmarks, only one benchmark was exceeded. It is worth noting that the one benchmark exceeded by the EPC is based on agricultural use. As less than 50% of the benzo(a)anthracene benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.
- The benzo(a)pyrene MDC exceeded two of the three available benchmarks. When the EPC for benzo(a)pyrene was compared to the same screening benchmarks, only one benchmark was exceeded. It is worth noting that the one benchmark exceeded by the EPC is based on agricultural use. As less than 50% of the benzo(a)pyrene benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.
- The benzo(b)fluoranthene MDC exceeded two of the three available benchmarks. When the EPC for benzo(b)fluoranthene was compared to the same screening benchmarks, only one benchmark was exceeded. It is worth noting that the one benchmark exceeded by the EPC is based on agricultural use. As less than 50% of the benzo(b)fluoranthene benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.

These results suggest that direct contact toxicity for lead in surface soil at the former Skeet Range may be a concern, assuming this metal is bioavailable.

6.7.3.2 Sediment

As there are no promulgated soil screening criteria for aquatic organisms potentially exposed to COPECs in sediment collected from the former Skeet Range, a weight-of-evidence approach was used, where the more sediment benchmarks exceeded by the COPEC concentration, the greater the potential for adverse effects. As most sediment dwelling biota are relatively non-mobile, maximum detected sediment concentrations are used. In addition, an exposure concentration more representative of potential community-level effects is also used in the evaluation, expressed as the 95% UCL. Sediment benchmarks used to assess direct contact exposure include the following:

- New Jersey DEP Ecological Screening Criteria;
  - Freshwater sediment screening values compiled from: USEPA Region 5 Ecological Screening Levels (ESLs; USEPA, 2003c) and other unspecified sources, lowest of the relevant benchmarks used as the screening value.
- Threshold Effect Concentrations from Assessment and Remediation of Contaminated Sediments (ARCS) program (ORNL, 1997). Probable Effect Concentrations from ARCS program (ORNL, 1997). No Effect Concentrations from ARCS program (ORNL, 1997);
  - Test organisms typically used by ARCS included sediment invertebrates such as *Hyallela azteca and C. riparius.*
- Sediment Quality Benchmarks (ORNL, 1997);
  - Based on sediment pore-water equilibrium partitioning and water quality criteria for the protection of aquatic life, including invertebrates such as *C. dubia*, vertebrates (fish), and other aquatic biota.
- Canadian Interim Sediment Quality Guidelines (CCME, 2003);
- Canadian Probable Effects Levels (PELs) (CCME, 2003); and
  - Test organisms typically used by CCME included amphipods, mussels, copepods, oysters, echinoderms, bivalves, polychaetes, and the bacterium *P. phosphoreum.*
- Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, (MacDonald et al., 2000).
  - Probable Effect Concentrations (PEC) and Threshold Effect Concentrations (TEC) were used.

Based on the results of the sediment screening evaluation for direct contact, eight COPECs detected in sediment had maximum concentrations that exceeded at least one benchmark, however, only five of these COPECs (antimony, arsenic, copper, lead, and zinc) had more than 50% of the available benchmarks exceeded (**Table 6-15**). When 95% UCL sediment concentrations are used in the screening assessment, all eight COPECs still screen in, and antimony, arsenic, copper, lead, and zinc still have more than 50% of the available benchmarks exceeded.

There were no available benchmarks for iron.

Detailed results of the sediment direct contact assessment are discussed below.

- The antimony MDC exceeded the only available benchmark for antimony. The calculated 95% UCL for antimony exceeded or equaled the MDC, therefore, the MDC was used for the EPC (see **Table 6-10**) and it exceeds the antimony benchmark. Based on this finding, it is possible that organisms inhabiting sediments at the Site may be adversely impacted by levels of antimony.
- The arsenic MDC exceeded all eight available benchmarks for arsenic. The arsenic EPC is based on the MDC (see **Table 6-10**) so it still exceeds all available benchmarks. Based on this finding, it is possible that organisms inhabiting sediments at the Site may be adversely impacted by levels of arsenic.

- The copper MDC exceeded all eight available benchmarks for copper. The copper EPC is based on the MDC (see **Table 6-10**) so it still exceeds all available benchmarks. Based on this finding, it is possible that organisms inhabiting sediments at the Site may be adversely impacted by levels of copper.
- The lead MDC exceeded all eight available benchmarks for lead. The lead EPC is based on the MDC (see **Table 6-10**) so it still exceeds all available benchmarks. Based on this finding, it is possible that organisms inhabiting sediments at the Site may be adversely impacted by levels of lead.
- The zinc MDC exceeded seven of eight available benchmarks for zinc. The zinc EPC is based on the MDC (see **Table 6-10**) so it still exceeds all available benchmarks. Based on this finding, it is possible that organisms inhabiting sediments at the Site may be adversely impacted by levels of zinc.

These results suggest that direct contact toxicity for COPECs in sediment at the former Skeet Range may be a concern for antimony, arsenic, copper, lead, and zinc.

6.7.3.3 Surface Water

For aquatic organisms potentially exposed to COPECs in surface water collected from the former Skeet Range, comparison of the MDC and EPC to promulgated water quality criteria or a weight-of-evidence approach (for constituents without promulgated criteria) was used. It should be noted that because of the nature of various benchmark sources, promulgated water quality criteria (e.g., National Ambient Water Quality Criteria [NAWQC] and New Jersey Surface Water Quality Standards) were determined to be more critical during the evaluation than non-promulgated benchmarks. Important COPEC toxicity was based on whether or not promulgated criteria were exceeded or, when no promulgated criteria were available, whether more than half of the available surface water benchmarks were exceeded. As some aquatic biota are relatively non-mobile, maximum detected surface water concentrations are used, in addition to a more realistic exposure concentration expressed as the 95% UCL. Surface water benchmarks used to assess direct contact exposure include the following, along with general information on the typical organisms utilized in formulating the criteria or benchmarks:

- New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B (January, 2010);
  - Values are for freshwater and a hardness of 100 milligrams per liter (mg/L) (as Ca CO3) is assumed for hardness-dependent criteria.
- USEPA (2009) - 4304T. National Recommended Water Quality Criteria. Values are for freshwater; and
- ORNL. 1996b. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision, ES/ER/TM-96/R2.
  - Tier II Secondary values include formulation similar to National Recommended Water Quality Criteria (USEPA, 2009; above); however, less than eight families of aquatic organisms are used, following the methodology used for the Great Lakes.
  - Lowest chronic effect values are for fish, daphnids, non-daphnids, and aquatic plants.

Using these surface water benchmarks, direct contact exposure to aquatic biota was assessed. As shown in **Table 6-16**, up to nine benchmarks were potentially available for comparison purposes for surface water COPECs. Using a weight-of-evidence approach, based on the MDC and the 95% EPC concentration for each COPEC, all six of the surface water COPECs had at least one exceedance of their respective surface water benchmarks. It should be noted that the calculated 95% UCLs exceeded or equaled the MDCs for all COPECs, therefore, maximum concentrations were used for the EPC (see **Table 6-11**) and only MDC-based results will be discussed. The results of the surface water screening are as follows:

- The antimony MDC exceeded one of the five available benchmarks for antimony. There are no promulgated standards available for antimony and the only exceedance was a Tier II-chronic value. As only one benchmark was exceeded and there are no promulgated

standards, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.

- The arsenic MDC exceeded one of the nine available benchmarks for arsenic. It did not exceed any of the promulgated standards (New Jersey SWQS or NAWQC) and the only exceedance was a Tier II-chronic value. Since no promulgated standards were exceeded, and less than 50% of the arsenic benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.
- The copper MDC exceeded all six available benchmarks or criteria for copper, which include the New Jersey SWQS for acute and chronic exposure. Since promulgated standards and all other available benchmarks were exceeded, there is potential for direct contact toxicity for copper in the former Skeet Range surface water. Based on this finding, it is possible that organisms inhabiting surface waters at the Site may be adversely impacted by levels of copper.
- The iron MDC exceeded all three available benchmarks or criteria for iron, including the NAWQC for chronic exposure. Since a promulgated standard and all other available benchmarks were exceeded, there is potential for direct contact toxicity for iron in the former Skeet Range surface water. Based on this finding, it is possible that organisms inhabiting surface waters at the Site may be adversely impacted by levels of iron.
- The lead MDC exceeded all eight available benchmarks or criteria for lead, which include the New Jersey SWQS and NAWQC for acute and chronic exposure. Since promulgated standards and all other available benchmarks were exceeded, there is potential for direct contact toxicity for lead in the former Skeet Range surface water. Based on this finding, it is possible that organisms inhabiting surface waters at the Site may be adversely impacted by levels of lead.
- The zinc MDC exceeded three of the eight available benchmarks for zinc. It did not exceed any of the promulgated standards (New Jersey SWQS or NAWQC). Since no promulgated standards were exceeded, and less than 50% of the zinc benchmarks were exceeded, the potential for direct contact toxicity is not significant enough to recommend further action at the Site.

These results suggest that direct contact toxicity for COPECs in surface water at the former Skeet Range may be a concern for copper, iron, and lead.

6.7.4 Background Metals Considerations

Statistical evaluations were conducted to compare metal and PAH concentrations (for hazard drivers) in soil, surface water, and sediment at the former Skeet Range with site-specific background concentrations (IT Corporation, 2002), or if unavailable from IT (2002), using 95th percentile BTVs from NJDEP (2002, 2003).

The metal and PAH COPECs identified as hazard drivers in soil, surface water, and sediment were selected for the background evaluation, as listed in **Table 6-17**.

As a first step in the background evaluation, maximum Site concentrations were compared with BTVs from IT (2002) for metals in soil, sediment, and surface water, and using 95th percentile BTVs from NJDEP (2002, 2003) for PAHs in soil. If MDCs exceeded the BTVs by only a moderate amount, than a refined background statistical evaluation was considered. This refined evaluation, if performed, would follow the procedures outlined in the USEPA Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (USEPA, 2002d) and would be conducted using USEPA's ProUCL 4.00.100 statistical program. Statistical analyses could include distribution testing of Site data sets and background data sets, evaluation of data using descriptive summary statistics, and comparisons of Site data to background.

For the former Skeet Range metal and PAH COPCs that were hazard drivers, the MDCs were compared with BTVs in **Table 6-17**. It should be noted that fluoranthene and pyrene were not analyzed in

the NJDEP (2002, 2003) background data base; therefore comparisons with these two PAH could not be made.

Based on comparisons presented in **Table 6-17**, none of the COPEC hazard drivers were found to be related to background.

A more refined background statistical analysis was not performed for the Site-related PAH and metal COPECs shown on **Table 6-17** due to the finding that the MDCs of these COPCs were considerably above the BTVs.

In conclusion, the Site hazard drivers that are PAHs and metals are expected to be related to the former Skeet Range, and not related to background.

6.8 UNCERTAINTY ANALYSIS

The results of the SLERA are influenced to some degree by variability and uncertainty. In theory, investigators might reduce variability by increasing sample size of the media or species sampled. Alternatively, uncertainty within the risk analysis can be reduced by using species-specific and site-specific data (i.e., to better quantify contamination of media, vegetation, and prey through: direct field measurements, toxicity testing of site-specific media, and field studies using site-specific receptor species). Detailed media, prey, and receptor field studies are costly; thus, the preliminary analyses of risk have been conducted to limit the potential use of these resource-intensive techniques to those COPECs that continue to show a relatively high potential for ecological risk. Since assessment criteria were developed based on conservative assumptions, the result of the assessment errs on the side of conservatism. This has the effect of maximizing the likelihood of accepting a false positive (Type I error: the rejection of a true null hypothesis) and simultaneously minimizing the likelihood of accepting a true negative (Type II error: the acceptance of a false null hypothesis).

A number of factors contribute to the overall variability and uncertainty inherent in ecological risk assessments. Variability is due primarily to measurement error; laboratory media analyses and receptor study design are the major sources of this kind of error. Uncertainty, on the other hand, is associated primarily with deficiency or irrelevancy of effects, exposure, or habitat data to actual ecological conditions at the Site. Calculating an estimated value based on a large number of assumptions is often the alternative to the accurate (but costly) method of direct field or laboratory observation, measurement, or testing.

The uncertainty analysis is presented in **Table 6-18** and lists some of the major assumptions made for the SLERA; the direction of bias caused by each assumption (i.e., if the uncertainty results in an overestimate or underestimate of risk); the likely magnitude of impact (quantitative [percent difference], or qualitative [high, medium, low, or unknown]); if possible, a description of recommendations for minimizing the identified uncertainties if the SLERA progresses to higher level assessment phases; and the ease of implementing the recommendation (USEPA, 1997b).

The uncertainty analysis identifies and, if possible, quantifies the uncertainty in the individual preliminary scoping assessment, problem formulation, exposure and effects assessment, and risk characterization phases of the SLERA. Based on this uncertainty analysis, the most important biases that may result in an overestimation of risk include the following:

- Assuming that COPECs are 100% bioavailable.
- Using some laboratory-derived or empirically-estimated partitioning and transfer factors to predict COPEC concentrations in plants, invertebrates, and/or prey species.
- Use of the HQ method to estimate risks to populations or communities.

6.8.1 Uncertainties Associated with Potential Exposure to Lead Shot

There is a potential concern that large lead particles, or lead shot, may be present at the former Skeet Range, and therefore may adversely impact certain species of birds that intentionally ingest grit to aid their digestion. To evaluate this concern for potential lead shot toxicity to avian species, and possible bioaccumulation in small birds and subsequent lead exposure to avian-consuming raptors, the following two questions were posed for the Site:

1. Are gallinaceous birds (grouse, pheasants, turkeys, partridges, domestic fowls, etc.) present or likely to be present on Site?
2. Are lead particles likely to be present in preferred grit sizes for a range of representative gallinaceous birds at the Site, for example, for quail with a preferred grit size of 0.8 - 2.2 mm diameter or turkey with a preferred grit size of 2.8 – 4.2 mm diameter (Gionfriddo and Best, 1991)?

For question No. 1, it is possible that gallinaceous birds might be present on the former Skeet Range, based on the presence of habitat for some of these types of birds, and the fact that the northern bobwhite quail was used as one of the representative wildlife avian species for the SLERA.

For question No. 2, although cursory visual examination during soil and sediment sample collection did not find evidence of lead shot or lead fragments (Cook, 2011), a systematic assessment for these types of particles was not performed.

Therefore, as gallinaceous birds are likely present on Site, and lead shot or lead fragments in the preferred grit size ranges may be present (particularly due to the very elevated lead concentrations in soil and sediment), further study is recommended.

6.8.2 Uncertainties Associated with Non-Detect Chemicals

There is some uncertainty associated with chemicals that were entirely non-detect in the surface soil, sediment, and surface water. It is possible that chemicals, while non-detect, could be present at some concentration between zero and the detection limit.

6.8.3 Uncertainties Associated Low Densities of Wildlife Receptors

As some of the selected wildlife receptor species used in this SLERA have relatively low densities, these low densities would be expected to mitigate exposure and result in limited population effects (even if exposure to isolated lead hotspots occur) given the small site areas with elevated lead concentrations. Estimated wildlife receptor average densities are presented below (from USEPA, 1993):

- American woodcock: 0.3 per acre
- Bobwhite quail: 0.7 per acre
- Short-tailed shrew: 3 per acre
- Meadow vole: 210 per acre
- Marsh wren: 5 per acre
- Raccoon: 0.2 per acre

Given this density information, the three receptors with densities less than 1 per acre (woodcock, quail, and raccoon) would not be expected to experience any significant population-level impacts as a result of lead exposure due to the premise that at least five animals would be needed to be present for a viable breeding population (i.e., a population that matters in a risk assessment sense; Tannenbaum, 2005). For the two receptors with densities between 1 and 10 per acre (shrew and wren), estimated population-level impacts may or may not be expected to occur, depending on the actual size of the area of elevated lead in soil and sediment. For the vole that has a high density, local population-level impacts might be expected to occur as a result of potential exposure to lead, as the estimated LOAEL-based EEQ for this COPEC was 31 (**Section 6.7.*2***).

6.9 SLERA RESULTS AND CONCLUSIONS

The data, results, and conclusions of the SLERA evaluated risks to ecological populations inhabiting the former Skeet Range. Conclusions are derived from the risk assessment and are based on the responses to the assessment hypotheses and assessment endpoints. The assessment results for food chain exposure are summarized in **Table 6-13**, and direct contact exposure results, which may serve as a food source for wildlife, are summarized in **Tables 6-14** (surface soil), **6-15** (sediment) and **6-16** (surface water) and discussed in **Section 6.7.3**.

The food chain assessment suggests potential adverse impacts to all modeled wildlife (marsh wrens, short-tailed shrews, American woodcocks, meadow voles, raccoons, and northern bobwhites) particularly for modeled contact with the hazard driver lead in soil and sediment (**Table 6-13**). Estimated wildlife hazards were as elevated as 4,375 for the marsh wren using more realistic Tier 2 LOAEL-based TRVs.

The direct contact assessment results suggest a potential reduction in wildlife food supply due to lead in surface soil; antimony, arsenic, copper, lead, and zinc in sediment; and copper, iron, and lead in surface water. Given the relatively large size of the Site (approximately 11 acres of soil and 12 acres of sediment), while some wildlife may forage in nearby areas that are not contaminated, other wildlife species, especially those with home ranges less than 11 to 12 acres, such as the marsh wren, short-tailed shrew, and meadow vole, may be adversely affected as a result of a reduced food supply. In addition, copper, iron, and lead concentrations in surface water exceeded promulgated state and/or federal water quality criteria for the protection of aquatic life.

There is a potential concern that large lead particles, or lead shot, may be present at the former Skeet Range, and therefore may be adversely impacting certain species of birds (such as the northern bobwhite quail) that intentionally ingest grit to aid their digestion.

The scientific/management decision point reached for the former Skeet Range, based on the results of this SLERA, is that a more thorough assessment is warranted. Further ecological evaluation will be contingent on the additional delineation sampling and the selected remedy.

Soil and Sediment

RI sampling conducted at the former Skeet Range in March 2011 indicated concentrations of PAHs and metals in excess of LOCs for soil and sediment. The metal exceedances included arsenic and lead in surface soil, lead in subsurface soil, and antimony, arsenic, copper, lead, and zinc in sediment samples. Lead is scattered within and around the former Skeet Range in soil and sediment at concentrations exceeding LOCs. The highest concentrations of lead appear to be within the maximum shot fall zone, including within the eastern and northeastern portions of this zone in soil, and within the central portion of this zone in sediment (**Figures 1-3 and 3-5**). Two soil samples collected to the east of the former Skeet Range had lead concentrations exceeding the LOC; however, the majority of the horizontal delineation samples to the east had concentrations of lead below the LOC. Vertical delineation of lead impacts in soil appears to have been achieved in most locations. This delineation is evident at sample locations B1181SS-10D and B1181SS-25C. Only at location B1181SS-14, there remains an elevated detection of lead in subsurface soil. This area is located within the northeastern maximum shot fall zone. While the full extent of lead impacts has not been determined, additional delineation is not deemed necessary at this time, based on the lead model results that are well above the threshold of concern.

The arsenic exceedances in soil/sediment samples included one arsenic exceedance in surface soil located on the western edge of the former Skeet Range impact fan (**Figure 3-3**), and two arsenic exceedances in sediment samples collected within the central portion of the former Skeet Range impact fan (**Figure 3-5**). Given arsenic was only found in one soil sample exceeding the LOC and the fact it was a marginal exceedance, arsenic in soil impacts seem to be localized and not representative of an area impacted from the former operation of the skeet range. The soil arsenic exceedance, along with the two sediment exceedances, may be related to former landfilling in this area of PTA.

The remaining metal exceedances in sediment appear to be primarily confined to the central and eastern portions of the former Skeet Range impact fan (**Figure 3-5**). Copper was the only metal found outside of the former Skeet Range impact fan above its LOC (to the east). These detections of munitions metals may be related to the former operations of the skeet range. It should be noted that concentrations of these metals in soil samples did not exceed LOCs. Therefore, it appears only potential ecological impacts are possible, given the strict ecological screening guidance used for sediment.

Only minor exceedances of PAHs were detected in one surface soil sample located to the west of the former Skeet Range impact fan (**Figure 3-4**). PAH exceedances were also detected in two subsurface soil samples analyzed for PAHs. These two samples were collected at previous surface soil locations with elevated PAH levels. When the subsurface soil results are compared to the surface soil sampling results from 2010 at these locations, concentrations of contaminants decrease significantly with depth. As stated in the 2010 data report, these exceedances may be related to nearby asphalt roads (B1181SS-23) or accumulation of clay pigeons (B1181SS-35). In addition, the location of the surface soil sample exceedance is proximal to subsurface sampling location B1181SS-23, and may also be related to nearby asphalt roads. Although the vertical extent of PAHs has not been defined, it is important to note that the PAH contamination has not impacted groundwater.

Based on a review of sediment sampling data, only one PAH was detected above the LOC, and at a relatively low concentration (**Figure 3-5**). This detection was found at a sampling location within the maximum shot fall zone and may be related to the historical use of clay pigeons associated with Skeet Range operations. Several metals were detected at concentrations exceeding their respective LOCs in at least one sediment sample. Lead was detected in five samples above the LOC and appears to be distributed throughout the former Skeet Range with the highest concentration located at a central location within the maximum shot fall zone. The remaining metals were for the most part found within the maximum shot fall zone, with the highest concentrations found in this zone. These metals may be related to the former operation of the Skeet Range or landfilling within the area.

Based on known impacts to soils and sediments at small arms firing ranges, the concentrations of antimony, arsenic, copper, and zinc could also be related to munitions used at the former Skeet Range. According to information obtained from the ITRC, lead is the primary constituent of a projectile (e.g.,

shotgun ammunition). Antimony is commonly present in shotgun ammunition to increase hardness. Arsenic is present within the lead shot since it increases the surface tension of lead which improves shot roundness. Copper and zinc are commonly present in shotgun ammunition as a jacket alloy metal (ITRC, 2003).

Horizontal delineation of soil impacts appears to have been achieved to the north, south, and west of the former Skeet Range. This delineation is evident to the north in sample numbers B1181SS-43, B1181SS-44, B1181SS-50, B1181SS-51, B1181SS-52, and B1181SS-53, to the south in sample numbers B1181SS-20, B1181SS-21, B1181SS-22, 180SS-12A, and 180SS-13A, and to the west in sample numbers B1181SS-24, B1181SS-39, B1181SS-56, and B1181SS-57 (**Figures 1-3, 3-3 and 3-4**).

Horizontal delineation of sediment is evident to the east of the maximum shot fall zone at sampling locations B1181SD-7 and B1181SD-8 (**Figure 3-5**). At least one metal or PAH remains at concentrations exceeding sediment LOCs in the remaining sediment sampling locations which are located within or adjacent to the maximum shot fall zone. This includes a lack of vertical delineation of copper, lead, zinc, and fluoranthene at sediment sampling location B1181SD-3C and a lack of horizontal delineation of lead (B1181SD-11) and copper (B1181SD-6). Although the elevated metals concentrations detected in the sediment samples from the drainage channel could be a continuing source contamination to Green Pond Brook, additional delineation is not deemed necessary because additional samples would be collected at or below the groundwater table and ecological impacts are typically assessed between the 0 to 1 foot interval. Additional vertical delineation sediment samples would be collected below this depth interval. In addition, additional horizontal delineation of lead and copper at these locations within the sampled drainage channel would lead to delineation into Green Pond Brook. Potential impacts to Green Pond Brook have been evaluated in a RI, FS, and ROD. The remedial alternative for this portion of Green Pond Brook includes annual chemical and biological sampling to assess the impacts to ecological receptors. No additional characterization of the drainage channel at the former Skeet Range or Green Pond Brook is warranted.

Groundwater

RI sampling conducted at the former Skeet Range in April 2011 indicated concentrations of iron and arsenic in excess of the LOCs for groundwater. The detections of arsenic above LOCs are located both upgradient and downgradient of the former Skeet Range. Arsenic is a known groundwater contaminant in Area C and is likely from historic landfilling operations or contamination from other sites. It is unlikely the arsenic detections in groundwater are related to the historic operation of the former Skeet Range. Iron concentrations in groundwater are consistent with levels detected in wells throughout the base and are due to local geologic conditions. Despite high concentrations of lead in the soil and sediment, and given the shallow groundwater level, lead was not detected above the LOC in the groundwater, suggesting that lead is absorbed to the soil and organic carbon, and it is not leaching into the groundwater or moving in solution. This is also applicable to the detections of antimony, copper, and zinc above LOCs in soil/sediment samples. Please refer to **Figure 3-1** for a depiction of the extent of contamination in groundwater.

Surface Water

RI sampling conducted at the former Skeet Range in March 2011 indicated concentrations of antimony, arsenic, iron, and lead in excess of LOCs for surface water. The detections of arsenic and antimony above the LOC are located both within the impact fan and to the east of the impact fan. Given that arsenic was also detected above the LOC in the sediment sample B1181SD-9, the elevated concentration of arsenic in surface water at this location could be related. Arsenic is a known contaminant in the area due to historic landfilling operations or contamination from other sites. Given that antimony was also detected above the LOC in sediment sample B1181SD-10, the elevated concentration of antimony in surface water at this location could be related. The detections of arsenic and antimony may also be related to turbid samples. The detection of iron above the LOC in surface water sample B1181SW-10 could be related to the historical operation of the Skeet Range. This is based on the high concentrations detected well above the PTA background concentrations. The elevated concentrations of lead in surface water samples appears to correspond with elevated concentrations of lead in both the sediment and soil samples and is likely associated with the historical operation of the former Skeet Range. Please refer to **Figure 3-1** for a depiction of the extent of contamination in surface water.

Based on a review of surface water data, the greatest impacts from metals was found at the surface water sample collected within the central portion of the skeet range maximum shot fall zone. Lead was detected above the LOC in five of six samples which is likely attributed to the former operation of the Skeet Range. The surface water samples which detected lead below the LOC were found outside of the shot fall zone at a location upgradient of the remaining surface water samples. The remaining metals detected above LOCs may be related to the high turbidity of samples, landfilling within the area, or weathering of the shot used at the skeet range.

Human Health Risk Assessment

The risk for current worker exposure scenarios are within the acceptable risk range. However, the current hazard is above the threshold value of 1.0 for the current routine worker with the hazard driver being antimony in sediment. It is important to note that there are no current workers at the site and no future plans to develop the site. Future routine workers and hypothetical future resident exposures scenarios exceeded the upper level of the acceptable risk range of 1.0E-04 with the COPCs having estimated risks greater than 1.0E-6 being PAHs in surface soil and arsenic in surface water, sediment and groundwater. The future hazard levels exceeded the threshold level of 1.0 with the hazard drivers being antimony in sediment and surface water and arsenic in groundwater.

Lead model results demonstrated that lead in surface soil and sediment at the former Skeet Range exceeded, by a considerable amount, safe exposure levels. The probability that lead in surface soil would result in unacceptable future child blood lead levels was 98.9 percent, and 99.9 percent for sediment, while the probability that lead in surface soil would result in unacceptable adult worker fetal blood lead levels was up to 44 percent, and up to 99 percent for sediment. As all these probability estimates exceed the 5 percent threshold of concern, potential lead exposure at the Site is unacceptable. It should be noted that environmental exposures associated with blood lead levels above 30 µg/dL (e.g., for Skeet Range sediment, but not soil) are above the range of values that have been used in the calibration and empirical validation of the model; therefore, these results have an elevated component of uncertainty.

Screening-Level Ecological Risk Assessment

The food chain assessment suggests potential adverse impacts to all modeled wildlife (marsh wrens, short-tailed shrews, American woodcocks, meadow voles, raccoons, and northern bobwhites) particularly for modeled contact with the hazard driver lead in soil and sediment. However, low average densities of five of these six receptors (except for voles), likely mitigates these estimated adverse impacts, as local populations would not be expected to be adversely impacted.

The direct contact assessment results suggest a potential reduction in wildlife food supply due to lead in surface soil; antimony, arsenic, copper, lead, and zinc in sediment; and copper, iron, and lead in surface water. Given the relatively large size of the Site (approximately 11 acres of soil and 12 acres of sediment), while some wildlife may forage in nearby areas that are not contaminated, other wildlife species, especially those with home ranges less than 11 to 12 acres, such as the marsh wren, short-tailed shrew, and meadow vole, may be adversely affected as a result of a reduced food supply. In addition, copper, iron, and lead concentrations in surface water exceeded promulgated state and/or federal water quality criteria for the protection of aquatic life.

There is a potential concern that large lead particles, or lead shot, may be present at the former Skeet Range, and therefore may be adversely impacting certain species of birds (such as the northern bobwhite quail) that intentionally ingest grit to aid their digestion. However, recent studies (Kerr et al., 2010, 2011) suggest that potential bird ingestion of lead shot is less of a concern than previously thought.

Conclusions

Since 2008, there have been three investigations conducted specifically to characterize the nature and extent of the impacts from the former Skeet Range. As part of these investigations, 80 soil samples, 15 sediment samples, 9 surface water samples, and 11 groundwater samples have been collected in proximity to the site. During the first two investigations, sampling analyses was focused on lead and PAHs. During the RI, sample analyses also included the additional munitions metals antimony, arsenic, copper, iron, and zinc. Of the 76 soil samples analyzed for lead, 36 samples exceed the lead

LOC of 800 mg/kg. Of the 15 sediment samples analyzed for lead, 8 samples exceed the lead LOC of 38.8 mg/kg. Of the 9 surface water samples analyzed for lead, 8 samples exceed the lead LOC of 3.2 µg/l. There has been no groundwater exceedances of lead in the samples collected since 2008. **Figure 1-3** shows the pattern/distribution of elevated lead concentrations in soil in the area of the former Skeet Range. **Figures 3-1 and 3-5** show the distribution of elevated lead concentrations in surface water and sediment in the area of the former Skeet Range. The distribution of lead contamination suggests that the primary source of the lead in the area is the former Skeet Range. Most of the lead concentrations in the maximum shot fall zone exceed the soil, sediment, or surface water LOC, with the highest concentrations located within the central and eastern portions of this zone. The lowest lead concentrations in soil are located closest to the shooter's stand and beyond the northwestern maximum shot fall zone. The lead in soil concentrations generally decrease with distance from the shooter's stand. The majority of lead shot falls to the ground approximately 400 to 600 feet from the shooter and minimal lead shot lands within 300 feet of the shooter. As indicated above, the lack of lead detections in groundwater above the LOC indicates elevated lead concentrations in soil and sediment are not leaching into the groundwater or moving in solution.

Other contaminants found above LOCs in surface water since 2008 include arsenic, antimony, and iron. The detections of antimony and arsenic in surface water above LOCs may be related to historic operations of the Skeet Range, especially considering the fact that these metals were detected in sediment above LOCs at these locations.

Other contaminants found above LOCs in groundwater since 2008 include arsenic, aluminum, iron, manganese, and vanadium. As indicated above, the detections of arsenic are likely attributed to historic landfilling in the area or contamination from other sites since arsenic is a known contaminant around this area of the base. The detection of vanadium above the LOC may also be related to historic landfilling in the area. Aluminum, iron, and manganese concentrations in groundwater are consistent with levels detected in wells throughout the base and are due to local geologic conditions.

Five PAHs and arsenic were detected above LOCs in soil since 2008. Six PAHs, arsenic, copper, and zinc were detected above LOCs in sediment since 2008. Arsenic was detected above the LOCs in three soil/sediment samples which may be attributed to former landfilling operations in the area. Copper and zinc were only detected above the LOC in sediment samples collected in 2011. These detections show no distinct pattern but may be related to the former operations of the skeet range. Only minor exceedances of PAHs have been found in soil and sediment samples within and around the former Skeet Range since 2008. Vertical delineation of these impacts has shown decreasing concentrations with depth. Horizontal impacts have been delineated in most directions from the former Skeet Range. One minor exceedance in surface soil remains to the west of the impact fan which is attributed to a nearby asphalt road and telephone stockpiling in the area. While the full extent of lead impacts has not been determined, additional delineation is not deemed necessary at this time, based on the lead model results that are well above the threshold of concern.

A Feasibility Study (FS) is recommended to evaluate remedial alternatives for the impacts found during investigations of the former Skeet Range. The FS should evaluate potential remedial alternatives to determine which option is deemed best suited for current and future uses of the site, while protective of human health and the environment. Existing institutional controls, as well as existing State regulations will preclude the installation of a potable well at the site or conversion of the marsh/wetlands into residential housing.

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TABLES

Table 3-1
Summary of Sampling Locations
Former Skeet Range
Picatinny Arsenal, New Jersey

Sample Identification	Sample Medium	PAHs	Munitions Metals	Lead	Sampling Rationale
B1181SS-10D	Subsurface Soil (4-4.5')			X	Vertical delineation at a former sampling location
B1181SS-14C	Subsurface Soil (2-2.5')			X	Vertical delineation at a former sampling location
B1181SS-23C	Subsurface Soil (2-2.5')	X			Vertical delineation at a former sampling location
B1181SS-25C	Subsurface Soil (2-2.5')			X	Vertical delineation at a former sampling location
B1181SS-34	Surface Soil	X	X		Horizontal delineation along the northern skeet range impact fan
B1181SS-35C	Subsurface Soil (2-2.5')	X			Vertical delineation at a former sampling location
B1181SS-39	Surface Soil	X	X		Horizontal delineation along the northwestern skeet range impact fan
B1181SS-42	Surface Soil	X	X		Horizontal delineation along the northwestern skeet range impact fan
B1181SS-43	Surface Soil	X	X		Horizontal delineation along the northern skeet range impact fan
B1181SS-44	Surface Soil		X		Horizontal delineation along the northern skeet range impact fan
B1181SS-45	Surface Soil	X	X		Horizontal delineation to the east of the skeet range impact fan
B1181SS-46	Surface Soil	X	X		Horizontal delineation to the east of the skeet range impact fan
B1181SS-48	Surface Soil			X	Horizontal delineation to the east of the skeet range impact fan
B1181SS-49	Surface Soil			X	Horizontal delineation to the east of the skeet range impact fan
B1181SS-50	Surface Soil			X	Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-51	Surface Soil			X	Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-52	Surface Soil			X	Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-53	Surface Soil			X	Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-54	Surface Soil	X	X		Horizontal delineation to the west of the former skeet range impact fan
B1181SS-56	Surface Soil	X	X		Horizontal delineation to the northwest of the former skeet range impact fan
B1181SS-57	Surface Soil	X	X		Horizontal delineation to the northwest of the former skeet range impact fan
B1181SS-58	Surface Soil	X	X		Horizontal delineation to the northwest of the former skeet range impact fan
B1181SS-59	Surface Soil	X	X		Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-60	Surface Soil	X	X		Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-61	Surface Soil	X	X		Horizontal delineation to the north of the skeet range impact fan along Shinkle Road
B1181SS-62	Surface Soil			X	Horizontal delineation within the skeet range maximum shot fall zone
B1181SD-3C	Subsurface Sediment (2-2.5')	X	X		Vertical delineation at a former sampling location
B1181SD-6	Surface Sediment	X	X		Delineation in a drainage channel to the east of the skeet range impact fan
B1181SD-7C	Subsurface Sediment (2-2.5')	X	X		Delineation in a drainage channel to the east of the skeet range impact fan
B1181SD-8	Surface Sediment	X	X		Delineation in a drainage channel to the northeast of the skeet range impact fan
B1181SD-9	Surface Sediment	X	X		Random delineation sample within or adajcent to the skeet range impact fan based on field observations

Table 3-1
Summary of Sampling Locations
Former Skeet Range
Picatinny Arsenal, New Jersey

Sample Identification	Sample Medium	PAHs	Munitions Metals	Lead	Sampling Rationale
B1181SD-10	Surface Sediment	X	X		Random delineation sample within or adajcent to the skeet range impact fan based on field observations
B1181SD-11	Surface Sediment			X	Delineation in a drainage channel within the skeet range impact fan
B1181SD-12	Surface Sediment			X	Delineation in a drainage channel within the skeet range impact fan
B1181SW-6	Surface Water	X	X		Delineation in a drainage channel to the east of the skeet range impact fan
B1181SW-7	Surface Water	X	X		Delineation in a drainage channel to the east of the skeet range impact fan
B1181SW-8	Surface Water	X	X		Delineation in a drainage channel to the northeast of the skeet range impact fan
B1181SW-9	Surface Water	X	X		Random delineation sample within or adajcent to the skeet range impact fan based on field observations
B1181SW-10	Surface Water	X	X		Random delineation sample within or adajcent to the skeet range impact fan based on field observations
C-1A	Groundwater	X	X		Groundwater impacts upgradient of the skeet range impact fan
C-1B	Groundwater	X	X		Groundwater impacts upgradient of the skeet range impact fan
DM19-3	Groundwater	X	X		Groundwater impacts downgradient of the skeet range impact fan
B1181MW-1	Groundwater	X	X		Groundwater impacts within and downgradient of the skeet range impact fan
B1181MW-2	Groundwater	X	X		Groundwater impacts within and downgradient of the skeet range impact fan

Table 3-2
Former Skeet Range
Summary of Groundwater Analytical Results

Analyte		Sample ID	B1181MW-1					B1181MW-1DUP					B1181MW-2					C1-A					C1-B					DM19-3				
		Sample Date	4/28/2011					4/28/2011					4/28/2011					4/28/2011					4/28/2011					4/28/2011				
		Sample Depth	7.7-12.7					7.7-12.7					11-16					77.2-87.2					12.3-22.3					10-20				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (ug/L)																																
Antimony	6	NJGWQC	0.46	J	U	*0.14*	*2*	0.36	J	U	*0.14*	*2*	2	U	U	*0.14*	*2*	2	U	U	*0.14*	*2*	2	U	U	*0.14*	*2*	0.27	J	U	*0.14*	*2*
Arsenic	3	NJPQL	0.92	J	U	*0.18*	*1*	0.26	J	U	*0.18*	*1*	1	U	U	*0.18*	*1*	1	U	U	*0.18*	*1*	4			*0.18*	*1*	10.3			*0.18*	*1*
Copper	1300	NJMCL, NJGWQC	1.8	J	U	*0.04*	*2*	2.4		U	*0.04*	*2*	6.3		U	*0.04*	*2*	1.8	J	U	*0.04*	*2*	3.8		U	*0.04*	*2*	3.8		U	*0.04*	*2*
Iron	300	NJGWQC	15300			*10.3*	*200*	14600			*10.3*	*200*	16900			*10.3*	*200*	209			*10.3*	*200*	624			*10.3*	*200*	2050			*10.3*	*200*
Lead	5	NJGWQC, NJPQL	0.87	J	U	*0.04*	*1*	1		U	*0.04*	*1*	2.9		U	*0.04*	*1*	0.49	J	U	*0.04*	*1*	1.1		U	*0.04*	*1*	1.2		U	*0.04*	*1*
Zinc	2000	NJGWQC	30.9		U	*0.09*	*2*	50.4		U	*0.09*	*2*	27.9		U	*0.09*	*2*	12.8		U	*0.09*	*2*	33		U	*0.09*	*2*	14.5		U	*0.09*	*2*
PAHs (ug/L)																																
Acenaphthene	400	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Acenaphthylene	100	NJGWQC*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Anthracene	2000	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Benzo(a)anthracene	0.1	NJPQL	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Benzo(a)pyrene	0.1	NJPQL	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Benzo(b)fluoranthene	0.2	NJPQL	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Benzo(g,h,i)perylene	100	NJGWQC*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Benzo(k)fluoranthene	0.5	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Chrysene	5	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Dibenz(a,h)anthracene	0.3	NJPQL	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Fluoranthene	300	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Fluorene	300	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Indeno(1,2,3-cd)pyrene	0.2	NJPQL	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Naphthalene	300	NJMCL, NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Phenanthrene	100	NJGWQC*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*
Pyrene	200	NJGWQC	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*

LOC = Level of Concern
NJGWQC = New Jersey Ground Water Quality Standards N.J.A.C. 7:9C, Specific Ground Water Quality Criteria (November, 2009)
NJGWQC* = New Jersey Ground Water Quality Standards N.J.A.C. 7:9C, Interim Ground Water Quality Criteria (November, 2009)
NJPQL = New Jersey Ground Water Quality Standards N.J.A.C. 7:9C, Practical Quantitation Limit (November, 2009)
NJMCL = New Jersey Drinking Water Quality Standards (October 2009)
RSL = EPA Regional Screening Levels, Tapwater (November 2011)

NA = None Available
LQ = Lab Qualifier
VQ = Validation Qualifier
MDL = Method detection limit
RL = Reporting Limit
NT = Not Tested
ug/L = micrograms/Liter

Shading The analyte was detected at concentrations above the LOC.
J = Indicates that the reported result is estimated.
U = Indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the MDL.

Table 3-3
Former Skeet Range
Summary of Surface Soil Analytical Results

Analyte		Sample ID	B1181SS-34					B1181SS-39					B1181SS-42					B1181SS-43					B1181SS-43DUP					B1181SS-44				
		Sample Date	3/19/2011					3/16/2011					3/16/2011					3/16/2011					3/16/2011					3/16/2011				
		Sample Depth	0-0.5					0-0.5					0-0.5					0-0.5					0-0.5					0-0.5				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																																
Antimony	450	NRDCSRS	3.99	J	J	*1.69*	*7.56*	0.97	J	J	*0.67*	*2.97*	1.77	J	J	*0.53*	*2.36*	3.95	U	U	*0.88*	*3.95*	0.88	J	J	*0.73*	*3.26*	2.57	U	UJ	*0.58*	*2.57*
Arsenic	19	NRDCSRS	3.37			*1*	*3.03*	7.88			*0.39*	*1.19*	24.1			*0.31*	*0.94*	4.04			*0.52*	*1.58*	4.39			*0.43*	*1.3*	9.87			*0.34*	*1.03*
Copper	45000	NRDCSRS	38.2			*0.97*	*3.03*	56.8		J	*0.38*	*1.19*	17.4		J	*0.3*	*0.94*	35.3		J	*0.51*	*1.58*	36.1		J	*0.42*	*1.3*	35.1		J	*0.33*	*1.03*
Iron	720000	USEPA Ind. RSL	9180			*4.02*	*15.1*	23800		J	*1.58*	*5.94*	30900		J	*1.25*	*4.72*	31000			*2.1*	*7.9*	29000			*1.73*	*6.52*	18300		J	*1.37*	*5.15*
Lead	800	NRDCSRS	407			*0.36*	*1.82*	161			*0.14*	*0.71*	239			*0.11*	*0.57*	36.3		J	*0.19*	*0.95*	58.2		J	*0.16*	*0.78*	90.2			*0.12*	*0.62*
Zinc	110000	NRDCSRS	59			*2.12*	*6.05*	124		J	*0.83*	*2.38*	23.5		J	*0.66*	*1.89*	85.2			*1.11*	*3.16*	87.7			*0.91*	*2.61*	91.8		J	*0.72*	*2.06*
PAHs (mg/kg)																																
Acenaphthene	37000	NRDCSRS	1.4	U	UJ	*0.039*	*1.4*	0.51	U	U	*0.014*	*0.51*	0.41	U	U	*0.012*	*0.41*	0.52	U	U	*0.015*	*0.52*	0.61	U	U	*0.017*	*0.61*	NT				
Acenaphthylene	300000	NRDCSRS	1.4	U	UJ	*0.035*	*1.4*	0.51	U	U	*0.013*	*0.51*	0.41	U	U	*0.01*	*0.41*	0.52	U	U	*0.013*	*0.52*	0.61	U	U	*0.016*	*0.61*	NT				
Anthracene	30000	NRDCSRS	1.4	U	UJ	*0.028*	*1.4*	0.51	U	U	*0.01*	*0.51*	0.083	J	J	*0.0085*	*0.41*	0.52	U	U	*0.011*	*0.52*	0.61	U	U	*0.013*	*0.61*	NT				
Benzo(a)anthracene	2	NRDCSRS	1.4	U	UJ	*0.066*	*1.4*	0.51	U	U	*0.024*	*0.51*	0.23	J	J	*0.02*	*0.41*	0.52	U	U	*0.025*	*0.52*	0.61	U	U	*0.029*	*0.61*	NT				
Benzo(a)pyrene	0.2	NRDCSRS	1.4	U	UJ	*0.03*	*1.4*	0.51	U	U	*0.011*	*0.51*	0.2	J	J	*0.009*	*0.41*	0.52	U	U	*0.011*	*0.52*	0.61	U	U	*0.013*	*0.61*	NT				
Benzo(b)fluoranthene	2	NRDCSRS	1.4	U	UJ	*0.045*	*1.4*	0.12	J	J	*0.017*	*0.51*	0.3	J	J	*0.014*	*0.41*	0.52	U	U	*0.017*	*0.52*	0.61	U	U	*0.02*	*0.61*	NT				
Benzo(g,h,i)perylene	30000	NRDCSRS	1.4	U	UJ	*0.056*	*1.4*	0.51	U	U	*0.021*	*0.51*	0.12	J	J	*0.017*	*0.41*	0.52	U	U	*0.021*	*0.52*	0.61	U	U	*0.025*	*0.61*	NT				
Benzo(k)fluoranthene	23	NRDCSRS	1.4	U	UJ	*0.065*	*1.4*	0.51	U	U	*0.024*	*0.51*	0.088	J	J	*0.02*	*0.41*	0.52	U	U	*0.025*	*0.52*	0.61	U	U	*0.029*	*0.61*	NT				
Chrysene	230	NRDCSRS	1.4	U	UJ	*0.063*	*1.4*	0.083	J	J	*0.023*	*0.51*	0.22	J	J	*0.019*	*0.41*	0.52	U	U	*0.024*	*0.52*	0.61	U	U	*0.028*	*0.61*	NT				
Dibenz(a,h)anthracene	0.2	NRDCSRS	1.4	U	UJ	*0.04*	*1.4*	0.51	U	U	*0.015*	*0.51*	0.41	U	U	*0.012*	*0.41*	0.52	U	U	*0.015*	*0.52*	0.61	U	U	*0.018*	*0.61*	NT				
Fluoranthene	24000	NRDCSRS	1.4	U	UJ	*0.028*	*1.4*	0.076	J	J	*0.01*	*0.51*	0.5			*0.0083*	*0.41*	0.52	U	U	*0.011*	*0.52*	0.61	U	U	*0.012*	*0.61*	NT				
Fluorene	24000	NRDCSRS	1.4	U	UJ	*0.052*	*1.4*	0.51	U	U	*0.019*	*0.51*	0.41	U	U	*0.016*	*0.41*	0.52	U	U	*0.02*	*0.52*	0.61	U	U	*0.023*	*0.61*	NT				
Indeno(1,2,3-cd)pyrene	2	NRDCSRS	1.4	U	UJ	*0.046*	*1.4*	0.51	U	U	*0.017*	*0.51*	0.087	J	J	*0.014*	*0.41*	0.52	U	U	*0.018*	*0.52*	0.61	U	U	*0.021*	*0.61*	NT				
Naphthalene	17	NRDCSRS	1.4	U	UJ	*0.048*	*1.4*	0.51	U	U	*0.018*	*0.51*	0.41	U	U	*0.014*	*0.41*	0.52	U	U	*0.018*	*0.52*	0.19	J	J	*0.021*	*0.61*	NT				
Phenanthrene	300000	NRDCSRS	1.4	U	UJ	*0.037*	*1.4*	0.51	U	U	*0.014*	*0.51*	0.32	J	J	*0.011*	*0.41*	0.52	U	U	*0.014*	*0.52*	0.61	U	U	*0.017*	*0.61*	NT				
Pyrene	18000	NRDCSRS	1.4	U	UJ	*0.033*	*1.4*	0.072	J	J	*0.012*	*0.51*	0.46			*0.01*	*0.41*	0.52	U	U	*0.013*	*0.52*	0.61	U	U	*0.015*	*0.61*	NT				

Table 3-3
Former Skeet Range
Summary of Surface Soil Analytical Results

Analyte		Sample ID	B1181SS-45					B1181SS-46					B1181SS-48					B1181SS-49					B1181SS-50					B1181SS-51				
		Sample Date	3/16/2011					3/16/2011					3/19/2011					3/19/2011					3/16/2011					3/16/2011				
		Sample Depth	0-0.5					0-0.5					0-0.5					0-0.5					0-0.5					0-0.5				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																																
Antimony	450	NRDCSRS	19.9			*1.72*	*7.7*	39.4			*1.5*	*6.7*	NT					NT					NT					NT				
Arsenic	19	NRDCSRS	8.45			*1.02*	*3.08*	11.4			*0.88*	*2.68*	NT					NT					NT					NT				
Copper	45000	NRDCSRS	66.7			*0.99*	*3.08*	70			*0.86*	*2.68*	NT					NT					NT					NT				
Iron	720000	USEPA Ind. RSL	13700			*4.1*	*15.4*	8650			*3.57*	*13.4*	NT					NT					NT					NT				
Lead	800	NRDCSRS	1330			*0.37*	*1.85*	8650			*0.32*	*1.61*	29.7			*0.14*	*0.68*	74.4			*0.37*	*1.84*	79		J	*0.18*	*0.89*	247		J	*0.23*	*1.17*
Zinc	110000	NRDCSRS	73.3			*2.16*	*6.16*	79.6			*1.88*	*5.36*	NT					NT					NT					NT				
PAHs (mg/kg)																																
Acenaphthene	37000	NRDCSRS	1.4	U	UJ	*0.039*	*1.4*	1.3	U	U	*0.037*	*1.3*	NT					NT					NT					NT				
Acenaphthylene	300000	NRDCSRS	1.4	U	UJ	*0.035*	*1.4*	1.3	U	U	*0.033*	*1.3*	NT					NT					NT					NT				
Anthracene	30000	NRDCSRS	1.4	U	UJ	*0.028*	*1.4*	1.3	U	U	*0.027*	*1.3*	NT					NT					NT					NT				
Benzo(a)anthracene	2	NRDCSRS	1.4	U	UJ	*0.066*	*1.4*	1.3	U	U	*0.063*	*1.3*	NT					NT					NT					NT				
Benzo(a)pyrene	0.2	NRDCSRS	1.4	U	UJ	*0.03*	*1.4*	1.3	U	U	*0.029*	*1.3*	NT					NT					NT					NT				
Benzo(b)fluoranthene	2	NRDCSRS	1.4	U	UJ	*0.045*	*1.4*	1.3	U	U	*0.043*	*1.3*	NT					NT					NT					NT				
Benzo(g,h,i)perylene	30000	NRDCSRS	1.4	U	UJ	*0.056*	*1.4*	1.3	U	U	*0.054*	*1.3*	NT					NT					NT					NT				
Benzo(k)fluoranthene	23	NRDCSRS	1.4	U	UJ	*0.065*	*1.4*	1.3	U	U	*0.063*	*1.3*	NT					NT					NT					NT				
Chrysene	230	NRDCSRS	1.4	U	UJ	*0.063*	*1.4*	1.3	U	U	*0.06*	*1.3*	NT					NT					NT					NT				
Dibenz(a,h)anthracene	0.2	NRDCSRS	1.4	U	UJ	*0.04*	*1.4*	1.3	U	U	*0.038*	*1.3*	NT					NT					NT					NT				
Fluoranthene	24000	NRDCSRS	1.4	U	UJ	*0.028*	*1.4*	1.3	U	U	*0.027*	*1.3*	NT					NT					NT					NT				
Fluorene	24000	NRDCSRS	1.4	U	UJ	*0.052*	*1.4*	1.3	U	U	*0.05*	*1.3*	NT					NT					NT					NT				
Indeno(1,2,3-cd)pyrene	2	NRDCSRS	1.4	U	UJ	*0.046*	*1.4*	1.3	U	U	*0.044*	*1.3*	NT					NT					NT					NT				
Naphthalene	17	NRDCSRS	1.4	U	UJ	*0.048*	*1.4*	1.3	U	U	*0.046*	*1.3*	NT					NT					NT					NT				
Phenanthrene	300000	NRDCSRS	1.4	U	UJ	*0.037*	*1.4*	1.3	U	U	*0.036*	*1.3*	NT					NT					NT					NT				
Pyrene	18000	NRDCSRS	1.4	U	UJ	*0.033*	*1.4*	1.3	U	U	*0.032*	*1.3*	NT					NT					NT					NT				

Table 3-3
Former Skeet Range
Summary of Surface Soil Analytical Results

Analyte		Sample ID	B1181SS-52					B1181SS-53					B1181SS-54					B1181SS-54DUP					B1181SS-56					B1181SS-57				
		Sample Date	3/16/2011					3/16/2011					3/16/2011					3/16/2011					3/16/2011					3/16/2011				
		Sample Depth	0-0.5					0-0.5					0-0.5					0-0.5					0-0.5					0-0.5				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																																
Antimony	450	NRDCSRS	NT					NT					8.73		J	0.98	4.36	10.1			0.62	2.79	2.8	U	U	0.63	2.8	3	U	U	0.67	3
Arsenic	19	NRDCSRS	NT					NT					11.7			0.58	1.75	12.6			0.37	1.12	2.06			0.37	1.12	5.29			0.4	1.2
Copper	45000	NRDCSRS	NT					NT					47.4		J	0.56	1.75	67.3		J	0.36	1.12	31.9		J	0.36	1.12	71.2		J	0.38	1.2
Iron	720000	USEPA Ind. RSL	NT					NT					23400		J	2.32	8.73	22200			1.48	5.58	14300			1.49	5.6	13600			1.6	6.01
Lead	800	NRDCSRS	114		J	0.13	0.65	94.7		J	0.2	1.01	896			0.21	1.05	1080		J	0.13	0.67	38.6		J	0.13	0.67	47.2		J	0.14	0.72
Zinc	110000	NRDCSRS	NT					NT					126		J	1.22	3.49	183		J	0.78	2.23	51.8			0.78	2.24	72.8			0.84	2.4
PAHs (mg/kg)																																
Acenaphthene	37000	NRDCSRS	NT					NT					0.54	J	J	0.016	0.58	1.2		J	0.015	0.51	0.47	U	U	0.013	0.47	0.53	U	U	0.015	0.53
Acenaphthylene	300000	NRDCSRS	NT					NT					0.58	U	U	0.015	0.58	0.51	U	U	0.013	0.51	0.47	U	U	0.012	0.47	0.53	U	U	0.014	0.53
Anthracene	30000	NRDCSRS	NT					NT					0.85		J	0.012	0.58	1.7		J	0.011	0.51	0.47	U	U	0.0097	0.47	0.53	U	U	0.011	0.53
Benzo(a)anthracene	2	NRDCSRS	NT					NT					2.4		J	0.028	0.58	5.7	D	J	0.12	2.6	0.47	U	U	0.023	0.47	0.53	U	U	0.026	0.53
Benzo(a)pyrene	0.2	NRDCSRS	NT					NT					2		J	0.013	0.58	3.9		J	0.011	0.51	0.47	U	U	0.01	0.47	0.53	U	U	0.012	0.53
Benzo(b)fluoranthene	2	NRDCSRS	NT					NT					2.6		J	0.019	0.58	6.2	D	J	0.085	2.6	0.47	U	U	0.016	0.47	0.53	U	U	0.018	0.53
Benzo(g,h,i)perylene	30000	NRDCSRS	NT					NT					1.1		J	0.024	0.58	2.2		J	0.021	0.51	0.47	U	U	0.019	0.47	0.53	U	U	0.022	0.53
Benzo(k)fluoranthene	23	NRDCSRS	NT					NT					1.1		J	0.028	0.58	1.9		J	0.024	0.51	0.47	U	U	0.022	0.47	0.53	U	U	0.025	0.53
Chrysene	230	NRDCSRS	NT					NT					2.3		J	0.026	0.58	5	D	J	0.12	2.6	0.47	U	U	0.022	0.47	0.53	U	U	0.024	0.53
Dibenz(a,h)anthracene	0.2	NRDCSRS	NT					NT					0.35	J	J	0.017	0.58	0.6		J	0.015	0.51	0.47	U	U	0.014	0.47	0.53	U	U	0.015	0.53
Fluoranthene	24000	NRDCSRS	NT					NT					3.8		J	0.012	0.58	11	D	J	0.052	2.6	0.47	U	U	0.0096	0.47	0.53	U	U	0.011	0.53
Fluorene	24000	NRDCSRS	NT					NT					0.47	J	J	0.022	0.58	0.9		J	0.02	0.51	0.47	U	U	0.018	0.47	0.53	U	U	0.02	0.53
Indeno(1,2,3-cd)pyrene	2	NRDCSRS	NT					NT					0.82		J	0.019	0.58	1.7		J	0.017	0.51	0.47	U	U	0.016	0.47	0.53	U	U	0.018	0.53
Naphthalene	17	NRDCSRS	NT					NT					0.29	J	J	0.02	0.58	0.34	J	J	0.018	0.51	0.47	U	U	0.016	0.47	0.53	U	U	0.019	0.53
Phenanthrene	300000	NRDCSRS	NT					NT					3.5		J	0.016	0.58	8.7	D	J	0.07	2.6	0.47	U	U	0.013	0.47	0.53	U	U	0.014	0.53
Pyrene	18000	NRDCSRS	NT					NT					4.6	D	J	0.028	1.2	9.4	D	J	0.062	2.6	0.47	U	U	0.011	0.47	0.53	U	U	0.013	0.53

Table 3-3
Former Skeet Range
Summary of Surface Soil Analytical Results

Analyte		Sample ID	B1181SS-58					B1181SS-59					B1181SS-60					B1181SS-61					B1181SS-62				
		Sample Date	3/16/2011					3/19/2011					3/19/2011					3/19/2011					3/16/2011				
		Sample Depth	0-0.5					0-0.5					0-0.5					0-0.5					0-0.5				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																											
Antimony	450	NRDCSRS	2.6	U	UJ	*0.58*	*2.6*	2.08	J	J	*1.63*	*7.29*	9.24	U	U	*2.07*	*9.24*	7.45	U	U	*1.67*	*7.45*	NT				
Arsenic	19	NRDCSRS	1.65			*0.34*	*1.04*	3.78			*0.96*	*2.92*	2.85	J	J	*1.22*	*3.7*	8.02			*0.98*	*2.98*	NT				
Copper	45000	NRDCSRS	32.8		J	*0.33*	*1.04*	64			*0.93*	*2.92*	27.1			*1.18*	*3.7*	62.9			*0.95*	*2.98*	NT				
Iron	720000	USEPA Ind. RSL	22900		J	*1.38*	*5.19*	13000			*3.88*	*14.6*	5520			*4.92*	*18.5*	13700			*3.97*	*14.9*	NT				
Lead	800	NRDCSRS	14.8			*0.12*	*0.62*	166			*0.35*	*1.75*	44.7			*0.44*	*2.22*	83.6			*0.36*	*1.79*	435			*0.18*	*0.91*
Zinc	110000	NRDCSRS	57.6		J	*0.73*	*2.08*	64.3			*2.04*	*5.84*	60.7			*2.59*	*7.39*	89.1			*2.09*	*5.96*	NT				
PAHs (mg/kg)																											
Acenaphthene	37000	NRDCSRS	2.1	U	U	*0.061*	*2.1*	1.4	U	U	*0.039*	*1.4*	1.8	U	U	*0.052*	*1.8*	1.3	U	U	*0.036*	*1.3*	NT				
Acenaphthylene	300000	NRDCSRS	2.1	U	U	*0.055*	*2.1*	1.4	U	U	*0.035*	*1.4*	1.8	U	U	*0.047*	*1.8*	1.3	U	U	*0.032*	*1.3*	NT				
Anthracene	30000	NRDCSRS	2.1	U	U	*0.044*	*2.1*	1.4	U	U	*0.028*	*1.4*	1.8	U	U	*0.038*	*1.8*	1.3	U	U	*0.026*	*1.3*	NT				
Benzo(a)anthracene	2	NRDCSRS	2.1	U	U	*0.1*	*2.1*	1.4	U	U	*0.066*	*1.4*	1.8	U	U	*0.088*	*1.8*	1.3	U	U	*0.061*	*1.3*	NT				
Benzo(a)pyrene	0.2	NRDCSRS	2.1	U	U	*0.047*	*2.1*	1.4	U	U	*0.03*	*1.4*	1.8	U	U	*0.04*	*1.8*	1.3	U	U	*0.028*	*1.3*	NT				
Benzo(b)fluoranthene	2	NRDCSRS	2.1	U	U	*0.071*	*2.1*	1.4	U	U	*0.045*	*1.4*	1.8	U	U	*0.06*	*1.8*	1.3	U	U	*0.042*	*1.3*	NT				
Benzo(g,h,i)perylene	30000	NRDCSRS	2.1	U	U	*0.088*	*2.1*	1.4	U	U	*0.056*	*1.4*	1.8	U	U	*0.075*	*1.8*	1.3	U	U	*0.052*	*1.3*	NT				
Benzo(k)fluoranthene	23	NRDCSRS	2.1	U	U	*0.1*	*2.1*	1.4	U	U	*0.065*	*1.4*	1.8	U	U	*0.087*	*1.8*	1.3	U	U	*0.06*	*1.3*	NT				
Chrysene	230	NRDCSRS	2.1	U	U	*0.098*	*2.1*	1.4	U	U	*0.063*	*1.4*	1.8	U	U	*0.084*	*1.8*	1.3	U	U	*0.058*	*1.3*	NT				
Dibenz(a,h)anthracene	0.2	NRDCSRS	2.1	U	U	*0.062*	*2.1*	1.4	U	U	*0.04*	*1.4*	1.8	U	U	*0.053*	*1.8*	1.3	U	U	*0.037*	*1.3*	NT				
Fluoranthene	24000	NRDCSRS	2.1	U	U	*0.043*	*2.1*	1.4	U	U	*0.028*	*1.4*	1.8	U	U	*0.037*	*1.8*	1.3	U	U	*0.026*	*1.3*	NT				
Fluorene	24000	NRDCSRS	2.1	U	U	*0.082*	*2.1*	1.4	U	U	*0.052*	*1.4*	1.8	U	U	*0.07*	*1.8*	1.3	U	U	*0.048*	*1.3*	NT				
Indeno(1,2,3-cd)pyrene	2	NRDCSRS	2.1	U	U	*0.072*	*2.1*	1.4	U	U	*0.046*	*1.4*	1.8	U	U	*0.062*	*1.8*	1.3	U	U	*0.043*	*1.3*	NT				
Naphthalene	17	NRDCSRS	2.1	U	U	*0.075*	*2.1*	1.4	U	U	*0.048*	*1.4*	1.8	U	U	*0.064*	*1.8*	1.3	U	U	*0.044*	*1.3*	NT				
Phenanthrene	300000	NRDCSRS	2.1	U	U	*0.058*	*2.1*	1.4	U	U	*0.037*	*1.4*	1.8	U	U	*0.05*	*1.8*	1.3	U	U	*0.035*	*1.3*	NT				
Pyrene	18000	NRDCSRS	2.1	U	U	*0.052*	*2.1*	1.4	U	U	*0.033*	*1.4*	1.8	U	U	*0.044*	*1.8*	1.3	U	U	*0.031*	*1.3*	NT				

LOC = Level of Concern
NRDCSRS = New Jersey Non-Residential Direct Contact Soil Remediation Standards, 2009.
USEPA Ind. RSL = USEPA Regional Screening Levels, Industrial Soil, November 2011.

NA = None Available
LQ = Lab Qualifier
VQ = Validation Qualifier
MDL = Method detection limit
RL = Reporting Limit
NT = Not Tested
ug/L = micrograms/Liter

Shading The analyte was detected at concentrations above the LOC.

D = The sample was rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve.

J = Indicates that the reported result is estimated.

U = Indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the MDL.

Table 3-4
Former Skeet Range
Summary of Subsurface Soil Analytical Results

Analyte		Sample ID	B1181SS-10D					B1181SS-14C					B1181SS-23C					B1181SS-25C					B1181SS-35C				
		Sample Date	3/16/2011					3/16/2011					3/16/2011					3/16/2011					3/16/2011				
		Sample Depth	4-4.5					2-2.5					2-2.5					2-2.5					2-2.5				
	LOC	LOC Chosen	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																											
Lead	800	NRDCSRS	273			*0.19*	*0.96*	3060			*0.32*	*1.58*	NT					82.5			*0.28*	*1.41*	NT				
PAHs (mg/kg)																											
Acenaphthene	37000	NRDCSRS	NT					NT					3			*0.063*	*2.2*	NT					3.9	U	U	*0.11*	*3.9*
Acenaphthylene	300000	NRDCSRS	NT					NT					2.2	U	U	*0.057*	*2.2*	NT					3.9	U	U	*0.099*	*3.9*
Anthracene	30000	NRDCSRS	NT					NT					4.7			*0.046*	*2.2*	NT					0.51	J	J	*0.08*	*3.9*
Benzo(a)anthracene	2	NRDCSRS	NT					NT					8			*0.11*	*2.2*	NT					5.4			*0.19*	*3.9*
Benzo(a)pyrene	0.2	NRDCSRS	NT					NT					6.8			*0.049*	*2.2*	NT					7.1			*0.085*	*3.9*
Benzo(b)fluoranthene	2	NRDCSRS	NT					NT					8.6			*0.073*	*2.2*	NT					3.1	J	J	*0.13*	*3.9*
Benzo(g,h,i)perylene	30000	NRDCSRS	NT					NT					3.3			*0.091*	*2.2*	NT					3.8	J	J	*0.16*	*3.9*
Benzo(k)fluoranthene	23	NRDCSRS	NT					NT					3.6			*0.11*	*2.2*	NT					1.3	J	J	*0.18*	*3.9*
Chrysene	230	NRDCSRS	NT					NT					7.1			*0.1*	*2.2*	NT					6.7			*0.18*	*3.9*
Dibenz(a,h)anthracene	0.2	NRDCSRS	NT					NT					1	J	J	*0.065*	*2.2*	NT					1.1	J	J	*0.11*	*3.9*
Fluoranthene	24000	NRDCSRS	NT					NT					14			*0.045*	*2.2*	NT					1.6	J	J	*0.079*	*3.9*
Fluorene	24000	NRDCSRS	NT					NT					2.8			*0.085*	*2.2*	NT					3.9	U	U	*0.15*	*3.9*
Indeno(1,2,3-cd)pyrene	2	NRDCSRS	NT					NT					2.7			*0.075*	*2.2*	NT					1.3	J	J	*0.13*	*3.9*
Naphthalene	17	NRDCSRS	NT					NT					1.3	J	J	*0.078*	*2.2*	NT					3.9	U	U	*0.14*	*3.9*
Phenanthrene	300000	NRDCSRS	NT					NT					16			*0.061*	*2.2*	NT					1.8	J	J	*0.11*	*3.9*
Pyrene	18000	NRDCSRS	NT					NT					16			*0.054*	*2.2*	NT					8.5			*0.094*	*3.9*

LOC = Level of Concern
NRDCSRS = New Jersey Non-Residential Direct Contact Soil Remediation Standards, 2009.
USEPA Ind. RSL = USEPA Regional Screening Levels, Industrial Soil, November 2011.

NA = None Available
LQ = Lab Qualifier
VQ = Validation Qualifier
MDL = Method detection limit
RL = Reporting Limit
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ug/L = micrograms/Liter

Shading The analyte was detected at concentrations above the LOC.

D = The sample was rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve.

J = Indicates that the reported result is estimated.

U = Indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the MDL.

Table 3-5
Former Skeet Range
Summary of Surface Water Analytical Results

Analyte		Sample ID	B1181SW-10					B1181SW-6					B1181SW-6DUP					B1181SW-7					B1181SW-8					B1181SW-9				
		Sample Date	3/21/2011					3/16/2011					3/16/2011					3/19/2011					3/19/2011					3/21/2011				
	LOC	LOC Chosen	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (ug/L)																																
Antimony	5.6	NJSWQC	73.4			*0.14*	*2*	12.5		J	*0.14*	*2*	8.7		J	*0.14*	*2*	0.72	J	U	*0.14*	*2*	0.35	J	U	*0.14*	*2*	4.1			*0.14*	*2*
Arsenic	1.38	PTA BC	23		J	*0.18*	*1*	1.4		J	*0.18*	*1*	0.38	J	U	*0.18*	*1*	1		U	*0.18*	*1*	0.3	J	U	*0.18*	*1*	0.42	J	U	*0.18*	*1*
Copper	1300	NJSWQC	22.1			*0.04*	*2*	4.2			*0.04*	*2*	3.3			*0.04*	*2*	2.8		U	*0.04*	*2*	3.4			*0.04*	*2*	3		U	*0.04*	*2*
Iron	1790	PTA BC	8340			*10.3*	*200*	1000			*10.3*	*200*	853			*10.3*	*200*	312			*10.3*	*200*	543			*10.3*	*200*	831			*10.3*	*200*
Lead	5	NJSWQC	7530			*0.04*	*1*	1050		J	*0.04*	*1*	698		J	*0.04*	*1*	18.8			*0.04*	*1*	4.3			*0.04*	*1*	70.6			*0.04*	*1*
Zinc	7400	NJSWQC	66.3			*0.09*	*2*	56.9			*0.09*	*2*	46.6			*0.09*	*2*	25.9		U	*0.09*	*2*	12.9		U	*0.09*	*2*	59.2			*0.09*	*2*
PAHs (ug/L)																																
Acenaphthene	670	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Acenaphthylene	830	NJSWQC**	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Anthracene	8300	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Benzo(a)anthracene	0.038	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Benzo(a)pyrene	0.0038	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Benzo(b)fluoranthene	0.038	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Benzo(g,h,i)perylene	830	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Benzo(k)fluoranthene	0.38	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Chrysene	3.8	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Dibenz(a,h)anthracene	0.0038	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Fluoranthene	130	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Fluorene	1100	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Indeno(1,2,3-cd)pyrene	0.038	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Naphthalene	0.14	USEPA RSL TW	0.1	U	UJ	*0.02*	*0.1*	0.1	U	UJ	*0.02*	*0.1*	0.1	U	UJ	*0.021*	*0.1*	0.1	U	UJ	*0.021*	*0.1*	0.11	U	UJ	*0.021*	*0.11*	0.11	U	UJ	*0.022*	*0.11*
Phenanthrene	830	NJSWQC**	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*
Pyrene	830	NJSWQC	0.1	U	UJ	*0.02*	*0.1*	0.1	U	U	*0.02*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.1	U	U	*0.021*	*0.1*	0.11	U	U	*0.021*	*0.11*	0.11	U	U	*0.022*	*0.11*

LOC = Level of Concern
USEPA RSL TW = USEPA, Regional Screening Levels, Tapwater, November 2011.
NJSWQC = NJDEP N.J.A.C. 7:9B, Surface Water Quality Standards, January, 2010.
PTA BC = Values are from the PTA Background Study Report.
** - Values for pyrene were used for PAHs where not criteria was available

NA = None Available
LQ = Lab Qualifier
VQ = Validation Qualifier
MDL = Method detection limit
RL = Reporting Limit
NT = Not Tested
ug/L = micrograms/Liter

Shading The analyte was detected at concentrations above the LOC.
J = Indicates that the reported result is estimated.
U = Indicates that the analyte was analyzed for but was not detected or the concentratio of the analyte quantitated below the MDL.

Table 3-6
Former Skeet Range
Summary of Sediment Analytical Results

Analyte		Sample ID	B1181SD-11					B1181SD-12					B1181SD-3C					B1181SD-10					B1181SD-6				
		Sample Date	3/16/2011					3/16/2011					3/16/2011					3/21/2011					3/16/2011				
		Sample Depth	0-0.5					0-0.5					2.-2.5					0-0.5					0-0.5				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																											
Antimony	450	NRDCSRS											84.4			*2.35*	*10.5*	6250			*21.1*	*94.2*	399		R	*1.68*	*7.51*
Arsenic	16	PTA BC											12.4			*1.39*	*4.21*	175			*12.4*	*37.7*	30.7		R	*0.99*	*3*
Copper	28	Eco SQB											213			*1.35*	*4.21*	514			*12.1*	*37.7*	129		J	*0.96*	*3*
Iron	720000	USEPA Ind. RSL											16400			*5.59*	*21*	5010			*50.1*	*188*	13600			*3.99*	*15*
Lead	38.8	PTA BC	780		J	*0.15*	*0.74*	2220			*0.4*	*2.01*	18000			*0.5*	*2.52*	186000			*4.52*	*22.6*	37300		R	*0.36*	*1.8*
Zinc	171	PTA BC											629			*2.94*	*8.41*	51.5	J	J	*26.4*	*75.4*	64.3			*2.1*	*6.01*
PAHs (mg/kg)																											
Acenaphthene	0.00671	Eco ISQC											2.1	U	U	*0.059*	*2.1*	1.6	U	U	*0.047*	*1.6*	1	U	U	*0.028*	*1*
Acenaphthylene	0.00587	Eco ISQC											2.1	U	U	*0.052*	*2.1*	1.6	U	U	*0.042*	*1.6*	1	U	U	*0.025*	*1*
Anthracene	0.03162	Eco SQB											2.1	U	U	*0.042*	*2.1*	1.6	U	U	*0.034*	*1.6*	1	U	U	*0.021*	*1*
Benzo(a)anthracene	0.0317	Eco ISQC											2.1	U	U	*0.099*	*2.1*	1.6	U	U	*0.079*	*1.6*	1	U	U	*0.048*	*1*
Benzo(a)pyrene	0.0319	Eco ISQC											2.1	U	U	*0.045*	*2.1*	1.6	U	U	*0.036*	*1.6*	1	U	U	*0.022*	*1*
Benzo(b)fluoranthene	0.0272	Eco SQB											2.1	U	U	*0.068*	*2.1*	1.6	U	U	*0.054*	*1.6*	1	U	U	*0.033*	*1*
Benzo(g,h,i)perylene	0.17	Eco NJDEP											2.1	U	U	*0.084*	*2.1*	1.6	U	U	*0.067*	*1.6*	1	U	U	*0.041*	*1*
Benzo(k)fluoranthene	0.0272	Eco SQB											2.1	U	U	*0.098*	*2.1*	1.6	U	U	*0.078*	*1.6*	1	U	U	*0.047*	*1*
Chrysene	0.0571	Eco ISQC											2.1	U	U	*0.094*	*2.1*	1.6	U	U	*0.075*	*1.6*	1	U	U	*0.046*	*1*
Dibenz(a,h)anthracene	0.00622	Eco ISQC											2.1	U	U	*0.06*	*2.1*	1.6	U	U	*0.048*	*1.6*	1	U	U	*0.029*	*1*
Fluoranthene	0.06423	Eco SQB											0.29	J	J	*0.042*	*2.1*	1.6	U	U	*0.033*	*1.6*	1	U	U	*0.02*	*1*
Fluorene	0.019	Eco NJDEP											2.1	U	U	*0.079*	*2.1*	1.6	U	U	*0.063*	*1.6*	1	U	U	*0.038*	*1*
Indeno(1,2,3-cd)pyrene	0.078	Eco SQB											2.1	U	U	*0.069*	*2.1*	1.6	U	U	*0.055*	*1.6*	1	U	U	*0.034*	*1*
Naphthalene	0.03275	Eco SQB											2.1	U	U	*0.072*	*2.1*	1.6	U	U	*0.057*	*1.6*	1	U	U	*0.035*	*1*
Phenanthrene	0.0419	Eco ISQC											2.1	U	U	*0.056*	*2.1*	1.6	U	U	*0.045*	*1.6*	1	U	U	*0.027*	*1*
Pyrene	0.053	Eco ISQC											2.1	U	U	*0.05*	*2.1*	1.6	U	U	*0.04*	*1.6*	1	U	U	*0.024*	*1*

Table 3-6
Former Skeet Range
Summary of Sediment Analytical Results

Analyte		Sample ID	B1181SD-6DUP					B1181SD-7C					B1181SD-8					B1181SD-9				
		Sample Date	3/16/2011					3/19/2011					3/19/2011					3/21/2011				
		Sample Depth	0-0.5					2.-2.5					0-0.5					0-0.5				
	LOC	**LOC Chosen**	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL	Result	LQ	VQ	MDL	RL
Metals (mg/kg)																						
Antimony	450	NRDCSRS	2070		R	*13.3*	*59.6*	2.3	U	U	*0.51*	*2.3*	3.47	U	U	*0.78*	*3.47*	4190			*2.5*	*11.2*
Arsenic	16	PTA BC	98.5		R	*7.86*	*23.8*	0.42	J	J	*0.3*	*0.92*	8.29			*0.46*	*1.39*	851			*1.47*	*4.47*
Copper	28	Eco SQB	344		J	*7.62*	*23.8*	6.15			*0.29*	*0.92*	12.3			*0.44*	*1.39*	238			*1.43*	*4.47*
Iron	720000	USEPA Ind. RSL	14500			*31.7*	*119*	7280			*1.22*	*4.6*	19900			*1.85*	*6.94*	11100			*5.94*	*22.3*
Lead	38.8	PTA BC	114000		R	*2.86*	*14.3*	4.34			*0.11*	*0.55*	26.3			*0.17*	*0.83*	71000			*0.54*	*2.68*
Zinc	171	PTA BC	58.8			*16.7*	*47.6*	23			*0.64*	*1.84*	29.9			*0.97*	*2.78*	211			*3.13*	*8.94*
PAHs (mg/kg)																						
Acenaphthene	0.00671	Eco ISQC	1.1	U	U	*0.031*	*1.1*	0.42	U	U	*0.012*	*0.42*	0.65	U	U	*0.018*	*0.65*	1.9	U	U	*0.055*	*1.9*
Acenaphthylene	0.00587	Eco ISQC	1.1	U	U	*0.028*	*1.1*	0.42	U	U	*0.011*	*0.42*	0.65	U	U	*0.016*	*0.65*	1.9	U	U	*0.049*	*1.9*
Anthracene	0.03162	Eco SQB	1.1	U	U	*0.023*	*1.1*	0.42	U	U	*0.0086*	*0.42*	0.65	U	U	*0.013*	*0.65*	1.9	U	U	*0.04*	*1.9*
Benzo(a)anthracene	0.0317	Eco ISQC	1.1	U	U	*0.053*	*1.1*	0.42	U	U	*0.02*	*0.42*	0.65	U	U	*0.031*	*0.65*	1.9	U	U	*0.093*	*1.9*
Benzo(a)pyrene	0.0319	Eco ISQC	1.1	U	U	*0.024*	*1.1*	0.42	U	U	*0.0091*	*0.42*	0.65	U	U	*0.014*	*0.65*	1.9	U	U	*0.042*	*1.9*
Benzo(b)fluoranthene	0.0272	Eco SQB	1.1	U	U	*0.036*	*1.1*	0.42	U	U	*0.014*	*0.42*	0.65	U	U	*0.021*	*0.65*	1.9	U	U	*0.064*	*1.9*
Benzo(g,h,i)perylene	0.17	Eco NJDEP	1.1	U	U	*0.045*	*1.1*	0.42	U	U	*0.017*	*0.42*	0.65	U	U	*0.026*	*0.65*	1.9	U	U	*0.079*	*1.9*
Benzo(k)fluoranthene	0.0272	Eco SQB	1.1	U	U	*0.052*	*1.1*	0.42	U	U	*0.02*	*0.42*	0.65	U	U	*0.031*	*0.65*	1.9	U	U	*0.092*	*1.9*
Chrysene	0.0571	Eco ISQC	1.1	U	U	*0.05*	*1.1*	0.42	U	U	*0.019*	*0.42*	0.65	U	U	*0.03*	*0.65*	1.9	U	U	*0.089*	*1.9*
Dibenz(a,h)anthracene	0.00622	Eco ISQC	1.1	U	U	*0.032*	*1.1*	0.42	U	U	*0.012*	*0.42*	0.65	U	U	*0.019*	*0.65*	1.9	U	U	*0.056*	*1.9*
Fluoranthene	0.06423	Eco SQB	1.1	U	U	*0.022*	*1.1*	0.42	U	U	*0.0084*	*0.42*	0.65	U	U	*0.013*	*0.65*	1.9	U	U	*0.039*	*1.9*
Fluorene	0.019	Eco NJDEP	1.1	U	U	*0.042*	*1.1*	0.42	U	U	*0.016*	*0.42*	0.65	U	U	*0.025*	*0.65*	1.9	U	U	*0.074*	*1.9*
Indeno(1,2,3-cd)pyrene	0.078	Eco SQB	1.1	U	U	*0.037*	*1.1*	0.42	U	U	*0.014*	*0.42*	0.65	U	U	*0.022*	*0.65*	1.9	U	U	*0.065*	*1.9*
Naphthalene	0.03275	Eco SQB	1.1	U	U	*0.038*	*1.1*	0.42	U	U	*0.014*	*0.42*	0.65	U	U	*0.023*	*0.65*	1.9	U	U	*0.067*	*1.9*
Phenanthrene	0.0419	Eco ISQC	1.1	U	U	*0.03*	*1.1*	0.42	U	U	*0.011*	*0.42*	0.65	U	U	*0.018*	*0.65*	1.9	U	U	*0.053*	*1.9*
Pyrene	0.053	Eco ISQC	1.1	U	U	*0.027*	*1.1*	0.42	U	U	*0.01*	*0.42*	0.65	U	U	*0.016*	*0.65*	1.9	U	U	*0.047*	*1.9*

LOC = Level of Concern
Eco ISQC = Ecological Screening Criteria, Interim Sediment Quality Guidline, CCME 2003.
Eco SQB = Ecological Screening Criteria, Sediment Quality Benchmark, ORNL 1997.
Eco NJDEP = Ecological Screening Criteria, Effect Range-Low, NJDEP 1998.
NRDCSRS = New Jersey Non-Residential Direct Contact Soil Remediation Standards, 2009.
PTA BC = Picatinny Background Concentrations
USEPA Ind. RSL = USEPA Regional Screening Levels, Industrial Soil, November 2011.
NA = None Available

LQ = Lab Qualifier
VQ = Validation Qualifier
MDL = Method detection limit
RL = Reporting Limit
mg/kg = milligrams per kilogram

Shading The analyte was detected at concentrations above the LOC.
J = Indicates that the reported result is estimated.
U = Indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the MDL.
R = Indicates that the reported result was rejected after data validation

Table 3-7
Summary of Groundwater Analytical Reporting Limits and Standards
Former Skeet Range
Picatinny Arsenal, New Jersey

Analyte	LOC	LOC Chosen	Laboratory Method Detection Limit	Laboratory Level of Detection	Laboratory Level of Quantitation	Human Health Risk Assessment Screening Level	Ecological Risk Assessment Screening Value*
2-Methylnaphthalene	30	GWQC	0.32	5.0	10	27 (A)	330 (D)
Acenaphthene	400	GWQC	0.21	5.0	10	400 (B)	38 (D)
Acenaphthylene	100	GWQC	0.70	5.0	10	200 (B, C)	4840 (D)
Anthracene	2000	GWQC	0.16	5.0	10	2000 (B)	0.035 (D)
Benz(a)anthracene	0.1	NJPQL	0.16	5.0	10	0.05 (B)	0.025 (D)
Benzo(a)pyrene	0.1	NJPQL	0.14	5.0	10	0.005 (B)	0.014 (D)
Benzo(b)fluoranthene	0.2	NJPQL	0.29	5.0	10	0.05 (B)	9.07 (D)
Benzo(g,h,i)perylene	100	GWQC	0.29	5.0	10	200 (B, C)	7.64 (D)
Benzo(k)fluoranthene	0.5	GWQC	0.18	5.0	10	0.5 (B)	0.3 (D, C)
Chrysene	5	GWQC	0.18	5.0	10	5 (B)	0.3 (D, C)
Dibenz(a,h)anthracene	0.3	NJPQL	0.42	5.0	10	0.005 (B)	0.3 (D, C)
Fluoroanthene	300	GWQC	0.40	5.0	10	300 (B)	1.9 (D)
Fluorene	300	GWQC	0.31	5.0	10	300 (B)	19 (D)
Indeno(1,2,3-cd)pyrene	0.2	NJPQL	0.15	5.0	10	0.05 (B)	4.31 (D)
Naphthalene	300	NJMCL, GWQC	0.12	5.0	10	300 (B)	13 (D)
Phenanthrene	100	GWQC	0.26	5.0	10	200 (B, C)	3.6 (D)
Pyrene	200	GWQC	0.21	5.0	10	200 (B)	0.3 (D)
Lead	5	GWQC, NJPQL	2.6	3.0	6	5 (B)	5.4 (D)
Antimony	6	FED MCL, NJMCL, GWQC	8.0	12.5	25	6 (B)	80 (D)
Arsenic	3	NJPQL	4.2	5.0	10	0.02 (B)	150 (D)
Copper	1300	NJMCL, GWQC	2.0	5.0	10	1300 (B)	8.5 (D, E)
Zinc	2000	GWQC	6.5	10.0	20	2000 (B)	113.8 (D, E)
Iron	300	GWQC	20.4	25.0	50	300 (B)	1000 (F)

Notes:
All values shown in micrograms per liter (µg/l)
GWQC - New Jersey Department of Environmental Protection Groundwater Quality Criteria
NJPQL - New Jersey Department of Environmental Protection Practical Quantitation Limit
NJMCL - New Jersey Department of Environmental Protection Maximum Contaminant Level
FED MCL - United States Environmental Protection Agency Maximum Contaminant Level
LOC - Level of Concern
(A) USEPA, Regional Screening Levels (RSLs), Tap Water Screening Value, November 2011.
(B) NJDEP Ground Water Quality Standards, N.J.A.C 7:9C, Ground Water Quality Criteria, July 2010.
(C) Pyrene used as surrogate.
(D) NJDEP, Ecological Screening Criteria, lower of the Fresh Water Surface Water Criteria given preference, March 2009.
(E) Hardness dependent criterion, assume a hardness of 100 mg/L.
(F) USEPA, National Recommended Water Quality Criteria, Chronic Value, 2009.

Table 3-8
Summary of Soil Analytical Reporting Limits and Standards
Former Skeet Range
Picatinny Arsenal, New Jersey

Analyte	LOC	LOC Chosen	Laboratory Method Detection Limit	Laboratory Level of Detection	Laboratory Level of Quantitation	Residential Human Health Risk Assessment Screening Level	Non-Residential Human Health Risk Assessment Screening Level	Ecological Risk Assessment Screening Value
2-Methylnaphthalene	2400	NRDCSRS	0.0084	0.17	0.33	230 (A)	2400 (D)	29 (F, G)
Acenaphthene	37000	NRDCSRS	0.0094	0.17	0.33	3400 (A)	37000 (D)	29 (F, G)
Acenaphthylene	300000	NRDCSRS	0.0084	0.17	0.33	1700 (A, B)	300000 (D)	29 (F, G)
Anthracene	30000	NRDCSRS	0.0068	0.17	0.33	17000 (A)	30000 (D)	29 (F, G)
Benz(a)anthracene	2	NRDCSRS	0.0159	0.17	0.33	0.6 (A)	2 (D)	1.1 (F, H)
Benzo(a)pyrene	0.2	NRDCSRS	0.0072	0.17	0.33	0.2 (A)	0.2 (D)	1.1 (F, H)
Benzo(b)fluoranthene	2	NRDCSRS	0.0109	0.17	0.33	0.6 (A)	2 (D)	1.1 (F, H)
Benzo(g,h,i)perylene	30000	NRDCSRS	0.0135	0.17	0.33	380000 (A)	30000 (D)	1.1 (F, H)
Benzo(k)fluoranthene	23	NRDCSRS	0.0157	0.17	0.33	6 (A)	23 (D)	1.1 (F, H)
Chrysene	230	NRDCSRS	0.0151	0.17	0.33	62 (A)	230 (D)	1.1 (F, H)
Dibenz(a,h)anthracene	0.2	NRDCSRS	0.0096	0.17	0.33	0.2 (A)	0.2 (D)	1.1 (F, H)
Fluoroanthene	24000	NRDCSRS	0.0067	0.17	0.33	2300 (A)	24000 (D)	29 (F, G)
Fluorene	24000	NRDCSRS	0.0126	0.17	0.33	2300 (A)	24000 (D)	29 (F, G)
Indeno(1,2,3-cd)pyrene	2	NRDCSRS	0.0111	0.17	0.33	0.6 (A)	2 (D)	1.1 (F, H)
Naphthalene	17	NRDCSRS	0.0115	0.17	0.33	6 (A)	17 (D)	29 (F, G)
Phenanthrene	300000	NRDCSRS	0.0090	0.17	0.33	1700 (A, B)	300000 (D)	29 (F, G)
Pyrene	18000	NRDCSRS	0.0080	0.17	0.33	1700 (A)	18000 (D)	1.1 (F, H)
Lead	800	NRDCSRS	0.1200	0.30	0.60	400 (A)	800 (D)	11 (F)
Antimony	450	NRDCSRS	0.5600	1.25	2.50	31 (A)	450 (D)	0.27 (F)
Arsenic	19	NRDCSRS	0.3300	0.50	1.00	19 (A)	19 (D)	18 (F)
Copper	45000	NRDCSRS	0.3200	0.50	1.00	3100 (A)	45000 (D)	28 (F)
Zinc	110000	NRDCSRS	0.7000	1.00	2.00	23000 (A)	110000 (D)	46 (F)
Iron	720000	USEPA Ind. RSL	1.3300	2.50	5.00	55000 (C)	720000 (E)	Narrative (I)

Notes:
All values shown in milligrams per kilogram (mg/kg)
NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard
USEPA Ind. RSL - United States Environmental Protection Agency Industrial Regional Screening Level
LOC - Level of Concern
(A) NJDEP Soil Remediation Standards, N.J.A.C 7:26D, Residential - Direct Contact Health Based Criteria, November 2009.
(B) Pyrene used as surrogate.
(C) USEPA, Regional Screening Levels (RSLs), Residential Soil Screening Value, November 2011.
(D) NJDEP Soil Remediation Standards, N.J.A.C 7:26D, Non-Residential - Direct Contact Health Based Criteria, November 2009.
(E) USEPA, Regional Screening Levels (RSLs), Industrial Soil Screening Value, November 2011.
(F) NJDEP, Ecological Screening Criteria, EcoSSLs given preference, followed by lower of the Wildlife PRGs and Terrestrial Plant Benchmarks, March 2009.
(G) Low molecular weight PAH.
(H) High molecular weight PAH.
(I) USEPA EcoSSL, Narrative Criterion. Iron is only a chemical of concern if the soil pH is below 5.

Table 3-9
Summary of Surface Water Analytical Reporting Limits and Standards
Former Skeet Range
Picatinny Arsenal, New Jersey

Analyte	LOC	LOC Chosen	Laboratory Method Detection Limit	Laboratory Level of Detection	Laboratory Level of Quantitation	Human Health Risk Assessment Screening Level	Ecological Risk Assessment Screening Value
2-Methylnaphthalene	27	USEPA RSL TW	0.32	5.0	10	27 (A)	330 (E)
Acenaphthene	670	NJSWQC	0.21	5.0	10	670 (B)	38 (E)
Acenaphthylene	830*	NJSWQC	0.70	5.0	10	830 (B, C)	4840 (E)
Anthracene	8300	NJSWQC	0.16	5.0	10	8300 (B)	0.035 (E)
Benz(a)anthracene	0.038	NJSWQC	0.16	5.0	10	0.038 (B)	0.025 (E)
Benzo(a)pyrene	0.0038	NJSWQC	0.14	5.0	10	0.0038 (B)	0.014 (E)
Benzo(b)fluoranthene	0.038	NJSWQC	0.29	5.0	10	0.038 (B)	9.07 (E)
Benzo(g,h,i)perylene	830*	NJSWQC	0.29	5.0	10	830 (B, C)	7.64 (E)
Benzo(k)fluoranthene	0.38	NJSWQC	0.18	5.0	10	0.38 (B)	0.3 (E, C)
Chrysene	3.8	NJSWQC	0.18	5.0	10	5 (D)	0.3 (E, C)
Dibenz(a,h)anthracene	0.0038	NJSWQC	0.42	5.0	10	0.0038 (B)	0.3 (E, C)
Fluoroanthene	130	NJSWQC	0.40	5.0	10	130 (B)	1.9 (E)
Fluorene	1100	NJSWQC	0.31	5.0	10	1100 (B)	19 (E)
Indeno(1,2,3-cd)pyrene	0.038	NJSWQC	0.15	5.0	10	0.038 (B)	4.31 (E)
Naphthalene	0.14	USEPA RSL TW	0.12	5.0	10	300 (D)	13 (E)
Phenanthrene	830*	NJSWQC	0.26	5.0	10	830 (B, C)	3.6 (E)
Pyrene	830	NJSWQC	0.21	5.0	10	830 (B)	0.3 (E)
Lead	5	NJSWQC	2.6	3.0	6	5 (B)	5.4 (E)
Antimony	5.6	NJSWQC	8.0	12.5	25	5.6 (B)	80 (E)
Arsenic	1.38	PTA Background	4.2	5.0	10	0.017 (B)	150 (E)
Copper	1300	NJSWQC	2.0	5.0	10	1300 (B)	8.5 (E, F)
Zinc	7400	NJSWQC	6.5	10.0	20	7400 (B)	113.8 (E, F)
Iron	1790	PTA Background	20.4	25.0	50	300 (D)	1000 (G)

Notes:
All values shown in micrograms per liter (µg/l)
* - Values for pyrene were used for polyaromatic hydrocarbons (PAHs) where criteria was not available

USEPA RSL TW - United States Environmental Protection Agency Regional Screening Level Tapwater
NJSWQC - New Jersey Surface Water Quality Criteria
PTA Background - Picatinny Arsenal background values
LOC - Level of Concern
(A) USEPA, Regional Screening Levels (RSLs), Tap Water Screening Value, June 2011.
(B) NJDEP Surface Water Quality Standards, N.J.A.C 7:9B, Human Health Fresh Water Criteria, January 2010.
(C) Pyrene used as surrogate.
(D) NJDEP Ground Water Quality Standards, N.J.A.C 7:9C, Ground Water Quality Criteria, July 2010.
(E) NJDEP, Ecological Screening Criteria, lower of the Fresh Water Surface Water Criteria given preference, March 2009.
(F) Hardness dependent criterion, assume a hardness of 100 mg/L.
(G) USEPA, National Recommended Water Quality Criteria, Chronic Value, 2009.

Table 3-10
Summary of Sediment Analytical Reporting Limits and Standards
Former Skeet Range
Picatinny Arsenal, New Jersey

Analyte	LOC	LOC Chosen	Laboratory Method Detection Limit	Laboratory Level of Detection	Laboratory Level of Quantitation	Residential Human Health Risk Assessment Screening Level	Non-Residential Human Health Risk Assessment Screening Level	Ecological Risk Assessment Screening Value
2-Methylnaphthalene	0.0202	CCME ISQG	0.0084	0.17	0.33	230 (A)	2400 (D)	0.0202 (F)
Acenaphthene	0.00671	CCME ISQG	0.0094	0.17	0.33	3400 (A)	37000 (D)	0.00671 (F)
Acenaphthylene	0.00587	CCME ISQG	0.0084	0.17	0.33	1700 (A, B)	300000 (D)	0.00587 (F)
Anthracene	0.03162	ORNL SQB	0.0068	0.17	0.33	17000 (A)	30000 (D)	0.0572 (F)
Benz(a)anthracene	0.0317	CCME ISQG	0.0159	0.17	0.33	0.6 (A)	2 (D)	0.108 (F)
Benzo(a)pyrene	0.0319	CCME ISQG	0.0072	0.17	0.33	0.2 (A)	0.2 (D)	0.15 (F)
Benzo(b)fluoranthene	0.0272	ORNL SQB	0.0109	0.17	0.33	0.6 (A)	2 (D)	10.4 (F)
Benzo(g,h,i)perylene	0.17	NJDEP ER-Ls	0.0135	0.17	0.33	380000 (A)	30000 (D)	0.17 (F)
Benzo(k)fluoranthene	0.0272	ORNL SQB	0.0157	0.17	0.33	6 (A)	23 (D)	0.24 (F)
Chrysene	0.0571	CCME ISQG	0.0151	0.17	0.33	62 (A)	230 (D)	0.166 (F)
Dibenz(a,h)anthracene	0.00622	CCME ISQG	0.0096	0.17	0.33	0.2 (A)	0.2 (D)	0.033 (F)
Fluoroanthene	0.06423	ORNL SQB	0.0067	0.17	0.33	2300 (A)	24000 (D)	0.423 (F)
Fluorene	0.019	NJDEP ER-Ls	0.0126	0.17	0.33	2300 (A)	24000 (D)	0.0774 (F)
Indeno(1,2,3-cd)pyrene	0.078	ORNL SQB	0.0111	0.17	0.33	0.6 (A)	2 (D)	0.2 (F)
Naphthalene	0.03275	ORNL SQB	0.0115	0.17	0.33	6 (A)	17 (D)	0.176 (F)
Phenanthrene	0.0419	CCME ISQG	0.0090	0.17	0.33	1700 (A, B)	300000 (D)	0.204 (F)
Pyrene	0.053	CCME ISQG	0.0080	0.17	0.33	1700 (A)	18000 (D)	0.195 (F)
Lead	38.8	PTA Background	0.1200	0.30	0.60	400 (A)	800 (D)	35.8 (F)
Antimony	450	NRDCSRS	0.5600	1.25	2.50	31 (A)	450 (D)	3 (F)
Arsenic	16	PTA Background	0.3300	0.50	1.00	19 (A)	19 (D)	9.979 (F)
Copper	28	ORNL SQB	0.3200	0.50	1.00	3100 (A)	45000 (D)	31.6 (F)
Zinc	171	PTA Background	0.7000	1.00	2.00	23000 (A)	110000 (D)	120 (F)
Iron	720000	USEPA Ind. Background	1.3300	2.50	5.00	55000 (C)	720000 (E)	NVA

Notes:
All values shown in milligrams per kilogram (mg/kg)
CCME ISQG - Canadian Council of Ministers of the Environment Interim Sediment Quality Guidelines
ORNL SQB - Oak Ridge National Laboratory Sediment Quality Benchmark
NJDEP ER-Ls - New Jersey Department of Environmental Protection Effect Range Low
PTA Background - Picatinny Arsenal background values
USEPA Ind. Background - United States Environmental Protection Agency Industrial Background Value
LOC - Level of Concern
(A) NJDEP Soil Remediation Standards, N.J.A.C 7:26D, Residential - Direct Contact Health Based Criteria, November 2009.
(B) Pyrene used as surrogate.
(C) USEPA, Regional Screening Levels (RSLs), Residential Soil Screening Value, November 2011.
(D) NJDEP Soil Remediation Standards, N.J.A.C 7:26D, Non-Residential - Direct Contact Health Based Criteria, November 2009.
(E) USEPA, Regional Screening Levels (RSLs), Industrial Soil Screening Value, November 2011.
(F) NJDEP, Ecological Screening Criteria, Freshwater Criteria, Lower of the LEL and SEL Values, March 2009.
NVA = No value available.

Table 5-1
Skeet Range Sample Groupings for HHRA
Picatinny Arsenal

Sample Number	Location Code	MATRIX	Beginning Depth (ft)	Ending Depth (ft)	Sample Date
B1181SS-34-03192011	B1181SS-34	SS	0	0.5	3/19/2011
B1181SS-39-03162011	B1181SS-39	SS	0	0.5	3/16/2011
B1181SS-42-03162011	B1181SS-42	SS	0	0.5	3/16/2011
B1181SS-43-03162011	B1181SS-43	SS	0	0.5	3/16/2011
B1181SS-43DUP-03162011	B1181SS-43	SS	0	0.5	3/16/2011
B1181SS-44-03162011	B1181SS-44	SS	0	0.5	3/16/2011
B1181SS-45-03162011	B1181SS-45	SS	0	0.5	3/16/2011
B1181SS-46-03162011	B1181SS-46	SS	0	0.5	3/16/2011
B1181SS-48-03192011	B1181SS-48	SS	0	0.5	3/19/2011
B1181SS-49-03192011	B1181SS-49	SS	0	0.5	3/19/2011
B1181SS-50-03162011	B1181SS-50	SS	0	0.5	3/16/2011
B1181SS-51-03162011	B1181SS-51	SS	0	0.5	3/16/2011
B1181SS-52-03162011	B1181SS-52	SS	0	0.5	3/16/2011
B1181SS-53-03162011	B1181SS-53	SS	0	0.5	3/16/2011
B1181SS-54-03162011	B1181SS-54	SS	0	0.5	3/16/2011
B1181SS-54DUP-03162011	B1181SS-54	SS	0	0.5	3/16/2011
B1181SS-56-03162011	B1181SS-56	SS	0	0.5	3/16/2011
B1181SS-57-03162011	B1181SS-57	SS	0	0.5	3/16/2011
B1181SS-58-03162011	B1181SS-58	SS	0	0.5	3/16/2011
B1181SS-59-03192011	B1181SS-59	SS	0	0.5	3/19/2011
B1181SS-60-03192011	B1181SS-60	SS	0	0.5	3/19/2011
B1181SS-61-03192011	B1181SS-61	SS	0	0.5	3/19/2011
B1181SS-62-03162011	B1181SS-62	SS	0	0.5	3/16/2011
B1181SS-23	B1181SS-23	SS	0	0.5	6/4/2010
B1181SS-24	B1181SS-24	SS	0	0.5	6/4/2010
B1181SS-25	B1181SS-25	SS	0	0.5	6/4/2010
B1181SS-26	B1181SS-26	SS	0	0.5	6/4/2010
B1181SS-32	B1181SS-32	SS	0	0.5	6/4/2010
B1181SS-31	B1181SS-31	SS	0	0.5	6/4/2010
B1181SS-30	B1181SS-30	SS	0	0.5	6/4/2010
B1181SS-29	B1181SS-29	SS	0	0.5	6/4/2010
B1181SS-28	B1181SS-28	SS	0	0.5	6/4/2010
B1181SS-27	B1181SS-27	SS	0	0.5	6/4/2010
B1181SS-33	B1181SS-33	SS	0	0.5	6/4/2010
B1181SS-22	B1181SS-22	SS	0	0.5	6/4/2010
B1181SS-22DUP	B1181SS-22	SS	0	0.5	6/4/2010
B1181SS-35	B1181SS-35	SS	0	0.5	6/4/2010
B1181SS-38	B1181SS-38	SS	0	0.5	6/4/2010
B1181SS-37	B1181SS-37	SS	0	0.5	6/17/2010
B1181SS-36	B1181SS-36	SS	0	0.5	6/17/2010
Sample Number	**Location Code**	**MATRIX**	**Beginning Depth (ft)**	**Ending Depth (ft)**	**Sample Date**
B1181SS-10D-03162011	B1181SS-10	SB	4	4.5	3/16/2011
B1181SS-14C-03162011	B1181SS-14C	SB	2	2.5	3/16/2011
B1181SS-23C-03162011	B1181SS-23C	SB	2	2.5	3/16/2011
B1181SS-25C-03162011	B1181SS-25C	SB	2	2.5	3/16/2011
B1181SS-35C-03162011	B1181SS-35C	SB	2	2.5	3/16/2011

Table 5-1
Skeet Range Sample Groupings for HHRA
Picatinny Arsenal

Sample Number	Location Code	MATRIX	Screen Depth (ft) Top	Screen Depth (ft) Bottom	Sample Date
B1181MW-1-04282011	B1181MW-1	GW	7.7	12.7	4/28/2011
B1181MW-1DUP-04282011	B1181MW-1	GW	7.7	12.7	4/28/2011
B1181MW-2-04282011	B1181MW-2	GW	11	16	4/28/2011
C1-A-04282011	C1-A	GW	77.2	87.2	4/28/2011
C1-B-04282011	C1-B	GW	12.3	22.3	4/28/2011
DM19-3-04282011	DM19-3	GW	10	20	4/28/2011
C1-A 06172010	C1-A	GW	77.2	87.2	6/17/2010
C1-B 06172010	C1-B	GW	12.3	22.3	6/17/2010
DM19-3 06172010	DM19-3	GW	10	20	6/17/2010
B1181MW-1 06172010	B1181MW-1	GW	7.7	12.7	6/17/2010
B1181MW-2 06172010	B1181MW-2	GW	11	16	6/17/2010
B1181MW-2 06172010DUP	B1181MW-2	GW	11	16	6/17/2010
Sample Number	**Location Code**	**MATRIX**	**Beginning Depth (ft)**	**Ending Depth (ft)**	**Sample Date**
B1181SW-10-03212011	B1181SW-10	SW	0	0	3/21/2011
B1181SW-6-03162011	B1181SW-6	SW	0	0	3/16/2011
B1181SW-6DUP-03162011	B1181SW-6	SW	0	0	3/16/2011
B1181SW-7-03192011	B1181SW-7	SW	0	0	3/19/2011
B1181SW-8-03192011	B1181SW-8	SW	0	0	3/19/2011
B1181SW-9-03212011	B1181SW-9	SW	0	0	3/21/2011
Sample Number	**Location Code**	**MATRIX**	**Beginning Depth (ft)**	**Ending Depth (ft)**	**Sample Date**
B1181SD-10-03212011	B1181SD-10	SD	0	0.5	3/21/2011
B1181SD-11-03162011	B1181SD-11	SD	0	0.5	3/16/2011
B1181SD-12-03162011	B1181SD-12	SD	0	0.5	3/16/2011
B1181SD-3C-03162011	B1181SD-3C	SD	2	2.5	3/16/2011
B1181SD-6-03162011	B1181SD-6	SD	0	0.5	3/16/2011
B1181SD-6DUP-03162011	B1181SD-6	SD	0	0.5	3/16/2011
B1181SD-7C-03192011	B1181SD-7C	SD	2	2.5	3/19/2011
B1181SD-8-03192011	B1181SD-8	SD	0	0.5	3/19/2011
B1181SD-9-03212011	B1181SD-9	SD	0	0.5	3/21/2011
B1181SD-5	B1181SD-5	SD	0	0.5	6/4/2010
B1181SD-4	B1181SD-4	SD	0	0.5	6/4/2010
B1181SD-4DUP	B1181SD-4	SD	0	0.5	6/4/2010

SS = surface soil
SB = subsurface soil
Note: Total soil = SS + SB
GW = groundwater
SW = surface water
SD = sediment
DUP = field duplicate

Table 5-2
Summary of Chemcals of Potential Concern at former Skeet Range
Picatinny Arsenal

COPCs in Surface Soil (0-1 ft bgs)

Antimony
Arsenic
Iron
Lead
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

COPCs in Total Soil (Surface plus Subsurface) Soil (0 - 10 ft bgs)

Antimony
Arsenic
Iron
Lead
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

COPCs in Groundwater

Arsenic
Chromium
Iron
Manganese

COPCs in Surface Water

Antimony
Arsenic
Iron
Lead

COPCs in Sediment

Antimony
Arsenic
Copper
Iron
Lead
Benzo(b)fluoranthene

Table 5-3
Summary of Cancer Risk and Noncancer Hazard, and Modeled Blood Lead Levels
Former Skeet Range
Picatinny Arsenal

Receptor	Total Cancer Risk	Risk Drivers	Total Noncancer Hazard	Hazard Drivers
Current Routine Worker (soil, surface water, and sediment exposure only)	8.8E-05	BaP, arsenic, BbF, DahA, BaA in surface soil; arsenic in sediment, arsenic in surface water.	1.7	Antimony in sediment.
Future Routine Worker (soil, surface water, sediment and groundwater exposure)	2.0E-04	BaP, arsenic, BbF, DahA, BaA in surface soil; arsenic in sediment, arsenic in surface water; arsenic in groundwater.	5.2	Antimony in sediment; manganese in groundwater.
Current/Future Construction Worker	2.0E-06	No individual COPCs with risk greater than 1E-6.	0.2	None
Future Adult Resident (Lifetime Exposure) [a]	1.5E-03	BaP, arsenic, BbF, DahA, BaA, BkF, IcdP in surface soil; arsenic in sediment; arsenic in surface water; arsenic in groundwater.	13	Antimony in sediment; antimony in surface water; manganese, arsenic in groundwater.
Future Child Resident [a]	1.1E-03	BaP, arsenic, BbF, DahA, BaA, BkF, IcdP in surface soil; arsenic in sediment; arsenic in surface water; arsenic in groundwater.	76	Antimony, arsenic in sediment; antimony in surface water; manganese, arsenic, iron in groundwater.

Receptors for Potential Lead Exposure	Estimated Blood Lead Level (ug/dL)	Probability Blood Lead Level Exceeds 10 ug/dL	
Child (soil)	29.4	98.9%	(Exceeds 5% probability threshold)
Child (sediment)	76.4	99.9%	(Exceeds 5% probability threshold)
Adult pregnant female worker (soil)	22 - 30	39 - 44%	(Exceeds 5% probability threshold)
Adult pregnant female worker (sediment)	108 - 140	97 - 99%	(Exceeds 5% probability threshold)

For risk and hazard details, see Appendix C, Tables 9.1 through 9.4.
For lead model results, see Appendix C, Attachment E.

[a] Benzo(a)anthracene (BaA), benzo(a)pyrene (BaP), benzo(b)fluoranthene (BbF), benzo(k)fluoranthene (BkF), dibenzo(ah)anthracene (DahA), and indeno(123cd)-pyrene (IcdP) cancer risks include mutagenic mode of action (MOA) for future adult and child residents (Section 5.3.1).

Table 5-4
Comparison of Former Skeet Range Risk Driver COPCs to Background Concentrations

Media	COPC Risk Drivers That May Be Considered Potentially Background Related										
	BaP	BbF	BaA	DahA	IcdP	BkF	As	Sb	Pb	Mn	Fe
	Maximum Detected Concentrations (mg/kg or mg/L) for Former Skeet Range										
Surface Soil (SS)	**21.6**	**27.1**	**27.6**	**4.88**	**16.5**	**27.1**	**24.1**	**39.4**	**84700**	--	**30900**
Total Soil (TS)	**21.6**	**27.1**	**27.6**	**4.88**	**16.5**	**27.1**	**24.1**	**39.4**	**84700**	--	**30900**
BG Threshold Value (SS)	0.10	0.19	0.12	ND	0.08	0.06	9.23	0.96	74.6	--	26500
Sediment (SED)	--	0.19	--	--	--	--	**851**	**6250**	**186000**	--	19900
BG Threshold Value (SED)	--	0.19 [a]	--	--	--	--	16	0.354	38.8	--	67600
Surface Water (SW)	--	--	--	--	--	--	**0.02**	0.07	**7.53**	--	**8.34**
BG Threshold Value (SW)	--	--	--	--	--	--	0.00138	NA	0.00236	--	1.79
Groundwater (GW)	--	--	--	--	--	--	0.01	--	--	3.35	18.3
BG Threshold Value (GW)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Footnotes

Site-specific background threshold values (BTVs) for soil, surface water and sediment, for metals, from IT Corporation (2002).
BTV = Lower of (1) maximum and (2) mean plus 3 standard deviations.
For PAHs, background values (95th percentiles) from NJDEP (2002, 2003); Highlands Physiological Province.
Site concentrations in bold font exceed BTVs.
ND= not detected. NA = not available.
-- = not a risk or hazard driver at the Site for specific media.
Risk drivers are those COPCs with estimated cancer risks greater than 1.0E-6.
[a] Soil used for sediment.

Benzo(a)anthracene (BaA), benzo(a)pyrene (BaP), benzo(b)fluoranthene (BbF), dibenzo(ah)anthracene (DahA), indeno(123cd)-pyrene (IcdP), benzo(k)fluoranthene ((BkF), Arsenic (As), Antimony (Sb), Lead (Pb), Manganese (Mn), and Iron (Fe).

Table 5-5
Comparison of Exposure Point Concentrations in Surface Soil and Total Soil, for Hypothetical Future Residential Exposure to COPCs in Deeper Soils
Former Skeet Range

COPCs in SS [1]	SS EPC [2]	COPCs in TS [3]	TS EPC	TS EPC/SS EPC [4]
Antimony	1.16E+01	Antimony	1.13E+01	0.97
Arsenic	1.09E+01	Arsenic	1.09E+01	1.00
Iron	2.09E+04	Iron	2.09E+04	1.00
Lead	2.52E+04	Lead	2.33E+04	0.93
Benzo(a)anthracene	3.85E+00	Benzo(a)anthracene	4.06E+00	**1.05**
Benzo(a)pyrene	7.10E+00	Benzo(a)pyrene	3.65E+00	0.51
Benzo(b)fluoranthene	1.28E+01	Benzo(b)fluoranthene	1.26E+01	0.98
Benzo(k)fluoranthene	4.06E+00	Benzo(k)fluoranthene	4.00E+00	0.99
Chrysene	3.77E+00	Chrysene	4.02E+00	**1.07**
Dibenzo(a,h)anthracene	9.19E-01	Dibenzo(a,h)anthracene	9.17E-01	1.00
Indeno(1,2,3-cd)pyrene	2.70E+00	Indeno(1,2,3-cd)pyrene	5.17E+00	**1.92**

[1] SS = surface soil (0-1 ft bgs)

[2] EPC = exposure point concentrations, in mg/kg (see **Appendix C**, Tables 3.1 and 3.2).

[3] TS = total soil (0-10 ft bgs)

[4] COPCs with EPC greater in total soil compared with surface soil have bolded ratio in final column.

Table 6-1
Threatened, Rare, and Endangered Species Identified at Picatinny Arsenal

Common Name	Scientific Name	Federal Status	State Status
Indiana bat	*Myotis sodalis*	Endangered	Endangered
Bog turtle	*Clemmys muhlenbergii*	Endangered	Endangered

Note: These endangered species have not been identified at Former Skeet Range, but they have been previously identified at Picatinny Arsenal.

Table 6-2
Picatinny Arsenal Former Skeet Range Sample Groupings

Medium	Sample Number	Sample Depth (feet bgs)
Sediment	B1181SD-10-03212011	0 – 0.5
Sediment	B1181SD-11-03162011	0 – 0.5
Sediment	B1181SD-12-03162011	0 – 0.5
Sediment	B1181SD-3C-03162011	2.5
Sediment	B1181SD-4	0 – 0.5
Sediment	B1181SD-4DUP (duplicate)	0 – 0.5
Sediment	B1181SD-5	0 – 0.5
Sediment	B1181SD-6-03162011	0 – 0.5
Sediment	B1181SD-6DUP-03162011 (duplicate)	0 – 0.5
Sediment	B1181SD-7C-03192011	2 – 2.5
Sediment	B1181SD-8-03192011	0 – 0.5
Sediment	B1181SD-9-03212011	0 – 0.5
Surface Soil	B1181SS-22	0 – 0.5
Surface Soil	B1181SS-22DUP (duplicate)	0 – 0.5
Surface Soil	B1181SS-23	0 – 0.5
Surface Soil	B1181SS-24	0 – 0.5
Surface Soil	B1181SS-25	0 – 0.5
Surface Soil	B1181SS-26	0 – 0.5
Surface Soil	B1181SS-27	0 – 0.5
Surface Soil	B1181SS-28	0 – 0.5
Surface Soil	B1181SS-29	0 – 0.5
Surface Soil	B1181SS-30	0 – 0.5
Surface Soil	B1181SS-31	0 – 0.5
Surface Soil	B1181SS-32	0 – 0.5
Surface Soil	B1181SS-33	0 – 0.5
Surface Soil	B1181SS-34-03192011	0 – 0.5
Surface Soil	B1181SS-35	0 – 0.5
Surface Soil	B1181SS-36	0 – 0.5
Surface Soil	B1181SS-37	0 – 0.5
Surface Soil	B1181SS-38	0 – 0.5
Surface Soil	B1181SS-39-03162011	0 – 0.5
Surface Soil	B1181SS-42-03162011	0 – 0.5
Surface Soil	B1181SS-43-03162011	0 – 0.5
Surface Soil	B1181SS-43DUP-03162011 (duplicate)	0 – 0.5
Surface Soil	B1181SS-44-03162011	0 – 0.5
Surface Soil	B1181SS-45-03162011	0 – 0.5
Surface Soil	B1181SS-46-03162011	0 – 0.5
Surface Soil	B1181SS-48-03192011	0 – 0.5
Surface Soil	B1181SS-49-03192011	0 – 0.5
Surface Soil	B1181SS-50-03162011	0 – 0.5
Surface Soil	B1181SS-51-03162011	0 – 0.5
Surface Soil	B1181SS-52-03162011	0 – 0.5
Surface Soil	B1181SS-53-03162011	0 – 0.5
Surface Soil	B1181SS-54-03162011	0 – 0.5
Surface Soil	B1181SS-54DUP-03162011 (duplicate)	0 – 0.5
Surface Soil	B1181SS-56-03162011	0 – 0.5
Surface Soil	B1181SS-57-03162011	0 – 0.5
Surface Soil	B1181SS-58-03162011	0 – 0.5
Surface Soil	B1181SS-59-03192011	0 – 0.5

Table 6-2
Picatinny Arsenal Former Skeet Range Sample Groupings

Medium	Sample Number	Sample Depth (feet bgs)
Surface Soil	B1181SS-60-03192011	0 – 0.5
Surface Soil	B1181SS-61-03192011	0 – 0.5
Surface Soil	B1181SS-62-03162011	0 – 0.5
Surface Water	B1181SW-10-03212011	---
Surface Water	B1181SW-6-03162011	---
Surface Water	B1181SW-6DUP-03162011 (duplicate)	---
Surface Water	B1181SW-7-03192011	---
Surface Water	B1181SW-8-03192011	---
Surface Water	B1181SW-9-03212011	---

TABLE 6-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR DIRECT CONTACT EXPOSURE, SURFACE SOIL (0 - 1 FT)

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion
	7440-36-0	Antimony	9.70E-01 J	3.94E+01	mg/kg	B1181SS-46-03162011	8/14	2.57E+00 - 9.24E+00	Yes	DET
Surface Soil	7440-38-2	Arsenic	1.65E+00	2.41E+01	mg/kg	B1181SS-42-03162011	14/14	N/A	Yes	DET
(0 - 1 ft. bgs)	7440-50-8	Copper	1.74E+01 J	7.12E+01 J	mg/kg	B1181SS-57-03162011	14/14	N/A	Yes	DET
	7439-89-6	Iron	5.52E+03	3.09E+04 J	mg/kg	B1181SS-42-03162011	14/14	N/A	Yes	DET
	7439-92-1	Lead	1.08E+01	8.47E+04	mg/kg	B1181SS-32	35/35	N/A	Yes	DET
	7440-66-6	Zinc	2.35E+01 J	1.55E+02 J	mg/kg	B1181SS-54-03162011	14/14	N/A	Yes	DET
	7440-44-0	Total Organic Carbon	2.03E+04 J	4.12E+05	mg/kg	B1181SS-37	17/17	N/A	No	CHEM
	91-57-6	2-Methylnaphthalene	5.99E-02 J	4.36E-01 J	mg/kg	B1181SS-23	7/13	1.95E-01 - 9.93E-01	Yes	DET
	83-32-9	Acenaphthene	8.25E-02 J	3.79E+00	mg/kg	B1181SS-23	5/26	2.25E-01 - 2.10E+00	Yes	DET
	208-96-8	Acenaphthylene	1.53E-01 J	2.53E-01 J	mg/kg	B1181SS-27	2/26	2.25E-01 - 2.10E+00	Yes	DET
	120-12-7	Anthracene	8.30E-02 J	7.88E+00	mg/kg	B1181SS-23	7/26	2.25E-01 - 2.10E+00	Yes	DET
	56-55-3	Benzo(a)anthracene	2.30E-01 J	2.76E+01	mg/kg	B1181SS-23	6/26	9.37E-02 - 2.10E+00	Yes	DET
	50-32-8	Benzo(a)pyrene	2.00E-01 J	2.16E+01	mg/kg	B1181SS-23	14/26	2.35E-01 - 2.10E+00	Yes	DET
	205-99-2	Benzo(b)fluoranthene	1.20E-01 J	2.71E+01	mg/kg	B1181SS-23	16/26	4.70E-01 - 2.10E+00	Yes	DET
	191-24-2	Benzo(ghi)perylene	1.20E-01 J	1.42E+01	mg/kg	B1181SS-23	7/26	2.44E-01 - 2.10E+00	Yes	DET
	207-08-9	Benzo(k)fluoranthene	8.80E-02 J	1.22E+01	mg/kg	B1181SS-23	15/26	4.70E-01 - 2.10E+00	Yes	DET
	218-01-9	Chrysene	8.30E-02 J	2.62E+01	mg/kg	B1181SS-23	9/26	9.37E-02 - 2.10E+00	Yes	DET
	53-70-3	Dibenzo(a,h)anthracene	2.03E-01 J	4.88E+00	mg/kg	B1181SS-23	9/26	2.25E-01 - 2.10E+00	Yes	DET
	206-44-0	Fluoranthene	7.60E-02 J	3.84E+01	mg/kg	B1181SS-23	16/26	4.70E-01 - 2.10E+00	Yes	DET
	86-73-7	Fluorene	7.30E-02 J	3.70E+00	mg/kg	B1181SS-23	7/26	2.25E-01 - 2.10E+00	Yes	DET
	193-39-5	Indeno(1,2,3-cd)pyrene	8.70E-02 J	1.65E+01	mg/kg	B1181SS-23	13/26	2.34E-01 - 2.10E+00	Yes	DET
	91-20-3	Naphthalene	1.16E-01 J	7.67E-01 J	mg/kg	B1181SS-23	7/26	2.30E-01 - 2.10E+00	Yes	DET
	85-01-8	Phenanthrene	6.55E-02 J	2.20E+01	mg/kg	B1181SS-23	15/26	4.70E-01 - 2.10E+00	Yes	DET
	129-00-0	Pyrene	7.20E-02 J	9.30E+00	mg/kg	B1181SS-35	15/25	4.70E-01 - 2.10E+00	Yes	DET

COPEC Selection Rationale Codes

TABLE 6-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR DIRECT CONTACT EXPOSURE, SURFACE SOIL (0 - 1 FT)

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion

Selection Reason: Detected constituent (DET)

Deletion Reason: Chemical/Physical property (CHEM)

Notes/Definitions:
N/A = Not Applicable or Not Available
COPEC = Chemical of Potential Ecological Concern
J = Estimated Value
L = Estimated Value
mg/kg = milligrams per kilogram

TABLE 6-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR FOOD CHAIN EXPOSURE, SURFACE SOIL (0 - 1 FT)

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion
Surface Soil (0 - 1 ft. bgs)	7440-36-0	Antimony	9.70E-01 J	3.94E+01	mg/kg	B1181SS-46-03162011	8/14	2.57E+00 - 9.24E+00	No	NIBC
	7440-38-2	Arsenic	1.65E+00	2.41E+01	mg/kg	B1181SS-42-03162011	14/14	N/A	Yes	IBC
	7440-50-8	Copper	1.74E+01 J	7.12E+01 J	mg/kg	B1181SS-57-03162011	14/14	N/A	Yes	IBC
	7439-89-6	Iron	5.52E+03	3.09E+04 J	mg/kg	B1181SS-42-03162011	14/14	N/A	No	NIBC
	7439-92-1	Lead	1.08E+01	8.47E+04	mg/kg	B1181SS-32	35/35	N/A	Yes	IBC
	7440-66-6	Zinc	2.35E+01 J	1.55E+02 J	mg/kg	B1181SS-54-03162011	14/14	N/A	Yes	IBC
	7440-44-0	Total Organic Carbon	2.03E+04 J	4.12E+05	mg/kg	B1181SS-37	17/17	N/A	No	CHEM, NIBC
	91-57-6	2-Methylnaphthalene	5.99E-02 J	4.36E-01 J	mg/kg	B1181SS-23	7/13	1.95E-01 - 9.93E-01	No	NIBC
	83-32-9	Acenaphthene	8.25E-02 J	3.79E+00	mg/kg	B1181SS-23	5/26	2.25E-01 - 2.10E+00	Yes	IBC
	208-96-8	Acenaphthylene	1.53E-01 J	2.53E-01 J	mg/kg	B1181SS-27	2/26	2.25E-01 - 2.10E+00	Yes	IBC
	120-12-7	Anthracene	8.30E-02 J	7.88E+00	mg/kg	B1181SS-23	7/26	2.25E-01 - 2.10E+00	Yes	IBC
	56-55-3	Benzo(a)anthracene	2.30E-01 J	2.76E+01	mg/kg	B1181SS-23	6/26	9.37E-02 - 2.10E+00	Yes	IBC
	50-32-8	Benzo(a)pyrene	2.00E-01 J	2.16E+01	mg/kg	B1181SS-23	14/26	2.35E-01 - 2.10E+00	Yes	IBC
	205-99-2	Benzo(b)fluoranthene	1.20E-01 J	2.71E+01	mg/kg	B1181SS-23	16/26	4.70E-01 - 2.10E+00	Yes	IBC
	191-24-2	Benzo(ghi)perylene	1.20E-01 J	1.42E+01	mg/kg	B1181SS-23	7/26	2.44E-01 - 2.10E+00	Yes	IBC
	207-08-9	Benzo(k)fluoranthene	8.80E-02 J	1.22E+01	mg/kg	B1181SS-23	15/26	4.70E-01 - 2.10E+00	Yes	IBC
	218-01-9	Chrysene	8.30E-02 J	2.62E+01	mg/kg	B1181SS-23	9/26	9.37E-02 - 2.10E+00	Yes	IBC
	53-70-3	Dibenzo(a,h)anthracene	2.03E-01 J	4.88E+00	mg/kg	B1181SS-23	9/26	2.25E-01 - 2.10E+00	Yes	IBC
	206-44-0	Fluoranthene	7.60E-02 J	3.84E+01	mg/kg	B1181SS-23	16/26	4.70E-01 - 2.10E+00	Yes	IBC
	86-73-7	Fluorene	7.30E-02 J	3.70E+00	mg/kg	B1181SS-23	7/26	2.25E-01 - 2.10E+00	Yes	IBC
	193-39-5	Indeno(1,2,3-cd)pyrene	8.70E-02 J	1.65E+01	mg/kg	B1181SS-23	13/26	2.34E-01 - 2.10E+00	Yes	IBC
	91-20-3	Naphthalene	1.16E-01 J	7.67E-01 J	mg/kg	B1181SS-23	7/26	2.30E-01 - 2.10E+00	No	NIBC
	85-01-8	Phenanthrene	6.55E-02 J	2.20E+01	mg/kg	B1181SS-23	15/26	4.70E-01 - 2.10E+00	Yes	IBC
	129-00-0	Pyrene	7.20E-02 J	9.30E+00	mg/kg	B1181SS-35	15/25	4.70E-01 - 2.10E+00	Yes	IBC

COPEC Selection Rationale Codes

TABLE 6-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR FOOD CHAIN EXPOSURE, SURFACE SOIL (0 - 1 FT)

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion

Selection Reason: Important Bioaccumulative Compounds (IBC) [as defined in Table 4-2, of USEPA 823-R-00-001, February 2000]

Deletion Reason: Not Important Bioaccumulative Compound (NIBC)
Chemical/Physical property (CHEM)

Notes/Definitions
N/A = Not Applicable or Not Available
COPEC = Chemical of Potential Ecological Concern
J = Estimated Value
L = Estimated Value
mg/kg = milligrams per kilogram

TABLE 6-5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR DIRECT CONTACT EXPOSURE, SEDIMENT

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion
Sediment	7440-36-0	Antimony	8.44E+01	6.25E+03	mg/kg	B1181SD-10-03212011	3/5	2.30E+00 - 3.47E+00	Yes	DET
	7440-38-2	Arsenic	4.20E-01 J	8.51E+02	mg/kg	B1181SD-9-03212011	5/5	N/A	Yes	DET
	7440-50-8	Copper	6.15E+00	5.14E+02	mg/kg	B1181SD-10-03212011	6/6	N/A	Yes	DET
	7439-89-6	Iron	5.01E+03	1.99E+04	mg/kg	B1181SD-8-03192011	6/6	N/A	Yes	DET
	7439-92-1	Lead	4.34E+00	1.86E+05	mg/kg	B1181SD-10-03212011	9/9	N/A	Yes	DET
	7440-66-6	Zinc	2.30E+01	6.29E+02	mg/kg	B1181SD-3C-03162011	6/6	N/A	Yes	DET
	7440-44-0	Total Organic Carbon	1.55E+04	3.68E+05	mg/kg	B1181SD-5	2/2	N/A	No	CHEM
	205-99-2	Benzo(b)fluoranthene	1.86E-01 J	1.86E-01 J	mg/kg	B1181SD-4	1/8	4.20E-01 - 2.10E+00	Yes	DET
	191-24-2	Benzo(ghi)perylene	1.69E+00 J	1.69E+00 J	mg/kg	B1181SD-5	1/8	2.72E-01 - 2.10E+00	Yes	DET
	207-08-9	Benzo(k)fluoranthene	2.16E-01 J	2.16E-01 J	mg/kg	B1181SD-4	1/8	4.20E-01 - 2.10E+00	Yes	DET
	206-44-0	Fluoranthene	1.29E-01 J	2.90E-01 J	mg/kg	B1181SD-3C-03162011	2/8	4.20E-01 - 1.90E+00	Yes	DET
	129-00-0	Pyrene	1.50E-01 J	4.67E-01 J	mg/kg	B1181SD-5	2/8	4.20E-01 - 2.10E+00	Yes	DET

COPEC Selection Rationale Codes

Selection Reason: Detected constituent (DET)

Deletion Reason: Chemical/Physical property (CHEM)

Notes/Definitions:

N/A = Not Applicable or Not Available

COPEC = Chemical of Potential Ecological Concern

TABLE 6-5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR DIRECT CONTACT EXPOSURE, SEDIMENT

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion

J = Estimated Value
L = Estimated Value
mg/kg = milligrams per kilogram

TABLE 6-6

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR FOOD CHAIN EXPOSURE, SEDIMENT

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Food Chain COPEC (Y/N)	Rationale for Selection or Deletion
Sediment	7440-36-0	Antimony	8.44E+01	6.25E+03	mg/kg	B1181SD-10-03212011	3/5	2.30E+00 - 3.47E+00	No	NIBC
	7440-38-2	Arsenic	4.20E-01 J	8.51E+02	mg/kg	B1181SD-9-03212011	5/5	N/A	Yes	IBC
	7440-50-8	Copper	6.15E+00	5.14E+02	mg/kg	B1181SD-10-03212011	6/6	N/A	Yes	IBC
	7439-89-6	Iron	5.01E+03	1.99E+04	mg/kg	B1181SD-8-03192011	6/6	N/A	No	NIBC
	7439-92-1	Lead	4.34E+00	1.86E+05	mg/kg	B1181SD-10-03212011	9/9	N/A	Yes	IBC
	7440-66-6	Zinc	2.30E+01	6.29E+02	mg/kg	B1181SD-3C-03162011	6/6	N/A	Yes	IBC
	7440-44-0	Total Organic Carbon	1.55E+04	3.68E+05	mg/kg	B1181SD-5	2/2	N/A	No	CHEM, NIBC
	205-99-2	Benzo(b)fluoranthene	1.86E-01 J	1.86E-01 J	mg/kg	B1181SD-4	1/8	4.20E-01 - 2.10E+00	Yes	IBC
	191-24-2	Benzo(ghi)perylene	1.69E+00 J	1.69E+00 J	mg/kg	B1181SD-5	1/8	2.72E-01 - 2.10E+00	Yes	IBC
	207-08-9	Benzo(k)fluoranthene	2.16E-01 J	2.16E-01 J	mg/kg	B1181SD-4	1/8	4.20E-01 - 2.10E+00	Yes	IBC
	206-44-0	Fluoranthene	1.29E-01 J	2.90E-01 J	mg/kg	B1181SD-3C-03162011	2/8	4.20E-01 - 1.90E+00	Yes	IBC
	129-00-0	Pyrene	1.50E-01 J	4.67E-01 J	mg/kg	B1181SD-5	2/8	4.20E-01 - 2.10E+00	Yes	IBC

COPEC Selection Rationale Codes

Selection Reason: Important Bioaccumulative Compounds (IBC) [as defined in Table 4-2, of USEPA 823-R-00-001, February 2000]
Explosives (EXP)

Deletion Reason: Not Important Bioaccumulative Compound (NIBC)
Chemical/Physical property (CHEM)

Notes/Definitions:

TABLE 6-6

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR FOOD CHAIN EXPOSURE, SEDIMENT

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Food Chain COPEC (Y/N)	Rationale for Selection or Deletion

N/A = Not Applicable or Not Available
COPEC = Chemical of Potential Ecological Concern
J = Estimated Value
L = Estimated Value
mg/kg = milligrams per kilogram

TABLE 6-7

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR DIRECT CONTACT EXPOSURE, SURFACE WATER

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion
Surface Water	7440-36-0	Antimony	4.10E-03	7.34E-02	mg/L	B1181SW-10-03212011	3/5	3.50E-04 - 7.20E-04	Yes	DET
	7440-38-2	Arsenic	7.95E-04 J	2.30E-02 J	mg/L	B1181SW-10-03212011	2/5	3.00E-04 - 1.00E-03	Yes	DET
	7440-50-8	Copper	3.40E-03	2.21E-02	mg/L	B1181SW-10-03212011	3/5	2.80E-03 - 3.00E-03	Yes	DET
	7439-89-6	Iron	3.12E-01	8.34E+00	mg/L	B1181SW-10-03212011	5/5	N/A	Yes	DET
	7439-92-1	Lead	4.30E-03	7.53E+00	mg/L	B1181SW-10-03212011	5/5	N/A	Yes	DET
	7440-66-6	Zinc	5.18E-02	6.63E-02	mg/L	B1181SW-10-03212011	3/5	1.29E-02 - 2.59E-02	Yes	DET

COPEC Selection Rationale Codes

Selection Reason: Detected constituent (DET)

Notes/Definitions:

N/A = Not Applicable or Not Available

COPEC = Chemical of Potential Ecological Concern

J = Estimated Value

L = Estimated Value

mg/L = milligrams per liter

TABLE 6-8

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR FOOD CHAIN EXPOSURE, SURFACE WATER

SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Direct Contact COPEC (Y/N)	Rationale for Selection or Deletion
Surface Water	7440-36-0	Antimony	4.10E-03	7.34E-02	mg/L	B1181SW-10-03212011	3/5	3.50E-04 - 7.20E-04	No	NIBC
	7440-38-2	Arsenic	7.95E-04 J	2.30E-02 J	mg/L	B1181SW-10-03212011	2/5	3.00E-04 - 1.00E-03	Yes	IBC
	7440-50-8	Copper	3.40E-03	2.21E-02	mg/L	B1181SW-10-03212011	3/5	2.80E-03 - 3.00E-03	Yes	IBC
	7439-89-6	Iron	3.12E-01	8.34E+00	mg/L	B1181SW-10-03212011	5/5	N/A	No	NIBC
	7439-92-1	Lead	4.30E-03	7.53E+00	mg/L	B1181SW-10-03212011	5/5	N/A	Yes	IBC
	7440-66-6	Zinc	5.18E-02	6.63E-02	mg/L	B1181SW-10-03212011	3/5	1.29E-02 - 2.59E-02	Yes	IBC

COPEC Selection Rationale Codes

Selection Reason: Important Bioaccumulative Compounds (IBC) [as defined in Table 4-2, of USEPA 823-R-00-001, February 2000]

Deletion Reason: Not Important Bioaccumulative Compound (NIBC)

Notes/Definitions

N/A = Not Applicable or Not Available

COPEC = Chemical of Potential Ecological Concern

J = Estimated Value

L = Estimated Value

mg/L = milligrams per liter

TABLE 6-9
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE SOIL
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/kg	9.87E+00	Yes	1.16E+01 (G)	3.94E+01	1.16E+01	mg/kg	95% KM-BCA	Test (1)
Arsenic	mg/kg	7.51E+00	No	1.09E+01 (G)	2.41E+01	1.09E+01	mg/kg	95% Approx. Gamma	Test (6)
Copper	mg/kg	4.77E+01	No	5.63E+01 (N)	7.12E+01	5.63E+01	mg/kg	95% Student's-t	Test (4)
Iron	mg/kg	1.72E+04	No	2.09E+04 (N)	3.09E+04	2.09E+04	mg/kg	95% Student's-t	Test (4)
Lead	mg/kg	5.88E+03	No	2.52E+04 (NP)	8.47E+04	2.52E+04	mg/kg	97.5% Cheby, Mean, SD	Test (3)
Zinc	mg/kg	7.78E+01	No	9.29E+01 (N)	1.55E+02	9.29E+01	mg/kg	95% Student's-t	Test (4)
2-Methylnaphthalene	mg/kg	1.96E-01	Yes	2.30E-01 (N)	4.36E-01	2.30E-01	mg/kg	95% KM-t	Test (1)
Acenaphthene	mg/kg	1.08E+00	Yes	6.16E-01 (G)	3.79E+00	6.16E-01	mg/kg	95% KM-t	Test (1)
Acenaphthylene	mg/kg	2.03E-01	Yes	2.53E-01 (NP)	2.53E-01	2.53E-01	mg/kg	Max	Test (2)
Anthracene	mg/kg	1.66E+00	Yes	1.12E+00 (G)	7.88E+00	1.12E+00	mg/kg	95% KM-t	Test (1)
Benzo(a)anthracene	mg/kg	7.36E+00	Yes	3.85E+00 (G)	2.76E+01	3.85E+00	mg/kg	95% KM-t	Test (1)
Benzo(a)pyrene	mg/kg	2.89E+00	Yes	7.10E+00 (L)	2.16E+01	7.10E+00	mg/kg	97.5% KM-Cheby	Test (1)
Benzo(b)fluoranthene	mg/kg	3.24E+00	Yes	1.28E+01 (NP)	2.71E+01	1.28E+01	mg/kg	99% KM-Cheby	Test (1)
Benzo(ghi)perylene	mg/kg	3.59E+00	Yes	2.11E+00 (G)	1.42E+01	2.11E+00	mg/kg	95% KM-t	Test (1)
Benzo(k)fluoranthene	mg/kg	1.62E+00	Yes	4.06E+00 (L)	1.22E+01	4.06E+00	mg/kg	97.5% KM-Cheby	Test (1)
Chrysene	mg/kg	5.26E+00	Yes	3.77E+00 (G)	2.62E+01	3.77E+00	mg/kg	95% KM-t	Test (1)
Dibenzo(a,h)anthracene	mg/kg	1.03E+00	Yes	9.19E-01 (L)	4.88E+00	9.19E-01	mg/kg	95% KM-% Btstrp	Test (1)
Fluoranthene	mg/kg	4.13E+00	Yes	1.78E+01 (L)	3.84E+01	1.78E+01	mg/kg	99% KM-Cheby	Test (1)
Fluorene	mg/kg	8.07E-01	Yes	5.66E-01 (G)	3.70E+00	5.66E-01	mg/kg	95% KM-t	Test (1)
Indeno(1,2,3-cd)pyrene	mg/kg	2.35E+00	Yes	2.70E+00 (L)	1.65E+01	2.70E+00	mg/kg	95% KM-BCA	Test (1)
Naphthalene	mg/kg	2.99E-01	Yes	3.00E-01 (G)	7.67E-01	3.00E-01	mg/kg	95% KM-t	Test (1)
Phenanthrene	mg/kg	2.65E+00	Yes	1.04E+01 (L)	2.20E+01	1.04E+01	mg/kg	99% KM-Cheby	Test (1)
Pyrene	mg/kg	2.15E+00	Yes	6.69E+00 (L)	9.30E+00	6.69E+00	mg/kg	99% KM-Cheby	Test (1)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

TABLE 6-9
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE SOIL
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby);
95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD);
97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T)
95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma);
95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.

TABLE 6-10
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SEDIMENT
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Sediment
Exposure Medium: Sediment

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/kg	3.51E+03	Yes	6.25E+03 (N)	6.25E+03	6.25E+03	mg/kg	Max	Test (2)
Arsenic	mg/kg	2.09E+02	No	5.43E+03 (G)	8.51E+02	8.51E+02	mg/kg	Max	Test (2)
Copper	mg/kg	2.03E+02	No	3.57E+02 (N)	5.14E+02	3.57E+02	mg/kg	95% Student's-t	Test (4)
Iron	mg/kg	1.23E+04	No	1.69E+04 (N)	1.99E+04	1.69E+04	mg/kg	95% Student's-t	Test (4)
Lead	mg/kg	3.09E+04	No	2.75E+05 (G)	1.86E+05	1.86E+05	mg/kg	Max	Test (2)
Zinc	mg/kg	1.68E+02	No	5.93E+02 (G)	6.29E+02	5.93E+02	mg/kg	95% Approx. Gamma	Test (6)
Benzo(b)fluoranthene	mg/kg	N/A	N/A	N/A	1.86E-01	1.86E-01	mg/kg	Max	Test (8)
Benzo(ghi)perylene	mg/kg	N/A	N/A	N/A	1.69E+00	1.69E+00	mg/kg	Max	Test (8)
Benzo(k)fluoranthene	mg/kg	N/A	N/A	N/A	2.16E-01	2.16E-01	mg/kg	Max	Test (8)
Fluoranthene	mg/kg	2.46E-01	Yes	3.29E-01 (N)	2.90E-01	2.90E-01	mg/kg	Max	Test (2)
Pyrene	mg/kg	3.45E-01	Yes	4.82E-01 (NP)	4.67E-01	4.67E-01	mg/kg	Max	Test (2)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.
Test (8):Infrequent detection resulted in ProUCL modeling uncertainty for this constituent, therefore statistical calculations from ProUCL are not available and the maximum concentration is

TABLE 6-10
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SEDIMENT
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]

used for EPC.

TABLE 6-11
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE WATER
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Surface Water
Exposure Medium: Surface Water

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/L	2.94E-02	Yes	7.34E-02 (N)	7.34E-02	7.34E-02	mg/L	Max	Test (2)
Arsenic	mg/L	1.19E-02	Yes	6.11E-02 (NP)	2.30E-02	2.30E-02	mg/L	Max	Test (2)
Copper	mg/L	9.75E-03	Yes	3.27E-02 (L)	2.21E-02	2.21E-02	mg/L	Max	Test (2)
Iron	mg/L	2.19E+00	No	8.91E+00 (L)	8.34E+00	8.34E+00	mg/L	Max	Test (2)
Lead	mg/L	1.70E+00	No	4.62E+01 (G)	7.53E+00	7.53E+00	mg/L	Max	Test (2)
Zinc	mg/L	5.91E-02	Yes	6.63E-02 (N)	6.63E-02	6.63E-02	mg/L	Max	Test (2)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.

Table 6-12
Assessment and Measurement Endpoints
Picatinny Arsenal Former Skeet Range

Assessment Endpoints	Measurement Endpoints	Measurement Receptor	Information Provided
Terrestrial Habitats			
Protection of trophic level 2 herbivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Meadow vole	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 omnivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Northern bobwhite	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 insectivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Short-tailed shrew, American woodcock	Impacts resulting from direct exposure and indirect exposure via food chains
Preservation of the viability of upper trophic level receptors utilizing the plant community as habitat, food source, and/or energy transfer	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Terrestrial plant community	Impacts resulting from potential loss of food source
Preservation of the viability of upper trophic level receptors utilizing the invertebrate community as habitat, food source, and/or energy transfer	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Terrestrial invertebrate community	Impacts resulting from potential loss of food source
Aquatic Habitats			
Protection of trophic level 3 omnivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Raccoon	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 insectivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Marsh wren	Impacts resulting from direct exposure and indirect exposure via food chains
Preservation of the viability of upper trophic level receptors utilizing the plant community as habitat, food source, and/or energy transfer	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Aquatic plant community	Impacts resulting from potential loss of food source
Preservation of the viability of upper trophic level receptors utilizing the invertebrate community as habitat, food source, and/or energy transfer	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Benthic invertebrate community	Impacts resulting from potential loss of food source

Notes:
COPEC = constituent of potential ecological concern
TRV = toxicity reference value
LOAEL = lowest-observed-adverse-effect level
NOAEL = no-observed-adverse-effect level

Table 6-13
Wildlife EEQ Hazard Summary
Picatinny Arsenal Former Skeet Range

Receptor	Tier 1[a]		Tier 2[b]	
	NOAEL-Based EEQ	LOAEL-Based EEQ	NOAEL-Based EEQ	LOAEL-Based EEQ
American woodcock	1,313	1,104	66	55
Hazard Driver(s)[c]:	Lead - soil and terr. invertebrate ingestion		Lead - soil and terr. invertebrate ingestion	
Northern bobwhite	125	105	15	12
Hazard Driver(s)[c]:	Lead - soil and terr. invertebrate ingestion		Lead - soil and terr. invertebrate ingestion	
Marsh wren	30,877	25,921	5,213	4,375
Hazard Driver(s)[c]:	Lead - aquatic invertebrate ingestion		Lead - sediment and aquatic invertebrate ingestion	
Short-tailed shrew	892	719	191	155
Hazard Driver(s)[c]:	Lead - soil and terr. invertebrate ingestion		Lead - soil and terr. invertebrate ingestion	
Meadow vole	329	271	42	33
Hazard Driver(s)[c]:	Lead - soil ingestion		Lead - soil ingestion	
Raccoon	776	724	14	13
Hazard Driver(s)[c]:	Lead - aquatic invertebrate ingestion		Lead - sediment and aquatic invertebrate ingestion	

[a] Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
[b] Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR less than or equal to 1.
[c] Hazard drivers are those chemicals contributing the most to the total estimated EEQ, and the primary route of exposure associated with this driver.

Notes:
EEQ = Ecological Effects Quotient
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
FHR = Fraction home range
BW = Body weight
BAF/BCF = Bioaccumulation Factor/Bioconcentration Factor
EPC = Exposure point concentration

TABLE 6-14
DIRECT TOXICITY EVALUATION FOR SURFACE SOIL
PICATINNY ARSENAL FORMER SKEET RANGE

Chemical (1)	Detection Frequency (1)	Maximum Concentration (1)	Exposure Point Concentration (2)	NJDEP Ecological Screening Criteria [Wildlife PRGs] (3)	NJDEP Ecological Screening Criteria [Terrestrial Plant Tox Benchmarks] (4)	NJDEP Ecological Screening Criteria [EcoSSLs] (5)	Dutch Intervention Value (6)	CCME Value (7)	USEPA EcoSSL Direct Contact Value (8)	ORNL Screening Benchmark for Invertebrates (9)	COPEC Weight of Evidence Summary - Number of Direct Contact Benchmarks Exceeded Using MDC	COPEC Weight of Evidence Summary - Number of Direct Contact Benchmarks Exceeded Using EPC	Comment
Antimony	8/14	3.94E+01	1.16E+01	5.00E+00 (plant)	---	7.80E+01 (invertebrate)	1.50E+01	2.00E+01	---	NVA	**3/4**	1/4	
Arsenic	14/14	2.41E+01	1.09E+01	9.90E+00 (plant)	1.00E+01	1.80E+01 (plant)	5.50E+01	1.20E+01	---	6.00E+01	**4/6**	2/6	
Copper	14/14	7.12E+01	5.63E+01	6.00E+01 (invertebrate)	1.00E+02	7.00E+01 (plant)	1.90E+02	6.30E+01	---	5.00E+01	**4/6**	1/6	
Iron	14/14	3.09E+04	2.09E+04	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	pH > 5.5
Lead	35/35	8.47E+04	2.52E+04	NVA	5.00E+01	1.20E+02 (plant)	5.30E+02	7.00E+01	---	5.00E+02	**5/5**	**5/5**	
Zinc	14/14	1.55E+02	9.29E+01	NVA	5.00E+01	1.20E+02 (invertebrate)	7.20E+02	2.00E+02	---	2.00E+02	2/5	1/5	
2-Methylnaphthalene	7/13	4.36E-01	2.30E-01	NVA	NVA	NVA	4.00E+01	NVA	NVA	NVA	0/1	0/1	
Acenaphthene	5/26	3.79E+00	6.16E-01	2.00E+01 (plant)	NVA	NVA	4.00E+01	NVA	29 (LMW)	NVA	0/3	0/3	
Acenaphthylene	2/26	2.53E-01	2.53E-01	NVA	NVA	NVA	4.00E+01	NVA	29 (LMW)	NVA	0/2	0/2	
Anthracene	7/26	7.88E+00	1.12E+00	NVA	NVA	NVA	4.00E+01	NVA	29 (LMW)	NVA	0/2	0/2	
Benzo(a)anthracene	6/26	2.76E+01	3.85E+00	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	**2/3**	1/3	CCME based on agriculture use
Benzo(a)pyrene	14/26	2.16E+01	7.10E+00	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	**2/3**	1/3	CCME based on agriculture use
Benzo(b)fluoranthene	16/26	2.71E+01	1.28E+01	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	**2/3**	1/3	CCME based on agriculture use
Benzo(ghi)perylene	7/26	1.42E+01	2.11E+00	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	1/3	1/3	
Benzo(k)fluoranthene	15/26	1.22E+01	4.06E+00	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	1/3	1/3	
Chrysene	9/26	2.62E+01	3.77E+00	NVA	NVA	NVA	4.00E+01	NVA	18 (HMW)	NVA	1/2	0/2	
Dibenzo(a,h)anthracene	9/26	4.88E+00	9.19E-01	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	1/3	1/3	
Fluoranthene	16/26	3.84E+01	1.78E+01	NVA	NVA	NVA	4.00E+01	NVA	29 (LMW)	NVA	1/2	0/2	
Fluorene	7/26	3.70E+00	5.66E-01	NVA	NVA	NVA	4.00E+01	NVA	29 (LMW)	NVA	0/2	0/2	
Indeno(1,2,3-cd)pyrene	13/26	1.65E+01	2.70E+00	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	1/3	1/3	
Naphthalene	7/26	7.67E-01	3.00E-01	NVA	NVA	NVA	4.00E+01	1.00E-01	29 (LMW)	NVA	1/3	1/3	
Phenanthrene	15/26	2.20E+01	1.04E+01	NVA	NVA	NVA	4.00E+01	1.00E-01	29 (LMW)	NVA	1/3	1/3	
Pyrene	15/25	9.30E+00	6.69E+00	NVA	NVA	NVA	4.00E+01	1.00E-01	18 (HMW)	NVA	1/3	1/3	

All values presented in mg/kg.
"---" = benchmark presented previously in the table
NVA = No Value Available
LMW = Low Molecular Weight PAH
HMW = High Molecular Weight PAH
Soil pH value = 6.4 (based on surface soil sample B1181SS-22).
Bold/shaded cell indicates MDC/EPC exceeds >50% of the benchmarks.

(1) COPECs, detection frequencies, and maximum concentrations are from Table 5-3.
(2) Exposure Point Concentrations are 95% UCLs, from Table 5-9.
(3) NJDEP Ecological Screening Criteria, Wildlife PRGs based on the lowest plant or earthworm study; accessed at http://www.state.nj.us/dep/srp/guidance/ecoscreening.
(4) NJDEP Ecological Screening Criteria, Terrestrial Plant Tox Benchmarks; accessed at http://www.state.nj.us/dep/srp/guidance/ecoscreening.
(5) NJDEP Ecological Screening Criteria, Lowest EcoSSL value for direct contact toxicity for either plants or terrestrial invertebrates; accessed at http://www.state.nj.us/dep/srp/guidance/ecoscreening.
(6) Dutch Intervention Values are from the Netherlands Ministry of Housing, Spacial Planning and Environment (February 2000).
(7) Canadian Council of Ministers of the Environment (CCME), Canadian Environmental Quality Guidelines, December 2003.
(8) Lowest EcoSSL value for direct contact toxicity for either plants or terrestrial invertebrates (USEPA, 2007).
(9) Screening benchmarks for earthworms from ORNL (1997, ES/ER/TM-126/R2).

Table 6-15
Direct Contact Toxicity Evaluation for Sediment
Picatinny Arsenal Former Skeet Range

COPEC	MDC (1)	EPC (2)	NJDEP Ecological Screening Criteria [Freshwater Sediment] (3)	ARCS (4)			SQB (4,5)	Canadian ISQG (6)	Canadian PEL (6)	MacDonald et al. (7)		Weight of Evidence Exceedence	
				TEC	PEC	NEC				TEC	PEC	Using MDC	Using EPC
Antimony	6.25E+03	6.25E+03	3.00E+00	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	1 / 1	1 / 1
Arsenic	8.51E+02	8.51E+02	9.98E+00	1.21E+01	5.70E+01	9.29E+01	NVA	5.90E+00	1.70E+01	9.79E+00	3.30E+01	8 / 8	8 / 8
Copper	5.14E+02	3.57E+02	1.60E+01	2.80E+01	7.77E+01	5.48E+01	NVA	3.57E+01	1.97E+02	3.16E+01	1.49E+02	8 / 8	8 / 8
Iron	1.99E+04	1.69E+04	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA
Lead	1.86E+05	1.86E+05	3.10E+01	3.42E+01	3.96E+02	6.87E+01	NVA	3.50E+01	9.13E+01	3.58E+01	1.28E+02	8 / 8	8 / 8
Zinc	6.29E+02	5.93E+02	1.20E+02	1.59E+02	1.53E+03	5.41E+02	NVA	1.23E+02	3.15E+02	1.21E+02	4.59E+02	7 / 8	7 / 8
Benzo(b)fluoranthene	1.86E-01	1.86E-01	1.04E+01	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	0 / 1	0 / 1
Benzo(ghi)perylene	1.69E+00	1.69E+00	1.70E-01	2.90E-01	6.30E+00	3.80E+00	NVA	NVA	NVA	NVA	NVA	2 / 4	2 / 4
Benzo(k)fluoranthene	2.16E-01	2.16E-01	2.40E-01	NVA	NVA	NVA	NVA	NVA	NVA	NVA	NVA	0 / 1	0 / 1
Fluoranthene	2.90E-01	2.90E-01	4.23E-01	6.42E-01	8.34E-01	7.50E+00	NVA	1.11E-01	2.36E+00	4.23E-01	2.23E+00	1 / 8	1 / 8
Pyrene	4.67E-01	4.67E-01	1.95E-01	5.70E-01	3.23E+00	6.10E+00	NVA	5.30E-02	8.75E-01	1.95E-01	1.52E+00	3 / 8	3 / 8

All values presented in mg/kg.
"---" = benchmark presented previously in the table
Bold/shaded cell indicates MDC/EPC exceeds >50% of the benchmarks.
NVA = No Value Available
Values are for freshwater environments.

ARCS = Assessment and Remediation of Contaminated Sediment
COPEC = Chemical of Potential Ecological Concern.
MDC = Maximum detected concentration.

EPC = Exposure Point Concentration. The 95% upper confidence limit concentration was selected as the EPC unless it exceeded the maximum detected concentration, in which case the MDC was chosen as the EPC.
NEC = High No Effect Concentration
PEC = Probable Effect Concentration
SQB = Sediment Quality Benchmark
TEC = Threshold Effect Concentration
FDEP = Florida Department of Environmental Protection
ISQG = Interim Sediment Quality Guideline

(1) COPECs, detection frequencies, and maximum concentrations are from Table 5-5.
(2) Exposure Point Concentrations are 95% UCLs, from Table 5-10.
(3) NJDEP Ecological Screening Criteria, freshwater sediment benchmark based on the lowest available value; accessed at http://www.state.nj.us/dep/srp/guidance/ecoscreening.
(4) Values from Jones, D.S and Suter, G.W. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. ES/ER/TM-95/R4.
(5) The lowest of the Eq P-derived sediment quality benchmarks presented in Jones, D.S and Suter, G.W. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. ES/ER/TM-95/R4 is presented here (assumed TOC of 1%).
(6) Values from Canadian Council of Ministers of the Environment (CCME). 2003. Canadian Environmental Quality Guidelines. Summary Table Update 2003 (freshwater).
(7) Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, MacDonald et al., 2000. Concensus-based values used.

Table 6-16
Surface Water Direct Contact Assessment for Aquatic Life
Picatinny Arsenal Former Skeet Range

COPEC	MDC (1)	EPC (2)	New Jersey Surface Water Quality Standards [Freshwater] (3)		NAWQC (4)		Tier II Secondary Values (5)		Lowest Chronic Values (5)				Weight of Evidence Exceedance	
			Acute	Chronic	Acute	Chronic	Acute	Chronic	Fish	Daphnids	Non-Daphnids	Aquatic Plants	Using MDC	Using EPC
Antimony	7.34E-02	7.34E-02	NVA	NVA	NVA	NVA	1.80E-01	3.00E-02	1.60E+00	5.40E+00	NVA	6.10E-01	1 / 5	1 / 5
Arsenic	2.30E-02	2.30E-02	3.40E-01	1.50E-01	3.40E-01	1.50E-01	6.60E-02	3.10E-03	2.96E+00	9.14E-01	NVA	2.32E+00	1 / 9	1 / 9
Copper	2.21E-02	2.21E-02	1.27E-02	8.50E-03	NVA	NVA	NVA	NVA	3.80E-03	2.30E-04	6.07E-03	1.00E-03	6 / 6	6 / 6
Iron	8.34E+00	8.34E+00	NVA	NVA	NVA	1.00E+00	NVA	NVA	1.30E+00	1.58E-01	NVA	NVA	3 / 3	3 / 3
Lead	7.53E+00	7.53E+00	3.80E-02	5.40E-03	6.50E-02	2.50E-03	NVA	NVA	1.90E-02	1.20E-02	2.50E-02	5.00E-01	8 / 8	8 / 8
Zinc	6.63E-02	6.63E-02	1.14E-01	1.14E-01	1.20E-01	1.20E-01	NVA	NVA	3.64E-02	4.67E-02	5.24E+00	3.00E-02	3 / 8	3 / 8

All values presented in mg/L.

NVA = No Value Available

COPEC = Chemical of potential ecological concern

EPC = Exposure Point Concentration. The 95% UCL was selected as the EPC unless it exceeded the maximum detected concentration, in which case the MDC was chosen as the EPC (all EPCs are the MDCs, see Table 5-11)

MDC = Maximum detected concentration

NAWQC = National Ambient Water Quality Criteria

95% UCL = 95% upper confidence limit concentration

(1) COPECs, detection frequencies, and maximum concentrations are from Table 5-7.

(2) Exposure Point Concentrations are 95% UCLs, from Table 5-11.

(3) N.J.A.C. 7:9B (January 4, 2010) Surface Water Quality Standards, A hardness of 100 mg/L is assumed for hardness-dependent criteria.

(4) Values from USEPA (2009) - 4304T. National Recommended Water Quality Criteria.

(5) Values from Suter, G.W., and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision, ES/ER/TM-96/R2.

Table 6-17
Comparison of Former Skeet Range Hazard Driver COPECs to Background Concentrations

Media	COPEC Hazard Drivers That May Be Considered Potentially Background Related											
	BkF	**BbF**	**Fluor.**	**Pyrene**	**IcdP**	**Chrysene**	**As**	**Sb**	**Pb**	**Zn**	**Cu**	**Fe**
	Maximum Detected Concentrations (mg/kg or mg/L) for Former Skeet Range											
Surface Soil (SS)	**12.2**	**27.1**	38.4	9.3	**16.5**	**26.2**	--	--	**84700**	--	--	--
BG Threshold Value (SS)	0.06	0.19	NA	NA	0.08	0.14	--	--	74.6	--	--	--
Sediment (SED)	--	--	--	--	--	--	**851**	**6250**	**186000**	**629**	**514**	--
BG Threshold Value (SED)	--	--	--	--	--	--	16	0.354	38.8	171	27.2	--
Surface Water (SW)	--	--	--	--	--	--	--	--	**7.53**	--	**0.022**	**8.34**
BG Threshold Value (SW)	--	--	--	--	--	--	--	--	0.00236	--	ND	1.79

Footnotes

Site-specific background threshold values (BTVs) for soil, surface water and sediment, for metals, from IT Corporation (2002).
BTV = Lower of (1) maximum and (2) mean plus 3 standard deviations.
For PAHs, background values (95th percentiles) from NJDEP (2002, 2003); Highlands Physiological Province.
Site concentrations in bold font exceed BTVs.
ND= not detected. NA = not available.
-- = not a hazard driver at the Site for specific media.

Benzo(b)fluoranthene (BbF), benzo(k)fluoranthene (BkF), fluoranthene (Fluor), and indeno(123cd)-pyrene (IcdP).
Arsenic (As), Antimony (Sb), Lead (Pb), Copper (Cu), Zinc (Zn), and Iron (Fe).

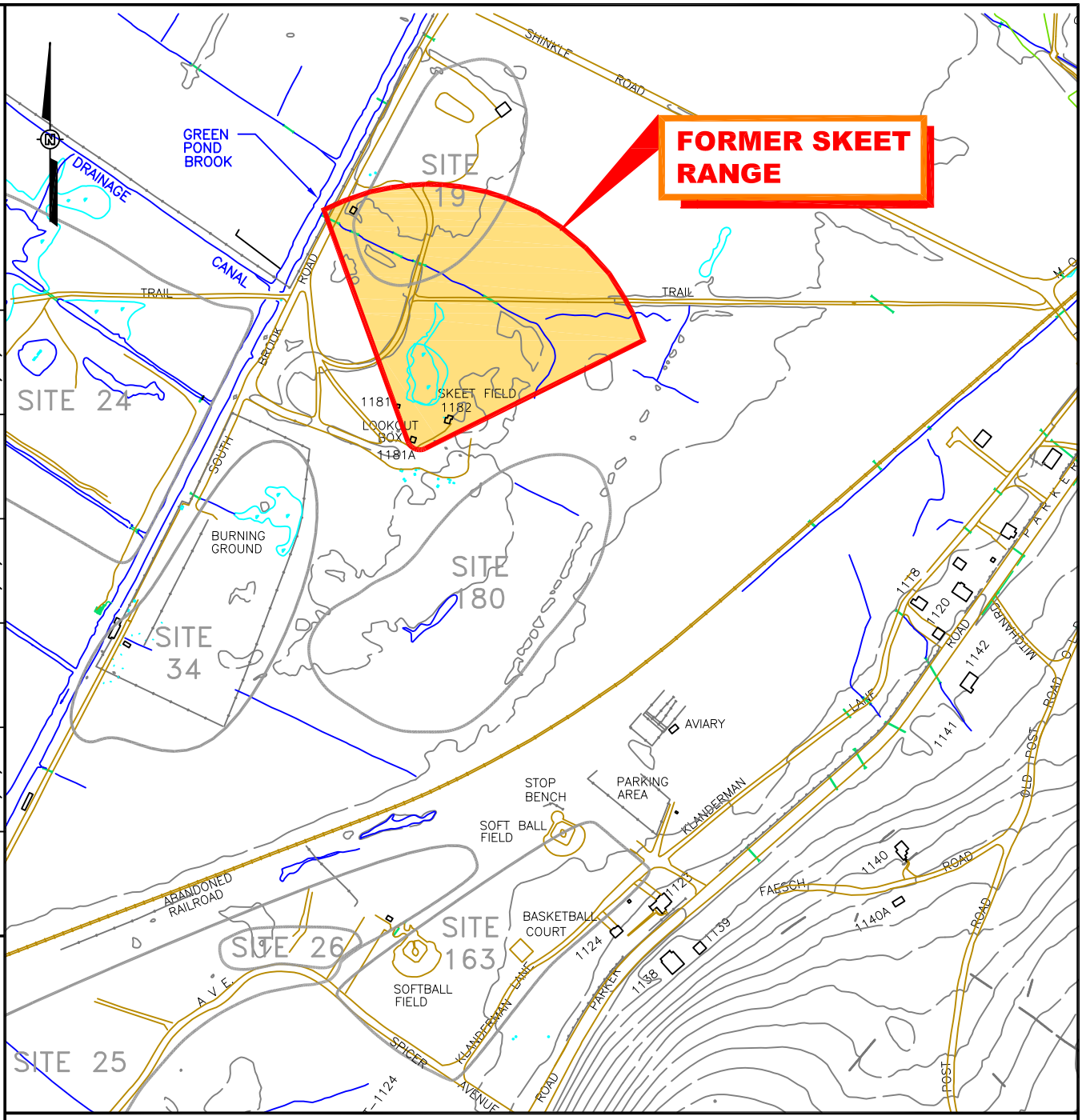
Table 6-18
Uncertainty Analysis

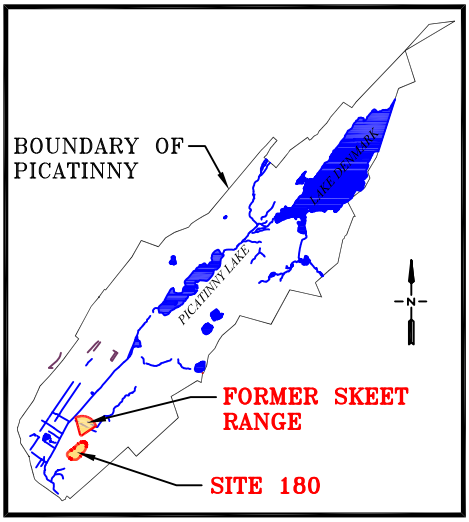
Picatinny Arsenal Former Skeet Range

Component	Bias	Magnitude	Ways to Minimize Uncertainty	Additional Comments
Use of 95% UCL as source-term concentration	Overestimates Risk	Medium	Use central tendency	Easy to implement, but may not be acceptable to Agency.
Use of subsurface sediment samples	Underestimates or Overestimates Risk	Low to Medium	Quantify surface and subsurface HQs separately	Could be implemented, but unlikely to change conclusions.
Using only chemical concentrations for COPECs that were detected at least once in a medium	Underestimates Risk	Low	Evaluate non-detected constituents risk based on detection limit	Easy to implement, but unlikely to change conclusions.
Use of representative receptor species for site ecological community	Underestimates Risk	Low	Select additional receptor species	Six representative species already used, additional species unlikely to change conclusions.
Use of conservative foraging factors (i.e., 100%) for some species	Overestimates Risk	Medium	Use more site-specific foraging factors, i.e., less than 100%	May be difficult to obtain site-specific foraging factors.
Assumption that COPECs are 100% bioavailable	Overestimates Risk	Medium to High	Obtain medium- and COPEC-specific bioavailability factors	Would be difficult and costly to obtain these bioavailability factors.
Discounting of dermal and inhalation exposure routes	Underestimates Risk	Low	Include dermal and inhalation routes of exposure	Would be difficult to quantify these routes of exposure.
Use of partitioning and transfer factors to estimate COPEC concentrations in plants, invertebrates, and prey items.	Overestimates Risk	Medium to High	Measure COPEC concentrations in site plants, invertebrates, and/or other prey species	Would be costly to implement, but could significantly reduce EEQs.
Use of surrogate constituents to estimate toxicity for those COPECs without available toxicity data	Overestimates Risk	Low to Medium	Obtain COPEC-specific toxicity data	Would be very costly to obtain COPEC-specific toxicity data, unless available in the literature.
Use of hazard quotient method to estimate risks to populations or communities may be biased	Overestimates Risk	High	Perform population or community studies	Would be very costly to perform.

FIGURES

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 01/05/10	G. Maresca 01/05/10	G. Maresca 01/05/10	A34010510.dwg





LEGEND

- BLDG. NO. — BUILDING
- BLDG. NO. — FORMER BUILDING
- COVERED WALKWAY
- SWAMPY AREA
- WATER
- RAILROAD
- FENCE
- TR-732 — TRANSFORMER
- BLAST WALL
- ===STS=== OR ---STS--- — STORM SEWER
- ===SS=== OR ---SS--- — SANITARY SEWER
- EARTH MOUND
- CONTOUR LINE

SCALE

0 400 800 FEET

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-1

FORMER SKEET RANGE LOCATION MAP

FORMER SKEET RANGE REMEDIAL INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

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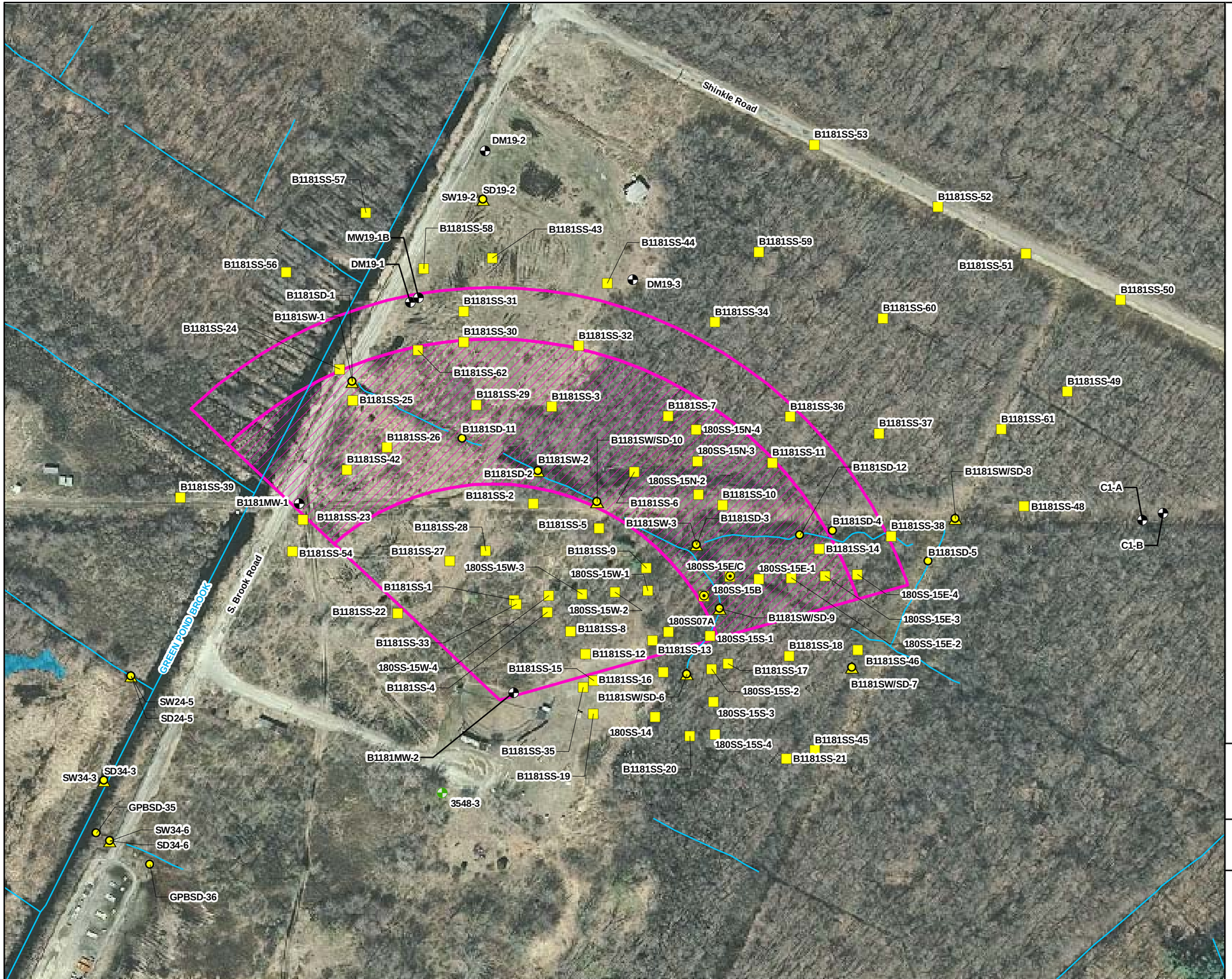
Plotted By: stephen.Wiafe



LEGEND

- Monitoring Well Location
- Abandoned Monitoring Well Location
- Sediment Sample Location
- Surface Soil Sample Location
- Surface and Subsurface Soil Sample Location
- Surface Water Sample Location
- Surface Water/Sediment Sample Location
- Water Feature
- Water Body
- Maximum Shot Fall Zone
- Former Skeet Range Impact Fan

Notes:
1) Aerial photography (1-foot resolution), dated 2007-2008, was obtained from New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).

N

0 75 150 300 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw® Shaw Environmental, Inc.

FIGURE 1-2
SAMPLE LOCATIONS

FORMER SKEET RANGE
REMEDIAL INVESTIGATION REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

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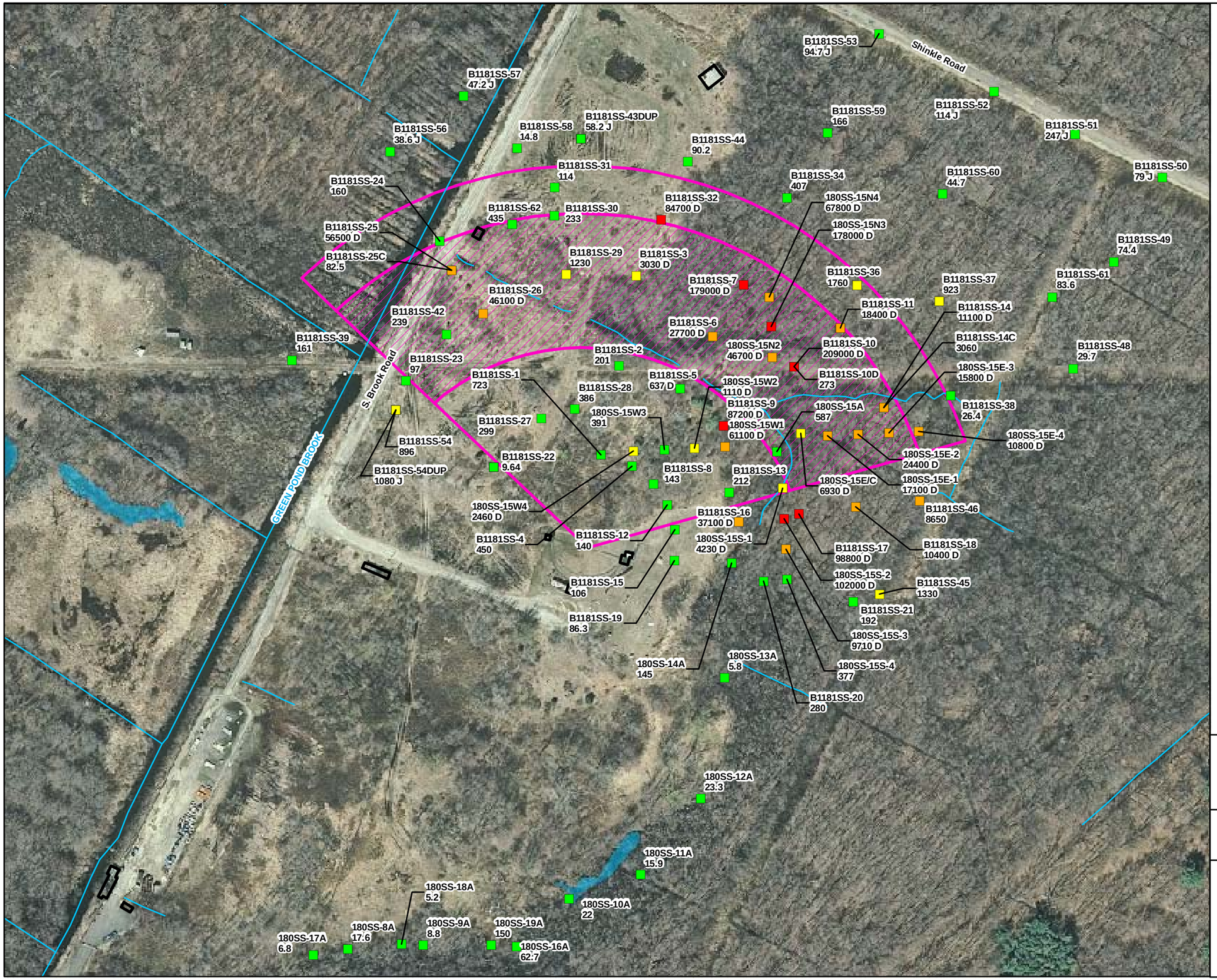

LEGEND

Lead Detects in Surface Soil (2005-2011)

- < 800 mg/kg
- 800 - 8,000 mg/kg
- 8,000 - 80,000 mg/kg
- > 80,000 mg/kg
- Water Feature
- Water Body
- Building
- Maximum Shot Fall Zone
- Former Skeet Range Impact Fan

Notes:
1) Aerial photography (1-foot resolution), dated 2007-2008, was obtained from New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).
2) D = Laboratory concentrations qualified at a secondary dilution.

N

0 80 160 320 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

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FIGURE 1-3
LEAD CONCENTRATIONS IN SOIL (2005-2011)

FORMER SKEET RANGE
REMEDIAL INVESTIGATION REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

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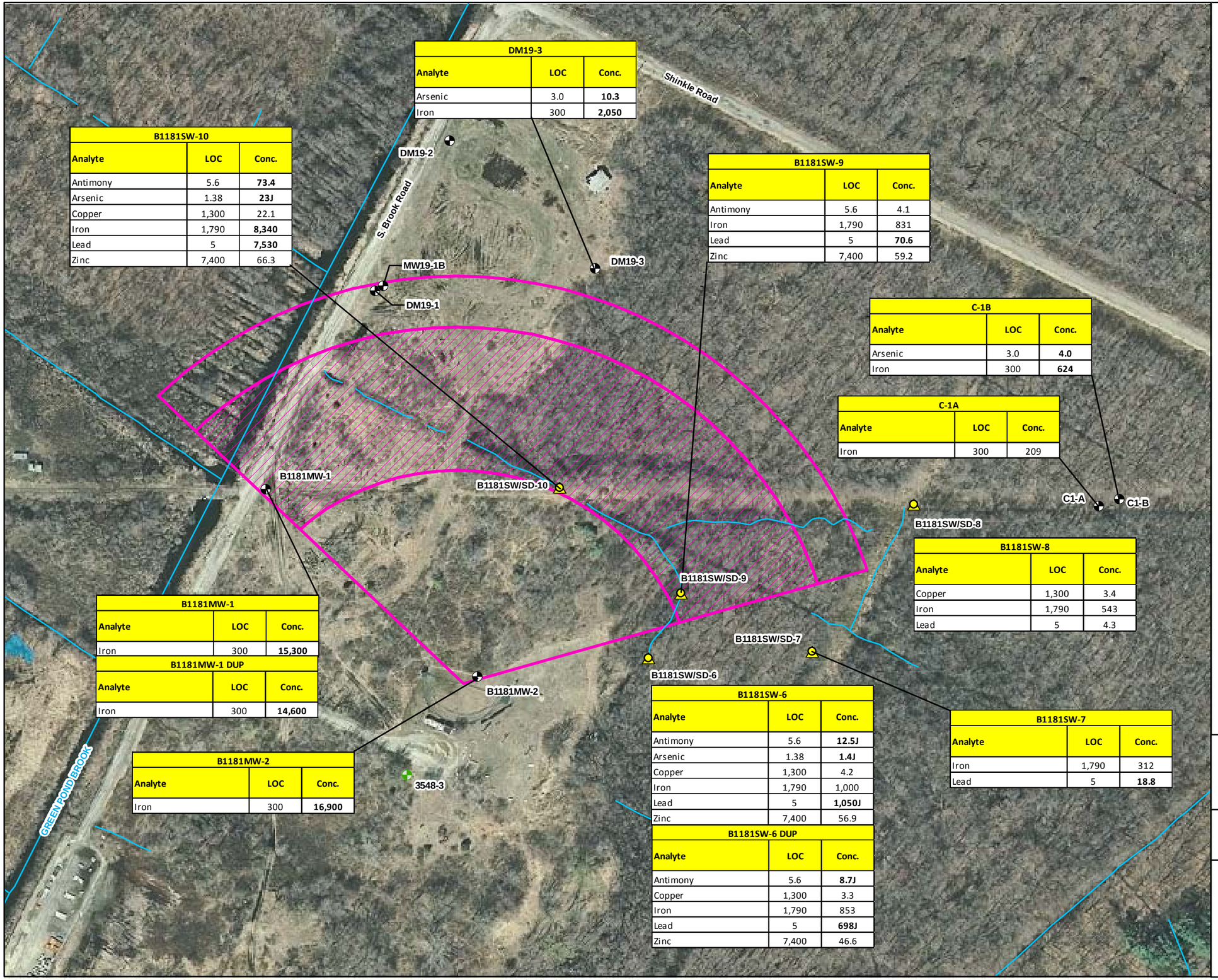


DM19-3		
Analyte	LOC	Conc.
Arsenic	3.0	**10.3**
Iron	300	**2,050**

B1181SW-10		
Analyte	LOC	Conc.
Antimony	5.6	**73.4**
Arsenic	1.38	**23J**
Copper	1,300	22.1
Iron	1,790	**8,340**
Lead	5	**7,530**
Zinc	7,400	66.3

B1181SW-9		
Analyte	LOC	Conc.
Antimony	5.6	4.1
Iron	1,790	831
Lead	5	**70.6**
Zinc	7,400	59.2

C-1B		
Analyte	LOC	Conc.
Arsenic	3.0	**4.0**
Iron	300	**624**

C-1A		
Analyte	LOC	Conc.
Iron	300	209

B1181SW-8		
Analyte	LOC	Conc.
Copper	1,300	3.4
Iron	1,790	543
Lead	5	4.3

B1181MW-1		
Analyte	LOC	Conc.
Iron	300	**15,300**

B1181MW-1 DUP		
Analyte	LOC	Conc.
Iron	300	**14,600**

B1181MW-2		
Analyte	LOC	Conc.
Iron	300	**16,900**

B1181SW-6		
Analyte	LOC	Conc.
Antimony	5.6	**12.5J**
Arsenic	1.38	**1.4J**
Copper	1,300	4.2
Iron	1,790	1,000
Lead	5	**1,050J**
Zinc	7,400	56.9

B1181SW-6 DUP		
Analyte	LOC	Conc.
Antimony	5.6	**8.7J**
Copper	1,300	3.3
Iron	1,790	853
Lead	5	**698J**
Zinc	7,400	46.6

B1181SW-7		
Analyte	LOC	Conc.
Iron	1,790	312
Lead	5	**18.8**

LEGEND

- Monitoring Well Location
- Abandoned Monitoring Well Location
- Surface Water/Sediment Sample Location
- Water Feature
- Water Body
- Maximum Shot Fall Zone
- Former Skeet Range Impact Fan

Notes:
1) Aerial photography (1-foot resolution), dated 2007-2008, was obtained from New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).
2) LOC = Level of Concern
3) Conc. = Concentration in micrograms per liter.
4) Bolded concentrations exceed the LOC.
5) Only analytes detected above the MDL are reported.

N

0 75 150 300 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw® Shaw Environmental, Inc.

FIGURE 3-1
METALS AND PAHs DETECTED IN GROUNDWATER AND SURFACE WATER (2011)

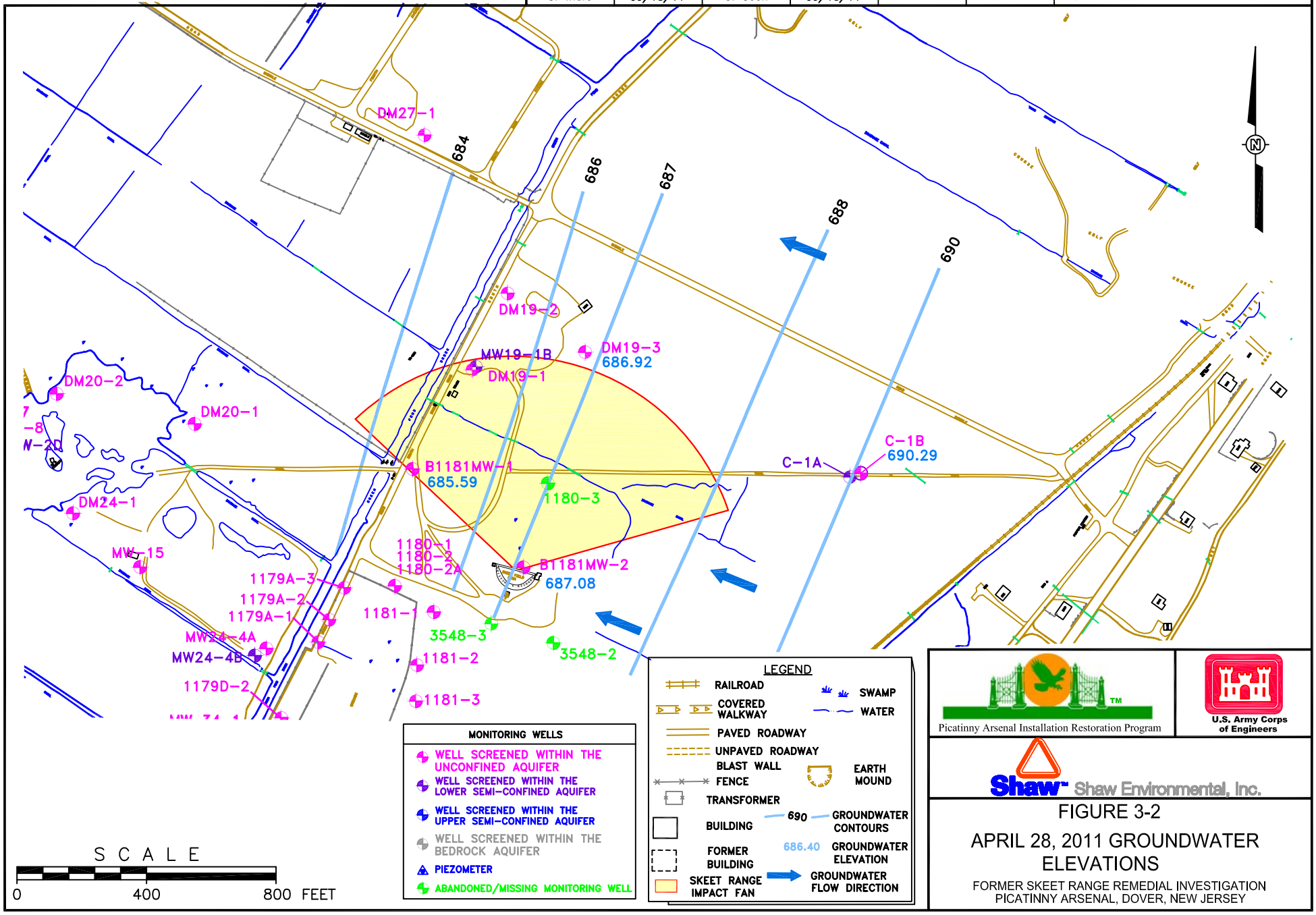
FORMER SKEET RANGE
REMEDIAL INVESTIGATION REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

N:\GIS\Picatinny\GIS_Documents\Project_Maps\PTA_028_Fig3-1_2011_GW_SW_Metal_PAH_FSR_RI.mxd (11/29/2011 1:07:43 PM)

File: N:\cad\CAD drawings\Picatinny\Area-C\site180\Proposed plan\SKTR091511.dwg
Plot Date/Time: Nov 29, 2011 - 10:54am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	SKTR091511.dwg
S. Wiafe	09/15/11	C. Cook	09/15/11	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

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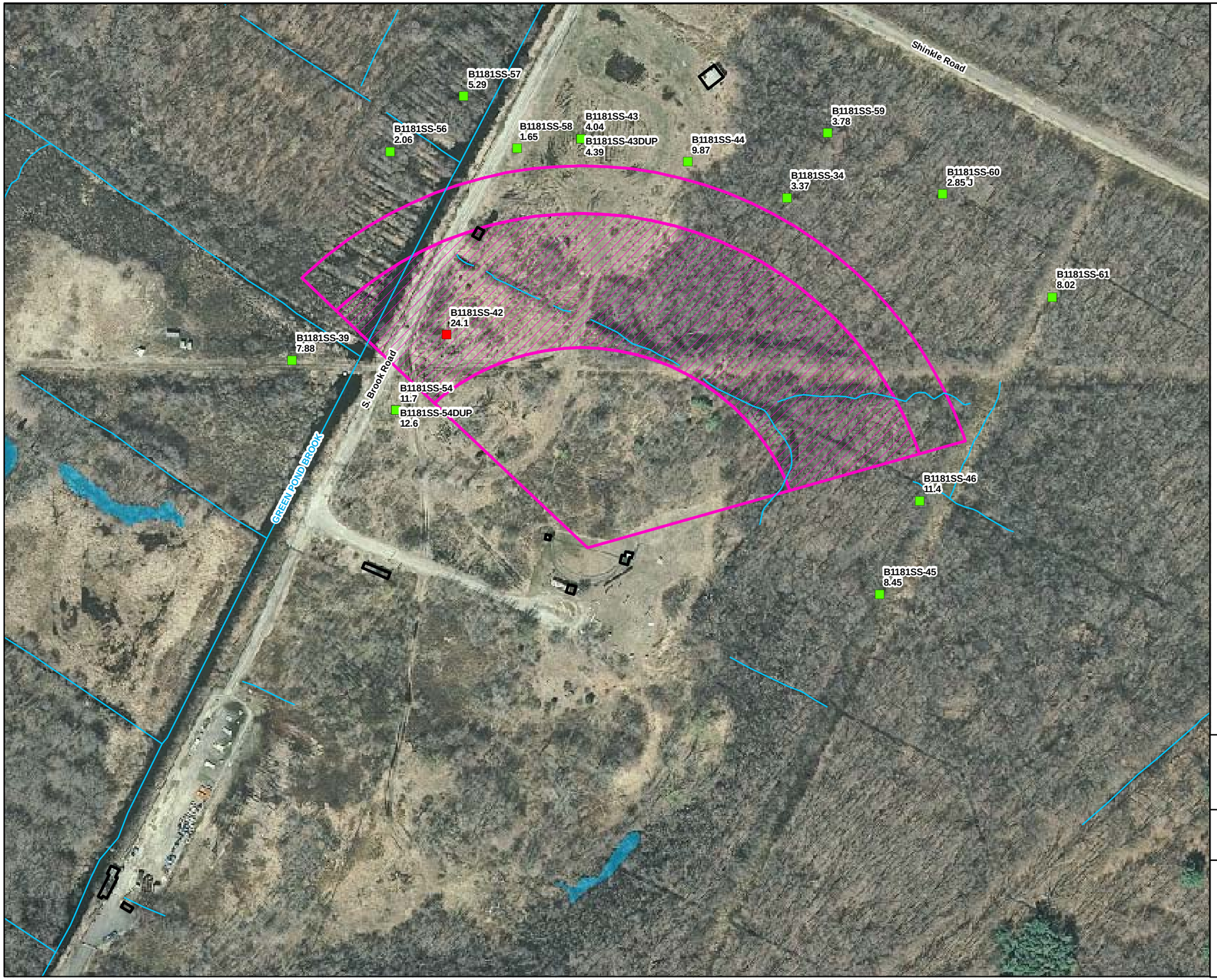
FIGURE 3-2

APRIL 28, 2011 GROUNDWATER ELEVATIONS

FORMER SKEET RANGE REMEDIAL INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY



LEGEND

Arsenic Detects in Surface Soil (2011)

- < 19 mg/kg
- > 19 mg/kg
- Water Feature
- Water Body
- Building
- Maximum Shot Fall Zone
- Former Skeet Range Impact Fan

Notes:
1) Aerial photography (1-foot resolution), dated 2007-2008, was obtained from New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).

N

0 80 160 320 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

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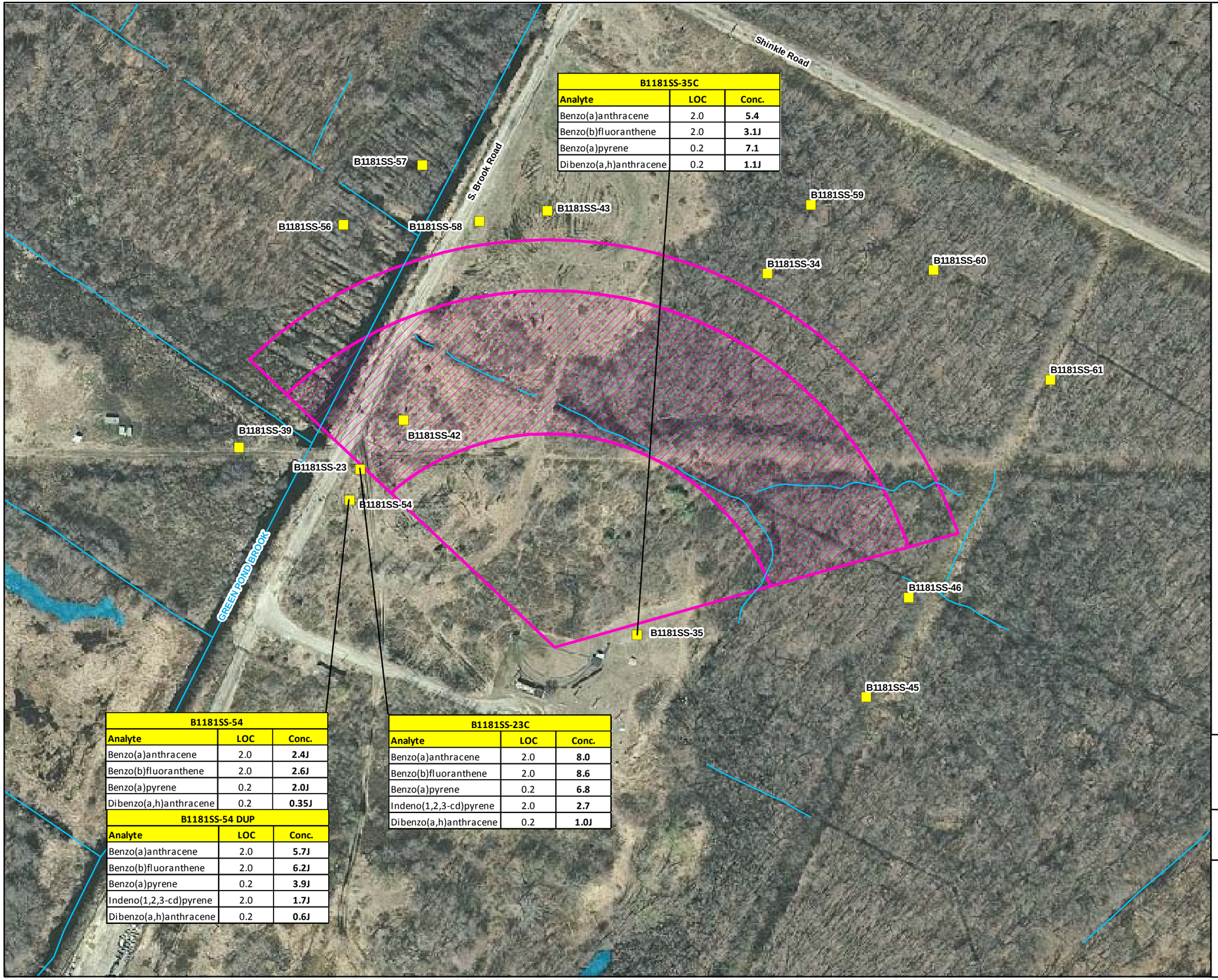
FIGURE 3-3
ARSENIC CONCENTRATIONS IN SURFACE SOIL

FORMER SKEET RANGE
REMEDIAL INVESTIGATION REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

N:\GIS\Picatinny\GIS_Documents\Project_Maps\PTA_032_Fig3-3_2011_SS_Arsenic_FSR_RI.mxd (11/29/2011 1:23:12 PM)



B1181SS-35C		
Analyte	LOC	Conc.
Benzo(a)anthracene	2.0	**5.4**
Benzo(b)fluoranthene	2.0	**3.1J**
Benzo(a)pyrene	0.2	**7.1**
Dibenzo(a,h)anthracene	0.2	**1.1J**

B1181SS-54		
Analyte	LOC	Conc.
Benzo(a)anthracene	2.0	**2.4J**
Benzo(b)fluoranthene	2.0	**2.6J**
Benzo(a)pyrene	0.2	**2.0J**
Dibenzo(a,h)anthracene	0.2	**0.35J**

B1181SS-54 DUP		
Analyte	LOC	Conc.
Benzo(a)anthracene	2.0	**5.7J**
Benzo(b)fluoranthene	2.0	**6.2J**
Benzo(a)pyrene	0.2	**3.9J**
Indeno(1,2,3-cd)pyrene	2.0	**1.7J**
Dibenzo(a,h)anthracene	0.2	**0.6J**

B1181SS-23C		
Analyte	LOC	Conc.
Benzo(a)anthracene	2.0	**8.0**
Benzo(b)fluoranthene	2.0	**8.6**
Benzo(a)pyrene	0.2	**6.8**
Indeno(1,2,3-cd)pyrene	2.0	**2.7**
Dibenzo(a,h)anthracene	0.2	**1.0J**

LEGEND

- Surface Soil Sample Location
- Water Feature
- Water Body
- Maximum Shot Fall Zone
- Former Skeet Range Impact Fan

Notes:
1) Aerial photography (1-foot resolution), dated 2007-2008, was obtained from New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).
2) Conc. = Concentration in milligrams per kilogram.
3) LOC = Level of Concern.
3) Only analytes detected above the LOC are reported.

N

0 75 150 300 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw Environmental, Inc.

FIGURE 3-4
PAH EXCEEDANCES IN SOIL (2011)

FORMER SKEET RANGE
REMEDIAL INVESTIGATION REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

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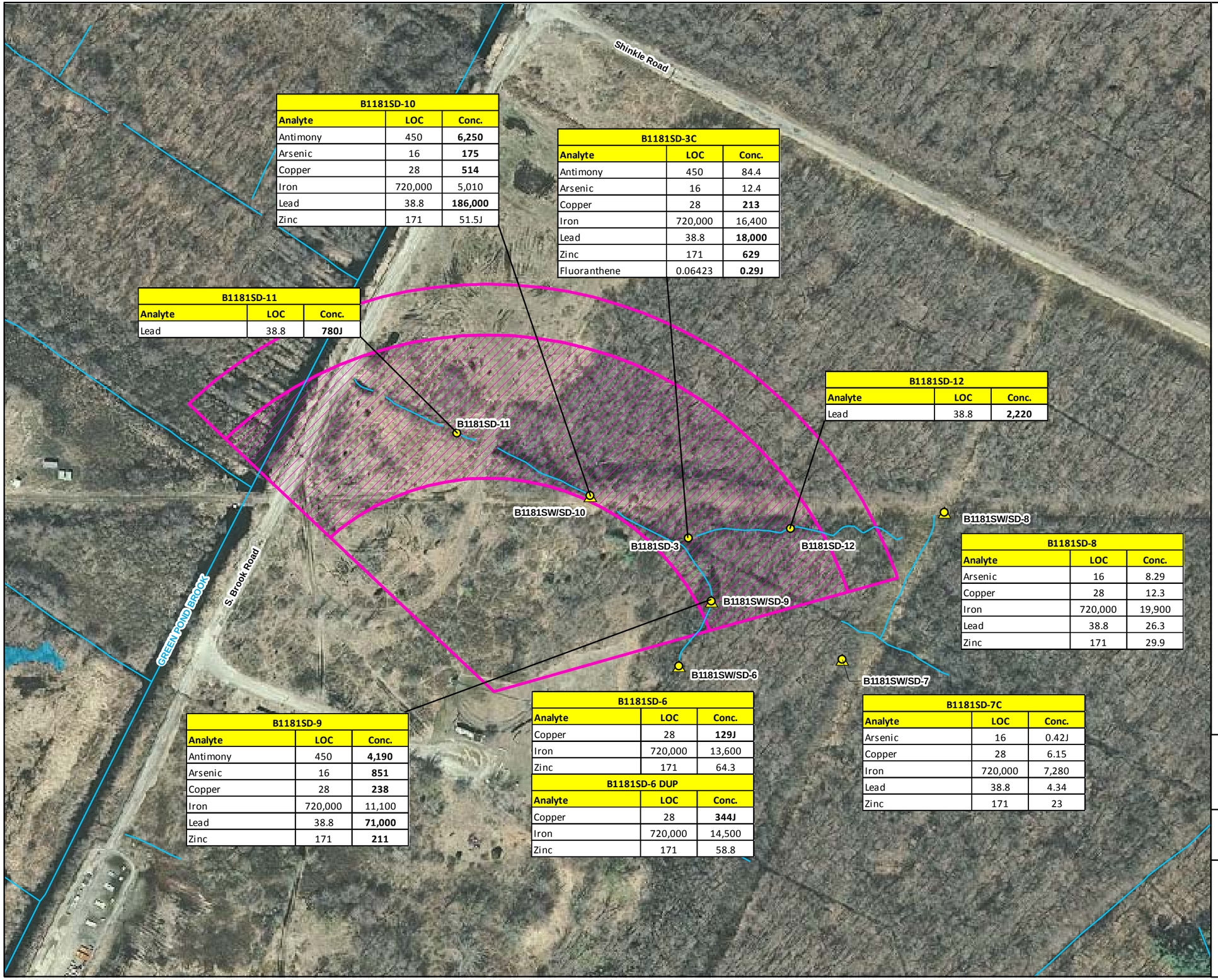

B1181SD-10		
Analyte	LOC	Conc.
Antimony	450	**6,250**
Arsenic	16	**175**
Copper	28	**514**
Iron	720,000	5,010
Lead	38.8	**186,000**
Zinc	171	51.5J

B1181SD-3C		
Analyte	LOC	Conc.
Antimony	450	84.4
Arsenic	16	12.4
Copper	28	**213**
Iron	720,000	16,400
Lead	38.8	**18,000**
Zinc	171	**629**
Fluoranthene	0.06423	**0.29J**

B1181SD-11		
Analyte	LOC	Conc.
Lead	38.8	**780J**

B1181SD-12		
Analyte	LOC	Conc.
Lead	38.8	**2,220**

B1181SD-8		
Analyte	LOC	Conc.
Arsenic	16	8.29
Copper	28	12.3
Iron	720,000	19,900
Lead	38.8	26.3
Zinc	171	29.9

B1181SD-9		
Analyte	LOC	Conc.
Antimony	450	**4,190**
Arsenic	16	**851**
Copper	28	**238**
Iron	720,000	11,100
Lead	38.8	**71,000**
Zinc	171	**211**

B1181SD-6		
Analyte	LOC	Conc.
Copper	28	**129J**
Iron	720,000	13,600
Zinc	171	64.3

B1181SD-6 DUP		
Analyte	LOC	Conc.
Copper	28	**344J**
Iron	720,000	14,500
Zinc	171	58.8

B1181SD-7C		
Analyte	LOC	Conc.
Arsenic	16	0.42J
Copper	28	6.15
Iron	720,000	7,280
Lead	38.8	4.34
Zinc	171	23

LEGEND

- Sediment Sample Location
- Surface Water/Sediment Sample Location
- Water Feature
- Water Body
- Maximum Shot Fall Zone
- Former Skeet Range Impact Fan

Notes:
1) Aerial photography (1-foot resolution), dated 2007-2008, was obtained from New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).
2) Conc. = Concentration in milligrams per kilogram.
3) Only analytes detected above the MDL are reported.
4) LOC = Level of Concern.

N

0 75 150 300 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw® Shaw Environmental, Inc.

FIGURE 3-5
METALS AND PAHs DETECTED IN SEDIMENT (2011)

FORMER SKEET RANGE
REMEDIAL INVESTIGATION REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

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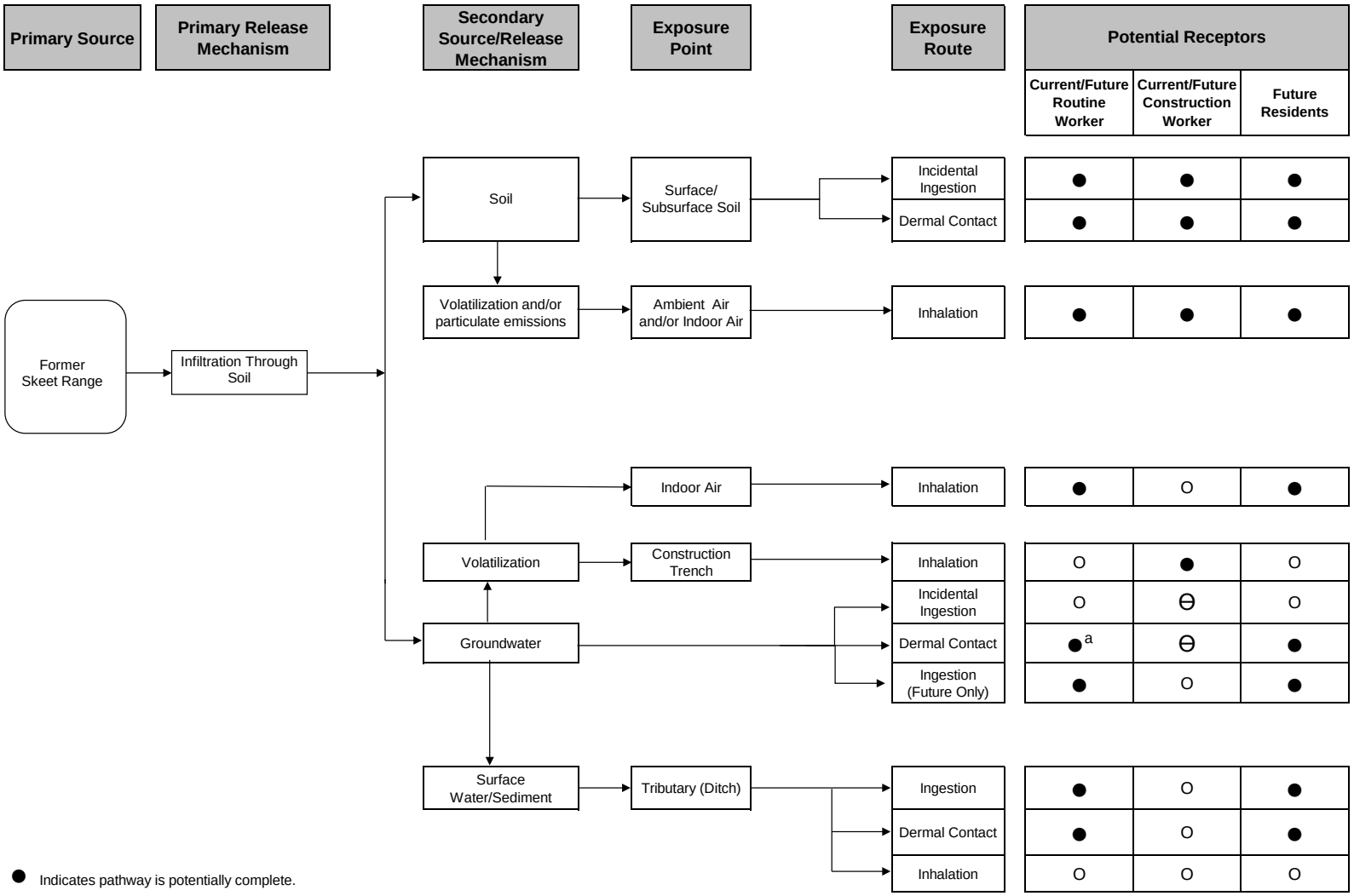
FIGURE 5-1
HUMAN HEALTH CONCEPTUAL SITE MODEL
Picatinny Arsenal Former Skeet Range



● Indicates pathway is potentially complete.

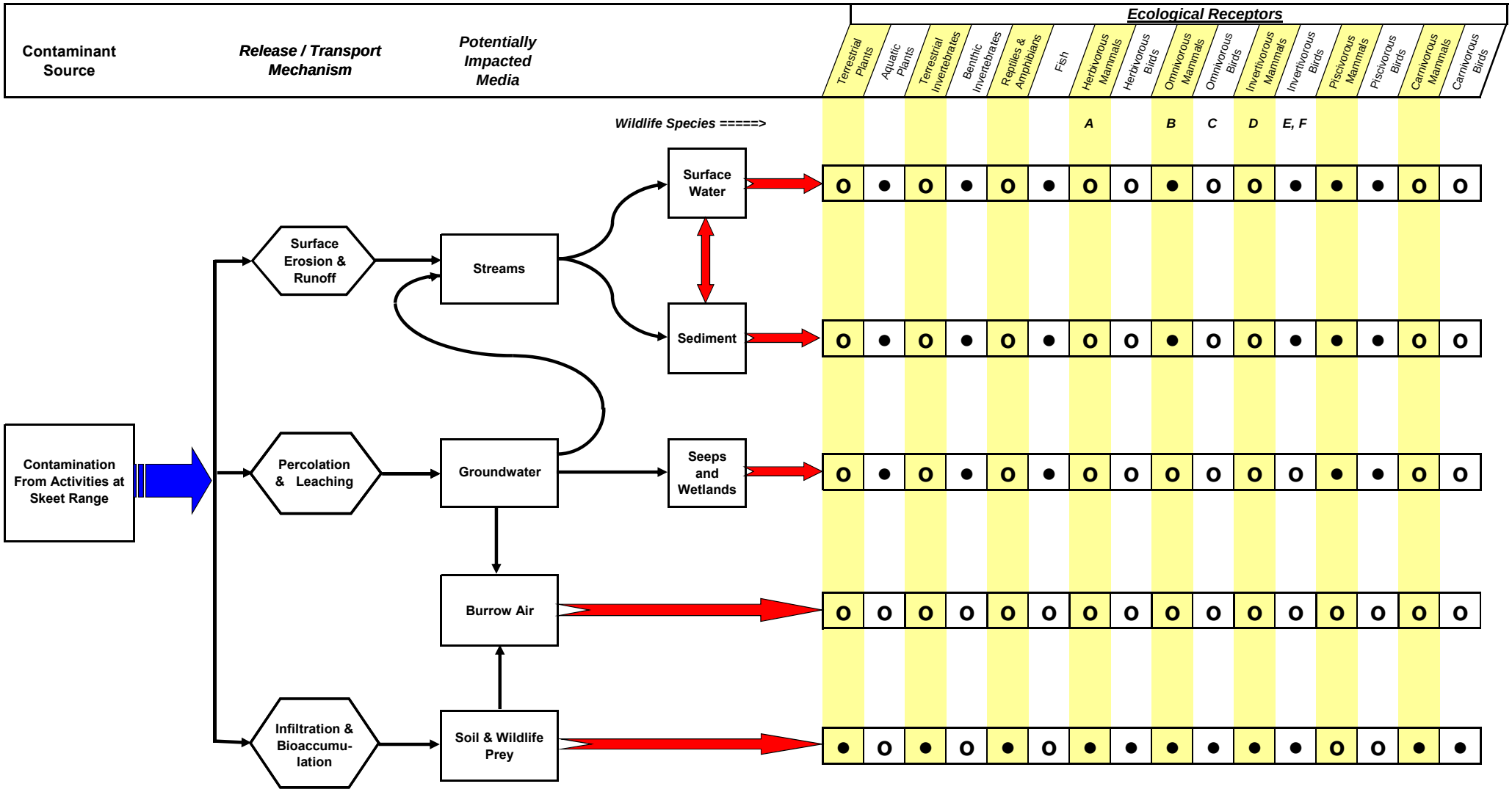
O Indicates pathway is incomplete.

Θ Indicates pathway is insignificant.

[a] Future Only.

Note: Ambient air exposures from suspension of dust or offgassing from soil, while indoor air exposures from vapor intrusion or offgassing from household or office use of groundwater.

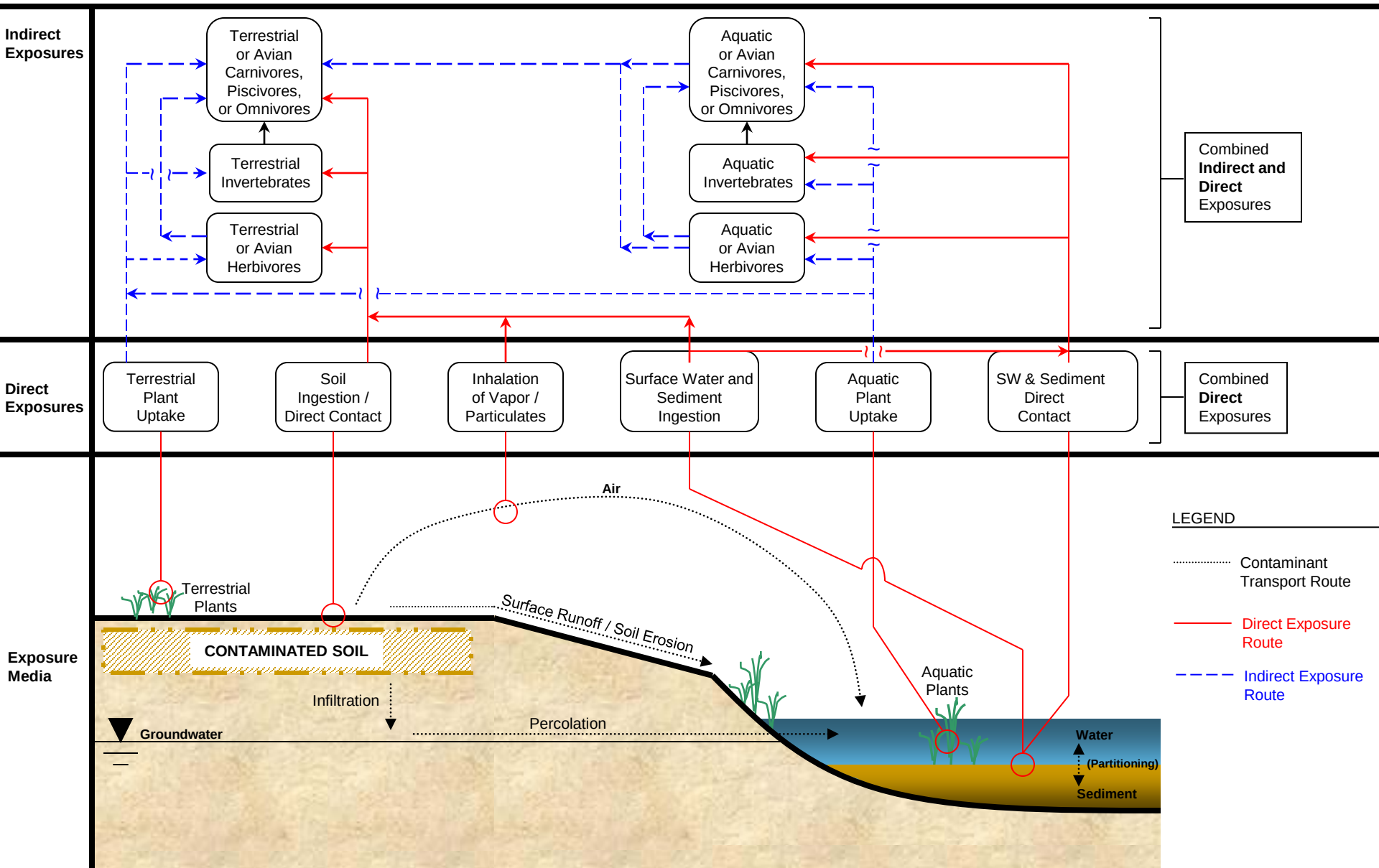
Figure 6-1
SLERA Conceptual Site Model
Skeet Range, Picatinny Arsenal



Key To Potential Exposure Routes

- ● - Potentially complete exposure pathway
- O - Incomplete exposure pathway
- ⊖ - Potentially complete exposure pathway but insignificant

Figure 6-2
Food Web
Former Skeet Range



APPENDIX A

ANALYTICAL DATA AND QA/QC EVALUATION RESULTS

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Edgewood, Maryland
410-612-6350
FAX: 410-612-6351

Shaw® Shaw Environmental, Inc.

MEMORANDUM

TO: Gerard Maresca, Shaw E&I Picatinny Arsenal (PTA) Project Manager

FROM: Eric Malarek, Shaw E&I PTA Project Chemist

SUBJECT: PTA Data Validation – Metals
Chemtech C1594

DATE: June 20, 2011

The purpose of this memorandum is to present the data validation report for the samples collected for the Skeet Range samples collected at the PTA Site on March 16, 2011, March 19, 2011, and March 21, 2011. Samples B1181SS-25C, B1181SS-62, B1181SS-53, B1181SS-52, B1181SS-51, B1181SS-50, and B1181SD-11 were analyzed for lead only. The remaining samples were analyzed for antimony, arsenic, copper, iron, lead, and zinc. The solid samples were analyzed for select metals using USEPA SW-846 3050B/6010B. The aqueous rinse blank samples were analyzed for select metals using USEPA SW-846 3010A/6010B. The aqueous surface water rinse blank samples were analyzed for select metals using USEPA SW-846 3010A/6020. A total of seventeen solid samples and four rinse blank samples were validated. The sample Ids are:

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
SS031611R1	C1594-01	B1181SS-53	C1594-17
SD031611R1	C1594-02	B1181SS-52	C1594-18
SW031611R1	C1594-03	B1181SS-51	C1594-19
B1181SS-39	C1594-04	B1181SS-50	C1594-20
B1181SS-42	C1594-06	B1181SD-11	C1594-21
B1181SS-25C	C1594-07	B1181SS-56	C1594-23
B1181SS-54	C1594-08	B1181SS-57	C1594-24
B1181SS-62	C1594-11	B1181SS-43DUP	C1594-25
B1181SS-58	C1594-12	B1181SS-54DUP	C1594-26
B1181SS-43	C1594-13	SS031911R1	C1594-27
B1181SS-44	C1594-16		

Data were reviewed and validated using a combination of project QAPP, *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2, October 2010* (DoD, 2010) (DoD QSM), and method-specific criteria. The data qualifier scheme was consistent with the *USEPA Region II Evaluation of Metals Data for the Contract Laboratory Program, Revision 13* (SOP HW-2, September 2006). Parameters evaluated are presented in **Table 1**. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA specifications.

Table 1 Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times and Preservation
	X	Initial and Continuing Calibration
	X	Blank Analysis
	X	ICP and ICPMS Interference Check Sample (ICS)
	X	Laboratory Control Sample (LCS)
X		Laboratory Duplicate
X		Matrix Spike (MS) and Spike Duplicate (MSD)
X		Field Duplicate
X		ICP and ICPMS Serial Dilution
X		Quantitation Verification and Data Review

The quality of data collected in support of this sampling activity is considered acceptable with noted qualifications.

Eric Malarek, Chemist

6/20/11
Date

PTA VALIDATION REPORT
METALS REVIEW
SDG C1595

I-Holding Times and Preservation

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample analysis. For ICP and ICPMS metals analysis, aqueous samples are received and stored at cool @4°C±2°C and preserved to pH<2 with nitric acid with a maximum holding time of 180 days from collection (USEPA criteria). For ICP and ICPMS metals analysis, solid samples are received and stored at cool @4°C±2°C with a maximum holding time of 180 days from collection (USEPA criteria).

- Temperature Review: The temperature blank was sent with each cooler and recorded by the laboratory upon receipt. For samples collected on 03/16/11, 03/19/11, and 03/21/11, the coolers were received by the laboratory (Chemtech) on 03/21/11 at 5°C, 5°C, and 5°C. All criteria were met. No qualifiers were applied.

- Holding Time Review: The solid and aqueous samples were collected on 03/16/11, 03/19/11, and 03/21/11 for select metals analysis. The soil samples were digested on 03/22/11 and analyzed on 03/23/11. The aqueous samples were digested on 03/22/11 and analyzed on 03/30/11 for ICPMS analysis. The analysis dates for each sample may be found on the attached form 1s. All criteria were met. No qualifiers were applied.

II-Initial and Continuing Calibration

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP and ICPMS:	1- blank (DoD QSM <LOD)
	3 – standards ($r \geq 0.995$)
	ICV/CCV (90-110%) (DoD QSM 90-110%)
	MRL (70-130%) (DoD QSM 80-120%)

- The aqueous samples were analyzed for ICPMS metals on 03/30/11. The soil samples were analyzed on 03/23/11 for ICP metals. All ICP and ICPMS metals were calibrated using 5 point calibrations with correlation coefficients >0.995. All ICV/CCV/MRL criteria were met for all metals and runs.

III-Blanks

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. One method blank per analytical batch must be run on each instrument used to analyze samples. Calibration blanks were analyzed initially and at a 10% frequency thereafter for each batch. No contaminants should be detected in any of the associated blanks >MDL. The DoD QSM criteria specifies all concentrations should be less than ½MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters) and <LOD (i.e. <2MDL) for the calibration blanks. Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters, or 5 times (5X) the maximum amount for other target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one and for solid matrices were converted to soil values from µg/L to mg/kg for ICP and ICPMS (soil conversion factor = 10), if needed. Rinse blank samples SS031611R1 (C1594-01) and SS031911R1 (C1594-27) apply to all surface soil "SS" samples collected in this SDG. Rinse blank sample SD031611R1 (C1594-02) applies to all sediment "SD" samples and rinse blank SW031611R1 (C1594-03) applies to all surface water "SW" samples.

III-Blanks

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. One method blank per analytical batch must be run on each instrument used to analyze samples. Calibration blanks were analyzed initially and at a 10% frequency thereafter for each batch. No contaminants should be detected in any of the associated blanks >MDL. The DoD QSM criteria specifies all concentrations should be less than ½MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters) and <LOD (i.e. <2MDL) for the calibration blanks. Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters, or 5 times (5X) the maximum amount for other target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one and for solid matrices were converted to soil values from µg/L to mg/kg for ICP and ICPMS (soil conversion factor = 10), if needed. Rinse blank samples SS031611R1 (C1594-01) and SS031911R1 (C1594-27) apply to all surface soil "SS" samples collected in this SDG. Rinse blank sample SD031611R1 (C1594-02) applies to all sediment "SD" samples and rinse blank SW031611R1 (C1594-03) applies to all surface water "SW" samples. The sediment and surface water samples may be found in SDG C1595.

Table 2 Blank Contamination Analysis Summary

Analysis Date	Analysis	QC Blank ID	Max Conc. µg/L	Action Level µg/L	U qualified samples (for this SDG)
03/23/11	ICP	ICB/CCBs	<LOD	NA	None
03/30/11	ICPMS-Sb	ICB/CCBs	0.494J	2.47	None
03/30/11	ICPMS-As	ICB/CCBs	0.233J	1.17	None
03/30/11	ICPMS-Cu	ICB/CCBs	0.204J	1.02	None
03/30/11	ICPMS-Fe	ICB/CCBs	14.33J	71.7	None
03/30/11	ICPMS-Pb	ICB/CCBs	0.163J	0.815	None
03/23/11	ICP	PB54266BL	<½MRL	NA	None
03/30/11	ICPMS	PB54268BL	<½MRL	NA	None
03/30/11	ICPMS-Cu	SW031611R1	0.65J	3.25	None
03/30/11	ICPMS-Pb	SW031611R1	0.42J	2.10	None
03/30/11	ICPMS-Zn	SW031611R1	7.8	39.0	None
Analysis Date	**Analysis**	**QC Blank ID**	**Max Conc. mg/kg**	**Action Level mg/kg**	**U qualified samples (for this SDG)**
03/23/11	ICP	ICB/CCBs	<LOD	NA	None
03/23/11	ICP	PB54260BL	<½MRL	NA	None
03/23/11	ICP	PB54264BL	<½MRL	NA	None
03/23/11	ICP	SS031611R1	<½MRL	NA	None
03/23/11	ICP	SS031911R1	<½MRL	NA	None
03/23/11	ICP-Zn	SD031611R1	0.977J	4.89	None

J = Estimated value <MRL and >MDL.
LOD = Limit of Detection
MRL = Method Reporting Limit
MDL = Method Detection Limit
NA = Not Applicable
SDG= Sample Delivery Group

IV-ICP and ICPMS Interference Check Sample (ICS)

The ICP and ICPMS interference check sample (ICS) verifies inter-element and background correction factors. ICP and ICPMS Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120% (DoD QSM limits 80-120%).

- All criteria were met for all runs. No qualifiers were applied.

V-Laboratory Control Samples (LCS)
The laboratory control sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. The DoD QSM aqueous LCS criteria are specified in Table G-18 of the DoD QSM (DoD, 2010) and are 80-120% and RPD≤20% for ICP and ICPMS metals. The DoD QSM solid LCS criteria are specified in Table G-19 of the DoD QSM (DoD, 2010) and are 80-120% (75-120% for silver) and RPD≤20% for ICP and ICPMS metals.

- Sample PB54260BS was used as solid LCS for ICP metals analysis dated 03/23/11. All criteria were met. No qualifiers were applied. Samples B1181SS-43 (C1594-13), B1181SS-53 (C1594-17), B1181SS-52 (C1594-18), B1181SS-51 (C1594-19), B1181SS-50 (C1594-20), B1181SD-11 (C1594-21), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), and B1181SS-54DUP (C1594-26) apply to this LCS.

- Sample PB54264BS was used as solid LCS for ICP metals analysis dated 03/23/11. All criteria were met. No qualifiers were applied. Samples B1181SS-39 (C1594-04), B1181SS-42 (C1594-06), B1181SS-25C (C1594-07), B1181SS-54 (C1594-08), B1181SS-62 (C1594-11), B1181SS-58 (C1594-12), and B1181SS-44 (C1594-16) apply to this LCS.

- Sample PB54266BS was used as aqueous LCS for ICP metals analysis dated 03/23/11. All criteria were met. No qualifiers were applied. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this LCS.

- Sample PB54268BS was used as aqueous LCS for ICPMS metals analysis dated 03/30/11. All criteria were met. No qualifiers were applied. Sample SW031611R1 (C1594-03) applies to this LCS.

VI-Laboratory Duplicate
Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analysis is also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. RPDs must be within established control limits. The DoD QSM limits for the aqueous and solid samples are ≤20% RPD for ICP and ICPMS metals.

- Sample B1181SS-43 (C1594-13) was used as the solid laboratory duplicate for the ICP metals analysis on 03/23/11. All criteria were met. No qualifiers were applied. Samples B1181SS-43 (C1594-13), B1181SS-53 (C1594-17), B1181SS-52 (C1594-18), B1181SS-51 (C1594-19), B1181SS-50 (C1594-20), B1181SD-11 (C1594-21), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), and B1181SS-54DUP (C1594-26) apply to this laboratory duplicate.

- Sample B1181SS-54 (C1594-08) was used as the solid laboratory duplicate for the ICP metals analysis on 03/23/11. All criteria were met. No qualifiers were applied. Samples B1181SS-39 (C1594-04), B1181SS-42 (C1594-06), B1181SS-25C (C1594-07), B1181SS-54 (C1594-08), B1181SS-62 (C1594-11), B1181SS-58 (C1594-12), and B1181SS-44 (C1594-16) apply to this laboratory duplicate.

- Sample SS031611R1 (C1594-01) was used as the aqueous laboratory duplicate for the ICP metals analysis on 03/23/11. All criteria were met. No qualifiers were applied. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this laboratory duplicate.

- Sample B1181SW-6 (C1595-04) was used as the aqueous laboratory duplicate for the ICPMS metals analysis on 03/30/11. Arsenic (35.2%) was outside criteria. Arsenic was non-detect for the associated sample; therefore, was qualified "UJ" based upon the low recoveries. All other metals and RPDs were within criteria limits. Sample SW031611R1 (C1594-03) applies to this laboratory duplicate.

VII-Matrix Spike (MS) and Spike Duplicate (MSD)

MS and MSD are generated to determine long-term accuracy and precision of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. Specific criteria include the analyses of matrix spike samples at a frequency of one MS/MSD per 20 samples of similar matrix. MS/MSD recoveries and relative percent differences between MS recoveries should be within the specified limits. The DoD MS and MSD aqueous recovery limits use the LCS criteria specified in Table G-18 of the DoD QSM (DoD, 2010) and are 80-120% and RPD≤20% for ICP and ICPMS metals. The DoD MS and MSD solid recovery limits use the LCS criteria specified in Table G-19 of the DoD QSM (DoD, 2010) and are 80-120% (75-120% for silver) and RPD≤20% for ICP and ICPMS metals. Post digestion spikes aqueous and solid limits are 75-125% for ICP and ICPMS metals.

- Sample B1181SS-43 (C1594-13) was used as the solid MS/MSD for the ICP metals analysis on 03/23/11. Iron (38.3%) was outside criteria. The sample concentration was >4 times the spike added for iron; therefore, no qualifiers were applied based upon this outlier. All other metals and RPDs were within criteria limits. Samples B1181SS-43 (C1594-13), B1181SS-53 (C1594-17), B1181SS-52 (C1594-18), B1181SS-51 (C1594-19), B1181SS-50 (C1594-20), B1181SD-11 (C1594-21), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), and B1181SS-54DUP (C1594-26) apply to this MS/MSD.

- Sample B1181SS-54 (C1594-08) was used as the solid MS/MSD for the ICP metals analysis on 03/23/11. Antimony (79.4%), iron (38.3%), lead (67.8%, 72.9%), and zinc (75.9%, 77.0%) were outside criteria. The sample concentration was >4 times the spike added for iron and lead; therefore, no qualifiers were applied based upon these outliers. Antimony and zinc were qualified estimated "J" for detections and "UJ" for non-detections based upon the low recoveries. All other metals and RPDs were within criteria limits. Samples B1181SS-39 (C1594-04), B1181SS-42 (C1594-06), B1181SS-25C (C1594-07), B1181SS-54 (C1594-08), B1181SS-62 (C1594-11), B1181SS-58 (C1594-12), and B1181SS-44 (C1594-16) apply to this MS/MSD.

- Sample SS031611R1 (C1594-01) was used as the aqueous MS/MSD for the ICP metals analysis on 03/23/11. All criteria were met. No qualifiers were applied. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this MS/MSD.

- Sample B1181SW-6 (C1595-04) was used as the aqueous MS/MSD for the ICPMS metals analysis on 03/30/11. Iron (77.0%), lead (77.0%, 53.0%), and zinc (79.2%) were outside criteria. The sample concentration was >4 times the spike added for lead; therefore, no qualifiers were applied based upon this outlier. Iron and zinc were qualified estimated "J" for detections and "UJ" for non-detections based upon the low recoveries. All other metals and RPDs were within criteria limits. Sample SW031611R1 (C1594-03) applies to this MS/MSD.

VIII-Field Duplicate Sample Analysis
Field duplicates were collected to identify the cumulative precision of the sampling and analytical process and sent to the laboratory blind. The RPD was calculated only for those analytes which were detected at levels exceeding the method reporting limits in both samples of the duplicate pair. Analytes that were rejected (R-qualified) in either sample of the duplicate pair were excluded from the duplicate assessment. Precision control criterion was established at ≤35% RPD for the solid samples and ≤25% RPD for aqueous samples.

- Field solid sample duplicate pair B1181SS-43 (C1594-13) and B1181SS-43DUP (C1594-25) was collected for select metals analysis. Arsenic was detected in the original sample at 4.04 mg/kg and in the duplicate pair at 4.39 mg/kg resulting in a RPD of 8.3%. Copper was detected in the original sample at 35.3 mg/kg and in the duplicate pair at 36.1 mg/kg resulting in a RPD of 2.2%. Iron was detected in the original sample at 31000 mg/kg and in the duplicate pair at 29000 mg/kg resulting in a RPD of 6.7%. Lead was detected in the original sample at 36.3 mg/kg and in the duplicate pair at 58.2 mg/kg resulting in a RPD of 46.4%. Zinc was detected in the original sample at 85.2 mg/kg and in the duplicate pair at 87.7 mg/kg resulting in a RPD of 2.9%. Lead was outside criteria and was qualified estimated "J" for the duplicate pair based upon the high RPD. For all other target metals, all criteria were met.

- Field solid sample duplicate pair B1181SS-54 (C1594-08) and B1181SS-54DUP (C1594-26) was collected for select metals analysis. Antimony was detected in the original sample at 8.73 mg/kg and in the duplicate pair at 10.1 mg/kg resulting in a RPD of 14.6%. Arsenic was detected in the original sample at 11.7 mg/kg and in the duplicate pair at 12.6 mg/kg resulting in a RPD of 7.4%. Copper was detected in the original sample at 47.4 mg/kg and in the duplicate pair at 67.3 mg/kg resulting in a RPD of 34.7%. Iron was detected in the original sample at 23400 mg/kg and in the duplicate pair at 22200 mg/kg resulting in a RPD of 5.3%. Lead was detected in the original sample at 896 mg/kg and in the duplicate pair at 1080 mg/kg resulting in a RPD of 18.6%. Zinc was detected in the original sample at 126 mg/kg and in the duplicate pair at 183 mg/kg resulting in a RPD of 36.9%. Zinc was outside criteria and was qualified estimated "J" for the duplicate pair based upon the high RPD. For all other target metals, all criteria were met.

IX-ICP and ICPMS Serial Dilution
A serial dilution is performed to determine whether significant physical or chemical interferences exist due to sample matrix at high concentrations. An analysis of a 5-fold dilution should agree within 10% difference of the original result when the concentration in sample is a factor of 50 above MDL for ICP and 100 above MDL for ICPMS.

- Sample B1181SS-43 (C1594-13) was used as the solid serial dilution for the ICP metals analysis on 03/23/11. Copper (11.8%) and lead (174%) were outside criteria. Copper and lead were detected in all associated samples; therefore, were qualified estimated "J" based upon the high %Ds. All other metals were within criteria limits. Samples B1181SS-43 (C1594-13), B1181SS-53 (C1594-17), B1181SS-52 (C1594-18), B1181SS-51 (C1594-19), B1181SS-50 (C1594-20), B1181SD-11 (C1594-21), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), and B1181SS-54DUP (C1594-26) apply to this serial dilution.

- Sample B1181SS-54 (C1594-08) was used as the solid serial dilution for the ICP metals analysis on 03/23/11. Copper (14.7%), iron (10.7%), and zinc (12.8%) were outside criteria. Copper, iron, and zinc were detected in all associated samples; therefore, were qualified estimated "J" based upon the high %Ds. All other metals were within criteria limits. Samples B1181SS-39 (C1594-04), B1181SS-42 (C1594-06), B1181SS-25C (C1594-07), B1181SS-54 (C1594-08), B1181SS-62 (C1594-11), B1181SS-58 (C1594-12), and B1181SS-44 (C1594-16) apply to this serial dilution.

- Sample SS031611R1 (C1594-01) was used as the aqueous serial dilution for the ICP metals analysis on 03/23/11. All criteria were met. No qualifiers were applied. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this serial dilution.

- Sample B1181SW-6 (C1595-04) was used as the aqueous serial dilution for the ICPMS metals analysis on 03/30/11. Arsenic (169%) was outside criteria. Sample concentrations were <100 times MDL for arsenic; therefore, no qualifiers were applied based upon this outlier. All other metals were within criteria limits. Sample SW031611R1 (C1594-03) applies to this serial dilution.

X-Quantitation Verification and Data Review
The accuracy of analytical results is verified through the calculation of several parameters. The percent difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification.

- Any sample value >MDL and <MRL or <3*MDL (whichever was greater) was qualified as estimated, "J."

Sample: B1181SS-39 (C1594-04), Lead

Conc. (mg/kg) = {(conc. µg/L)*(Final Volume L)*(DF)} / {(Weight Sample g)*(Fraction Solids)}

Conc. (mg/kg) = {(1350.8 µg/L)*(0.100 L)*(1)} / {(1.30 g)*(0.6470)} = 161 µg/g = 161 mg/kg

Reported concentration = 161 mg/kg
%D = 0.0%
Values were within 10% difference.

Sample: SD031611R1 (C1594-02), Zinc

Conc. (µg/L) = (conc. µg/L) * (Final Volume mL) * (DF) / (Volume Sample mL)

Conc. (µg/L) = (9.77 µg/L) * (50 mL) * (1) / (50 mL) = 9.77 µg/L

Reported concentration = 9.77 µg/L
%D = 0.0%
Values were within 10% difference.

Sample: SW031611R1 (C1594-03), Zinc

Conc. (µg/L) = (conc. µg/L) * (Final Volume mL) * (DF) / (Volume Sample mL)

Conc. (µg/L) = (7.844 µg/L) * (50 mL) * (1) / (50 mL) = 7.8 µg/L

Reported concentration = 7.8 µg/L
%D = 0.0%
Values were within 10% difference.

Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
No Code	Confirmed identification.
U	Undetected at the limit of detection: The associated data value is the limit of detection, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more quality control criteria failed.
USEPA Region II Data Validation Qualifiers[2]	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meeting the Quality Control criteria. The presence or absence of the analyte cannot be verified.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

[1]The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2]The USEPA data validation qualifiers are referenced from *USEPA Region II Evaluation of Metals Data for the Contract Laboratory Program, Revision 13 (SOP HW-2, September 2006).*

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SS031611R1	SDG No.:	C1594
Lab Sample ID:	C1594-01	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	25	U	1	8	12.5	25	ug/L	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	10	U	1	4.2	5	10	ug/L	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	10	U	1	2	5	10	ug/L	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	50	U	1	20.4	25	50	ug/L	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	6	U	1	2.6	3	6	ug/L	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	20	U	1	6.5	10	20	ug/L	03/22/11	03/23/11	SW6010B

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SD031611R1	SDG No.:	C1594
Lab Sample ID:	C1594-02	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	25	U	1	8	12.5	25	ug/L	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	10	U	1	4.2	5	10	ug/L	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	10	U	1	2	5	10	ug/L	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	50	U	1	20.4	25	50	ug/L	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	6	U	1	2.6	3	6	ug/L	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	9.77	J J	1	6.5	10	20	ug/L	03/22/11	03/23/11	SW6010B

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SW031611R1	SDG No.:	C1594
Lab Sample ID:	C1594-03	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2	U	1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	1	U UJ	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	0.65	J J	1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	200	U UJ	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	0.42	J J	1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	7.8	J	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:					

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
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E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-39	SDG No.:	C1594
Lab Sample ID:	C1594-04	Matrix:	SOIL
Level (low/med):	low	% Solid:	64.7

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.97	J J	1	0.67	1.485	2.97	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	7.88		1	0.39	0.595	1.19	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	56.8	J	1	0.38	0.595	1.19	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	23800	J	1	1.58	2.97	5.94	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	161		1	0.14	0.355	0.71	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	124	J	1	0.83	1.19	2.38	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-42	SDG No.:	C1594
Lab Sample ID:	C1594-06	Matrix:	SOIL
Level (low/med):	low	% Solid:	79.7

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	1.77	J J	1	0.53	1.18	2.36	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	24.1		1	0.31	0.47	0.94	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	17.4	J	1	0.3	0.47	0.94	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	30900	J	1	1.25	2.36	4.72	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	239		1	0.11	0.285	0.57	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	23.5	J	1	0.66	0.945	1.89	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-25C	SDG No.:	C1594
Lab Sample ID:	C1594-07	Matrix:	SOIL
Level (low/med):	low	% Solid:	30.8

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	82.5		1	0.28	0.705	1.41	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-54	SDG No.:	C1594
Lab Sample ID:	C1594-08	Matrix:	SOIL
Level (low/med):	low	% Solid:	57.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	8.73	J	1	0.98	2.18	4.36	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	11.7		1	0.58	0.875	1.75	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	47.4	J	1	0.56	0.875	1.75	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	23400	J	1	2.32	4.365	8.73	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	896		1	0.21	0.525	1.05	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	126	J	1	1.22	1.745	3.49	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-62	SDG No.:	C1594
Lab Sample ID:	C1594-11	Matrix:	SOIL
Level (low/med):	low	% Solid:	53.4

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	435		1	0.18	0.455	0.91	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-58	SDG No.:	C1594
Lab Sample ID:	C1594-12	Matrix:	SOIL
Level (low/med):	low	% Solid:	77

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2.6	U UJ	1	0.58	1.3	2.6	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	1.65		1	0.34	0.52	1.04	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	32.8	J	1	0.33	0.52	1.04	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	22900	J	1	1.38	2.595	5.19	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	14.8		1	0.12	0.31	0.62	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	57.6	J	1	0.73	1.04	2.08	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-43	SDG No.:	C1594
Lab Sample ID:	C1594-13	Matrix:	SOIL
Level (low/med):	low	% Solid:	63.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	3.95	U	1	0.88	1.975	3.95	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	4.04		1	0.52	0.79	1.58	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	35.3	J	1	0.51	0.79	1.58	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	31000		1	2.1	3.95	7.9	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	36.3	J	1	0.19	0.475	0.95	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	85.2		1	1.11	1.58	3.16	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-44	SDG No.:	C1594
Lab Sample ID:	C1594-16	Matrix:	SOIL
Level (low/med):	low	% Solid:	70.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2.57	U UJ	1	0.58	1.285	2.57	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	9.87		1	0.34	0.515	1.03	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	35.1	J	1	0.33	0.515	1.03	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	18300	J	1	1.37	2.575	5.15	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	90.2		1	0.12	0.31	0.62	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	91.8	J	1	0.72	1.03	2.06	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Clarity Before:	Texture:
Color After:	Clarity After:	Artifacts:
Comments: Metals Group3		

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-53	SDG No.:	C1594
Lab Sample ID:	C1594-17	Matrix:	SOIL
Level (low/med):	low	% Solid:	40.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	94.7	J	1	0.2	0.505	1.01	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-52	SDG No.:	C1594
Lab Sample ID:	C1594-18	Matrix:	SOIL
Level (low/med):	low	% Solid:	63.2

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	114	J	1	0.13	0.325	0.65	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-51	SDG No.:	C1594
Lab Sample ID:	C1594-19	Matrix:	SOIL
Level (low/med):	low	% Solid:	38.9

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	247	J	1	0.23	0.585	1.17	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-50	SDG No.:	C1594
Lab Sample ID:	C1594-20	Matrix:	SOIL
Level (low/med):	low	% Solid:	51.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	79	J	1	0.18	0.445	0.89	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-11	SDG No.:	C1594
Lab Sample ID:	C1594-21	Matrix:	SOIL
Level (low/med):	low	% Solid:	61.7

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	780	J	1	0.15	0.37	0.74	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-56	SDG No.:	C1594
Lab Sample ID:	C1594-23	Matrix:	SOIL
Level (low/med):	low	% Solid:	70.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2.8	U	1	0.63	1.4	2.8	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	2.06		1	0.37	0.56	1.12	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	31.9	J	1	0.36	0.56	1.12	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	14300		1	1.49	2.8	5.6	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	38.6	J	1	0.13	0.335	0.67	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	51.8		1	0.78	1.12	2.24	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-57	SDG No.:	C1594
Lab Sample ID:	C1594-24	Matrix:	SOIL
Level (low/med):	low	% Solid:	62.1

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	3	U	1	0.67	1.5	3	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	5.29		1	0.4	0.6	1.2	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	71.2	J	1	0.38	0.6	1.2	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	13600		1	1.6	3.005	6.01	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	47.2	J	1	0.14	0.36	0.72	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	72.8		1	0.84	1.2	2.4	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-43DUP	SDG No.:	C1594
Lab Sample ID:	C1594-25	Matrix:	SOIL
Level (low/med):	low	% Solid:	54

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.88	J J	1	0.73	1.63	3.26	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	4.39		1	0.43	0.65	1.3	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	36.1	J	1	0.42	0.65	1.3	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	29000		1	1.73	3.26	6.52	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	58.2	J	1	0.16	0.39	0.78	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	87.7		1	0.91	1.305	2.61	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-54DUP	SDG No.:	C1594
Lab Sample ID:	C1594-26	Matrix:	SOIL
Level (low/med):	low	% Solid:	64

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	10.1		1	0.62	1.395	2.79	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	12.6		1	0.37	0.56	1.12	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	67.3	J	1	0.36	0.56	1.12	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	22200		1	1.48	2.79	5.58	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	1080	J	1	0.13	0.335	0.67	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	183	J	1	0.78	1.115	2.23	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SS031911R1	SDG No.:	C1594
Lab Sample ID:	C1594-27	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	25	U	1	8	12.5	25	ug/L	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	10	U	1	4.2	5	10	ug/L	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	10	U	1	2	5	10	ug/L	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	50	U	1	20.4	25	50	ug/L	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	6	U	1	2.6	3	6	ug/L	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	20	U	1	6.5	10	20	ug/L	03/22/11	03/23/11	SW6010B

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

Shaw Environmental, Inc.
2113 Emmorton Park Road
Edgewood, Maryland
410-612-6350
FAX: 410-612-6351

Shaw® Shaw Environmental, Inc.

MEMORANDUM

TO: Gerard Maresca, Shaw E&I Picatinny Arsenal (PTA) Project Manager

FROM: Eric Malarek, Shaw E&I PTA Project Chemist

SUBJECT: PTA Data Validation – Polynuclear Aromatic Hydrocarbons
Chemtech C1594

DATE: June 17, 2011

The purpose of this memorandum is to present the data validation report for the Skeet Range samples collected at the PTA Site on March 16, 2011, March 19, 2011, and March 21, 2011. Samples were analyzed for polynuclear aromatic hydrocarbons (PAHs) using USEPA SW846 Methods 3541/8270C for the solid sample analysis and using USEPA SW846 Methods 3510C/8270C for the rinse blank samples. A total of thirteen solid samples (includes two dilution analyses) and four rinse blank samples were validated. The sample Ids are:

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
SS031611R1	C1594-01	B1181SS-43	C1594-13
SD031611R1	C1594-02	B1181SS-35C	C1594-22
SW031611R1	C1594-03	B1181SS-56	C1594-23
B1181SS-39	C1594-04	B1181SS-57	C1594-24
B1181SS-23C	C1594-05	B1181SS-43DUP	C1594-25
B1181SS-42	C1594-06	B1181SS-54DUP	C1594-26
B1181SS-54	C1594-08	B1181SS-54DUP	C1594-26DL
B1181SS-54	C1594-08DL	SS031911R1	C1594-27
B1181SS-58	C1594-12		

Data were reviewed and validated using a combination of project QAPP, *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2, April 2010* (DoD, 2010) (DoD QSM), method-specific criteria, and laboratory SOP criteria. The data qualifier scheme was consistent with the *USEPA Region II SOP Validating Semivolatile Organic Compounds by Gas Chromatography / Mass Spectroscopy SW-846 Method 8270D, Revision 4 (SOP HW-22, August 2008)*. Parameters evaluated are presented in **Table 1**. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA specifications.

Table 1 Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times and Preservation
	X	Instrument Performance Check
	X	Initial Calibration
	X	Continuing Calibration
	X	Blank Analysis
X		Surrogate Spikes
X		Internal Standards
X		Laboratory Control Sample and Laboratory Control Sample Duplicate
X		Matrix Spike/Spike Duplicate
X		Field Duplicate
X		Quantitation Verification and Data Review

The quality of data collected in support of this sampling activity is considered acceptable with noted qualifications; except for the following. For sample B1181SS-54 (C1594-08), pyrene exceeded calibration range and was qualified rejected "R". The diluted sample B1181SS-54 (C1594-08DL) should be used for this compound. For sample B1181SS-54DUP (C1594-26), benzo(a)anthracene, chrysene, benzo(b)fluoranthene, pyrene, phenanthrene, and fluoranthene exceeded calibration range and were qualified rejected "R". The diluted sample B1181SS-54DUP (C1594-26DL) should be used for these compounds. There were no impacts regarding data usability.

Eric Malarek, Chemist

6/17/11
Date

PTA VALIDATION REPORT
PAH REVIEW
SDG C1594

I-Holding Times and Preservation
The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. All samples are cooled @4°C ± 2°C. The maximum holding time criteria for PAHs for aqueous samples is 7 days from sample collection to preparative extraction and 40 days from preparative extraction to determinative analysis and for solid samples is 14 days from sample collection to preparative extraction and 40 days from preparative extraction to determinative analysis (USEPA criteria).

- Temperature Review: The temperature blank was sent with each cooler and recorded by the laboratory upon receipt. For samples collected on 03/16/11, 03/19/11, and 03/21/11, the coolers were received by the laboratory (Chemtech) on 03/21/11 at 5°C, 5°C, and 5°C. All criteria were met. No qualifiers were applied.

- Holding Time Review: The solid samples and aqueous rinse blank samples were collected on 03/16/11, 03/19/11, and 03/21/11 for PAH analysis. For the solid samples, the PAHs were extracted on 03/22/11 and analyzed on 03/30/11 and 03/31/11. For the aqueous rinse blank sample, the PAHs were extracted on 03/22/11 and analyzed on 03/24/11, 03/25/11, and 03/28/11. Sample collection dates may be found on the attached form 1s. All criteria were met. No qualifiers were applied.

II-Instrument Performance Check
GC/MS instrument performance checks are performed to ensure mass resolution, identification and, to some degree, sensitivity. The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed.

- The instrument performance check, decafluorotriphenylphosphine (DFTPP), met the ion abundance criteria. No qualification was applied.

III-Initial Calibration
Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for reported PAH compounds. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The DoD QSM specifies that for compounds analyzed using linear regression or second order, correlation coefficients must be >0.995 (coefficient of determination r^2>0.99 for higher order). The minimum relative response factor (RRF) criteria must be ≥0.05. Initial calibration percent relative standard deviation (%RSD) must be ≤15% on the average for all compounds (<30% for CCCs).

- Initial calibration for the PAHs was performed on 03/11/11 on instrument BNAE. All criteria were met for the reported target PAHs. No qualifiers were applied. No samples were reported using this initial calibration.

- Initial calibration for the PAHs was performed on 03/28/11 on instrument BNAE. Flourene (18.9%) was outside criteria; however, was quantified using linear regression with a coefficient of determination of 0.999. No qualifiers were applied based upon this outlier. All criteria were met for the reported target PAHs. No qualifiers were applied. Sample SW031611R1 (C1594-03) applies to this initial calibration.

- Initial calibration for the PAHs was performed on 03/22/11 on instrument BNAF. All criteria were met for the reported target PAHs. No qualifiers were applied. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this initial calibration.

- Initial calibration for the PAHs was performed on 03/28/11 on instrument BNAF. All criteria were met for the reported target PAHs. No qualifiers were applied. Samples B1181SS-39 (C1594-04), B1181SS-23C (C1594-05), B1181SS-42 (C1594-06), B1181SS-54 (C1594-08), B1181SS-54 (C1594-08DL), B1181SS-58 (C1594-12), B1181SS-43 (C1594-13), B1181SS-35C (C1594-22), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), B1181SS-54DUP (C1594-26), and B1181SS-54DUP (C1594-26DL) apply to this initial calibration.

IV-Continuing Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for PAH target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum relative response factors (RRF) for PAH target compounds and surrogates must be ≥0.05. The DoD QSM specifies that the percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within ±20% for all target compounds.

- For initial calibration verification performed on 03/11/11 @17:24 on instrument BNAE, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this initial calibration verification.

- For continuing calibration performed on 03/24/11 @18:18 on instrument BNAE, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this continuing calibration.

- For initial calibration verification performed on 03/28/11 @18:58 on instrument BNAE, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Sample SW031611R1 (C1594-03) applies to this initial calibration verification.

- For initial calibration verification performed on 03/22/11 @16:47 on instrument BNAF, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this initial calibration verification.

- For continuing calibration performed on 03/24/11 @17:35 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this continuing calibration.

- For initial calibration verification performed on 03/28/11 @17:58 on instrument BNAF, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Sample SW031611R1 (C1594-03) applies to this initial calibration verification.

- For continuing calibration performed on 03/29/11 @16:24 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this continuing calibration.

- For continuing calibration performed on 03/30/11 @6:08 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples B1181SS-39 (C1594-04), B1181SS-23C (C1594-05), B1181SS-42 (C1594-06), B1181SS-58 (C1594-12), B1181SS-35C (C1594-22), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), and B1181SS-54DUP (C1594-26) apply to this continuing calibration.

- For continuing calibration performed on 03/30/11 @17:46 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples B1181SS-54 (C1594-08), B1181SS-43 (C1594-13), and B1181SS-54DUP (C1594-26DL) apply to this continuing calibration.

- For continuing calibration performed on 03/31/11 @6:19 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Sample B1181SS-54 (C1594-08DL) applies to this continuing calibration.

V-Blank Analysis

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of DFTPP. No contaminants should be detected in any of the associated blanks >MDL. DoD QSM criteria specifies all concentrations should be less than one-half MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters). Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants phthalate esters, or 5 times (5X) the maximum amount for other semivolatile target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one and for solid matrices were converted to soil values (soil conversion factor = 33), if needed. Rinse blank samples SS031611R1 (C1594-01) and SS031911R1 (C1594-27) apply to all surface soil "SS" samples collected in this SDG. Rinse blank sample SD031611R1 (C1594-02) applies to all sediment "SD" samples and rinse blank SW031611R1 (C1594-03) applies to all surface water "SW" samples. The sediment and surface water samples may be found in SDG C1595.

Table 2 Blank Contamination Analysis Summary

Analysis Date	QC Blank ID	Compound	Max Conc. µg/L	Action Level µg/L	U qualified samples (For this SDG)
03/24/11	PB54251B	All target <½MRL	NA	NA	None
03/28/11	PB54256B	All target <½MRL	NA	NA	None
03/28/11	SW031611R1	All target <½MRL	NA	NA	None
Analysis Date	**QC Blank ID**	**Compound**	**Max Conc. µg/kg**	**Action Level µg/kg**	**U qualified samples (For this SDG)**
03/30/11	PB54258B	All target <½MRL	NA	NA	None
03/24/11	SS031611R1	All target <½MRL	NA	NA	None
03/25/11	SS031911R1	All target <½MRL	NA	NA	None
03/24/11	SD031611R1	All target <½MRL	NA	NA	None

MRL = Method Reporting Limit.
NA = Not Applicable

VI-Surrogate Spikes

Laboratory performance on individual samples is evaluated through the review of surrogate spike samples. Surrogate spikes are added to all samples and blanks to measure their recovery in sample and blank matrices. The percent recoveries (%Rs) must be within the specified control limits.

Aqueous Criteria: Nitrobenzene-d5 (20-139%) – (DoD QSM Criteria: 40-110%)
2-Fluorobiphenyl (10-173%) – (DoD QSM Criteria: 50-110%)
p-Terphenyl – d14 (20-171%) – (DoD QSM Criteria: 50-135%)

Solid Criteria: Nitrobenzene-d5 (30-150%) – (DoD QSM Criteria: 35-100%)
2-Fluorobiphenyl (19-182%) – (DoD QSM Criteria: 45-105%)
p-Terphenyl – d14 (24-191%) – (DoD QSM Criteria: 30-125%)

- For sample SS031611R1 (C1594-01), surrogates nitrobenzene-d5 (115%) and 2-fluorobiphenyl (111%) were outside DOD criteria. All target were non-detect and were qualified estimated "UJ" based upon these outliers.

- For sample SS031911R1 (C1594-27), surrogates nitrobenzene-d5 (118%) and 2-fluorobiphenyl (117%) were outside DOD criteria. All target were non-detect and were qualified estimated "UJ" based upon these outliers.

- For sample B1181SS-43DUP (C1594-25), surrogate 2-fluorobiphenyl (39%) was outside DOD criteria. Since only one base-neutral surrogate was outside DOD criteria, no qualifiers were applied based upon this outlier.

- For all other samples, all criteria were met.

VII-Internal Standards
Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated calibration standard.

- For sample B1181SS-54DUP (C1594-26), internal standard perylene-d12 was below criteria. All other internal standards were within criteria. The associated target compounds benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene were qualified estimated "J" and non-detections "UJ" based upon this outlier.

- For all other samples, all criteria were met. No qualifiers were applied.

VIII-Laboratory Control Sample and Laboratory Control Sample Duplicate
Laboratory control samples (LCS) are used to monitor laboratory accuracy by calculating the percent recoveries of the spiked compounds. All LCS/LCSD percent recoveries must be within the specified control limits. DoD LCS/LCSD aqueous recovery limits are specified in Table G-2 and Table G-6 of the DoD QSM (DoD, 2010). DoD LCS solid recovery limits are specified in Table G-2 and Table G-7 of the DoD QSM (DoD, 2010). The DoD MS/MSD precision RPD criteria is ≤30% for aqueous and solid matrices. The DoD QSM LCS criterion for non-listed SVOCs is to use current laboratory in-house limits.

- Sample PB54258BS was used as the solid LCS for the PAH analysis on 03/30-31/11. All criteria were met. No qualifiers were applied. Samples B1181SS-39 (C1594-04), B1181SS-23C (C1594-05), B1181SS-42 (C1594-06), B1181SS-54 (C1594-08), B1181SS-54 (C1594-08DL), B1181SS-58 (C1594-12), B1181SS-43 (C1594-13), B1181SS-35C (C1594-22), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), B1181SS-54DUP (C1594-26), and B1181SS-54DUP (C1594-26DL) apply to this LCS.

- Samples PB54251BS and PB54251BSD were used as the aqueous LCS/LCSD for the PAH analysis on 03/24-25/11. Acenaphthylene (108%), acenaphthene (112%), and anthracene (106%) were outside DOD criteria. For all other target compounds, all criteria were met. All associated samples were non-detect; therefore, no qualification was required based upon the high recoveries. Samples SS031611R1 (C1594-01), SD031611R1 (C1594-02), and SS031911R1 (C1594-27) apply to this LCS/LCSD.

- Sample PB54256BS was used as the aqueous LCS for the PAH analysis on 03/28/11. Naphthalene (19%) was outside lab/DOD criteria. For all other target compounds, all criteria were met. All associated samples were non-detect; therefore, was qualified "UJ" for naphthalene based upon the low recoveries. Sample SW031611R1 (C1594-03) applies to this LCS.

IX-Matrix Spike/Matrix Spike Duplicate

Data for matrix spike/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. The percent recoveries (%Rs) and the relative percent difference (RPD) must be within the specified control limits. DoD LCS/LCSD aqueous recovery limits are specified in Table G-2 and Table G-6 of the DoD QSM (DoD, 2010). DoD MS and MSD solid recovery limits use the LCS criteria specified in Table G-2 and Table G-7 of the DoD QSM (DoD, 2010). The DoD MS/MSD precision RPD criteria is ≤30% for aqueous and solid matrices. The DoD QSM LCS criterion for non-listed SVOCs is to use current laboratory in-house limits.

- Sample B1181SS-43 (C1594-13) was used as the solid MS/MSD for the PAH analysis on 03/30-31/11. All criteria were met. No qualifiers were applied. Samples B1181SS-39 (C1594-04), B1181SS-23C (C1594-05), B1181SS-42 (C1594-06), B1181SS-54 (C1594-08), B1181SS-54 (C1594-08DL), B1181SS-58 (C1594-12), B1181SS-43 (C1594-13), B1181SS-35C (C1594-22), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), B1181SS-54DUP (C1594-26), and B1181SS-54DUP (C1594-26DL) apply to this MS/MSD.

- Sample B1181SS-54 (C1594-08) was used as the solid MS/MSD for the PAH analysis on 03/30-31/11. Target compounds acenaphthylene (RPD=26%), acenaphthene (361%, 168%; RPD=73%), fluorene (308%, 142%; RPD=74%), phenanthrene (1466%, 466%; RPD=104%), anthracene (626%, 184%; RPD=189%), fluoranthene (1593%, 421%; RPD=116%), pyrene (1762%, 590%; RPD=100%), benzo(a)anthracene (1297%, 400%; RPD=106%), chrysene (1197%, 369%; RPD=106%), benzo(b)fluoranthene (1979%, 428%; RPD=129%), benzo(k)fluoranthene (376%, 152%; RPD=85%), benzo(a)pyrene (1310%, 310%; RPD=123%), indeno(1,2,3-cd)pyrene (489%, 182%; RPD=92%), dibenz(a,h)anthracene (367%; RPD=111%), and benzo(g,h,i)perylene (652%, 193%; RPD=109%) were outside lab/DOD criteria. For all other target compounds, all criteria were met. The associated LCS was within criteria for all target compounds (see Section VIII). Acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene were detected in the spiked sample; therefore, were qualified estimated "J" based upon the high recoveries. Skeet containing samples often exhibit matrix interferences for given method SW-8270C. Samples B1181SS-39 (C1594-04), B1181SS-23C (C1594-05), B1181SS-42 (C1594-06), B1181SS-54 (C1594-08), B1181SS-54 (C1594-08DL), B1181SS-58 (C1594-12), B1181SS-43 (C1594-13), B1181SS-35C (C1594-22), B1181SS-56 (C1594-23), B1181SS-57 (C1594-24), B1181SS-43DUP (C1594-25), B1181SS-54DUP (C1594-26), and B1181SS-54DUP (C1594-26DL) apply to this MS/MSD.

- Sample B1181SW-6 (C1595-04) was used as the aqueous MS/MSD for the PAH analysis on 03/28/11. Target compounds naphthalene (16%, 14%), acenaphthylene (RPD=21%), acenaphthene (RPD=21%), fluorene (RPD=21%), fluoranthene (RPD=21%), pyrene (RPD=21%), benzo(a)anthracene (RPD=21%), chrysene (RPD=21%), benzo(k)fluoranthene (RPD=22%), benzo(a)pyrene (RPD=21%), indeno(1,2,3-cd)pyrene (RPD=23%), dibenz(a,h)anthracene (RPD=22%), and benzo(g,h,i)perylene (RPD=21%) were outside lab/DOD criteria. For all other target compounds, all criteria were met. The associated LCS was within criteria for all target compounds (see Section VIII). Acenaphthylene, acenaphthene, fluorene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene were non-detect in the spiked sample; therefore, no qualification was required based upon the high RPDs. Naphthalene was qualified estimated "UJ" for the spiked sample based upon the low recoveries. Sample SW031611R1 (C1594-03) applies to this MS/MSD.

- No project specific sample was used as the aqueous MS/MSD for the PAH analysis on 03/24-25/11; therefore, was not evaluated.

X-Field Duplicate Sample Analysis

Field duplicates were collected to identify the cumulative precision of the sampling and analytical process and sent to the laboratory blind. The RPD was calculated only for those analytes which were detected at levels exceeding the method reporting limits in both samples of the duplicate pair. Analytes that were rejected (R-qualified) in either sample of the duplicate pair and any tentatively identified compounds (TICs) were excluded from the duplicate assessment. Precision control criterion was established at 50% RPD for the aqueous and solid samples.

- Field solid sample duplicate pair B1181SS-43 (C1594-13) and B1181SS-43DUP (C1594-25) was collected for PAHs. All detected PAHs found in the sample and its duplicate pair and associated RPDs are noted in **Table 3**. Naphthalene was detected below the MRL for the duplicate pair and non-detect for the original sample; therefore, no qualification was required. All other PAH target compounds were non-detect. All criteria were met. No qualifiers were applied.

Table 3 Field Precision Hits Analysis Summary for PAHs for Duplicate Pair B1181SS-43 (C1594-13) and B1181SS-43DUP (C1594-25)

Compound	Original Sample (µg/kg)	Duplicate Pair (µg/kg)	RPD
Naphthalene	520U	190J	NA

J = Estimated value <MRL and >MDL. Data point qualified was estimated "J".
U = Non-detect as <MRL
MRL = Method Reporting Limit
MDL = Method Detection Limit
NA = Not Applicable.

- Field solid sample duplicate pair B1181SS-54 (C1594-08) and B1181SS-54DUP (C1594-26) was collected for PAHs. All detected PAHs found in the sample and its duplicate pair and associated RPDs are noted in **Table 4**. All other PAH target compounds were non-detect. Acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene, chrysene, benzo(b)fluoranthene, benzo(a)anthracene, anthracene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene were outside RPD criteria; therefore, were qualified estimated "J" for the duplicate pair based upon these outliers. Skeet containing samples often exhibit matrix interferences for given method SW-8270C. For all other target compounds, all criteria were met.

Table 4 Field Precision Hits Analysis Summary for PAHs for Duplicate Pair B1181SS-54 (C1594-08) and B1181SS-54DUP (C1594-26)

Compound	Original Sample (µg/kg)	Duplicate Pair (µg/kg)	RPD
Naphthalene	290J	340J	15.9
Acenaphthene	540J	1200	75.9
Fluorene	470J	900	62.8
Phenanthrene	3500	8700D	85.3
Anthracene	850	1700	66.7
Fluoranthene	3800	11000D	97.3
Pyrene	4600D	9400D	68.6
Chrysene	2300	5000D	74.0
Benzo(b)fluoranthene	2600	6200D	81.8
Benzo(k)fluoranthene	1100	1900	53.3
Benzo(a)pyrene	2000	3900	64.4
Indeno(1,2,3-cd)pyrene	820	1700	69.8
Dibenz(a,h)anthracene	350J	600	52.6
Benzo(g,h,i)perylene	1100	2200	66.7
Benzo(a)anthracene	2400	5700D	81.5

J = Estimated value <MRL and >MDL. Data point qualified was estimated "J".
D = Value reported from diluted run.
MRL = Method Reporting Limit
MDL = Method Detection Limit

XI-Quantitation Verification and Data Review

The accuracy of analytical results was verified through the calculation of several parameters. Percent difference (%D) between the calculated and reported values must be ≤10%.

- Any sample value >MDL and <MRL or <3*MDL (whichever is greater) was qualified as estimated, "J."
- Samples B1181SS-23C (C1594-05), B1181SS-58 (C1594-12), and B1181SS-35C (C1594-22) were diluted due to matrix effects. Skeet containing samples often exhibit matrix interferences for given method SW-8270C.
- For sample B1181SS-54 (C1594-08), pyrene exceeded calibration range and was qualified rejected "R". The diluted sample B1181SS-54 (C1594-08DL) should be used for this compound. There were no impacts to the data usability.
- For sample B1181SS-54DUP (C1594-26), benzo(a)anthracene, chrysene, benzo(b)fluoranthene, pyrene, phenanthrene, and fluoranthene exceeded calibration range and were qualified rejected "R". The diluted sample B1181SS-54DUP (C1594-26DL) should be used for these compounds. There were no impacts to the data usability.

Sample: B1181SS-39 (C1594-04), Chrysene

Conc. μg/kg = (Ax * Is * Vt * DF) / (Ais * RRF * Vi * Ws * D)

where:
- Conc. = Sample concentration in μg/kg
- Ax = Area of characteristic ion for compound being measured.
- Is = Amount of internal standard injected (ng).
- Vt = Volume of total extract (uL).
- Ais = Area of characteristic ion for the internal standard.
- RRF = Average relative response factor for compound being measured (from ICAL)
- Vi = Volume of extract injected (uL).
- W(s) = Weight of sample extracted or diluted in grams.
- D = Percent dry weight (100 - % moisture in sample)/100
- DF = Dilution factor

Conc. μg/kg = (15170 * 20 * 1000 * 1) / (189462 * 0.980 * 1 * 30.12 * 0.6500) = 83 μg/kg

Reported Value = 83 μg/kg
% Difference = 0.0%
Values were within 10% difference.

Sample: PB54256BS, Acenaphthene

Conc. (µg/L) = {(Ax)*(Is)*(Vt)*(DF)}/{(Ais)*(RRF)*(V_o)*(V_i)}

where:	$Conc_{sample}$	=	Sample concentration in µg/L
	A_x	=	Area of characteristic ion for compound being measured.
	I_s	=	Amount of internal standard injected (ng).
	V_t	=	Volume of total extract, taking into account dilutions (µL).
	A_{is}	=	Area of characteristic ion for the internal standard.
	RRF_A	=	Average relative response factor for compound being measured
	V_o	=	Volume of water extracted (mL).
	V_i	=	Volume of extract injected (µL).
	DF	=	Dilution Factor

Conc. µg/L = (61107 * 5ng * 1000µL * 1) / (28768 * 1.170 * 1000mL * 1 µL) = 9.1 ng/mL
= 9.1 µg/L

Reported Value = 9.1 µg/L
% Difference = 0.0%
Values were within 10% difference.

Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
No Code	Confirmed identification.
U	Undetected at the limit of detection: The associated data value is the limit of detection, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more quality control criteria failed.
USEPA Region II Data Validation Qualifiers[2]	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meeting the Quality Control criteria. The presence or absence of the analyte cannot be verified.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

[1]The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2]The USEPA data validation qualifiers are referenced from *USEPA Region II SOP Validating Semivolatile Organic Compounds by Gas Chromatography / Mass Spectroscopy SW-846 Method 8270D, Revision 4 (SOP HW-22, August 2008).*

Form I Copy

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SS031611R1	SDG No.:	C1594
Lab Sample ID:	C1594-01	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	980 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044171.D	1	03/22/11	03/24/11	PB54251

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	10	U UJ	0.12	5	10	ug/L
208-96-8	Acenaphthylene	10	U UJ	0.71	5	10	ug/L
83-32-9	Acenaphthene	10	U UJ	0.21	5	10	ug/L
86-73-7	Fluorene	10	U UJ	0.32	5	10	ug/L
85-01-8	Phenanthrene	10	U UJ	0.27	5	10	ug/L
120-12-7	Anthracene	10	U UJ	0.16	5	10	ug/L
206-44-0	Fluoranthene	10	U UJ	0.41	5	10	ug/L
129-00-0	Pyrene	10	U UJ	0.2	5	10	ug/L
56-55-3	Benzo(a)anthracene	10	U UJ	0.16	5	10	ug/L
218-01-9	Chrysene	10	U UJ	0.18	5	10	ug/L
205-99-2	Benzo(b)fluoranthene	10	U UJ	0.3	5	10	ug/L
207-08-9	Benzo(k)fluoranthene	10	U UJ	0.18	5	10	ug/L
50-32-8	Benzo(a)pyrene	10	U UJ	0.14	5	10	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	10	U UJ	0.15	5	10	ug/L
53-70-3	Dibenz(a,h)anthracene	10	U UJ	0.43	5	10	ug/L
191-24-2	Benzo(g,h,i)perylene	10	U UJ	0.3	5	10	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	115		20 - 139		115%	SPK: 100
321-60-8	2-Fluorobiphenyl	111		10 - 173		111%	SPK: 100
1718-51-0	Terphenyl-d14	102		20 - 171		102%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	41993	4.7				
1146-65-2	Naphthalene-d8	159570	5.86				
15067-26-2	Acenaphthene-d10	76529	7.53				
1517-22-2	Phenanthrene-d10	107675	9.16				
1719-03-5	Chrysene-d12	79815	12.33				
1520-96-3	Perylene-d12	81857	14.13				

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SD031611R1	SDG No.:	C1594
Lab Sample ID:	C1594-02	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	970 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044172.D	1	03/22/11	03/24/11	PB54251

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	10	U	0.12	5	10	ug/L
208-96-8	Acenaphthylene	10	U	0.72	5	10	ug/L
83-32-9	Acenaphthene	10	U	0.22	5	10	ug/L
86-73-7	Fluorene	10	U	0.32	5	10	ug/L
85-01-8	Phenanthrene	10	U	0.27	5	10	ug/L
120-12-7	Anthracene	10	U	0.16	5	10	ug/L
206-44-0	Fluoranthene	10	U	0.41	5	10	ug/L
129-00-0	Pyrene	10	U	0.21	5	10	ug/L
56-55-3	Benzo(a)anthracene	10	U	0.16	5	10	ug/L
218-01-9	Chrysene	10	U	0.19	5	10	ug/L
205-99-2	Benzo(b)fluoranthene	10	U	0.3	5	10	ug/L
207-08-9	Benzo(k)fluoranthene	10	U	0.19	5	10	ug/L
50-32-8	Benzo(a)pyrene	10	U	0.14	5	10	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	10	U	0.15	5	10	ug/L
53-70-3	Dibenz(a,h)anthracene	10	U	0.43	5	10	ug/L
191-24-2	Benzo(g,h,i)perylene	10	U	0.3	5	10	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	108		20 - 139		108%	SPK: 100
321-60-8	2-Fluorobiphenyl	108		10 - 173		109%	SPK: 100
1718-51-0	Terphenyl-d14	100		20 - 171		100%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	43521	4.7				
1146-65-2	Naphthalene-d8	170674	5.86				
15067-26-2	Acenaphthene-d10	81325	7.52				
1517-22-2	Phenanthrene-d10	111483	9.16				
1719-03-5	Chrysene-d12	83318	12.33				
1520-96-3	Perylene-d12	85797	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SW031611R1	SDG No.:	C1594
Lab Sample ID:	C1594-03	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	970 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069938.D	1	03/22/11	03/28/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.1	U UJ	0.021	0.05	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.021	0.05	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.021	0.05	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.021	0.05	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.021	0.05	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.021	0.05	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.021	0.05	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.021	0.05	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.021	0.05	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.021	0.05	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.021	0.05	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.021	0.05	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.021	0.05	0.1	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	6.27		20 - 139		63%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.08		10 - 173		71%	SPK: 10
1718-51-0	Terphenyl-d14	9.56		20 - 171		96%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	11553	8.89				
1146-65-2	Naphthalene-d8	52921	11.07				
15067-26-2	Acenaphthene-d10	34513	14.02				
1517-22-2	Phenanthrene-d10	71706	16.51				
1719-03-5	Chrysene-d12	75419	21.02				
1520-96-3	Perylene-d12	61572	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-39			SDG No.:	C1594
Lab Sample ID:	C1594-04			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	35
Sample Wt/Vol:	30.12	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044318.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	510	U	18	255	510	ug/Kg
208-96-8	Acenaphthylene	510	U	13	255	510	ug/Kg
83-32-9	Acenaphthene	510	U	14	255	510	ug/Kg
86-73-7	Fluorene	510	U	19	255	510	ug/Kg
85-01-8	Phenanthrene	510	U	14	255	510	ug/Kg
120-12-7	Anthracene	510	U	10	255	510	ug/Kg
206-44-0	Fluoranthene	76	J J	10	255	510	ug/Kg
129-00-0	Pyrene	72	J J	12	255	510	ug/Kg
56-55-3	Benzo(a)anthracene	510	U	24	255	510	ug/Kg
218-01-9	Chrysene	83	J J	23	255	510	ug/Kg
205-99-2	Benzo(b)fluoranthene	120	J J	17	255	510	ug/Kg
207-08-9	Benzo(k)fluoranthene	510	U	24	255	510	ug/Kg
50-32-8	Benzo(a)pyrene	510	U	11	255	510	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	510	U	17	255	510	ug/Kg
53-70-3	Dibenz(a,h)anthracene	510	U	15	255	510	ug/Kg
191-24-2	Benzo(g,h,i)perylene	510	U	21	255	510	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	87.3		30 - 150		87%	SPK: 100
321-60-8	2-Fluorobiphenyl	68		19 - 182		68%	SPK: 100
1718-51-0	Terphenyl-d14	42.3		24 - 191		42%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	87572	4.65				
1146-65-2	Naphthalene-d8	312999	5.82				
15067-26-2	Acenaphthene-d10	165083	7.47				
1517-22-2	Phenanthrene-d10	222359	9.12				
1719-03-5	Chrysene-d12	189462	12.27				
1520-96-3	Perylene-d12	185860	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-23C			SDG No.:	C1594
Lab Sample ID:	C1594-05			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	26
Sample Wt/Vol:	30.07	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044324.D	5	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1300	J J	78	1100	2200	ug/Kg
208-96-8	Acenaphthylene	2200	U	57	1100	2200	ug/Kg
83-32-9	Acenaphthene	3000		63	1100	2200	ug/Kg
86-73-7	Fluorene	2800		85	1100	2200	ug/Kg
85-01-8	Phenanthrene	16000		61	1100	2200	ug/Kg
120-12-7	Anthracene	4700		46	1100	2200	ug/Kg
206-44-0	Fluoranthene	14000		45	1100	2200	ug/Kg
129-00-0	Pyrene	16000		54	1100	2200	ug/Kg
56-55-3	Benzo(a)anthracene	8000		110	1100	2200	ug/Kg
218-01-9	Chrysene	7100		100	1100	2200	ug/Kg
205-99-2	Benzo(b)fluoranthene	8600		73	1100	2200	ug/Kg
207-08-9	Benzo(k)fluoranthene	3600		110	1100	2200	ug/Kg
50-32-8	Benzo(a)pyrene	6800		49	1100	2200	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	2700		75	1100	2200	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1000	J J	65	1100	2200	ug/Kg
191-24-2	Benzo(g,h,i)perylene	3300		91	1100	2200	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	83.6		30 - 150		84%	SPK: 100
321-60-8	2-Fluorobiphenyl	62.6		19 - 182		63%	SPK: 100
1718-51-0	Terphenyl-d14	62		24 - 191		62%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	82370	4.65				
1146-65-2	Naphthalene-d8	321793	5.82				
15067-26-2	Acenaphthene-d10	168282	7.47				
1517-22-2	Phenanthrene-d10	257431	9.12				
1719-03-5	Chrysene-d12	138355	12.28				
1520-96-3	Perylene-d12	114627	14.06				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-42			SDG No.:	C1594
Lab Sample ID:	C1594-06			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	20
Sample Wt/Vol:	30.09	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044325.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	410	U	14	205	410	ug/Kg
208-96-8	Acenaphthylene	410	U	10	205	410	ug/Kg
83-32-9	Acenaphthene	410	U	12	205	410	ug/Kg
86-73-7	Fluorene	410	U	16	205	410	ug/Kg
85-01-8	Phenanthrene	320	J J	11	205	410	ug/Kg
120-12-7	Anthracene	83	J J	8.5	205	410	ug/Kg
206-44-0	Fluoranthene	500		8.3	205	410	ug/Kg
129-00-0	Pyrene	460		10	205	410	ug/Kg
56-55-3	Benzo(a)anthracene	230	J J	20	205	410	ug/Kg
218-01-9	Chrysene	220	J J	19	205	410	ug/Kg
205-99-2	Benzo(b)fluoranthene	300	J J	14	205	410	ug/Kg
207-08-9	Benzo(k)fluoranthene	88	J J	20	205	410	ug/Kg
50-32-8	Benzo(a)pyrene	200	J J	9	205	410	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	87	J J	14	205	410	ug/Kg
53-70-3	Dibenz(a,h)anthracene	410	U	12	205	410	ug/Kg
191-24-2	Benzo(g,h,i)perylene	120	J J	17	205	410	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	96		30 - 150		96%	SPK: 100
321-60-8	2-Fluorobiphenyl	91.5		19 - 182		91%	SPK: 100
1718-51-0	Terphenyl-d14	80.4		24 - 191		80%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	59016	4.65				
1146-65-2	Naphthalene-d8	233911	5.82				
15067-26-2	Acenaphthene-d10	119957	7.47				
1517-22-2	Phenanthrene-d10	192824	9.11				
1719-03-5	Chrysene-d12	128034	12.27				
1520-96-3	Perylene-d12	105028	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-54			SDG No.:	C1594
Lab Sample ID:	C1594-08			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	43
Sample Wt/Vol:	30.03	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044345.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	290	J J	20	290	580	ug/Kg
208-96-8	Acenaphthylene	580	U	15	290	580	ug/Kg
83-32-9	Acenaphthene	540	J J	16	290	580	ug/Kg
86-73-7	Fluorene	470	J J	22	290	580	ug/Kg
85-01-8	Phenanthrene	3500	J	16	290	580	ug/Kg
120-12-7	Anthracene	850	J	12	290	580	ug/Kg
206-44-0	Fluoranthene	3800	J	12	290	580	ug/Kg
129-00-0	Pyrene	4900	E R	14	290	580	ug/Kg
56-55-3	Benzo(a)anthracene	2400	J	28	290	580	ug/Kg
218-01-9	Chrysene	2300	J	26	290	580	ug/Kg
205-99-2	Benzo(b)fluoranthene	2600	J	19	290	580	ug/Kg
207-08-9	Benzo(k)fluoranthene	1100	J	28	290	580	ug/Kg
50-32-8	Benzo(a)pyrene	2000	J	13	290	580	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	820	J	19	290	580	ug/Kg
53-70-3	Dibenz(a,h)anthracene	350	J J	17	290	580	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1100	J	24	290	580	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	80.1		30 - 150		80%	SPK: 100
321-60-8	2-Fluorobiphenyl	59.3		19 - 182		59%	SPK: 100
1718-51-0	Terphenyl-d14	58		24 - 191		58%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	71726	4.63				
1146-65-2	Naphthalene-d8	294810	5.8				
15067-26-2	Acenaphthene-d10	149864	7.45				
1517-22-2	Phenanthrene-d10	232357	9.09				
1719-03-5	Chrysene-d12	109426	12.25				
1520-96-3	Perylene-d12	87693	14.01				

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-54DL	SDG No.:	C1594
Lab Sample ID:	C1594-08DL	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	43
Sample Wt/Vol:	30.03 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044370.D	2	03/22/11	03/31/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	300	JD J	40	600	1200	ug/Kg
208-96-8	Acenaphthylene	1200	UD	29	600	1200	ug/Kg
83-32-9	Acenaphthene	580	JD J	33	600	1200	ug/Kg
86-73-7	Fluorene	520	JD J	44	600	1200	ug/Kg
85-01-8	Phenanthrene	3800	D J	32	600	1200	ug/Kg
120-12-7	Anthracene	910	JD J	24	600	1200	ug/Kg
206-44-0	Fluoranthene	4600	D J	23	600	1200	ug/Kg
129-00-0	Pyrene	4600	D J	28	600	1200	ug/Kg
56-55-3	Benzo(a)anthracene	2500	D J	56	600	1200	ug/Kg
218-01-9	Chrysene	2300	D J	53	600	1200	ug/Kg
205-99-2	Benzo(b)fluoranthene	3100	D J	38	600	1200	ug/Kg
207-08-9	Benzo(k)fluoranthene	890	JD J	55	600	1200	ug/Kg
50-32-8	Benzo(a)pyrene	2000	D J	25	600	1200	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	920	JD J	39	600	1200	ug/Kg
53-70-3	Dibenz(a,h)anthracene	300	JD J	34	600	1200	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1100	JD J	47	600	1200	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	90.8		30 - 150		91%	SPK: 100
321-60-8	2-Fluorobiphenyl	67.3		19 - 182		67%	SPK: 100
1718-51-0	Terphenyl-d14	55.1		24 - 191		55%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	85624	4.63				
1146-65-2	Naphthalene-d8	315575	5.8				
15067-26-2	Acenaphthene-d10	160338	7.46				
1517-22-2	Phenanthrene-d10	258032	9.09				
1719-03-5	Chrysene-d12	154862	12.25				
1520-96-3	Perylene-d12	136564	14.02				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-58			SDG No.:	C1594
Lab Sample ID:	C1594-12			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	23
Sample Wt/Vol:	30.01	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044319.D	5	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	2100	U	75	1050	2100	ug/Kg
208-96-8	Acenaphthylene	2100	U	55	1050	2100	ug/Kg
83-32-9	Acenaphthene	2100	U	61	1050	2100	ug/Kg
86-73-7	Fluorene	2100	U	82	1050	2100	ug/Kg
85-01-8	Phenanthrene	2100	U	58	1050	2100	ug/Kg
120-12-7	Anthracene	2100	U	44	1050	2100	ug/Kg
206-44-0	Fluoranthene	2100	U	43	1050	2100	ug/Kg
129-00-0	Pyrene	2100	U	52	1050	2100	ug/Kg
56-55-3	Benzo(a)anthracene	2100	U	100	1050	2100	ug/Kg
218-01-9	Chrysene	2100	U	98	1050	2100	ug/Kg
205-99-2	Benzo(b)fluoranthene	2100	U	71	1050	2100	ug/Kg
207-08-9	Benzo(k)fluoranthene	2100	U	100	1050	2100	ug/Kg
50-32-8	Benzo(a)pyrene	2100	U	47	1050	2100	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	2100	U	72	1050	2100	ug/Kg
53-70-3	Dibenz(a,h)anthracene	2100	U	62	1050	2100	ug/Kg
191-24-2	Benzo(g,h,i)perylene	2100	U	88	1050	2100	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	97.8		30 - 150		98%	SPK: 100
321-60-8	2-Fluorobiphenyl	76.6		19 - 182		77%	SPK: 100
1718-51-0	Terphenyl-d14	56.6		24 - 191		57%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	87342	4.65				
1146-65-2	Naphthalene-d8	318403	5.82				
15067-26-2	Acenaphthene-d10	170410	7.47				
1517-22-2	Phenanthrene-d10	276931	9.11				
1719-03-5	Chrysene-d12	229140	12.27				
1520-96-3	Perylene-d12	222659	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-43			SDG No.:	C1594
Lab Sample ID:	C1594-13			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	37
Sample Wt/Vol:	30.03	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044348.D	1	03/22/11	03/31/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	520	U	18	260	520	ug/Kg
208-96-8	Acenaphthylene	520	U	13	260	520	ug/Kg
83-32-9	Acenaphthene	520	U	15	260	520	ug/Kg
86-73-7	Fluorene	520	U	20	260	520	ug/Kg
85-01-8	Phenanthrene	520	U	14	260	520	ug/Kg
120-12-7	Anthracene	520	U	11	260	520	ug/Kg
206-44-0	Fluoranthene	520	U	11	260	520	ug/Kg
129-00-0	Pyrene	520	U	13	260	520	ug/Kg
56-55-3	Benzo(a)anthracene	520	U	25	260	520	ug/Kg
218-01-9	Chrysene	520	U	24	260	520	ug/Kg
205-99-2	Benzo(b)fluoranthene	520	U	17	260	520	ug/Kg
207-08-9	Benzo(k)fluoranthene	520	U	25	260	520	ug/Kg
50-32-8	Benzo(a)pyrene	520	U	11	260	520	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	520	U	18	260	520	ug/Kg
53-70-3	Dibenz(a,h)anthracene	520	U	15	260	520	ug/Kg
191-24-2	Benzo(g,h,i)perylene	520	U	21	260	520	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	81.8		30 - 150		82%	SPK: 100
321-60-8	2-Fluorobiphenyl	58.8		19 - 182		59%	SPK: 100
1718-51-0	Terphenyl-d14	51.4		24 - 191		51%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	70784	4.63				
1146-65-2	Naphthalene-d8	279341	5.8				
15067-26-2	Acenaphthene-d10	147103	7.46				
1517-22-2	Phenanthrene-d10	229842	9.09				
1719-03-5	Chrysene-d12	139374	12.25				
1520-96-3	Perylene-d12	115996	14.01				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-35C			SDG No.:	C1594
Lab Sample ID:	C1594-22			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	15
Sample Wt/Vol:	30.04	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044323.D	10	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	3900	U	140	1950	3900	ug/Kg
208-96-8	Acenaphthylene	3900	U	99	1950	3900	ug/Kg
83-32-9	Acenaphthene	3900	U	110	1950	3900	ug/Kg
86-73-7	Fluorene	3900	U	150	1950	3900	ug/Kg
85-01-8	Phenanthrene	1800	J J	110	1950	3900	ug/Kg
120-12-7	Anthracene	510	J J	80	1950	3900	ug/Kg
206-44-0	Fluoranthene	1600	J J	79	1950	3900	ug/Kg
129-00-0	Pyrene	8500		94	1950	3900	ug/Kg
56-55-3	Benzo(a)anthracene	5400		190	1950	3900	ug/Kg
218-01-9	Chrysene	6700		180	1950	3900	ug/Kg
205-99-2	Benzo(b)fluoranthene	3100	J J	130	1950	3900	ug/Kg
207-08-9	Benzo(k)fluoranthene	1300	J J	180	1950	3900	ug/Kg
50-32-8	Benzo(a)pyrene	7100		85	1950	3900	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1300	J J	130	1950	3900	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1100	J J	110	1950	3900	ug/Kg
191-24-2	Benzo(g,h,i)perylene	3800	J J	160	1950	3900	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	96.5		30 - 150		97%	SPK: 100
321-60-8	2-Fluorobiphenyl	85.4		19 - 182		85%	SPK: 100
1718-51-0	Terphenyl-d14	97.1		24 - 191		97%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	80192	4.65				
1146-65-2	Naphthalene-d8	294668	5.82				
15067-26-2	Acenaphthene-d10	160599	7.47				
1517-22-2	Phenanthrene-d10	257032	9.11				
1719-03-5	Chrysene-d12	117589	12.28				
1520-96-3	Perylene-d12	86494	14.05				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-56			SDG No.:	C1594
Lab Sample ID:	C1594-23			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	30
Sample Wt/Vol:	30.01	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044315.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	470	U	16	235	470	ug/Kg
208-96-8	Acenaphthylene	470	U	12	235	470	ug/Kg
83-32-9	Acenaphthene	470	U	13	235	470	ug/Kg
86-73-7	Fluorene	470	U	18	235	470	ug/Kg
85-01-8	Phenanthrene	470	U	13	235	470	ug/Kg
120-12-7	Anthracene	470	U	9.7	235	470	ug/Kg
206-44-0	Fluoranthene	470	U	9.6	235	470	ug/Kg
129-00-0	Pyrene	470	U	11	235	470	ug/Kg
56-55-3	Benzo(a)anthracene	470	U	23	235	470	ug/Kg
218-01-9	Chrysene	470	U	22	235	470	ug/Kg
205-99-2	Benzo(b)fluoranthene	470	U	16	235	470	ug/Kg
207-08-9	Benzo(k)fluoranthene	470	U	22	235	470	ug/Kg
50-32-8	Benzo(a)pyrene	470	U	10	235	470	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	470	U	16	235	470	ug/Kg
53-70-3	Dibenz(a,h)anthracene	470	U	14	235	470	ug/Kg
191-24-2	Benzo(g,h,i)perylene	470	U	19	235	470	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	89.3		30 - 150		89%	SPK: 100
321-60-8	2-Fluorobiphenyl	67.2		19 - 182		67%	SPK: 100
1718-51-0	Terphenyl-d14	55.1		24 - 191		55%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	77543	4.65				
1146-65-2	Naphthalene-d8	287365	5.82				
15067-26-2	Acenaphthene-d10	150767	7.47				
1517-22-2	Phenanthrene-d10	251384	9.11				
1719-03-5	Chrysene-d12	194761	12.27				
1520-96-3	Perylene-d12	201280	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-57	SDG No.:	C1594
Lab Sample ID:	C1594-24	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	38
Sample Wt/Vol:	30.05 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044316.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	530	U	19	265	530	ug/Kg
208-96-8	Acenaphthylene	530	U	14	265	530	ug/Kg
83-32-9	Acenaphthene	530	U	15	265	530	ug/Kg
86-73-7	Fluorene	530	U	20	265	530	ug/Kg
85-01-8	Phenanthrene	530	U	14	265	530	ug/Kg
120-12-7	Anthracene	530	U	11	265	530	ug/Kg
206-44-0	Fluoranthene	530	U	11	265	530	ug/Kg
129-00-0	Pyrene	530	U	13	265	530	ug/Kg
56-55-3	Benzo(a)anthracene	530	U	26	265	530	ug/Kg
218-01-9	Chrysene	530	U	24	265	530	ug/Kg
205-99-2	Benzo(b)fluoranthene	530	U	18	265	530	ug/Kg
207-08-9	Benzo(k)fluoranthene	530	U	25	265	530	ug/Kg
50-32-8	Benzo(a)pyrene	530	U	12	265	530	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	530	U	18	265	530	ug/Kg
53-70-3	Dibenz(a,h)anthracene	530	U	15	265	530	ug/Kg
191-24-2	Benzo(g,h,i)perylene	530	U	22	265	530	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	87.4		30 - 150		87%	SPK: 100
321-60-8	2-Fluorobiphenyl	66.7		19 - 182		67%	SPK: 100
1718-51-0	Terphenyl-d14	54.8		24 - 191		55%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	74644	4.65				
1146-65-2	Naphthalene-d8	278762	5.82				
15067-26-2	Acenaphthene-d10	146597	7.47				
1517-22-2	Phenanthrene-d10	238077	9.11				
1719-03-5	Chrysene-d12	184540	12.27				
1520-96-3	Perylene-d12	154217	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-43DUP			SDG No.:	C1594
Lab Sample ID:	C1594-25			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	46
Sample Wt/Vol:	30.07	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044317.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	190	J J	21	305	610	ug/Kg
208-96-8	Acenaphthylene	610	U	16	305	610	ug/Kg
83-32-9	Acenaphthene	610	U	17	305	610	ug/Kg
86-73-7	Fluorene	610	U	23	305	610	ug/Kg
85-01-8	Phenanthrene	610	U	17	305	610	ug/Kg
120-12-7	Anthracene	610	U	13	305	610	ug/Kg
206-44-0	Fluoranthene	610	U	12	305	610	ug/Kg
129-00-0	Pyrene	610	U	15	305	610	ug/Kg
56-55-3	Benzo(a)anthracene	610	U	29	305	610	ug/Kg
218-01-9	Chrysene	610	U	28	305	610	ug/Kg
205-99-2	Benzo(b)fluoranthene	610	U	20	305	610	ug/Kg
207-08-9	Benzo(k)fluoranthene	610	U	29	305	610	ug/Kg
50-32-8	Benzo(a)pyrene	610	U	13	305	610	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	610	U	21	305	610	ug/Kg
53-70-3	Dibenz(a,h)anthracene	610	U	18	305	610	ug/Kg
191-24-2	Benzo(g,h,i)perylene	610	U	25	305	610	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	51.6		30 - 150		52%	SPK: 100
321-60-8	2-Fluorobiphenyl	39.4		19 - 182		39%	SPK: 100
1718-51-0	Terphenyl-d14	37.3		24 - 191		37%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	86381	4.65				
1146-65-2	Naphthalene-d8	315916	5.82				
15067-26-2	Acenaphthene-d10	162126	7.47				
1517-22-2	Phenanthrene-d10	264757	9.11				
1719-03-5	Chrysene-d12	227248	12.27				
1520-96-3	Perylene-d12	227186	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-54DUP			SDG No.:	C1594
Lab Sample ID:	C1594-26			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	36
Sample Wt/Vol:	30.12	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044322.D	1	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	340	J J	18	255	510	ug/Kg
208-96-8	Acenaphthylene	510	U	13	255	510	ug/Kg
83-32-9	Acenaphthene	1200	J	15	255	510	ug/Kg
86-73-7	Fluorene	900	J	20	255	510	ug/Kg
85-01-8	Phenanthrene	6700	E R	14	255	510	ug/Kg
120-12-7	Anthracene	1700	J	11	255	510	ug/Kg
206-44-0	Fluoranthene	6900	E R	10	255	510	ug/Kg
129-00-0	Pyrene	9500	E R	12	255	510	ug/Kg
56-55-3	Benzo(a)anthracene	4800	E R	25	255	510	ug/Kg
218-01-9	Chrysene	4500	E R	23	255	510	ug/Kg
205-99-2	Benzo(b)fluoranthene	5600	E R	17	255	510	ug/Kg
207-08-9	Benzo(k)fluoranthene	1900	J	24	255	510	ug/Kg
50-32-8	Benzo(a)pyrene	3900	J	11	255	510	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1700	J	17	255	510	ug/Kg
53-70-3	Dibenz(a,h)anthracene	600	J	15	255	510	ug/Kg
191-24-2	Benzo(g,h,i)perylene	2200	J	21	255	510	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	81.5		30 - 150		81%	SPK: 100
321-60-8	2-Fluorobiphenyl	58.8		19 - 182		59%	SPK: 100
1718-51-0	Terphenyl-d14	56.8		24 - 191		57%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	68133	4.65				
1146-65-2	Naphthalene-d8	279402	5.82				
15067-26-2	Acenaphthene-d10	142697	7.47				
1517-22-2	Phenanthrene-d10	208879	9.12				
1719-03-5	Chrysene-d12	90910	12.29				
1520-96-3	Perylene-d12	80169	14.06				

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-54DUPDL	SDG No.:	C1594
Lab Sample ID:	C1594-26DL	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	36
Sample Wt/Vol:	30.12 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044342.D	5	03/22/11	03/30/11	PB54258

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	360	JD J	89	1300	2600	ug/Kg
208-96-8	Acenaphthylene	2600	UD	65	1300	2600	ug/Kg
83-32-9	Acenaphthene	1400	JD J	73	1300	2600	ug/Kg
86-73-7	Fluorene	1100	JD J	98	1300	2600	ug/Kg
85-01-8	Phenanthrene	8700	D J	70	1300	2600	ug/Kg
120-12-7	Anthracene	2200	JD J	53	1300	2600	ug/Kg
206-44-0	Fluoranthene	11000	D J	52	1300	2600	ug/Kg
129-00-0	Pyrene	9400	D J	62	1300	2600	ug/Kg
56-55-3	Benzo(a)anthracene	5700	D J	120	1300	2600	ug/Kg
218-01-9	Chrysene	5000	D J	120	1300	2600	ug/Kg
205-99-2	Benzo(b)fluoranthene	6200	D J	85	1300	2600	ug/Kg
207-08-9	Benzo(k)fluoranthene	2500	JD J	120	1300	2600	ug/Kg
50-32-8	Benzo(a)pyrene	4500	D J	56	1300	2600	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	2200	JD J	86	1300	2600	ug/Kg
53-70-3	Dibenz(a,h)anthracene	710	JD J	75	1300	2600	ug/Kg
191-24-2	Benzo(g,h,i)perylene	2600	D J	110	1300	2600	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	99.2		30 - 150		99%	SPK: 100
321-60-8	2-Fluorobiphenyl	72		19 - 182		72%	SPK: 100
1718-51-0	Terphenyl-d14	59.2		24 - 191		59%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	66649	4.63				
1146-65-2	Naphthalene-d8	268180	5.8				
15067-26-2	Acenaphthene-d10	136774	7.45				
1517-22-2	Phenanthrene-d10	226714	9.09				
1719-03-5	Chrysene-d12	154357	12.24				
1520-96-3	Perylene-d12	139371	14				

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	SS031911R1	SDG No.:	C1594
Lab Sample ID:	C1594-27	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	990 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044173.D	1	03/22/11	03/25/11	PB54251

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	10	U UJ	0.12	5	10	ug/L
208-96-8	Acenaphthylene	10	U UJ	0.71	5	10	ug/L
83-32-9	Acenaphthene	10	U UJ	0.21	5	10	ug/L
86-73-7	Fluorene	10	U UJ	0.31	5	10	ug/L
85-01-8	Phenanthrene	10	U UJ	0.26	5	10	ug/L
120-12-7	Anthracene	10	U UJ	0.16	5	10	ug/L
206-44-0	Fluoranthene	10	U UJ	0.4	5	10	ug/L
129-00-0	Pyrene	10	U UJ	0.2	5	10	ug/L
56-55-3	Benzo(a)anthracene	10	U UJ	0.16	5	10	ug/L
218-01-9	Chrysene	10	U UJ	0.18	5	10	ug/L
205-99-2	Benzo(b)fluoranthene	10	U UJ	0.29	5	10	ug/L
207-08-9	Benzo(k)fluoranthene	10	U UJ	0.18	5	10	ug/L
50-32-8	Benzo(a)pyrene	10	U UJ	0.14	5	10	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	10	U UJ	0.15	5	10	ug/L
53-70-3	Dibenz(a,h)anthracene	10	U UJ	0.42	5	10	ug/L
191-24-2	Benzo(g,h,i)perylene	10	U UJ	0.29	5	10	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	118		20 - 139		118%	SPK: 100
321-60-8	2-Fluorobiphenyl	117		10 - 173		117%	SPK: 100
1718-51-0	Terphenyl-d14	115		20 - 171		115%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	44831	4.7				
1146-65-2	Naphthalene-d8	168747	5.86				
15067-26-2	Acenaphthene-d10	79514	7.52				
1517-22-2	Phenanthrene-d10	111047	9.16				
1719-03-5	Chrysene-d12	75648	12.33				
1520-96-3	Perylene-d12	80430	14.13				

Shaw Environmental, Inc.
2113 Emmorton Park Road
Edgewood, Maryland
410-612-6350
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Shaw® Shaw Environmental, Inc.

MEMORANDUM

TO: Gerard Maresca, Shaw E&I Picatinny Arsenal (PTA) Project Manager

FROM: Eric Malarek, Shaw E&I PTA Project Chemist

SUBJECT: PTA Data Validation – Metals
Chemtech C1595

DATE: June 21, 2011

The purpose of this memorandum is to present the data validation report for the samples collected for the Skeet Range samples collected at the PTA Site on March 16, 2011, March 19, 2011, and March 21, 2011. Samples B1181SS-10D, B1181SD-12, B1181SS-14C, B1181SS-49, and B1181SS-48 were analyzed for lead only. The remaining samples were analyzed for antimony, arsenic, copper, iron, lead, and zinc. The solid samples were analyzed for select metals using USEPA SW-846 3050B/6010B. The aqueous samples were analyzed for select metals using USEPA SW-846 3010A/6020. A total of eighteen solid samples and six aqueous samples were validated. The sample Ids are:

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
B1181SD-6	C1595-01	B1181SS-49	C1595-17
B1181SW-6	C1595-04	B1181SS-61	C1595-18
B1181SS-45	C1595-07	B1181SS-60	C1595-19
B1181SS-46	C1595-08	B1181SS-59	C1595-20
B1181SD-3C	C1595-09	B1181SS-34	C1595-21
B1181SS-10D	C1595-10	B1181SS-48	C1595-22
B1181SD-12	C1595-11	B1181SD-9	C1595-23
B1181SS-14C	C1595-12	B1181SW-9	C1595-24
B1181SD-7C	C1595-13	B1181SD-10	C1595-25
B1181SW-7	C1595-14	B1181SW-10	C1595-26
B1181SD-8	C1595-15	B1181SD-6DUP	C1595-27
B1181SW-8	C1595-16	B1181SW-6DUP	C1595-28

Data were reviewed and validated using a combination of project QAPP, *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2, October 2010* (DoD, 2010) (DoD QSM), and method-specific criteria. The data qualifier scheme was consistent with the *USEPA Region II Evaluation of Metals Data for the Contract Laboratory Program, Revision 13* (SOP HW-2, September 2006). Parameters evaluated are presented in **Table 1**. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA specifications.

Table 1 Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times and Preservation
	X	Initial and Continuing Calibration
X		Blank Analysis
	X	ICP and ICPMS Interference Check Sample (ICS)
	X	Laboratory Control Sample (LCS)
X		Laboratory Duplicate
X		Matrix Spike (MS) and Spike Duplicate (MSD)
X		Field Duplicate
	X	ICP and ICPMS Serial Dilution
X		Quantitation Verification and Data Review

The quality of data collected in support of this sampling activity is considered acceptable with noted qualifications; except for the following. For the field duplicate pair B1181SD-6 (C1595-01) and B1181SD-6DUP (C1595-27), antimony, arsenic, and lead were grossly outside RPD criteria and were detected above the MRL; therefore, they were qualified rejected "R" for the duplicate pair based upon the very high RPDs (>100%). See Section VIII for further details.

Eric Malarek, Chemist

6/21/11
Date

PTA VALIDATION REPORT
METALS REVIEW
SDG C1595

I-Holding Times and Preservation

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample analysis. For ICP and ICPMS metals analysis, aqueous samples are received and stored at cool @4°C±2°C and preserved to pH<2 with nitric acid with a maximum holding time of 180 days from collection (USEPA criteria). For ICP and ICPMS metals analysis, solid samples are received and stored at cool @4°C±2°C with a maximum holding time of 180 days from collection (USEPA criteria).

- Temperature Review: The temperature blank was sent with each cooler and recorded by the laboratory upon receipt. For samples collected on 03/16/11, 03/19/11, and 03/21/11, the coolers were received by the laboratory (Chemtech) on 03/21/11 at 5°C, 5°C, and 5°C. All criteria were met. No qualifiers were applied.

- Holding Time Review: The solid samples and aqueous rinse blank samples were collected on 03/16/11, 03/19/11, and 03/21/11 for select metals analysis. The soil samples were digested on 03/22/11 and analyzed on 03/23/11. The aqueous samples were digested on 03/22/11 and analyzed on 03/30/11 for ICPMS analysis. The analysis dates for each sample may be found on the attached form 1s. All criteria were met. No qualifiers were applied.

II-Initial and Continuing Calibration

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP and ICPMS:	1- blank (DoD QSM <LOD)
	3 – standards ($r \geq 0.995$)
	ICV/CCV (90-110%) (DoD QSM 90-110%)
	MRL (70-130%) (DoD QSM 80-120%)

- The aqueous samples were analyzed for ICPMS metals on 03/30/11. The soil samples were analyzed on 03/23/11 for ICP metals. All ICP and ICPMS metals were calibrated using 5 point calibrations with correlation coefficients >0.995. All ICV/CCV/MRL criteria were met for all metals and runs.

III-Blanks

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. One method blank per analytical batch must be run on each instrument used to analyze samples. Calibration blanks were analyzed initially and at a 10% frequency thereafter for each batch. No contaminants should be detected in any of the associated blanks >MDL. The DoD QSM criteria specifies all concentrations should be less than ½MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters) and <LOD (i.e. <2MDL) for the calibration blanks. Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters, or 5 times (5X) the maximum amount for other target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one and for solid matrices were converted to soil values from µg/L to mg/kg for ICP and ICPMS (soil conversion factor = 10), if needed. Rinse blank samples SS031611R1 (C1594-01) and SS031911R1 (C1594-27) apply to all surface soil "SS" samples collected in this SDG. Rinse blank sample SD031611R1 (C1594-02) applies to all sediment "SD" samples and rinse blank SW031611R1 (C1594-03) applies to all surface water "SW" samples.

Table 2 Blank Contamination Analysis Summary

Analysis Date	Analysis	QC Blank ID	Max Conc. µg/L	Action Level µg/L	U qualified samples (for this SDG)
03/30/11	ICPMS-Sb	ICB/CCBs	0.494J	2.47	B1181SW-7, B1181SW-8
03/30/11	ICPMS-As	ICB/CCBs	0.233J	1.17	B1181SW-7, B1181SW-8, B1181SW-9, B1181SW-6DUP
03/30/11	ICPMS-Cu	ICB/CCBs	0.204J	1.02	None
03/30/11	ICPMS-Fe	ICB/CCBs	14.33J	71.7	None
03/30/11	ICPMS-Pb	ICB/CCBs	0.163J	0.815	None
03/30/11	ICPMS	PB54268BL	<½MRL	NA	None
03/30/11	ICPMS-Cu	SW031611R1	0.65J	3.25	B1181SW-7, B1181SW-9
03/30/11	ICPMS-Pb	SW031611R1	0.42J	2.10	None
03/30/11	ICPMS-Zn	SW031611R1	7.8	39.0	B1181SW-7, B1181SW-8
Analysis Date	**Analysis**	**QC Blank ID**	**Max Conc. mg/kg**	**Action Level mg/kg**	**U qualified samples (for this SDG)**
03/23/11	ICP	ICB/CCBs	<LOD	NA	None
03/23/11	ICP	PB54269BL	<½MRL	NA	None
03/23/11	ICP	SS031611R1	<½MRL	NA	None
03/23/11	ICP	SS031911R1	<½MRL	NA	None
03/23/11	ICP-Zn	SD031611R1	0.977J	4.89	None

J = Estimated value <MRL and >MDL.
LOD = Limit of Detection
MRL = Method Reporting Limit
MDL = Method Detection Limit
NA = Not Applicable
SDG= Sample Delivery Group

IV-ICP and ICPMS Interference Check Sample (ICS)

The ICP and ICPMS interference check sample (ICS) verifies inter-element and background correction factors. ICP and ICPMS Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120% (DoD QSM limits 80-120%).

- All criteria were met for all runs. No qualifiers were applied.

V-Laboratory Control Samples (LCS)

The laboratory control sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. The DoD QSM aqueous LCS criteria are specified in Table G-18 of the DoD QSM (DoD, 2010) and are 80-120% and RPD≤20% for ICP and ICPMS metals. The DoD QSM solid LCS criteria are specified in Table G-19 of the DoD QSM (DoD, 2010) and are 80-120% (75-120% for silver) and RPD≤20% for ICP and ICPMS metals.

- Sample PB54269BS was used as solid LCS for ICP metals analysis dated 03/23/11. All criteria were met. No qualifiers were applied. Samples B1181SD-6 (C1595-01), B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SS-10D (C1595-10), B1181SD-12 (C1595-11), B1181SS-14C (C1595-12), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-49 (C1595-17), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), B1181SS-34 (C1595-21), B1181SS-48 (C1595-22), B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this LCS.

- Sample PB54268BS was used as aqueous LCS for ICPMS metals analysis dated 03/30/11. All criteria were met. No qualifiers were applied. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this LCS.

VI-Laboratory Duplicate
Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analysis is also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. RPDs must be within established control limits. The DoD QSM limits for the aqueous and solid samples are ≤20% RPD for ICP and ICPMS metals.

- Sample B1181SD-6 (C1595-01)) was used as the solid laboratory duplicate for the ICP metals analysis on 03/23/11. All criteria were met. No qualifiers were applied. Samples B1181SD-6 (C1595-01), B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SS-10D (C1595-10), B1181SD-12 (C1595-11), B1181SS-14C (C1595-12), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-49 (C1595-17), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), B1181SS-34 (C1595-21), B1181SS-48 (C1595-22), B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this laboratory duplicate.

- Sample B1181SW-6 (C1595-04) was used as the aqueous laboratory duplicate for the ICPMS metals analysis on 03/30/11. Arsenic (35.2%) was outside criteria. Arsenic was detected for the associated samples; therefore, was qualified estimated "J" based upon the low recoveries. All other metals and RPDs were within criteria limits. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this laboratory duplicate.

VII-Matrix Spike (MS) and Spike Duplicate (MSD)
MS and MSD are generated to determine long-term accuracy and precision of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. Specific criteria include the analyses of matrix spike samples at a frequency of one MS/MSD per 20 samples of similar matrix. MS/MSD recoveries and relative percent differences between MS recoveries should be within the specified limits. The DoD MS and MSD aqueous recovery limits use the LCS criteria specified in Table G-18 of the DoD QSM (DoD, 2010) and are 80-120% and RPD≤20% for ICP and ICPMS metals. The DoD MS and MSD solid recovery limits use the LCS criteria specified in Table G-19 of the DoD QSM (DoD, 2010) and are 80-120% (75-120% for silver) and RPD≤20% for ICP and ICPMS metals. Post digestion spikes aqueous and solid limits are 75-125% for ICP and ICPMS metals.

- Sample B1181SS-54 (C1594-08) was used as the solid MS/MSD for the ICP metals analysis on 03/23/11. Iron (71.1%) and lead (-130%, -272%) were outside criteria. The sample concentration was >4 times the spike added for iron and lead; therefore, no qualifiers were applied based upon these outliers. All other metals and RPDs were within criteria limits. Samples B1181SD-6 (C1595-01), B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SS-10D (C1595-10), B1181SD-12 (C1595-11), B1181SS-14C (C1595-12), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-49 (C1595-17), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), B1181SS-34 (C1595-21), B1181SS-48 (C1595-22), B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this MS/MSD.

- Sample B1181SW-6 (C1595-04) was used as the aqueous MS/MSD for the ICPMS metals analysis on 03/30/11. Iron (77.0%), lead (77.0%, 53.0%), and zinc (79.2%) were outside criteria. The sample concentration was >4 times the spike added for lead; therefore, no qualifiers were applied based upon this outlier. Iron and zinc were detected for the associated samples; therefore, were qualified estimated "J" based upon the low recoveries. All other metals and RPDs were within criteria limits. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this MS/MSD.

VIII-Field Duplicate Sample Analysis
Field duplicates were collected to identify the cumulative precision of the sampling and analytical process and sent to the laboratory blind. The RPD was calculated only for those analytes which were detected at levels exceeding the method reporting limits in both samples of the duplicate pair. Analytes that were rejected (R-qualified) in either sample of the duplicate pair were excluded from the duplicate assessment. Precision control criterion was established at ≤35% RPD for the solid samples and ≤25% RPD for aqueous samples.

- Field solid sample duplicate pair B1181SD-6 (C1595-01) and B1181SD-6DUP (C1595-27) was collected for select metals analysis. Antimony was detected in the original sample at 399 mg/kg and in the duplicate pair at 2070 mg/kg resulting in a RPD of 135%. Arsenic was detected in the original sample at 30.7 mg/kg and in the duplicate pair at 98.5 mg/kg resulting in a RPD of 105%. Copper was detected in the original sample at 129 mg/kg and in the duplicate pair at 344 mg/kg resulting in a RPD of 90.9%. Iron was detected in the original sample at 13600 mg/kg and in the duplicate pair at 14500 mg/kg resulting in a RPD of 6.4%. Lead was detected in the original sample at 37300 mg/kg and in the duplicate pair at 114000 mg/kg resulting in a RPD of 106%. Zinc was detected in the original sample at 64.3 mg/kg and in the duplicate pair at 58.8 mg/kg resulting in a RPD of 8.9%. Antimony, arsenic, and lead were grossly outside criteria and detected above the MRL; therefore, were qualified rejected "R" for the duplicate pair based upon the very high RPDs (>100%). Copper was qualified estimated "J" for the duplicate pair based upon the high RPD. For all other target metals, all criteria were met. Sample in-homogeneity and/or matrix effects are probable causes for these outliers.

- Field aqueous sample duplicate pair B1181SW-6 (C1595-04) and B1181SW-6DUP (C1595-28) was collected for select metals analysis. Antimony was detected in the original sample at 12.5 µg/L and in the duplicate pair at 8.7 µg/L resulting in a RPD of 35.9%. Arsenic was detected in the original sample at 1.4 µg/L and in the duplicate pair at 0.38J µg/L resulting in a RPD of 114%. Copper was detected in the original sample at 4.2 µg/L and in the duplicate pair at 3.3 µg/L resulting in a RPD of 24.0%. Iron was detected in the original sample at 1000 µg/L and in the duplicate pair at 853 µg/L resulting in a RPD of 15.9%. Lead was detected in the original sample at 1050 µg/L and in the duplicate pair at 698 µg/L resulting in a RPD of 40.3%. Zinc was detected in the original sample at 56.9 µg/L and in the duplicate pair at 46.6 µg/L resulting in a RPD of 19.9%. Antimony, arsenic, and lead were outside criteria and was qualified estimated "J" for the duplicate pair based upon the high RPDs. The arsenic results were at or below the MRL levels. For all other target metals, all criteria were met.

IX-ICP and ICPMS Serial Dilution
A serial dilution is performed to determine whether significant physical or chemical interferences exist due to sample matrix at high concentrations. An analysis of a 5-fold dilution should agree within 10% difference of the original result when the concentration in sample is a factor of 50 above MDL for ICP and 100 above MDL for ICPMS.

- Sample B1181SD-6 (C1595-01) was used as the solid serial dilution for the ICP metals analysis on 03/23/11. Arsenic (11.7%) was outside criteria. Sample concentrations were <50 times MDL for arsenic; therefore, no qualifiers were applied based upon this outlier. All other metals were within criteria limits. Samples B1181SD-6 (C1595-01), B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SS-10D (C1595-10), B1181SD-12 (C1595-11), B1181SS-14C (C1595-12), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-49 (C1595-17), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), B1181SS-34 (C1595-21), B1181SS-48 (C1595-22), B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this serial dilution.

- Sample B1181SW-6 (C1595-04) was used as the aqueous serial dilution for the ICPMS metals analysis on 03/30/11. Arsenic (169%) was outside criteria. Sample concentrations were <100 times MDL for arsenic; therefore, no qualifiers were applied based upon this outlier. All other metals were within criteria limits. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this serial dilution.

X-Quantitation Verification and Data Review
The accuracy of analytical results is verified through the calculation of several parameters. The percent difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification.

- Samples B1181SD-10 (C1595-25) and B1181SD-6DUP (C1595-27) were diluted due high concentrations.

- Any sample value >MDL and <MRL or <3*MDL (whichever was greater) was qualified as estimated, "J."

Sample: B1181SD-6 (C1595-01), Lead

Conc. (mg/kg) = {(conc. µg/L)*(Final Volume L)*(DF)} / {(Weight Sample g)*(Fraction Solids)}

Conc. (mg/kg) = {(124350 µg/L)*(0.100 L)*(1)} / {(1.00 g)*(0.3330)} = 37300 µg/g = 37300 mg/kg

Reported concentration = 37300 mg/kg
%D = 0.0%
Values were within 10% difference.

Sample: B1181SW-6 (C1595-04), Zinc

Conc. (µg/L) = (conc. µg/L) * (Final Volume mL) * (DF) / (Volume Sample mL)

Conc. (µg/L) = (56.85 µg/L) * (50 mL) * (1) / (50 mL) = 56.9 µg/L

Reported concentration = 56.9 µg/L
%D = 0.0%
Values were within 10% difference.

Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
No Code	Confirmed identification.
U	Undetected at the limit of detection: The associated data value is the limit of detection, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more quality control criteria failed.
USEPA Region II Data Validation Qualifiers[2]	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meeting the Quality Control criteria. The presence or absence of the analyte cannot be verified.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

[1]The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2]The USEPA data validation qualifiers are referenced from *USEPA Region II Evaluation of Metals Data for the Contract Laboratory Program, Revision 13 (SOP HW-2, September 2006).*

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-6	SDG No.:	C1595
Lab Sample ID:	C1595-01	Matrix:	SOIL
Level (low/med):	low	% Solid:	33.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	399	R	1	1.68	3.755	7.51	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	30.7	R	1	0.99	1.5	3	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	129	J	1	0.96	1.5	3	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	13600		1	3.99	7.5	15	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	37300	R	1	0.36	0.9	1.8	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	64.3		1	2.1	3.005	6.01	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-6	SDG No.:	C1595
Lab Sample ID:	C1595-04	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	12.5	J	1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	1.4	J	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	4.2		1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	1000	J	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	1050	J	1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	56.9	J	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Brown	Clarity Before:	Cloudy	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-45	SDG No.:	C1595
Lab Sample ID:	C1595-07	Matrix:	SOIL
Level (low/med):	low	% Solid:	23.7

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	19.9		1	1.72	3.85	7.7	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	8.45		1	1.02	1.54	3.08	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	66.7		1	0.99	1.54	3.08	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	13700		1	4.1	7.7	15.4	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	1330		1	0.37	0.925	1.85	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	73.3		1	2.16	3.08	6.16	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-46	SDG No.:	C1595
Lab Sample ID:	C1595-08	Matrix:	SOIL
Level (low/med):	low	% Solid:	25.2

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	39.4		1	1.5	3.35	6.7	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	11.4		1	0.88	1.34	2.68	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	70		1	0.86	1.34	2.68	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	8650		1	3.57	6.7	13.4	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	8650		1	0.32	0.805	1.61	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	79.6		1	1.88	2.68	5.36	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-3C	SDG No.:	C1595
Lab Sample ID:	C1595-09	Matrix:	SOIL
Level (low/med):	low	% Solid:	16.4

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	84.4		1	2.35	5.25	10.5	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	12.4		1	1.39	2.105	4.21	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	213		1	1.35	2.105	4.21	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	16400		1	5.59	10.5	21	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	18000		1	0.5	1.26	2.52	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	629		1	2.94	4.205	8.41	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-10D	SDG No.:	C1595
Lab Sample ID:	C1595-10	Matrix:	SOIL
Level (low/med):	low	% Solid:	49.1

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	273		1	0.19	0.48	0.96	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-12	SDG No.:	C1595
Lab Sample ID:	C1595-11	Matrix:	SOIL
Level (low/med):	low	% Solid:	21.6

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	2220		1	0.4	1.005	2.01	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-14C	SDG No.:	C1595
Lab Sample ID:	C1595-12	Matrix:	SOIL
Level (low/med):	low	% Solid:	29.7

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	3060		1	0.32	0.79	1.58	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-7C	SDG No.:	C1595
Lab Sample ID:	C1595-13	Matrix:	SOIL
Level (low/med):	low	% Solid:	79.4

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2.3	U	1	0.51	1.15	2.3	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	0.42	J J	1	0.3	0.46	0.92	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	6.15		1	0.29	0.46	0.92	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	7280		1	1.22	2.3	4.6	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	4.34		1	0.11	0.275	0.55	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	23		1	0.64	0.92	1.84	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-7	SDG No.:	C1595
Lab Sample ID:	C1595-14	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.72	J U	1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	1	U	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	2.8	U	1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	312	J	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	18.8		1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	25.9	U	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Brown	Clarity Before:	Cloudy	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-8	SDG No.:	C1595
Lab Sample ID:	C1595-15	Matrix:	SOIL
Level (low/med):	low	% Solid:	51.1

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	3.47	U	1	0.78	1.735	3.47	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	8.29		1	0.46	0.695	1.39	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	12.3		1	0.44	0.695	1.39	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	19900		1	1.85	3.47	6.94	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	26.3		1	0.17	0.415	0.83	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	29.9		1	0.97	1.39	2.78	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-8	SDG No.:	C1595
Lab Sample ID:	C1595-16	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.35	J U	1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	0.3	J U	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	3.4		1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	543	J	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	4.3		1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	12.9	U	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Brown	Clarity Before:	Cloudy	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
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OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-49	SDG No.:	C1595
Lab Sample ID:	C1595-17	Matrix:	SOIL
Level (low/med):	low	% Solid:	22.8

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	74.4		1	0.37	0.92	1.84	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
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OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-61	SDG No.:	C1595
Lab Sample ID:	C1595-18	Matrix:	SOIL
Level (low/med):	low	% Solid:	25.8

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	7.45	U	1	1.67	3.725	7.45	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	8.02		1	0.98	1.49	2.98	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	62.9		1	0.95	1.49	2.98	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	13700		1	3.97	7.45	14.9	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	83.6		1	0.36	0.895	1.79	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	89.1		1	2.09	2.98	5.96	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-60	SDG No.:	C1595
Lab Sample ID:	C1595-19	Matrix:	SOIL
Level (low/med):	low	% Solid:	18.4

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	9.24	U	1	2.07	4.62	9.24	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	2.85	J J	1	1.22	1.85	3.7	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	27.1		1	1.18	1.85	3.7	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	5520		1	4.92	9.25	18.5	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	44.7		1	0.44	1.11	2.22	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	60.7		1	2.59	3.695	7.39	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

Form I Copy

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-59	SDG No.:	C1595
Lab Sample ID:	C1595-20	Matrix:	SOIL
Level (low/med):	low	% Solid:	23.8

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2.08	J J	1	1.63	3.645	7.29	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	3.78		1	0.96	1.46	2.92	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	64		1	0.93	1.46	2.92	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	13000		1	3.88	7.3	14.6	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	166		1	0.35	0.875	1.75	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	64.3		1	2.04	2.92	5.84	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-34	SDG No.:	C1595
Lab Sample ID:	C1595-21	Matrix:	SOIL
Level (low/med):	low	% Solid:	24.3

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	3.99	J J	1	1.69	3.78	7.56	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	3.37		1	1	1.515	3.03	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	38.2		1	0.97	1.515	3.03	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	9180		1	4.02	7.55	15.1	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	407		1	0.36	0.91	1.82	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	59		1	2.12	3.025	6.05	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-48	SDG No.:	C1595
Lab Sample ID:	C1595-22	Matrix:	SOIL
Level (low/med):	low	% Solid:	60.6

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7439-92-1	Lead	29.7		1	0.14	0.34	0.68	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group4				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/21/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-9	SDG No.:	C1595
Lab Sample ID:	C1595-23	Matrix:	SOIL
Level (low/med):	low	% Solid:	16.7

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	4190		1	2.5	5.6	11.2	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	851		1	1.47	2.235	4.47	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	238		1	1.43	2.235	4.47	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	11100		1	5.94	11.15	22.3	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	71000		1	0.54	1.34	2.68	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	211		1	3.13	4.47	8.94	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/21/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-9	SDG No.:	C1595
Lab Sample ID:	C1595-24	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	4.1		1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	0.42	J U	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	3	U	1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	831	J	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	70.6		1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	59.2	J	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Brown	Clarity Before:	Cloudy	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/21/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-10	SDG No.:	C1595
Lab Sample ID:	C1595-25	Matrix:	SOIL
Level (low/med):	low	% Solid:	19.8

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	6250	D	10	21.1	47.1	94.2	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	175	D	10	12.4	18.85	37.7	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	514	D	10	12.1	18.85	37.7	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	5010	D	10	50.1	94	188	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	186000	D	10	4.52	11.3	22.6	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	51.5	JD J	10	26.4	37.7	75.4	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Brown	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

Form I Copy

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/21/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-10	SDG No.:	C1595
Lab Sample ID:	C1595-26	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	73.4		1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	23	J	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	22.1		1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	8340	J	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	7530		1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	66.3	J	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Brown	Clarity Before:	Cloudy	Texture:	
Color After:	Yellow	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-6DUP	SDG No.:	C1595
Lab Sample ID:	C1595-27	Matrix:	SOIL
Level (low/med):	low	% Solid:	30.2

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2070	D R	10	13.3	29.8	59.6	mg/Kg	03/22/11	03/23/11	SW6010B
7440-38-2	Arsenic	98.5	D R	10	7.86	11.9	23.8	mg/Kg	03/22/11	03/23/11	SW6010B
7440-50-8	Copper	344	D J	10	7.62	11.9	23.8	mg/Kg	03/22/11	03/23/11	SW6010B
7439-89-6	Iron	14500	D	10	31.7	59.5	119	mg/Kg	03/22/11	03/23/11	SW6010B
7439-92-1	Lead	114000	D R	10	2.86	7.15	14.3	mg/Kg	03/22/11	03/23/11	SW6010B
7440-66-6	Zinc	58.8	D	10	16.7	23.8	47.6	mg/Kg	03/22/11	03/23/11	SW6010B

Color Before:	Black	Clarity Before:		Texture:	Medium
Color After:	Yellow	Clarity After:		Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-6DUP	SDG No.:	C1595
Lab Sample ID:	C1595-28	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOD	LOQ	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	8.7	J	1	0.14	1	2	ug/L	03/22/11	03/30/11	SW6020
7440-38-2	Arsenic	0.38	J U	1	0.18	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-50-8	Copper	3.3		1	0.04	1	2	ug/L	03/22/11	03/30/11	SW6020
7439-89-6	Iron	853	J	1	10.3	100	200	ug/L	03/22/11	03/30/11	SW6020
7439-92-1	Lead	698	J	1	0.04	0.5	1	ug/L	03/22/11	03/30/11	SW6020
7440-66-6	Zinc	46.6	J	1	0.09	1	2	ug/L	03/22/11	03/30/11	SW6020

Color Before:	Brown	Clarity Before:	Cloudy	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

Shaw Environmental, Inc.
2113 Emmorton Park Road
Edgewood, Maryland
410-612-6350
FAX: 410-612-6351

Shaw® Shaw Environmental, Inc.

MEMORANDUM

TO: Gerard Maresca, Shaw E&I Picatinny Arsenal (PTA) Project Manager

FROM: Eric Malarek, Shaw E&I PTA Project Chemist

SUBJECT: PTA Data Validation – Polynuclear Aromatic Hydrocarbons
Chemtech C1595

DATE: June 21, 2011

The purpose of this memorandum is to present the data validation report for the Skeet Range samples collected at the PTA Site on March 16, 2011, March 19, 2011, and March 21, 2011. Samples were analyzed for polynuclear aromatic hydrocarbons (PAHs) using USEPA SW846 Methods 3541/8270C for the solid sample analysis and using USEPA SW846 Methods 3510C/8270C for the rinse blank samples. A total of thirteen solid samples and six aqueous samples were validated. The sample Ids are:

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
B1181SD-6	C1595-01	B1181SS-60	C1595-19
B1181SW-6	C1595-04	B1181SS-59	C1595-20
B1181SS-45	C1595-07	B1181SS-34	C1595-21
B1181SS-46	C1595-08	B1181SD-9	C1595-23
B1181SD-3C	C1595-09	B1181SW-9	C1595-24
B1181SD-7C	C1595-13	B1181SD-10	C1595-25
B1181SW-7	C1595-14	B1181SW-10	C1595-26
B1181SD-8	C1595-15	B1181SD-6DUP	C1595-27
B1181SW-8	C1595-16	B1181SW-6DUP	C1595-28
B1181SS-61	C1595-18		

Data were reviewed and validated using a combination of project QAPP, *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2, April 2010* (DoD, 2010) (DoD QSM), method-specific criteria, and laboratory SOP criteria. The data qualifier scheme was consistent with the *USEPA Region II SOP Validating Semivolatile Organic Compounds by Gas Chromatography / Mass Spectroscopy SW-846 Method 8270D, Revision 4 (SOP HW-22, August 2008)*. Parameters evaluated are presented in **Table 1**. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA specifications.

Table 1 Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times and Preservation
	X	Instrument Performance Check
	X	Initial Calibration
	X	Continuing Calibration
	X	Blank Analysis
X		Surrogate Spikes
	X	Internal Standards
X		Laboratory Control Sample and Laboratory Control Sample Duplicate
X		Matrix Spike/Spike Duplicate
	X	Field Duplicate
X		Quantitation Verification and Data Review

The quality of data collected in support of this sampling activity is considered acceptable with noted qualifications.

Eric Malarek, Chemist

6/21/11
Date

PTA VALIDATION REPORT
PAH REVIEW
SDG C1595

I-Holding Times and Preservation
The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. All samples are cooled @4°C ± 2°C. The maximum holding time criteria for PAHs for aqueous samples is 7 days from sample collection to preparative extraction and 40 days from preparative extraction to determinative analysis and for solid samples is 14 days from sample collection to preparative extraction and 40 days from preparative extraction to determinative analysis (USEPA criteria).

- Temperature Review: The temperature blank was sent with each cooler and recorded by the laboratory upon receipt. For samples collected on 03/16/11, 03/19/11, and 03/21/11, the coolers were received by the laboratory (Chemtech) on 03/21/11 at 5°C, 5°C, and 5°C. All criteria were met. No qualifiers were applied.

- Holding Time Review: The solid samples and aqueous samples were collected on 03/16/11, 03/19/11, and 03/21/11 for PAH analysis. For the solid samples, the PAHs were extracted on 03/23/11 and analyzed on 03/25/11, 03/26/11, and 03/29/11. For the aqueous samples, the PAHs were extracted on 03/22/11 and analyzed on 03/28/11 and 03/29/11. Sample collection dates may be found on the attached form 1s. All criteria were met. No qualifiers were applied.

II-Instrument Performance Check
GC/MS instrument performance checks are performed to ensure mass resolution, identification and, to some degree, sensitivity. The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed.

- The instrument performance check, decafluorotriphenylphosphine (DFTPP), met the ion abundance criteria. No qualification was applied.

III-Initial Calibration
Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for reported PAH compounds. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The DoD QSM specifies that for compounds analyzed using linear regression or second order, correlation coefficients must be >0.995 (coefficient of determination r^2>0.99 for higher order). The minimum relative response factor (RRF) criteria must be ≥0.05. Initial calibration percent relative standard deviation (%RSD) must be ≤15% on the average for all compounds (<30% for CCCs).

- Initial calibration for the PAHs was performed on 03/11/11 on instrument BNAE. All criteria were met for the reported target PAHs. No qualifiers were applied. Samples B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this initial calibration.

- Initial calibration for the PAHs was performed on 03/28/11 on instrument BNAE. Flourene (18.9%) was outside criteria; however, was quantified using linear regression with a coefficient of determination of 0.999. No qualifiers were applied based upon this outlier. All criteria were met for the reported target PAHs. No qualifiers were applied. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this initial calibration.

- Initial calibration for the PAHs was performed on 03/22/11 on instrument BNAF. All criteria were met for the reported target PAHs. No qualifiers were applied. Samples B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), and B1181SS-34 (C1595-21) apply to this initial calibration.

- Initial calibration for the PAHs was performed on 03/28/11 on instrument BNAF. All criteria were met for the reported target PAHs. No qualifiers were applied. Sample B1181SD-6 (C1595-01) applies to this initial calibration.

IV-Continuing Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for PAH target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum relative response factors (RRF) for PAH target compounds and surrogates must be ≥0.05. The DoD QSM specifies that the percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within ±20% for all target compounds.

- For initial calibration verification performed on 03/11/11 @17:24 on instrument BNAE, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this initial calibration verification.

- For continuing calibration performed on 03/24/11 @18:18 on instrument BNAE, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this continuing calibration.

- For continuing calibration performed on 03/26/11 @08:20 on instrument BNAE, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this continuing calibration.

- For initial calibration verification performed on 03/28/11 @18:58 on instrument BNAE, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Sample B1181SW-6 (C1595-04) applies to this initial calibration verification.

- For continuing calibration performed on 03/29/11 @03:04 on instrument BNAE, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this continuing calibration.

- For initial calibration verification performed on 03/22/11 @16:47 on instrument BNAF, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this initial calibration verification.

- For continuing calibration performed on 03/24/11 @17:35 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), and B1181SS-34 (C1595-21) apply to this continuing calibration.

- For initial calibration verification performed on 03/28/11 @17:58 on instrument BNAF, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. No samples were reported using this initial calibration verification.

- For continuing calibration performed on 03/29/11 @16:24 on instrument BNAF, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Sample B1181SD-6 (C1595-01) applies to this continuing calibration.

V-Blank Analysis

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of DFTPP. No contaminants should be detected in any of the associated blanks >MDL. DoD QSM criteria specifies all concentrations should be less than one-half MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters). Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants phthalate esters, or 5 times (5X) the maximum amount for other semivolatile target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one and for solid matrices were converted to soil values (soil conversion factor = 33), if needed. Rinse blank samples SS031611R1 (C1594-01) and SS031911R1 (C1594-27) apply to all surface soil "SS" samples collected in this SDG. Rinse blank sample SD031611R1 (C1594-02) applies to all sediment "SD" samples and rinse blank SW031611R1 (C1594-03) applies to all surface water "SW" samples. The sediment and surface water samples may be found in SDG C1595.

Table 2 Blank Contamination Analysis Summary

Analysis Date	QC Blank ID	Compound	Max Conc. µg/L	Action Level µg/L	U qualified samples (For this SDG)
03/28/11	PB54256B	All target <½MRL	NA	NA	None
03/28/11	SW031611R1	All target <½MRL	NA	NA	None
Analysis Date	**QC Blank ID**	**Compound**	**Max Conc. µg/kg**	**Action Level µg/kg**	**U qualified samples (For this SDG)**
03/25/11	PB54272B	All target <½MRL	NA	NA	None
03/24/11	SS031611R1	All target <½MRL	NA	NA	None
03/25/11	SS031911R1	All target <½MRL	NA	NA	None
03/24/11	SD031611R1	All target <½MRL	NA	NA	None

MRL = Method Reporting Limit.
NA = Not Applicable

VI-Surrogate Spikes

Laboratory performance on individual samples is evaluated through the review of surrogate spike samples. Surrogate spikes are added to all samples and blanks to measure their recovery in sample and blank matrices. The percent recoveries (%Rs) must be within the specified control limits.

Aqueous Criteria: Nitrobenzene-d5 (20-139%) – (DoD QSM Criteria: 40-110%)
2-Fluorobiphenyl (10-173%) – (DoD QSM Criteria: 50-110%)
p-Terphenyl – d14 (20-171%) – (DoD QSM Criteria: 50-135%)

Solid Criteria: Nitrobenzene-d5 (30-150%) – (DoD QSM Criteria: 35-100%)
2-Fluorobiphenyl (19-182%) – (DoD QSM Criteria: 45-105%)
p-Terphenyl – d14 (24-191%) – (DoD QSM Criteria: 30-125%)

- For sample B1181SS-45 (C1595-07), surrogates nitrobenzene-d5 (33%), 2-fluorobiphenyl (23%), and p-Terphenyl – d14 (22%) were outside DOD criteria. All target were non-detect and were qualified estimated "UJ" based upon these outliers.

- For sample B1181SS-34 (C1595-21), surrogates nitrobenzene-d5 (9%) and 2-fluorobiphenyl (19%) were outside DOD criteria. All target were non-detect and were qualified estimated "UJ" based upon these outliers.

- For sample B1181SW-10 (C1595-26), surrogates nitrobenzene-d5 (36%) and 2-fluorobiphenyl (41%) were outside DOD criteria. All target were non-detect and were qualified estimated "UJ" based upon these outliers.

- For all other samples, all criteria were met.

VII-Internal Standards
Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated calibration standard.

- All criteria were met for all runs. No qualifiers were applied.

VIII-Laboratory Control Sample and Laboratory Control Sample Duplicate
Laboratory control samples (LCS) are used to monitor laboratory accuracy by calculating the percent recoveries of the spiked compounds. All LCS/LCSD percent recoveries must be within the specified control limits. DoD LCS/LCSD aqueous recovery limits are specified in Table G-2 and Table G-6 of the DoD QSM (DoD, 2010). DoD LCS solid recovery limits are specified in Table G-2 and Table G-7 of the DoD QSM (DoD, 2010). The DoD MS/MSD precision RPD criteria is ≤30% for aqueous and solid matrices. The DoD QSM LCS criterion for non-listed SVOCs is to use current laboratory in-house limits.

- Sample PB54272BS was used as the solid LCS for the PAH analysis on 03/25/11. All criteria were met. No qualifiers were applied. Samples B1181SD-6 (C1595-01), B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), B1181SS-34 (C1595-21), B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this LCS.

- Sample PB54256BS was used as the aqueous LCS for the PAH analysis on 03/28/11. Naphthalene (19%) was outside lab/DOD criteria. For all other target compounds, all criteria were met. All associated samples were non-detect; therefore, was qualified "UJ" for naphthalene based upon the low recoveries. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this LCS.

IX-Matrix Spike/Matrix Spike Duplicate
Data for matrix spike/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. The percent recoveries (%Rs) and the relative percent difference (RPD) must be within the specified control limits. DoD LCS/LCSD aqueous recovery limits are specified in Table G-2 and Table G-6 of the DoD QSM (DoD, 2010). DoD MS and MSD solid recovery limits use the LCS criteria specified in Table G-2 and Table G-7 of the DoD QSM (DoD, 2010). The DoD MS/MSD precision RPD criteria is ≤30% for aqueous and solid matrices. The DoD QSM LCS criterion for non-listed SVOCs is to use current laboratory in-house limits.

- Sample B1181SD-6 (C1595-01) was used as the solid MS/MSD for the PAH analysis on 03/29/11. All criteria were met. No qualifiers were applied. Samples B1181SD-6 (C1595-01), B1181SS-45 (C1595-07), B1181SS-46 (C1595-08), B1181SD-3C (C1595-09), B1181SD-7C (C1595-13), B1181SD-8 (C1595-15), B1181SS-61 (C1595-18), B1181SS-60 (C1595-19), B1181SS-59 (C1595-20), B1181SS-34 (C1595-21), B1181SD-9 (C1595-23), B1181SD-10 (C1595-25), and B1181SD-6DUP (C1595-27) apply to this MS/MSD.

- Sample B1181SW-6 (C1595-04) was used as the aqueous MS/MSD for the PAH analysis on 03/28/11. Target compounds naphthalene (16%, 14%), acenaphthylene (RPD=21%), acenaphthene (RPD=21%), fluorene (RPD=21%), fluoranthene (RPD=21%), pyrene (RPD=21%), benzo(a)anthracene (RPD=21%), chrysene (RPD=21%), benzo(k)fluoranthene (RPD=22%), benzo(a)pyrene (RPD=21%), indeno(1,2,3-cd)pyrene (RPD=23%), dibenz(a,h)anthracene (RPD=22%), and benzo(g,h,i)perylene (RPD=21%) were outside lab/DOD criteria. For all other target compounds, all criteria were met. The associated LCS was within criteria for all target compounds (see Section VIII). Acenaphthylene, acenaphthene, fluorene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene were non-detect in the spiked sample; therefore, no qualification was required based upon the high RPDs. Naphthalene was qualified estimated "UJ" for the spiked sample based upon the low recoveries. Samples B1181SW-6 (C1595-04), B1181SW-7 (C1595-14), B1181SW-8 (C1595-16), B1181SW-9 (C1595-24), B1181SW-10 (C1595-26), and B1181SW-6DUP (C1595-28) apply to this MS/MSD.

X-Field Duplicate Sample Analysis

Field duplicates were collected to identify the cumulative precision of the sampling and analytical process and sent to the laboratory blind. The RPD was calculated only for those analytes which were detected at levels exceeding the method reporting limits in both samples of the duplicate pair. Analytes that were rejected (R-qualified) in either sample of the duplicate pair and any tentatively identified compounds (TICs) were excluded from the duplicate assessment. Precision control criterion was established at 50% RPD for the aqueous and solid samples.

- Field solid sample duplicate pair B1181SD-6 (C1595-01) and B1181SD-6DUP (C1595-27) was collected for PAHs. All PAH target compounds were non-detect. All criteria were met. No qualifiers were applied.

- Field aqueous sample duplicate pair B1181SW-6 (C1595-04) and B1181SW-6DUP (C1595-28) was collected for PAHs. All PAH target compounds were non-detect. All criteria were met. No qualifiers were applied.

XI-Quantitation Verification and Data Review

The accuracy of analytical results was verified through the calculation of several parameters. Percent difference (%D) between the calculated and reported values must be ≤10%.

- Any sample value >MDL and <MRL or <3*MDL (whichever is greater) was qualified as estimated, "J."

Sample: B1181SD-3C (C1595-09), Fluoranthene

Conc. μg/kg = (Ax * Is * Vt * DF) / (Ais * RRF * Vi * Ws * D)

where:
- Conc. = Sample concentration in μg/kg
- Ax = Area of characteristic ion for compound being measured.
- Is = Amount of internal standard injected (ng).
- Vt = Volume of total extract (uL).
- Ais = Area of characteristic ion for the internal standard.
- RRF = Average relative response factor for compound being measured (from ICAL)
- Vi = Volume of extract injected (uL).
- W(s) = Weight of sample extracted or diluted in grams.
- D = Percent dry weight (100 - % moisture in sample)/100
- DF = Dilution factor

Conc. μg/kg = (6793 * 20 * 1000 * 1) / (98573 * 1.002 * 1 * 30.08 * 0.1600) = 290 μg/kg
Reported Value = 290 μg/kg
% Difference = 0.0%
Values were within 10% difference.

Sample: PB54256BS, Acenaphthene

Conc. (μg/L) = {(Ax)*(Is)*(Vt)*(DF)}/{(Ais)*(RRF)*(V_o)*(V_i)}

where:	$Conc_{sample}$	=	Sample concentration in μg/L
	A_x	=	Area of characteristic ion for compound being measured.
	I_s	=	Amount of internal standard injected (ng).
	V_t	=	Volume of total extract, taking into account dilutions (μL).
	A_{is}	=	Area of characteristic ion for the internal standard.
	RRF_A	=	Average relative response factor for compound being measured
	V_o	=	Volume of water extracted (mL).
	V_i	=	Volume of extract injected (μL).
	DF	=	Dilution Factor

Conc. μg/L = (61107 * 5ng * 1000μL * 1) / (28768 * 1.170 * 1000mL * 1 μL) = 9.1 ng/mL
= 9.1 μg/L

Reported Value = 9.1 μg/L
% Difference = 0.0%
Values were within 10% difference.

Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
No Code	Confirmed identification.
U	Undetected at the limit of detection: The associated data value is the limit of detection, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more quality control criteria failed.
USEPA Region II Data Validation Qualifiers[2]	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meeting the Quality Control criteria. The presence or absence of the analyte cannot be verified.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

[1]The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2]The USEPA data validation qualifiers are referenced from *USEPA Region II SOP Validating Semivolatile Organic Compounds by Gas Chromatography / Mass Spectroscopy SW-846 Method 8270D, Revision 4 (SOP HW-22, August 2008).*

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

Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-6			SDG No.:	C1595
Lab Sample ID:	C1595-01			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	67
Sample Wt/Vol:	30.05	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044295.D	1	03/23/11	03/29/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1000	U	35	500	1000	ug/Kg
208-96-8	Acenaphthylene	1000	U	25	500	1000	ug/Kg
83-32-9	Acenaphthene	1000	U	28	500	1000	ug/Kg
86-73-7	Fluorene	1000	U	38	500	1000	ug/Kg
85-01-8	Phenanthrene	1000	U	27	500	1000	ug/Kg
120-12-7	Anthracene	1000	U	21	500	1000	ug/Kg
206-44-0	Fluoranthene	1000	U	20	500	1000	ug/Kg
129-00-0	Pyrene	1000	U	24	500	1000	ug/Kg
56-55-3	Benzo(a)anthracene	1000	U	48	500	1000	ug/Kg
218-01-9	Chrysene	1000	U	46	500	1000	ug/Kg
205-99-2	Benzo(b)fluoranthene	1000	U	33	500	1000	ug/Kg
207-08-9	Benzo(k)fluoranthene	1000	U	47	500	1000	ug/Kg
50-32-8	Benzo(a)pyrene	1000	U	22	500	1000	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1000	U	34	500	1000	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1000	U	29	500	1000	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1000	U	41	500	1000	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	84.8		30 - 150		85%	SPK: 100
321-60-8	2-Fluorobiphenyl	58.1		19 - 182		58%	SPK: 100
1718-51-0	Terphenyl-d14	45.7		24 - 191		46%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	63935	4.65				
1146-65-2	Naphthalene-d8	254560	5.82				
15067-26-2	Acenaphthene-d10	124667	7.47				
1517-22-2	Phenanthrene-d10	204501	9.11				
1719-03-5	Chrysene-d12	141366	12.27				
1520-96-3	Perylene-d12	117332	14.04				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-6			SDG No.:	C1595
Lab Sample ID:	C1595-01			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	67
Sample Wt/Vol:	30.05	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044295.D	1	03/23/11	03/29/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-6	SDG No.:	C1595
Lab Sample ID:	C1595-04	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	980 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069940.D	1	03/22/11	03/28/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.1	U UJ	0.02	0.05	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.02	0.05	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.02	0.05	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.02	0.05	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.02	0.05	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.02	0.05	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.02	0.05	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.02	0.05	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.02	0.05	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.02	0.05	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.02	0.05	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.02	0.05	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.02	0.05	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.02	0.05	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.02	0.05	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.02	0.05	0.1	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	6.29		20 - 139		63%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.1		10 - 173		71%	SPK: 10
1718-51-0	Terphenyl-d14	9.8		20 - 171		98%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	9945	8.89				
1146-65-2	Naphthalene-d8	44698	11.07				
15067-26-2	Acenaphthene-d10	28505	14.02				
1517-22-2	Phenanthrene-d10	58563	16.51				
1719-03-5	Chrysene-d12	63195	21.01				
1520-96-3	Perylene-d12	52555	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-6	SDG No.:	C1595
Lab Sample ID:	C1595-04	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	980 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069940.D	1	03/22/11	03/28/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-45	SDG No.:	C1595
Lab Sample ID:	C1595-07	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	76
Sample Wt/Vol:	30.12 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044174.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1400	U UJ	48	700	1400	ug/Kg
208-96-8	Acenaphthylene	1400	U UJ	35	700	1400	ug/Kg
83-32-9	Acenaphthene	1400	U UJ	39	700	1400	ug/Kg
86-73-7	Fluorene	1400	U UJ	52	700	1400	ug/Kg
85-01-8	Phenanthrene	1400	U UJ	37	700	1400	ug/Kg
120-12-7	Anthracene	1400	U UJ	28	700	1400	ug/Kg
206-44-0	Fluoranthene	1400	U UJ	28	700	1400	ug/Kg
129-00-0	Pyrene	1400	U UJ	33	700	1400	ug/Kg
56-55-3	Benzo(a)anthracene	1400	U UJ	66	700	1400	ug/Kg
218-01-9	Chrysene	1400	U UJ	63	700	1400	ug/Kg
205-99-2	Benzo(b)fluoranthene	1400	U UJ	45	700	1400	ug/Kg
207-08-9	Benzo(k)fluoranthene	1400	U UJ	65	700	1400	ug/Kg
50-32-8	Benzo(a)pyrene	1400	U UJ	30	700	1400	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1400	U UJ	46	700	1400	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1400	U UJ	40	700	1400	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1400	U UJ	56	700	1400	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	33		30 - 150		33%	SPK: 100
321-60-8	2-Fluorobiphenyl	23.4		19 - 182		23%	SPK: 100
1718-51-0	Terphenyl-d14	22.3	*	24 - 191		22%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	39261	4.7				
1146-65-2	Naphthalene-d8	144095	5.86				
15067-26-2	Acenaphthene-d10	67405	7.52				
1517-22-2	Phenanthrene-d10	92723	9.16				
1719-03-5	Chrysene-d12	67540	12.33				
1520-96-3	Perylene-d12	63431	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-45			SDG No.:	C1595
Lab Sample ID:	C1595-07			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	76
Sample Wt/Vol:	30.12	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044174.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-46	SDG No.:	C1595
Lab Sample ID:	C1595-08	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	75
Sample Wt/Vol:	30.09 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044175.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1300	U	46	650	1300	ug/Kg
208-96-8	Acenaphthylene	1300	U	33	650	1300	ug/Kg
83-32-9	Acenaphthene	1300	U	37	650	1300	ug/Kg
86-73-7	Fluorene	1300	U	50	650	1300	ug/Kg
85-01-8	Phenanthrene	1300	U	36	650	1300	ug/Kg
120-12-7	Anthracene	1300	U	27	650	1300	ug/Kg
206-44-0	Fluoranthene	1300	U	27	650	1300	ug/Kg
129-00-0	Pyrene	1300	U	32	650	1300	ug/Kg
56-55-3	Benzo(a)anthracene	1300	U	63	650	1300	ug/Kg
218-01-9	Chrysene	1300	U	60	650	1300	ug/Kg
205-99-2	Benzo(b)fluoranthene	1300	U	43	650	1300	ug/Kg
207-08-9	Benzo(k)fluoranthene	1300	U	63	650	1300	ug/Kg
50-32-8	Benzo(a)pyrene	1300	U	29	650	1300	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1300	U	44	650	1300	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1300	U	38	650	1300	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1300	U	54	650	1300	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	86.5		30 - 150		86%	SPK: 100
321-60-8	2-Fluorobiphenyl	69.9		19 - 182		70%	SPK: 100
1718-51-0	Terphenyl-d14	62.3		24 - 191		62%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	37297	4.7				
1146-65-2	Naphthalene-d8	139955	5.86				
15067-26-2	Acenaphthene-d10	62292	7.52				
1517-22-2	Phenanthrene-d10	85924	9.16				
1719-03-5	Chrysene-d12	49946	12.33				
1520-96-3	Perylene-d12	43820	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-46			SDG No.:	C1595
Lab Sample ID:	C1595-08			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	75
Sample Wt/Vol:	30.09	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044175.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-3C			SDG No.:	C1595
Lab Sample ID:	C1595-09			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	84
Sample Wt/Vol:	30.08	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044176.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	2100	U	72	1050	2100	ug/Kg
208-96-8	Acenaphthylene	2100	U	52	1050	2100	ug/Kg
83-32-9	Acenaphthene	2100	U	59	1050	2100	ug/Kg
86-73-7	Fluorene	2100	U	79	1050	2100	ug/Kg
85-01-8	Phenanthrene	2100	U	56	1050	2100	ug/Kg
120-12-7	Anthracene	2100	U	42	1050	2100	ug/Kg
206-44-0	Fluoranthene	290	J J	42	1050	2100	ug/Kg
129-00-0	Pyrene	2100	U	50	1050	2100	ug/Kg
56-55-3	Benzo(a)anthracene	2100	U	99	1050	2100	ug/Kg
218-01-9	Chrysene	2100	U	94	1050	2100	ug/Kg
205-99-2	Benzo(b)fluoranthene	2100	U	68	1050	2100	ug/Kg
207-08-9	Benzo(k)fluoranthene	2100	U	98	1050	2100	ug/Kg
50-32-8	Benzo(a)pyrene	2100	U	45	1050	2100	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	2100	U	69	1050	2100	ug/Kg
53-70-3	Dibenz(a,h)anthracene	2100	U	60	1050	2100	ug/Kg
191-24-2	Benzo(g,h,i)perylene	2100	U	84	1050	2100	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	83		30 - 150		83%	SPK: 100
321-60-8	2-Fluorobiphenyl	50.9		19 - 182		51%	SPK: 100
1718-51-0	Terphenyl-d14	38.5		24 - 191		38%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	39057	4.7				
1146-65-2	Naphthalene-d8	144311	5.86				
15067-26-2	Acenaphthene-d10	66021	7.52				
1517-22-2	Phenanthrene-d10	98573	9.16				
1719-03-5	Chrysene-d12	73816	12.33				
1520-96-3	Perylene-d12	63569	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-3C			SDG No.:	C1595
Lab Sample ID:	C1595-09			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	84
Sample Wt/Vol:	30.08	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044176.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-7C	SDG No.:	C1595
Lab Sample ID:	C1595-13	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	21
Sample Wt/Vol:	30.12 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044177.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	420	U	14	210	420	ug/Kg
208-96-8	Acenaphthylene	420	U	11	210	420	ug/Kg
83-32-9	Acenaphthene	420	U	12	210	420	ug/Kg
86-73-7	Fluorene	420	U	16	210	420	ug/Kg
85-01-8	Phenanthrene	420	U	11	210	420	ug/Kg
120-12-7	Anthracene	420	U	8.6	210	420	ug/Kg
206-44-0	Fluoranthene	420	U	8.4	210	420	ug/Kg
129-00-0	Pyrene	420	U	10	210	420	ug/Kg
56-55-3	Benzo(a)anthracene	420	U	20	210	420	ug/Kg
218-01-9	Chrysene	420	U	19	210	420	ug/Kg
205-99-2	Benzo(b)fluoranthene	420	U	14	210	420	ug/Kg
207-08-9	Benzo(k)fluoranthene	420	U	20	210	420	ug/Kg
50-32-8	Benzo(a)pyrene	420	U	9.1	210	420	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	420	U	14	210	420	ug/Kg
53-70-3	Dibenz(a,h)anthracene	420	U	12	210	420	ug/Kg
191-24-2	Benzo(g,h,i)perylene	420	U	17	210	420	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	81		30 - 150		81%	SPK: 100
321-60-8	2-Fluorobiphenyl	69.5		19 - 182		70%	SPK: 100
1718-51-0	Terphenyl-d14	50.1		24 - 191		50%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	40934	4.7				
1146-65-2	Naphthalene-d8	151129	5.86				
15067-26-2	Acenaphthene-d10	70705	7.52				
1517-22-2	Phenanthrene-d10	97271	9.16				
1719-03-5	Chrysene-d12	77312	12.33				
1520-96-3	Perylene-d12	78019	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-7C			SDG No.:	C1595
Lab Sample ID:	C1595-13			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	21
Sample Wt/Vol:	30.12	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044177.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SW-7			SDG No.:	C1595
Lab Sample ID:	C1595-14			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	970	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069955.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.1	U UJ	0.021	0.05	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.021	0.05	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.021	0.05	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.021	0.05	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.021	0.05	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.021	0.05	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.021	0.05	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.021	0.05	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.021	0.05	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.021	0.05	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.021	0.05	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.021	0.05	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.021	0.05	0.1	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	7.12		20 - 139		71%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.59		10 - 173		76%	SPK: 10
1718-51-0	Terphenyl-d14	9.83		20 - 171		98%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	10716	8.9				
1146-65-2	Naphthalene-d8	48558	11.07				
15067-26-2	Acenaphthene-d10	29792	14.02				
1517-22-2	Phenanthrene-d10	58982	16.51				
1719-03-5	Chrysene-d12	61318	21.02				
1520-96-3	Perylene-d12	54979	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SW-7			SDG No.:	C1595
Lab Sample ID:	C1595-14			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	970	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069955.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SD-8	SDG No.:	C1595
Lab Sample ID:	C1595-15	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	49
Sample Wt/Vol:	30.01 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044178.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	650	U	23	325	650	ug/Kg
208-96-8	Acenaphthylene	650	U	16	325	650	ug/Kg
83-32-9	Acenaphthene	650	U	18	325	650	ug/Kg
86-73-7	Fluorene	650	U	25	325	650	ug/Kg
85-01-8	Phenanthrene	650	U	18	325	650	ug/Kg
120-12-7	Anthracene	650	U	13	325	650	ug/Kg
206-44-0	Fluoranthene	650	U	13	325	650	ug/Kg
129-00-0	Pyrene	650	U	16	325	650	ug/Kg
56-55-3	Benzo(a)anthracene	650	U	31	325	650	ug/Kg
218-01-9	Chrysene	650	U	30	325	650	ug/Kg
205-99-2	Benzo(b)fluoranthene	650	U	21	325	650	ug/Kg
207-08-9	Benzo(k)fluoranthene	650	U	31	325	650	ug/Kg
50-32-8	Benzo(a)pyrene	650	U	14	325	650	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	650	U	22	325	650	ug/Kg
53-70-3	Dibenz(a,h)anthracene	650	U	19	325	650	ug/Kg
191-24-2	Benzo(g,h,i)perylene	650	U	26	325	650	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	83.8		30 - 150		84%	SPK: 100
321-60-8	2-Fluorobiphenyl	55.7		19 - 182		56%	SPK: 100
1718-51-0	Terphenyl-d14	43.6		24 - 191		44%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	38462	4.7				
1146-65-2	Naphthalene-d8	147567	5.86				
15067-26-2	Acenaphthene-d10	68442	7.52				
1517-22-2	Phenanthrene-d10	97514	9.16				
1719-03-5	Chrysene-d12	72108	12.33				
1520-96-3	Perylene-d12	74260	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-8			SDG No.:	C1595
Lab Sample ID:	C1595-15			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	49
Sample Wt/Vol:	30.01	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044178.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-8	SDG No.:	C1595
Lab Sample ID:	C1595-16	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	950 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069947.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.11	U VJ	0.021	0.055	0.11	ug/L
208-96-8	Acenaphthylene	0.11	U	0.021	0.055	0.11	ug/L
83-32-9	Acenaphthene	0.11	U	0.021	0.055	0.11	ug/L
86-73-7	Fluorene	0.11	U	0.021	0.055	0.11	ug/L
85-01-8	Phenanthrene	0.11	U	0.021	0.055	0.11	ug/L
120-12-7	Anthracene	0.11	U	0.021	0.055	0.11	ug/L
206-44-0	Fluoranthene	0.11	U	0.021	0.055	0.11	ug/L
129-00-0	Pyrene	0.11	U	0.021	0.055	0.11	ug/L
56-55-3	Benzo(a)anthracene	0.11	U	0.021	0.055	0.11	ug/L
218-01-9	Chrysene	0.11	U	0.021	0.055	0.11	ug/L
205-99-2	Benzo(b)fluoranthene	0.11	U	0.021	0.055	0.11	ug/L
207-08-9	Benzo(k)fluoranthene	0.11	U	0.021	0.055	0.11	ug/L
50-32-8	Benzo(a)pyrene	0.11	U	0.021	0.055	0.11	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.11	U	0.021	0.055	0.11	ug/L
53-70-3	Dibenz(a,h)anthracene	0.11	U	0.021	0.055	0.11	ug/L
191-24-2	Benzo(g,h,i)perylene	0.11	U	0.021	0.055	0.11	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	6.43		20 - 139		64%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.29		10 - 173		73%	SPK: 10
1718-51-0	Terphenyl-d14	9.36		20 - 171		94%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	9494	8.89				
1146-65-2	Naphthalene-d8	42537	11.07				
15067-26-2	Acenaphthene-d10	27625	14.02				
1517-22-2	Phenanthrene-d10	57578	16.51				
1719-03-5	Chrysene-d12	60643	21.01				
1520-96-3	Perylene-d12	48316	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SW-8			SDG No.:	C1595
Lab Sample ID:	C1595-16			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	950	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069947.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-61			SDG No.:	C1595
Lab Sample ID:	C1595-18			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	74
Sample Wt/Vol:	30.03	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044179.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1300	U	44	650	1300	ug/Kg
208-96-8	Acenaphthylene	1300	U	32	650	1300	ug/Kg
83-32-9	Acenaphthene	1300	U	36	650	1300	ug/Kg
86-73-7	Fluorene	1300	U	48	650	1300	ug/Kg
85-01-8	Phenanthrene	1300	U	35	650	1300	ug/Kg
120-12-7	Anthracene	1300	U	26	650	1300	ug/Kg
206-44-0	Fluoranthene	1300	U	26	650	1300	ug/Kg
129-00-0	Pyrene	1300	U	31	650	1300	ug/Kg
56-55-3	Benzo(a)anthracene	1300	U	61	650	1300	ug/Kg
218-01-9	Chrysene	1300	U	58	650	1300	ug/Kg
205-99-2	Benzo(b)fluoranthene	1300	U	42	650	1300	ug/Kg
207-08-9	Benzo(k)fluoranthene	1300	U	60	650	1300	ug/Kg
50-32-8	Benzo(a)pyrene	1300	U	28	650	1300	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1300	U	43	650	1300	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1300	U	37	650	1300	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1300	U	52	650	1300	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	68.7		30 - 150		69%	SPK: 100
321-60-8	2-Fluorobiphenyl	52.5		19 - 182		52%	SPK: 100
1718-51-0	Terphenyl-d14	35.5		24 - 191		36%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	39932	4.7				
1146-65-2	Naphthalene-d8	143014	5.86				
15067-26-2	Acenaphthene-d10	64608	7.52				
1517-22-2	Phenanthrene-d10	93819	9.16				
1719-03-5	Chrysene-d12	65941	12.33				
1520-96-3	Perylene-d12	63741	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-61			SDG No.:	C1595
Lab Sample ID:	C1595-18			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	74
Sample Wt/Vol:	30.03	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044179.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-60			SDG No.:	C1595
Lab Sample ID:	C1595-19			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	82
Sample Wt/Vol:	30.05	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044180.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1800	U	64	900	1800	ug/Kg
208-96-8	Acenaphthylene	1800	U	47	900	1800	ug/Kg
83-32-9	Acenaphthene	1800	U	52	900	1800	ug/Kg
86-73-7	Fluorene	1800	U	70	900	1800	ug/Kg
85-01-8	Phenanthrene	1800	U	50	900	1800	ug/Kg
120-12-7	Anthracene	1800	U	38	900	1800	ug/Kg
206-44-0	Fluoranthene	1800	U	37	900	1800	ug/Kg
129-00-0	Pyrene	1800	U	44	900	1800	ug/Kg
56-55-3	Benzo(a)anthracene	1800	U	88	900	1800	ug/Kg
218-01-9	Chrysene	1800	U	84	900	1800	ug/Kg
205-99-2	Benzo(b)fluoranthene	1800	U	60	900	1800	ug/Kg
207-08-9	Benzo(k)fluoranthene	1800	U	87	900	1800	ug/Kg
50-32-8	Benzo(a)pyrene	1800	U	40	900	1800	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1800	U	62	900	1800	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1800	U	53	900	1800	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1800	U	75	900	1800	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	86.6		30 - 150		87%	SPK: 100
321-60-8	2-Fluorobiphenyl	56.7		19 - 182		57%	SPK: 100
1718-51-0	Terphenyl-d14	44		24 - 191		44%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	39572	4.7				
1146-65-2	Naphthalene-d8	147786	5.86				
15067-26-2	Acenaphthene-d10	64772	7.52				
1517-22-2	Phenanthrene-d10	94339	9.16				
1719-03-5	Chrysene-d12	63945	12.33				
1520-96-3	Perylene-d12	48464	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-60			SDG No.:	C1595
Lab Sample ID:	C1595-19			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	82
Sample Wt/Vol:	30.05	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044180.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Client:	Shaw E & I, Inc.	Date Collected:	03/19/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SS-59	SDG No.:	C1595
Lab Sample ID:	C1595-20	Matrix:	SOIL
Analytical Method:	SW8270C	% Moisture:	76
Sample Wt/Vol:	30.06 Units: g	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SOXH Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044181.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1400	U	48	700	1400	ug/Kg
208-96-8	Acenaphthylene	1400	U	35	700	1400	ug/Kg
83-32-9	Acenaphthene	1400	U	39	700	1400	ug/Kg
86-73-7	Fluorene	1400	U	52	700	1400	ug/Kg
85-01-8	Phenanthrene	1400	U	37	700	1400	ug/Kg
120-12-7	Anthracene	1400	U	28	700	1400	ug/Kg
206-44-0	Fluoranthene	1400	U	28	700	1400	ug/Kg
129-00-0	Pyrene	1400	U	33	700	1400	ug/Kg
56-55-3	Benzo(a)anthracene	1400	U	66	700	1400	ug/Kg
218-01-9	Chrysene	1400	U	63	700	1400	ug/Kg
205-99-2	Benzo(b)fluoranthene	1400	U	45	700	1400	ug/Kg
207-08-9	Benzo(k)fluoranthene	1400	U	65	700	1400	ug/Kg
50-32-8	Benzo(a)pyrene	1400	U	30	700	1400	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1400	U	46	700	1400	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1400	U	40	700	1400	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1400	U	56	700	1400	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	94.8		30 - 150		95%	SPK: 100
321-60-8	2-Fluorobiphenyl	81.6		19 - 182		82%	SPK: 100
1718-51-0	Terphenyl-d14	65.6		24 - 191		66%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	40797	4.7				
1146-65-2	Naphthalene-d8	153169	5.86				
15067-26-2	Acenaphthene-d10	71685	7.52				
1517-22-2	Phenanthrene-d10	98707	9.16				
1719-03-5	Chrysene-d12	75733	12.33				
1520-96-3	Perylene-d12	75130	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-59			SDG No.:	C1595
Lab Sample ID:	C1595-20			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	76
Sample Wt/Vol:	30.06	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044181.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-34			SDG No.:	C1595
Lab Sample ID:	C1595-21			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	76
Sample Wt/Vol:	30.02	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044182.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1400	U UJ	48	700	1400	ug/Kg
208-96-8	Acenaphthylene	1400	U UJ	35	700	1400	ug/Kg
83-32-9	Acenaphthene	1400	U UJ	39	700	1400	ug/Kg
86-73-7	Fluorene	1400	U UJ	52	700	1400	ug/Kg
85-01-8	Phenanthrene	1400	U UJ	37	700	1400	ug/Kg
120-12-7	Anthracene	1400	U UJ	28	700	1400	ug/Kg
206-44-0	Fluoranthene	1400	U UJ	28	700	1400	ug/Kg
129-00-0	Pyrene	1400	U UJ	33	700	1400	ug/Kg
56-55-3	Benzo(a)anthracene	1400	U UJ	66	700	1400	ug/Kg
218-01-9	Chrysene	1400	U UJ	63	700	1400	ug/Kg
205-99-2	Benzo(b)fluoranthene	1400	U UJ	45	700	1400	ug/Kg
207-08-9	Benzo(k)fluoranthene	1400	U UJ	65	700	1400	ug/Kg
50-32-8	Benzo(a)pyrene	1400	U UJ	30	700	1400	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1400	U UJ	46	700	1400	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1400	U UJ	40	700	1400	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1400	U UJ	56	700	1400	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	8.96	*	30 - 150		9%	SPK: 100
321-60-8	2-Fluorobiphenyl	18.5		19 - 182		19%	SPK: 100
1718-51-0	Terphenyl-d14	35.3		24 - 191		35%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	40877	4.7				
1146-65-2	Naphthalene-d8	153934	5.86				
15067-26-2	Acenaphthene-d10	71239	7.52				
1517-22-2	Phenanthrene-d10	104054	9.16				
1719-03-5	Chrysene-d12	80148	12.33				
1520-96-3	Perylene-d12	79546	14.13				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/19/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SS-34			SDG No.:	C1595
Lab Sample ID:	C1595-21			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	76
Sample Wt/Vol:	30.02	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BF044182.D	1	03/23/11	03/25/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/21/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-9			SDG No.:	C1595
Lab Sample ID:	C1595-23			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	83
Sample Wt/Vol:	30.08	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069914.D	1	03/23/11	03/26/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1900	U	67	950	1900	ug/Kg
208-96-8	Acenaphthylene	1900	U	49	950	1900	ug/Kg
83-32-9	Acenaphthene	1900	U	55	950	1900	ug/Kg
86-73-7	Fluorene	1900	U	74	950	1900	ug/Kg
85-01-8	Phenanthrene	1900	U	53	950	1900	ug/Kg
120-12-7	Anthracene	1900	U	40	950	1900	ug/Kg
206-44-0	Fluoranthene	1900	U	39	950	1900	ug/Kg
129-00-0	Pyrene	1900	U	47	950	1900	ug/Kg
56-55-3	Benzo(a)anthracene	1900	U	93	950	1900	ug/Kg
218-01-9	Chrysene	1900	U	89	950	1900	ug/Kg
205-99-2	Benzo(b)fluoranthene	1900	U	64	950	1900	ug/Kg
207-08-9	Benzo(k)fluoranthene	1900	U	92	950	1900	ug/Kg
50-32-8	Benzo(a)pyrene	1900	U	42	950	1900	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1900	U	65	950	1900	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1900	U	56	950	1900	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1900	U	79	950	1900	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	69.7		30 - 150		70%	SPK: 100
321-60-8	2-Fluorobiphenyl	73.7		19 - 182		74%	SPK: 100
1718-51-0	Terphenyl-d14	86.9		24 - 191		87%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	56916	8.89				
1146-65-2	Naphthalene-d8	220756	11.07				
15067-26-2	Acenaphthene-d10	130739	14.03				
1517-22-2	Phenanthrene-d10	259582	16.51				
1719-03-5	Chrysene-d12	254888	21.02				
1520-96-3	Perylene-d12	227064	24.99				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/21/11		
Project:	PTA Skeet Range			Date Received:	03/21/11		
Client Sample ID:	B1181SD-9			SDG No.:	C1595		
Lab Sample ID:	C1595-23			Matrix:	SOIL		
Analytical Method:	SW8270C			% Moisture:	83		
Sample Wt/Vol:	30.08	Units:	g	Final Vol:	1000		uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH		
Extraction Type :	SOXH	Decanted :	N	Level :	LOW		
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N	PH :	N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069914.D	1	03/23/11	03/26/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/21/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-9	SDG No.:	C1595
Lab Sample ID:	C1595-24	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	930 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069948.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.11	U UJ	0.022	0.055	0.11	ug/L
208-96-8	Acenaphthylene	0.11	U	0.022	0.055	0.11	ug/L
83-32-9	Acenaphthene	0.11	U	0.022	0.055	0.11	ug/L
86-73-7	Fluorene	0.11	U	0.022	0.055	0.11	ug/L
85-01-8	Phenanthrene	0.11	U	0.022	0.055	0.11	ug/L
120-12-7	Anthracene	0.11	U	0.022	0.055	0.11	ug/L
206-44-0	Fluoranthene	0.11	U	0.022	0.055	0.11	ug/L
129-00-0	Pyrene	0.11	U	0.022	0.055	0.11	ug/L
56-55-3	Benzo(a)anthracene	0.11	U	0.022	0.055	0.11	ug/L
218-01-9	Chrysene	0.11	U	0.022	0.055	0.11	ug/L
205-99-2	Benzo(b)fluoranthene	0.11	U	0.022	0.055	0.11	ug/L
207-08-9	Benzo(k)fluoranthene	0.11	U	0.022	0.055	0.11	ug/L
50-32-8	Benzo(a)pyrene	0.11	U	0.022	0.055	0.11	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.11	U	0.022	0.055	0.11	ug/L
53-70-3	Dibenz(a,h)anthracene	0.11	U	0.022	0.055	0.11	ug/L
191-24-2	Benzo(g,h,i)perylene	0.11	U	0.022	0.055	0.11	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	6.86		20 - 139		69%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.92		10 - 173		79%	SPK: 10
1718-51-0	Terphenyl-d14	10.3		20 - 171		103%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	9021	8.9				
1146-65-2	Naphthalene-d8	40515	11.07				
15067-26-2	Acenaphthene-d10	26042	14.02				
1517-22-2	Phenanthrene-d10	53916	16.51				
1719-03-5	Chrysene-d12	55869	21.02				
1520-96-3	Perylene-d12	44098	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/21/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SW-9			SDG No.:	C1595
Lab Sample ID:	C1595-24			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	930	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069948.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/21/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-10			SDG No.:	C1595
Lab Sample ID:	C1595-25			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	80
Sample Wt/Vol:	30.09	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069915.D	1	03/23/11	03/26/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1600	U	57	800	1600	ug/Kg
208-96-8	Acenaphthylene	1600	U	42	800	1600	ug/Kg
83-32-9	Acenaphthene	1600	U	47	800	1600	ug/Kg
86-73-7	Fluorene	1600	U	63	800	1600	ug/Kg
85-01-8	Phenanthrene	1600	U	45	800	1600	ug/Kg
120-12-7	Anthracene	1600	U	34	800	1600	ug/Kg
206-44-0	Fluoranthene	1600	U	33	800	1600	ug/Kg
129-00-0	Pyrene	1600	U	40	800	1600	ug/Kg
56-55-3	Benzo(a)anthracene	1600	U	79	800	1600	ug/Kg
218-01-9	Chrysene	1600	U	75	800	1600	ug/Kg
205-99-2	Benzo(b)fluoranthene	1600	U	54	800	1600	ug/Kg
207-08-9	Benzo(k)fluoranthene	1600	U	78	800	1600	ug/Kg
50-32-8	Benzo(a)pyrene	1600	U	36	800	1600	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1600	U	55	800	1600	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1600	U	48	800	1600	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1600	U	67	800	1600	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	69.5		30 - 150		70%	SPK: 100
321-60-8	2-Fluorobiphenyl	62.5		19 - 182		62%	SPK: 100
1718-51-0	Terphenyl-d14	73.4		24 - 191		73%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	53259	8.89				
1146-65-2	Naphthalene-d8	204126	11.07				
15067-26-2	Acenaphthene-d10	121478	14.03				
1517-22-2	Phenanthrene-d10	238254	16.51				
1719-03-5	Chrysene-d12	241427	21.02				
1520-96-3	Perylene-d12	211050	24.98				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/21/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-10			SDG No.:	C1595
Lab Sample ID:	C1595-25			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	80
Sample Wt/Vol:	30.09	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069915.D	1	03/23/11	03/26/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/21/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-10	SDG No.:	C1595
Lab Sample ID:	C1595-26	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	990 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069949.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.1	U UJ	0.02	0.05	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U UJ	0.02	0.05	0.1	ug/L
83-32-9	Acenaphthene	0.1	U UJ	0.02	0.05	0.1	ug/L
86-73-7	Fluorene	0.1	U UJ	0.02	0.05	0.1	ug/L
85-01-8	Phenanthrene	0.1	U UJ	0.02	0.05	0.1	ug/L
120-12-7	Anthracene	0.1	U UJ	0.02	0.05	0.1	ug/L
206-44-0	Fluoranthene	0.1	U UJ	0.02	0.05	0.1	ug/L
129-00-0	Pyrene	0.1	U UJ	0.02	0.05	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U UJ	0.02	0.05	0.1	ug/L
218-01-9	Chrysene	0.1	U UJ	0.02	0.05	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U UJ	0.02	0.05	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U UJ	0.02	0.05	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U UJ	0.02	0.05	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U UJ	0.02	0.05	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U UJ	0.02	0.05	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U UJ	0.02	0.05	0.1	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	3.56		20 - 139		36%	SPK: 10
321-60-8	2-Fluorobiphenyl	4.08		10 - 173		41%	SPK: 10
1718-51-0	Terphenyl-d14	5		20 - 171		50%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	10955	8.9				
1146-65-2	Naphthalene-d8	50467	11.07				
15067-26-2	Acenaphthene-d10	33416	14.02				
1517-22-2	Phenanthrene-d10	69646	16.51				
1719-03-5	Chrysene-d12	72353	21.02				
1520-96-3	Perylene-d12	58564	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/21/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SW-10			SDG No.:	C1595
Lab Sample ID:	C1595-26			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069949.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-6DUP			SDG No.:	C1595
Lab Sample ID:	C1595-27			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	70
Sample Wt/Vol:	30.07	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069916.D	1	03/23/11	03/26/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	1100	U	38	550	1100	ug/Kg
208-96-8	Acenaphthylene	1100	U	28	550	1100	ug/Kg
83-32-9	Acenaphthene	1100	U	31	550	1100	ug/Kg
86-73-7	Fluorene	1100	U	42	550	1100	ug/Kg
85-01-8	Phenanthrene	1100	U	30	550	1100	ug/Kg
120-12-7	Anthracene	1100	U	23	550	1100	ug/Kg
206-44-0	Fluoranthene	1100	U	22	550	1100	ug/Kg
129-00-0	Pyrene	1100	U	27	550	1100	ug/Kg
56-55-3	Benzo(a)anthracene	1100	U	53	550	1100	ug/Kg
218-01-9	Chrysene	1100	U	50	550	1100	ug/Kg
205-99-2	Benzo(b)fluoranthene	1100	U	36	550	1100	ug/Kg
207-08-9	Benzo(k)fluoranthene	1100	U	52	550	1100	ug/Kg
50-32-8	Benzo(a)pyrene	1100	U	24	550	1100	ug/Kg
193-39-5	Indeno(1,2,3-cd)pyrene	1100	U	37	550	1100	ug/Kg
53-70-3	Dibenz(a,h)anthracene	1100	U	32	550	1100	ug/Kg
191-24-2	Benzo(g,h,i)perylene	1100	U	45	550	1100	ug/Kg
SURROGATES							
4165-60-0	Nitrobenzene-d5	72.1		30 - 150		72%	SPK: 100
321-60-8	2-Fluorobiphenyl	58.7		19 - 182		59%	SPK: 100
1718-51-0	Terphenyl-d14	54.5		24 - 191		55%	SPK: 100
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	55179	8.9				
1146-65-2	Naphthalene-d8	209743	11.07				
15067-26-2	Acenaphthene-d10	124051	14.04				
1517-22-2	Phenanthrene-d10	245075	16.51				
1719-03-5	Chrysene-d12	243418	21.02				
1520-96-3	Perylene-d12	211120	24.98				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SD-6DUP			SDG No.:	C1595
Lab Sample ID:	C1595-27			Matrix:	SOIL
Analytical Method:	SW8270C			% Moisture:	70
Sample Wt/Vol:	30.07	Units:	g	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SOXH	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : N/A

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069916.D	1	03/23/11	03/26/11	PB54272

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	03/16/11
Project:	PTA Skeet Range	Date Received:	03/21/11
Client Sample ID:	B1181SW-6DUP	SDG No.:	C1595
Lab Sample ID:	C1595-28	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	960 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup : N	PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069950.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units
TARGETS							
91-20-3	Naphthalene	0.1	U UJ	0.021	0.05	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.021	0.05	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.021	0.05	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.021	0.05	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.021	0.05	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.021	0.05	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.021	0.05	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.021	0.05	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.021	0.05	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.021	0.05	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.021	0.05	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.021	0.05	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.021	0.05	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.021	0.05	0.1	ug/L
SURROGATES							
4165-60-0	Nitrobenzene-d5	6.88		20 - 139		69%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.92		10 - 173		79%	SPK: 10
1718-51-0	Terphenyl-d14	10.1		20 - 171		101%	SPK: 10
INTERNAL STANDARDS							
3855-82-1	1,4-Dichlorobenzene-d4	9668	8.89				
1146-65-2	Naphthalene-d8	43513	11.07				
15067-26-2	Acenaphthene-d10	28346	14.02				
1517-22-2	Phenanthrene-d10	59866	16.5				
1719-03-5	Chrysene-d12	62528	21.01				
1520-96-3	Perylene-d12	50635	24.96				

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	03/16/11
Project:	PTA Skeet Range			Date Received:	03/21/11
Client Sample ID:	B1181SW-6DUP			SDG No.:	C1595
Lab Sample ID:	C1595-28			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	960	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BE069950.D	1	03/22/11	03/29/11	PB54256

CAS Number	Parameter	Conc.	Qualifier	MDL	LOD	LOQ	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

Shaw Environmental, Inc.
2113 Emmorton Park Road
Edgewood, Maryland
410-612-6350
FAX: 410-612-6351

Shaw® Shaw Environmental, Inc.

MEMORANDUM

TO: Gerard Maresca, Shaw E&I Picatinny Arsenal (PTA) Project Manager

FROM: Eric Malarek, Shaw E&I PTA Project Chemist

SUBJECT: PTA Data Validation – Metals
Chemtech C2048

DATE: June 22, 2011

The purpose of this memorandum is to present the data validation report for the samples collected for the Skeet Range samples collected at the PTA Site on April 28, 2011. The samples were analyzed for antimony, arsenic, copper, iron, lead, and zinc. The aqueous samples were analyzed for select metals using USEPA SW-846 3010A/6020. A total of six aqueous groundwater samples and one rinse blank sample were validated. The sample Ids are:

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
GW042811R1	C2048-01	DM19-3	C2048-05
C-1B	C2048-02	B1181MW-1	C2048-06
C-1A	C2048-03	B1181MW-1DUP	C2048-09
B1181MW-2	C2048-04		

Data were reviewed and validated using a combination of project QAPP, *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2, October 2010* (DoD, 2010) (DoD QSM), and method-specific criteria. The data qualifier scheme was consistent with the *USEPA Region II Evaluation of Metals Data for the Contract Laboratory Program, Revision 13* (SOP HW-2, September 2006). Parameters evaluated are presented in **Table 1**. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA specifications.

Table 1 Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times and Preservation
	X	Initial and Continuing Calibration
X		Blank Analysis
	X	ICPMS Interference Check Sample (ICS)
	X	Laboratory Control Sample (LCS)
X		Laboratory Duplicate
X		Matrix Spike (MS) and Spike Duplicate (MSD)
X		Field Duplicate
	X	ICPMS Serial Dilution
X		Quantitation Verification and Data Review

The quality of data collected in support of this sampling activity is considered acceptable with noted qualifications.

Eric Malarek, Chemist

6/22/11
Date

PTA VALIDATION REPORT
METALS REVIEW
SDG C2048

I-Holding Times and Preservation

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample analysis. For ICPMS metals analysis, aqueous samples are received and stored at cool @4°C±2°C and preserved to pH<2 with nitric acid with a maximum holding time of 180 days from collection (USEPA criteria).

- Temperature Review: The temperature blank was sent with each cooler and recorded by the laboratory upon receipt. For samples collected on 04/28/11, the cooler was received by the laboratory (Chemtech) on 04/29/11 at 4°C. All criteria were met. No qualifiers were applied.

- Holding Time Review: The aqueous samples and aqueous rinse blank sample were collected on 04/28/11 for select metals analysis. The aqueous samples were digested on 05/03/11 and analyzed on 05/04/11 for ICPMS analysis. The analysis dates for each sample may be found on the attached form 1s. All criteria were met. No qualifiers were applied.

II-Initial and Continuing Calibration

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICPMS:
1- blank (DoD QSM <LOD)
3 – standards ($r \geq 0.995$)
ICV/CCV (90-110%) (DoD QSM 90-110%)
MRL (70-130%) (DoD QSM 80-120%)

- The aqueous samples were analyzed for ICPMS metals on 05/04/11. All ICPMS metals were calibrated using 5 point calibrations with correlation coefficients >0.995. For ICPMS zinc analysis, MRL standards (158%, 76.0%) were outside criteria. Zinc was detected in all associated samples with concentrations >2*MRL (>2*2 µg/L = >4 µg/L); therefore, no qualifiers were applied based upon these outliers. All other ICV/CCV/MRL criteria were met for all metals and runs.

III-Blanks

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. One method blank per analytical batch must be run on each instrument used to analyze samples. Calibration blanks were analyzed initially and at a 10% frequency thereafter for each batch. No contaminants should be detected in any of the associated blanks >MDL. The DoD QSM criteria specifies all concentrations should be less than ½MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters) and <LOD (i.e. <2MDL) for the calibration blanks. Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters, or 5 times (5X) the maximum amount for other target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one. Rinse blank GW042811R1 (C2048-01) applies to all groundwater samples.

Table 2 Blank Contamination Analysis Summary

Analysis Date	Analysis	QC Blank ID	Max Conc. µg/L	Action Level µg/L	U qualified samples (for this SDG)
05/04/11	ICPMS-Sb	ICB/CCBs	0.907J	4.54	B1181MW-1, B1181MW-1DUP, DM19-3
05/04/11	ICPMS-As	ICB/CCBs	0.729J	3.65	B1181MW-1DUP, B1181MW-1
05/04/11	ICPMS-Cu	ICB/CCBs	0.680J	3.40	B1181MW-1, B1181MW-1DUP, C-1A
05/04/11	ICPMS-Fe	ICB/CCBs	23.2J	116	None
05/04/11	ICPMS-Pb	ICB/CCBs	0.537J	2.69	C-1B, B1181MW-1, B1181MW-1DUP, C-1A, DM19-3
05/04/11	ICPMS-Zn	ICB/CCBs	0.333J	1.67	None
05/04/11	ICPMS	PB55032BL	<½MRL	NA	None
05/04/11	ICPMS-Cu	GW042811R1	2.8	14.0	C-1B, B1181MW-1, B1181MW-1DUP, C-1A, B1181MW-2, DM19-3
05/04/11	ICPMS-Fe	GW042811R1	39.5J	198	None
05/04/11	ICPMS-Pb	GW042811R1	0.88J	4.40	C-1B, B1181MW-1, B1181MW-1DUP, C-1A, B1181MW-2, DM19-3
05/04/11	ICPMS-Zn	GW042811R1	34.5N*	173	C-1B, B1181MW-1, B1181MW-1DUP, C-1A, B1181MW-2, DM19-3

J = Estimated value <MRL and >MDL.
N = Lab spike recovery failed.
* = Lab duplicate RPD failed.
MRL = Method Reporting Limit
MDL = Method Detection Limit
NA = Not Applicable
SDG= Sample Delivery Group

IV-ICPMS Interference Check Sample (ICS)

The ICPMS interference check sample (ICS) verifies inter-element and background correction factors. ICPMS Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120% (DoD QSM limits 80-120%).

- All criteria were met for all runs. No qualifiers were applied.

V-Laboratory Control Samples (LCS)

The laboratory control sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. The DoD QSM aqueous LCS criteria are specified in Table G-18 of the DoD QSM (DoD, 2010) and are 80-120% and RPD≤20% for ICPMS metals.

- Sample PB55032BS was used as aqueous LCS for ICPMS metals analysis dated 05/04/11. All criteria were met. No qualifiers were applied. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this LCS.

VI-Laboratory Duplicate

Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analysis is also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. RPDs must be within established control limits. The DoD QSM limits for the aqueous samples are ≤20% RPD for ICPMS metals.

- Sample B1181MW-1 (C2048-06) was used as the aqueous laboratory duplicate for the ICPMS metals analysis on 05/04/11. Arsenic (35.2%) and zinc (26.8%) were outside criteria. Arsenic was outside due to low sample concentrations (i.e. <MRL); therefore, no qualifiers were applied based upon this outlier. Zinc was detected for the associated samples; therefore, was qualified estimated "J" based upon the low recoveries. All other metals and RPDs were within criteria limits. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this laboratory duplicate.

VII-Matrix Spike (MS) and Spike Duplicate (MSD)
MS and MSD are generated to determine long-term accuracy and precision of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. Specific criteria include the analyses of matrix spike samples at a frequency of one MS/MSD per 20 samples of similar matrix. MS/MSD recoveries and relative percent differences between MS recoveries should be within the specified limits. The DoD MS and MSD aqueous recovery limits use the LCS criteria specified in Table G-18 of the DoD QSM (DoD, 2010) and are 80-120% and RPD≤20% for ICPMS metals. Post digestion spikes aqueous limits are 75-125% for ICPMS metals.

- Sample B1181MW-1 (C2048-06) was used as the aqueous MS/MSD for the ICPMS metals analysis on 05/04/11. Iron (237%, 133%), lead (122%), and zinc (46.1%, 51.4%) were outside criteria. The sample concentration was >4 times the spike added for iron; therefore, no qualifiers were applied based upon this outlier. Lead and zinc were detected for the associated samples; therefore, were qualified estimated "J" based upon these outliers. All other metals and RPDs were within criteria limits. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this MS/MSD.

VIII-Field Duplicate Sample Analysis
Field duplicates were collected to identify the cumulative precision of the sampling and analytical process and sent to the laboratory blind. The RPD was calculated only for those analytes which were detected at levels exceeding the method reporting limits in both samples of the duplicate pair. Analytes that were rejected (R-qualified) in either sample of the duplicate pair were excluded from the duplicate assessment. Precision control criterion was established at ≤25% RPD for aqueous samples.

- Field aqueous sample duplicate pair B1181MW-1 (C2048-06) and B1181MW-1DUP (C2048-09) was collected for select metals analysis. Antimony was detected in the original sample at 0.46J µg/L and in the duplicate pair at 0.36J µg/L resulting in a RPD of 24.4%. Arsenic was detected in the original sample at 0.92J µg/L and in the duplicate pair at 0.26J µg/L resulting in a RPD of 111%. Copper was detected in the original sample at 1.8J µg/L and in the duplicate pair at 2.4 µg/L resulting in a RPD of 28.6%. Iron was detected in the original sample at 15300 µg/L and in the duplicate pair at 14600 µg/L resulting in a RPD of 4.7%. Lead was detected in the original sample at 0.87J µg/L and in the duplicate pair at 1.0 µg/L resulting in a RPD of 13.9%. Zinc was detected in the original sample at 30.9 µg/L and in the duplicate pair at 50.4 µg/L resulting in a RPD of 48.0%. Arsenic, copper, and zinc were outside criteria and was qualified estimated "J" for the duplicate pair based upon the high RPDs. The arsenic results were at or below the MRL levels. For all other target metals, all criteria were met.

IX-ICPMS Serial Dilution
A serial dilution is performed to determine whether significant physical or chemical interferences exist due to sample matrix at high concentrations. An analysis of a 5-fold dilution should agree within 10% difference of the original result when the concentration in sample is a factor of 100 above MDL for ICPMS.

- Sample B1181MW-1 (C2048-06) was used as the aqueous serial dilution for the ICPMS metals analysis on 05/04/11. Antimony (100%), arsenic (273%), copper (49.7%), and lead (29.9%) were outside criteria. Sample concentrations were <100 times MDL for antimony, arsenic, copper, and lead; therefore, no qualifiers were applied based upon these outliers. All other metals were within criteria limits. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this serial dilution.

X-Quantitation Verification and Data Review
The accuracy of analytical results is verified through the calculation of several parameters. The percent difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification.

- Any sample value >MDL and <MRL or <3*MDL (whichever was greater) was qualified as estimated, "J."

Sample: C-1B (C2048-02), Zinc

Conc. (µg/L) = (conc. µg/L) * (Final Volume mL) * (DF) / (Volume Sample mL)

Conc. (µg/L) = (32.96 µg/L) * (50 mL) * (1) / (50 mL) = 33.0 µg/L

Reported concentration = 33.0 µg/L
%D = 0.0%
Values were within 10% difference.

Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
No Code	Confirmed identification.
U	Undetected at the limit of detection: The associated data value is the limit of detection, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more quality control criteria failed.
USEPA Region II Data Validation Qualifiers[2]	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meeting the Quality Control criteria. The presence or absence of the analyte cannot be verified.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

[1]The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2]The USEPA data validation qualifiers are referenced from *USEPA Region II Evaluation of Metals Data for the Contract Laboratory Program, Revision 13 (SOP HW-2, September 2006).*

Form I Copy

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	GW042811R1	SDG No.:	C2048
Lab Sample ID:	C2048-01	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2	U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	1	U	1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	2.8		1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	39.5	J J	1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	0.88	J J	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	34.5	N* J	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	C-1B	SDG No.:	C2048
Lab Sample ID:	C2048-02	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2	U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	4		1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	3.8	U	1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	624		1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	1.1	U	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	33	N* U	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	C-1A	SDG No.:	C2048
Lab Sample ID:	C2048-03	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2	U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	1	U	1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	1.8	J U	1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	209		1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	0.49	J U	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	12.8	N* U	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	Colorless	Clarity Before:	Clear	Texture:	
Color After:	Colorless	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	B1181MW-2	SDG No.:	C2048
Lab Sample ID:	C2048-04	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	2	U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	1	U	1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	6.3	U	1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	16900		1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	2.9	U	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	27.9	N* U	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	YELLOW	Clarity Before:	Cloudy	Texture:	
Color After:	YELLOW	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	DM19-3	SDG No.:	C2048
Lab Sample ID:	C2048-05	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.27	J U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	10.3		1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	3.8	U	1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	2050		1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	1.2	U	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	14.5	N* U	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	YELLOW	Clarity Before:	Clear	Texture:	
Color After:	YELLOW	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

Form I Copy

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

Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	B1181MW-1	SDG No.:	C2048
Lab Sample ID:	C2048-06	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.46	J U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	0.92	J U	1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	1.8	J U	1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	15300		1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	0.87	J U	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	30.9	N* U	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	YELLOW	Clarity Before:	Clear	Texture:	
Color After:	Yellow	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	B1181MW-1DUP	SDG No.:	C2048
Lab Sample ID:	C2048-09	Matrix:	WATER
Level (low/med):	low	% Solid:	0

Cas	Parameter	Conc.	Qua.	DF	MDL	LOQ / CRQL	Units	Prep Date	Date Ana.	Ana Met.
7440-36-0	Antimony	0.36	J U	1	0.14	2	ug/L	05/03/11	05/04/11	SW6020
7440-38-2	Arsenic	0.26	J U	1	0.18	1	ug/L	05/03/11	05/04/11	SW6020
7440-50-8	Copper	2.4	U	1	0.04	2	ug/L	05/03/11	05/04/11	SW6020
7439-89-6	Iron	14600		1	10.3	200	ug/L	05/03/11	05/04/11	SW6020
7439-92-1	Lead	1	U	1	0.04	1	ug/L	05/03/11	05/04/11	SW6020
7440-66-6	Zinc	50.4	N* U	1	0.09	2	ug/L	05/03/11	05/04/11	SW6020

Color Before:	YELLOW	Clarity Before:	Clear	Texture:	
Color After:	YELLOW	Clarity After:	Clear	Artifacts:	
Comments:	Metals Group3				

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
D = Dilution

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
E = Value Exceeds Calibration Range
OR = Over Range

Shaw Environmental, Inc.
2113 Emmorton Park Road
Edgewood, Maryland
410-612-6350
FAX: 410-612-6351

Shaw® Shaw Environmental, Inc.

MEMORANDUM

TO: Gerard Maresca, Shaw E&I Picatinny Arsenal (PTA) Project Manager

FROM: Eric Malarek, Shaw E&I PTA Project Chemist

SUBJECT: PTA Data Validation – Polynuclear Aromatic Hydrocarbons
Chemtech C2048

DATE: June 23, 2011

The purpose of this memorandum is to present the data validation report for the Skeet Range samples collected at the PTA Site on April 28, 2011. Samples were analyzed for polynuclear aromatic hydrocarbons (PAHs) using USEPA SW846 Methods 3510C/8270C for the aqueous and rinse blank samples. A total of six aqueous groundwater samples and one rinse blank sample were validated. The sample Ids are:

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
GW042811R1	C2048-01	DM19-3	C2048-05
C-1B	C2048-02	B1181MW-1	C2048-06
C-1A	C2048-03	B1181MW-1DUP	C2048-09
B1181MW-2	C2048-04		

Data were reviewed and validated using a combination of project QAPP, *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2, April 2010* (DoD, 2010) (DoD QSM), method-specific criteria, and laboratory SOP criteria. The data qualifier scheme was consistent with the *USEPA Region II SOP Validating Semivolatile Organic Compounds by Gas Chromatography / Mass Spectroscopy SW-846 Method 8270D, Revision 4 (SOP HW-22, August 2008*). Parameters evaluated are presented in **Table 1**. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA specifications.

Table 1 Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times and Preservation
	X	Instrument Performance Check
	X	Initial Calibration
	X	Continuing Calibration
	X	Blank Analysis
	X	Surrogate Spikes
	X	Internal Standards
	X	Laboratory Control Sample and Laboratory Control Sample Duplicate
	X	Matrix Spike/Spike Duplicate
	X	Field Duplicate
	X	Quantitation Verification and Data Review

The quality of data collected in support of this sampling activity is considered acceptable.

Eric Malarek, Chemist

6/23/11
Date

PTA VALIDATION REPORT
PAH REVIEW
SDG C2048

I-Holding Times and Preservation
The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. All samples are cooled @4°C ± 2°C. The maximum holding time criteria for PAHs for aqueous samples is 7 days from sample collection to preparative extraction and 40 days from preparative extraction to determinative analysis (USEPA criteria).

- Temperature Review: The temperature blank was sent with each cooler and recorded by the laboratory upon receipt. For samples collected on 04/28/11, the cooler was received by the laboratory (Chemtech) on 04/29/11 at 4°C. All criteria were met. No qualifiers were applied.

- Holding Time Review: The aqueous and rinse blank samples were collected on 04/28/11 for PAH analysis. For the aqueous samples, the PAHs were extracted on 05/04/11 and analyzed on 05/05/11 and 05/06/11. Sample collection dates may be found on the attached form 1s. All criteria were met. No qualifiers were applied.

II-Instrument Performance Check
GC/MS instrument performance checks are performed to ensure mass resolution, identification and, to some degree, sensitivity. The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed.

- The instrument performance check, decafluorotriphenylphosphine (DFTPP), met the ion abundance criteria. No qualification was applied.

III-Initial Calibration
Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for reported PAH compounds. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The DoD QSM specifies that for compounds analyzed using linear regression or second order, correlation coefficients must be >0.995 (coefficient of determination r^2>0.99 for higher order). The minimum relative response factor (RRF) criteria must be ≥0.05. Initial calibration percent relative standard deviation (%RSD) must be ≤15% on the average for all compounds (<30% for CCCs).

- Initial calibration for the PAHs was performed on 05/05/11 on instrument BNAB. Phenanthrene (16.1%) was outside criteria; however, was quantified using linear regression with a coefficient of determination of 0.994. No qualifiers were applied based upon this outlier. All criteria were met for the reported target PAHs. No qualifiers were applied. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this initial calibration.

IV-Continuing Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for PAH target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum relative response factors (RRF) for PAH target compounds and surrogates must be ≥0.05. The DoD QSM specifies that the percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within ±20% for all target compounds.

- For initial calibration verification performed on 05/05/11 @19:41 on instrument BNAB, all criteria were met for all PAH target compounds (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples GW042811R1 (C2048-01) and B1181MW-1 (C2048-06) apply to this initial calibration verification.

- For continuing calibration performed on 05/06/11 @01:08 on instrument BNAB, all PAH target compounds were within criteria (%D≤20%; %Drift≤20%; RRF≥0.05). No qualifiers were applied. Samples C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), and B1181MW-1DUP (C2048-09) apply to this continuing calibration.

V-Blank Analysis

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of DFTPP. No contaminants should be detected in any of the associated blanks >MDL. DoD QSM criteria specifies all concentrations should be less than one-half MRL (<MRL for common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters). Positive sample results are reported and qualified "U", if the concentration of the compound in the sample is ≤10 times (10x) the maximum amount in any blank for the common laboratory contaminants phthalate esters, or 5 times (5X) the maximum amount for other semivolatile target compounds. **Table 2** summarizes the blank contamination analysis. Action levels are based upon dilution factor of one. Rinse blank GW042811R1 (C2048-01) applies to all groundwater samples.

Table 2 Blank Contamination Analysis Summary

Analysis Date	QC Blank ID	Compound	Max Conc. µg/L	Action Level µg/L	U qualified samples (For this SDG)
05/05/11	PB55047B	All target <½MRL	NA	NA	None
05/05/11	GW042811R1	All target <½MRL	NA	NA	None

MRL = Method Reporting Limit.
NA = Not Applicable

VI-Surrogate Spikes

Laboratory performance on individual samples is evaluated through the review of surrogate spike samples. Surrogate spikes are added to all samples and blanks to measure their recovery in sample and blank matrices. The percent recoveries (%Rs) must be within the specified control limits.

Aqueous Criteria: Nitrobenzene-d5 (20-139%) – (DoD QSM Criteria: 40-110%)
2-Fluorobiphenyl (10-173%) – (DoD QSM Criteria: 50-110%)
p-Terphenyl – d14 (20-171%) – (DoD QSM Criteria: 50-135%)

- All criteria were met. No qualifiers were applied.

VII-Internal Standards
Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated calibration standard.

- All criteria were met for all runs. No qualifiers were applied.

VIII-Laboratory Control Sample and Laboratory Control Sample Duplicate
Laboratory control samples (LCS) are used to monitor laboratory accuracy by calculating the percent recoveries of the spiked compounds. All LCS/LCSD percent recoveries must be within the specified control limits. DoD LCS/LCSD aqueous recovery limits are specified in Table G-2 and Table G-6 of the DoD QSM (DoD, 2010). The DoD MS/MSD precision RPD criteria is ≤30% for aqueous matrices. The DoD QSM LCS criterion for non-listed SVOCs is to use current laboratory in-house limits.

- Sample PB55047BS was used as the aqueous LCS for the PAH analysis on 05/05/11. All criteria were met. No qualifiers were applied. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this LCS.

IX-Matrix Spike/Matrix Spike Duplicate
Data for matrix spike/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. The percent recoveries (%Rs) and the relative percent difference (RPD) must be within the specified control limits. DoD LCS/LCSD aqueous recovery limits are specified in Table G-2 and Table G-6 of the DoD QSM (DoD, 2010). The DoD MS/MSD precision RPD criteria is ≤30% for aqueous matrices. The DoD QSM LCS criterion for non-listed SVOCs is to use current laboratory in-house limits.

- Sample B1181MW-1 (C2048-06) was used as the aqueous MS/MSD for the PAH analysis on 05/05/11. Target compound chrysene (RPD=23%) was outside lab criteria. For all other target compounds, all criteria were met. The associated LCS was within criteria for all target compounds (see Section VIII). Chrysene was non-detect in the spiked sample; therefore, no qualification was required based upon the high RPD. Samples GW042811R1 (C2048-01), C-1B (C2048-02), C-1A (C2048-03), B1181MW-2 (C2048-04), DM19-3 (C2048-05), B1181MW-1 (C2048-06), and B1181MW-1DUP (C2048-09) apply to this MS/MSD.

X-Field Duplicate Sample Analysis
Field duplicates were collected to identify the cumulative precision of the sampling and analytical process and sent to the laboratory blind. The RPD was calculated only for those analytes which were detected at levels exceeding the method reporting limits in both samples of the duplicate pair. Analytes that were rejected (R-qualified) in either sample of the duplicate pair and any tentatively identified compounds (TICs) were excluded from the duplicate assessment. Precision control criterion was established at 50% RPD for the aqueous samples.

- Field aqueous sample duplicate pair B1181MW-1 (C2048-06) and B1181MW-1DUP (C2048-09) was collected for PAHs. All PAH target compounds were non-detect. All criteria were met. No qualifiers were applied.

XI-Quantitation Verification and Data Review

The accuracy of analytical results was verified through the calculation of several parameters. Percent difference (%D) between the calculated and reported values must be ≤10%.

- Any sample value >MDL and <MRL or <3*MDL (whichever is greater) was qualified as estimated, "J."

Sample: PB55047BS, Acenaphthene

Conc. (µg/L) = {(Ax)*(Is)*(Vt)*(DF)}/{(Ais)*(RRF)*(V_o)*(V_i)}

where:	$Conc_{sample}$	=	Sample concentration in µg/L
	A_x	=	Area of characteristic ion for compound being measured.
	I_s	=	Amount of internal standard injected (ng).
	V_t	=	Volume of total extract, taking into account dilutions (µL).
	A_{is}	=	Area of characteristic ion for the internal standard.
	RRF_A	=	Average relative response factor for compound being measured
	V_o	=	Volume of water extracted (mL).
	V_i	=	Volume of extract injected (µL).
	DF	=	Dilution Factor

Conc. µg/L = (166272 * 5ng * 1000µL * 1) / (97203 * 1.132 * 1000mL * 1 µL) = 7.6 ng/mL
= 7.6 µg/L

Reported Value = 7.6 µg/L
% Difference = 0.0%
Values were within 10% difference.

Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
No Code	Confirmed identification.
U	Undetected at the limit of detection: The associated data value is the limit of detection, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more quality control criteria failed.
USEPA Region II Data Validation Qualifiers[2]	
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meeting the Quality Control criteria. The presence or absence of the analyte cannot be verified.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

[1]The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DOD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2]The USEPA data validation qualifiers are referenced from *USEPA Region II SOP Validating Semivolatile Organic Compounds by Gas Chromatography / Mass Spectroscopy SW-846 Method 8270D, Revision 4 (SOP HW-22, August 2008).*

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	GW042811R1			SDG No.:	C2048
Lab Sample ID:	C2048-01			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	970	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056022.D	1	05/04/11	05/05/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.021	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.021	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.021	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.021	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.021	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.021	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.021	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.021	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.021	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.021	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.021	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.021	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.021	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.021	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.021	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.021	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	6.18		20 - 139	62%	SPK: 10
321-60-8	2-Fluorobiphenyl	6.66		10 - 173	67%	SPK: 10
1718-51-0	Terphenyl-d14	8.51		20 - 171	85%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	46381	5.79			
1146-65-2	Naphthalene-d8	189284	8.21			
15067-26-2	Acenaphthene-d10	95374	12.31			
1517-22-2	Phenanthrene-d10	175687	15.59			
1719-03-5	Chrysene-d12	145214	20.97			
1520-96-3	Perylene-d12	132342	23.75			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	GW042811R1			SDG No.:	C2048
Lab Sample ID:	C2048-01			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	970	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056022.D	1	05/04/11	05/05/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	C-1B	SDG No.:	C2048
Lab Sample ID:	C2048-02	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	980 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056025.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.02	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.02	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.02	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.02	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.02	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.02	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.02	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.02	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.02	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.02	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.02	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.02	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.02	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.02	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.02	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.02	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	6.64		20 - 139	66%	SPK: 10
321-60-8	2-Fluorobiphenyl	6.97		10 - 173	70%	SPK: 10
1718-51-0	Terphenyl-d14	9.08		20 - 171	91%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	45980	5.79			
1146-65-2	Naphthalene-d8	174038	8.22			
15067-26-2	Acenaphthene-d10	91827	12.31			
1517-22-2	Phenanthrene-d10	168277	15.6			
1719-03-5	Chrysene-d12	142567	20.97			
1520-96-3	Perylene-d12	124276	23.76			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	C-1B			SDG No.:	C2048
Lab Sample ID:	C2048-02			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	980	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056025.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	C-1A			SDG No.:	C2048
Lab Sample ID:	C2048-03			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056026.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.02	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.02	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.02	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.02	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.02	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.02	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.02	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.02	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.02	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.02	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.02	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.02	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.02	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.02	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.02	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.02	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	6.29		20 - 139	63%	SPK: 10
321-60-8	2-Fluorobiphenyl	6.78		10 - 173	68%	SPK: 10
1718-51-0	Terphenyl-d14	8.93		20 - 171	89%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	49735	5.79			
1146-65-2	Naphthalene-d8	173284	8.22			
15067-26-2	Acenaphthene-d10	95218	12.31			
1517-22-2	Phenanthrene-d10	167781	15.59			
1719-03-5	Chrysene-d12	140198	20.97			
1520-96-3	Perylene-d12	119467	23.75			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	C-1A			SDG No.:	C2048
Lab Sample ID:	C2048-03			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056026.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	B1181MW-2			SDG No.:	C2048
Lab Sample ID:	C2048-04			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056027.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.02	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.02	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.02	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.02	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.02	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.02	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.02	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.02	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.02	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.02	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.02	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.02	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.02	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.02	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.02	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.02	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	7.45		20 - 139	75%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.78		10 - 173	78%	SPK: 10
1718-51-0	Terphenyl-d14	8.4		20 - 171	84%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	50687	5.79			
1146-65-2	Naphthalene-d8	184392	8.22			
15067-26-2	Acenaphthene-d10	100167	12.31			
1517-22-2	Phenanthrene-d10	191308	15.6			
1719-03-5	Chrysene-d12	152840	20.97			
1520-96-3	Perylene-d12	130765	23.76			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	B1181MW-2			SDG No.:	C2048
Lab Sample ID:	C2048-04			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056027.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	DM19-3			SDG No.:	C2048
Lab Sample ID:	C2048-05			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	970	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056028.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.021	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.021	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.021	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.021	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.021	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.021	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.021	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.021	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.021	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.021	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.021	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.021	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.021	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.021	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.021	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.021	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	6.98		20 - 139	70%	SPK: 10
321-60-8	2-Fluorobiphenyl	7.18		10 - 173	72%	SPK: 10
1718-51-0	Terphenyl-d14	7.98		20 - 171	80%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	47820	5.8			
1146-65-2	Naphthalene-d8	176474	8.21			
15067-26-2	Acenaphthene-d10	94107	12.32			
1517-22-2	Phenanthrene-d10	176021	15.6			
1719-03-5	Chrysene-d12	146203	20.97			
1520-96-3	Perylene-d12	125272	23.75			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	DM19-3			SDG No.:	C2048
Lab Sample ID:	C2048-05			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	970	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056028.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.	Date Collected:	04/28/11
Project:	PTA Skeet Range	Date Received:	04/28/11
Client Sample ID:	B1181MW-1	SDG No.:	C2048
Lab Sample ID:	C2048-06	Matrix:	WATER
Analytical Method:	SW8270C	% Moisture:	100
Sample Wt/Vol:	980 Units: mL	Final Vol:	1000 uL
Soil Aliquot Vol:	uL	Test:	SVOC-PAH
Extraction Type :	SEPF Decanted : N	Level :	LOW
Injection Volume :	1 GPC Factor : 1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056019.D	1	05/04/11	05/05/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.02	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.02	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.02	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.02	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.02	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.02	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.02	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.02	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.02	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.02	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.02	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.02	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.02	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.02	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.02	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.02	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	6.81		20 - 139	68%	SPK: 10
321-60-8	2-Fluorobiphenyl	6.73		10 - 173	67%	SPK: 10
1718-51-0	Terphenyl-d14	8.24		20 - 171	82%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	48973	5.79			
1146-65-2	Naphthalene-d8	176083	8.22			
15067-26-2	Acenaphthene-d10	97707	12.32			
1517-22-2	Phenanthrene-d10	177328	15.59			
1719-03-5	Chrysene-d12	155161	20.97			
1520-96-3	Perylene-d12	146564	23.75			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	B1181MW-1			SDG No.:	C2048
Lab Sample ID:	C2048-06			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	980	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056019.D	1	05/04/11	05/05/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	B1181MW-1DUP			SDG No.:	C2048
Lab Sample ID:	C2048-09			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup : N	PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056029.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units
TARGETS						
91-20-3	Naphthalene	0.1	U	0.02	0.1	ug/L
208-96-8	Acenaphthylene	0.1	U	0.02	0.1	ug/L
83-32-9	Acenaphthene	0.1	U	0.02	0.1	ug/L
86-73-7	Fluorene	0.1	U	0.02	0.1	ug/L
85-01-8	Phenanthrene	0.1	U	0.02	0.1	ug/L
120-12-7	Anthracene	0.1	U	0.02	0.1	ug/L
206-44-0	Fluoranthene	0.1	U	0.02	0.1	ug/L
129-00-0	Pyrene	0.1	U	0.02	0.1	ug/L
56-55-3	Benzo(a)anthracene	0.1	U	0.02	0.1	ug/L
218-01-9	Chrysene	0.1	U	0.02	0.1	ug/L
205-99-2	Benzo(b)fluoranthene	0.1	U	0.02	0.1	ug/L
207-08-9	Benzo(k)fluoranthene	0.1	U	0.02	0.1	ug/L
50-32-8	Benzo(a)pyrene	0.1	U	0.02	0.1	ug/L
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	U	0.02	0.1	ug/L
53-70-3	Dibenz(a,h)anthracene	0.1	U	0.02	0.1	ug/L
191-24-2	Benzo(g,h,i)perylene	0.1	U	0.02	0.1	ug/L
SURROGATES						
4165-60-0	Nitrobenzene-d5	6.77		20 - 139	68%	SPK: 10
321-60-8	2-Fluorobiphenyl	6.75		10 - 173	68%	SPK: 10
1718-51-0	Terphenyl-d14	7.56		20 - 171	76%	SPK: 10
INTERNAL STANDARDS						
3855-82-1	1,4-Dichlorobenzene-d4	46864	5.79			
1146-65-2	Naphthalene-d8	179358	8.22			
15067-26-2	Acenaphthene-d10	93060	12.31			
1517-22-2	Phenanthrene-d10	173724	15.59			
1719-03-5	Chrysene-d12	144645	20.97			
1520-96-3	Perylene-d12	129764	23.75			

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Report of Analysis

Client:	Shaw E & I, Inc.			Date Collected:	04/28/11
Project:	PTA Skeet Range			Date Received:	04/28/11
Client Sample ID:	B1181MW-1DUP			SDG No.:	C2048
Lab Sample ID:	C2048-09			Matrix:	WATER
Analytical Method:	SW8270C			% Moisture:	100
Sample Wt/Vol:	990	Units:	mL	Final Vol:	1000 uL
Soil Aliquot Vol:			uL	Test:	SVOC-PAH
Extraction Type :	SEPF	Decanted :	N	Level :	LOW
Injection Volume :	1	GPC Factor :	1.0	GPC Cleanup :	N PH : 5

File ID/Qc Batch:	Dilution:	Prep Date	Date Analyzed	Prep Batch ID
BB056029.D	1	05/04/11	05/06/11	PB55047

CAS Number	Parameter	Conc.	Qualifier	MDL	LOQ / CRQL	Units

U = Not Detected
LOQ = Limit of Quantitation
MDL = Method Detection Limit
LOD = Limit of Detection
E = Value Exceeds Calibration Range

J = Estimated Value
B = Analyte Found in Associated Method Blank
N = Presumptive Evidence of a Compound
* = Values outside of QC limits
D = Dilution

APPENDIX B

GROUNDWATER SAMPLING DATA SHEETS

LOW FLOW SAMPLING
DATA SHEET

SHEET 1 OF 1

SITE: Skeet Range
DATE: 4/28/11
WEATHER: 74°F Light rain

CONSULTING FIRM:
FIELD PERSONNEL:

MONITOR WELL #: C-1A
WELL PERMIT #:
WELL DEPTH: 87.2'
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 77.2-87.2'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 82.0 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 1.11 ft below TOC
MAKE/MODEL OF PUMP: Grundfos Geopump Rediflow 2

TIME	PURGING	SAMPLING	pH (pH units) READING	pH CHANGE*	SPECIFIC CONDUCTIVITY (mS/cm) READING	SPECIFIC CONDUCTIVITY CHANGE*	REDOX POTENTIAL (mv) READING	REDOX POTENTIAL CHANGE*	DISSOLVED OXYGEN (mg/l) READING	DISSOLVED OXYGEN CHANGE*	TURBIDITY (NTU) READING	TURBIDITY CHANGE*	TEMPERATURE (degrees C) READING	TEMPERATURE CHANGE*	PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
1040	X		7.45	NA	0.271	NA	170.9	NA	6.97	NA	12.3	NA	11.61	NA		1.11
1045	X		7.54		0.274		170.2		6.53		9.7		11.94			2.00
1050	X		7.79		0.279		144.8		5.29		114.4		11.77			2.27
1055	X		7.95		0.273		109.7		3.22		48.5		11.25			2.98
1100	X		7.97		0.272		87.8		1.20		66.7		11.00			2.98
1105	X		7.96		0.273		52.0		0.95		31.3		11.23			
1110	X		7.98		0.273		35.3		0.85		16.3		11.28			
1115	X		7.99		0.274		18.2		0.77		9.2		11.36			
1120	X		7.98		0.274		13.6		0.75		8.1		11.23			
1125		X	7.99		0.274		10.7		0.70		6.2		11.17			
			SAMPLE													

COMMENTS:
10:50 Cleaned flo-thru

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

LOW FLOW SAMPLING
DATA SHEET

SHEET 1 OF 2

SITE: Skeet Range 180
DATE: 04/28/11
WEATHER: 74 Cloudy

CONSULTING FIRM: Shaw
FIELD PERSONNEL: T. McHugh M. Lobsiger

MONITOR WELL #: C-1B
WELL PERMIT #:
WELL DEPTH: 22.3'
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 12.3-22.3'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 17.0 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 2.15 ft below TOC
MAKE/MODEL OF PUMP: Grunfos Geopump Rediflow 2

TIME	PURGING	SAMPLING	pH (pH units) READING	pH CHANGE*	SPECIFIC CONDUCTIVITY (mS/cm) READING	SPECIFIC CONDUCTIVITY CHANGE*	REDOX POTENTIAL (mv) READING	REDOX POTENTIAL CHANGE*	DISSOLVED OXYGEN (mg/l) READING	DISSOLVED OXYGEN CHANGE*	TURBIDITY (NTU) READING	TURBIDITY CHANGE*	TEMPERATURE (degrees C) READING	TEMPERATURE CHANGE*	PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
0915	X		7.29	NA	0.175	NA	132.1	NA	2.92	NA	42.3	NA	11.17	NA		2.15
0920	X		7.53		0.177		148.9		1.38		81.2		11.38			3.20
0925	X		7.64		0.179		157.6		1.09		53.2		11.80			3.23
0930	X		7.69		0.179		159.2		1.01		50.1		11.90			3.23
0935	X		7.65		0.186		161.1		0.92		41.2		12.02			
0940	X		7.57		0.196		162.0		0.87		34.6		11.95			
0945	X		7.52		0.200		162.3		0.84		32.1		12.04			
0950	X		7.44		0.205		163.4		0.80		25.3		12.06			
0955	X		7.38		0.214		164.2		0.75		23.8		12.21			
1000	X		7.26		0.219		165.9		0.71		18.9		11.51			
1005	X		7.22		0.222		167.0		0.68		14.9		11.40			

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

LOW FLOW SAMPLING
DATA SHEET

SHEET 2 OF 2

SITE: Skeet Range
DATE: 4-28-2011
WEATHER: 74° Cloudy

CONSULTING FIRM: Shaw E+I
FIELD PERSONNEL: T. McHugh, M. Lobsiger

MONITOR WELL #: C-1B
WELL PERMIT #:
WELL DEPTH: 22.3'
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 12.3-22.3'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 17.0 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 2.15 ft below TOC
MAKE/MODEL OF PUMP: Grunfos Geopump Rediflow 2

TIME	PURGING	SAMPLING	pH (pH units)		SPECIFIC CONDUCTIVITY (mS/cm)		REDOX POTENTIAL (mv)		DISSOLVED OXYGEN (mg/l)		TURBIDITY (NTU)		TEMPERATURE (degrees C)		PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
			READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*		
1010	X		7.21	NA	0.224	NA	166.7	NA	0.67	NA	9.98	NA	11.51	NA		3.23
1015	X		7.21		0.226		167.4		0.65		8.99		11.60			
1020		X	7.20		0.228		167.6		0.64		8.04		11.56			
					SAMPLE											

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

LOW FLOW SAMPLING
DATA SHEET

SHEET 1 OF 1

SITE: Picatinny Skeet Range
DATE: 4-28-2011
WEATHER: 74° Cloudy

CONSULTING FIRM: Shaw E+I
FIELD PERSONNEL:

MONITOR WELL #: DM19-3
WELL PERMIT #:
WELL DEPTH: 20'
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 10-20'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 15 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 6.21 ft below TOC
MAKE/MODEL OF PUMP: Grundfos Geopump Redi-Flow 2

TIME	PURGING	SAMPLING	pH (pH units) READING	pH CHANGE*	SPECIFIC CONDUCTIVITY (mS/cm) READING	SPECIFIC CONDUCTIVITY CHANGE*	REDOX POTENTIAL (mv) READING	REDOX POTENTIAL CHANGE*	DISSOLVED OXYGEN (mg/l) READING	DISSOLVED OXYGEN CHANGE*	TURBIDITY (NTU) READING	TURBIDITY CHANGE*	TEMPERATURE (degrees C) READING	TEMPERATURE CHANGE*	PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
1545	X		7.11	NA	0.283	NA	81.5	NA	7.27	NA	28.1	NA	11.55	NA		6.21
1550	X		6.94		0.278		87.2		6.39		24.6		11.37			6.22
1555	X		6.89		0.276		74.0		5.88		21.9		11.18			6.22
1600	X		6.89		0.276		31.5		5.20		20.3		11.10			6.22
1605	X		6.86		0.277		4.7		4.84				11.08			
1610	X		6.84		0.278		2.4		4.41				10.91			
1615		X	6.83		0.280		-0.9		4.30				10.99			
			SAMPLE													

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

LOW FLOW SAMPLING
DATA SHEET

SHEET 1 OF 2

SITE: Skeet range
DATE: 4/28/11
WEATHER: Rain 65°

CONSULTING FIRM: Shaw E+I
FIELD PERSONNEL: T. McHugh M. Lobsiger

MONITOR WELL #: B1181MW-2
WELL DEPTH: 16.0'
WELL PERMIT #:
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 11-16'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 13.0 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 4.26 ft below TOC
MAKE/MODEL OF PUMP: Grundfos Geopump Red.-Flow 2

TIME	PURGING	SAMPLING	pH (pH units) READING	pH CHANGE*	SPECIFIC CONDUCTIVITY (mS/cm) READING	SPECIFIC CONDUCTIVITY CHANGE*	REDOX POTENTIAL (mv) READING	REDOX POTENTIAL CHANGE*	DISSOLVED OXYGEN (mg/l) READING	DISSOLVED OXYGEN CHANGE*	TURBIDITY (NTU) READING	TURBIDITY CHANGE*	TEMPERATURE (degrees C) READING	TEMPERATURE CHANGE*	PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
1340	X		6.40	NA	0.279	NA	-24.8	NA	3.40	NA	82.0	NA	10.79	NA		4.26
1345	X		6.26		0.281		-28.2		2.43		43.3		10.95			4.28
1350	X		6.24		0.281		-31.1		2.19		45.1		10.94			4.28
1355	X		6.23		0.280		-33.5		1.70		54.0		10.87			4.28
1400	X		6.19		0.282		-33.5		1.29		52.8		11.16			
1405	X		6.22		0.273		-30.1		2.75		245.6		10.56			
1410	X		6.26		0.296		-40.5		0.75		36.3		13.18			
1415	X		6.29		0.301		-44.3		0.63		136.8		13.20			
1420	X		6.29		0.297		-45.5		0.59		111.8		12.77			
1425	X		6.29		0.295		-46.6		0.57		101.5		12.63			
1430	X		6.29		0.297		-47.2		0.55		63.4		12.84			

cleared cup

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

LOW FLOW SAMPLING
DATA SHEET

SHEET 2 OF 2

SITE: Picatinny Skeet Range
DATE: 11-28-2011
WEATHER: Rain 65°

CONSULTING FIRM: Shaw E+I
FIELD PERSONNEL: T. McHugh, M. Lobsiger

MONITOR WELL #: B118MW-2
WELL PERMIT #:
WELL DEPTH: 16.0'
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 11-16'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 13.0 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 4.26 ft below TOC
MAKE/MODEL OF PUMP: Grundfos Geopump Redi-Flow 2

TIME	PURGING	SAMPLING	pH (pH units) READING	pH CHANGE*	SPECIFIC CONDUCTIVITY (mS/cm) READING	SPECIFIC CONDUCTIVITY CHANGE*	REDOX POTENTIAL (mv) READING	REDOX POTENTIAL CHANGE*	DISSOLVED OXYGEN (mg/l) READING	DISSOLVED OXYGEN CHANGE*	TURBIDITY (NTU) READING	TURBIDITY CHANGE*	TEMPERATURE (degrees C) READING	TEMPERATURE CHANGE*	PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
1435	X		6.29	NA	0.297	NA	-47.7	NA	0.53	NA	53.1	NA	12.89	NA		4.28
1440	X		6.29		0.297		-47.8		0.52		31.1		13.06			
1445	X		6.29		0.297		-48.0		0.52		22.7		13.04			
1450	X		6.29		0.299		-48.4		0.51		11.5		13.13			
1455	X		6.29		0.300		-48.6		0.50		9.8		13.15			
1500		X	6.29		0.300		-48.7		0.51		9.6		13.20			
				SAMPLE												

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

LOW FLOW SAMPLING
DATA SHEET

SHEET 1 OF 1

SITE: Picatinny Skeet Range
DATE: 4-28-2011
WEATHER: Rain 65°

CONSULTING FIRM: Shaw E+I
FIELD PERSONNEL: T. McHugh, M. Lobsiger

MONITOR WELL #: B1181MW-1
WELL PERMIT #:
WELL DEPTH: 12.7'
WELL DIAMETER: 2 inches
SCREENED/OPEN INTERVAL: 7.7-12.7'

PID/FID READINGS (ppm):
BACKGROUND: 0.0
BENEATH OUTER CAP: 0.0
BENEATH INNER CAP: 0.0

PUMP INTAKE DEPTH: 10.0 ft below TOC
DEPTH TO WATER BEFORE PUMP INSTALLATION: 4.44 ft below TOC
MAKE/MODEL OF PUMP: Grundfos Geopump Redi-Flow 2

TIME	PURGING	SAMPLING	pH (pH units) READING	pH CHANGE*	SPECIFIC CONDUCTIVITY (mS/cm) READING	SPECIFIC CONDUCTIVITY CHANGE*	REDOX POTENTIAL (mv) READING	REDOX POTENTIAL CHANGE*	DISSOLVED OXYGEN (mg/l) READING	DISSOLVED OXYGEN CHANGE*	TURBIDITY (NTU) READING	TURBIDITY CHANGE*	TEMPERATURE (degrees C) READING	TEMPERATURE CHANGE*	PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
1635	X		6.61	NA	0.303	NA	-40.0	NA	2.90	NA	403.6	NA	10.83	NA		4.44
1640	X		6.46		0.310		-51.4		0.94		65.1		11.74			4.50
1645	X		6.44		0.311		-54.9		0.75		57.9		11.66			
1650	X		6.42		0.310		-56.9		0.64		43.7		11.49			
1655	X		6.41		0.311		-59.0		0.59		24.6		11.65			
1700	X		6.39		0.313		-60.3		0.55		16.4		11.85			
1705	X		6.38		0.314		-61.0		0.53		12.8		11.95			
1710	X		6.37		0.314		-61.6		0.52		10.1		11.99			
1715	X		6.37		0.315		-62.0		0.51		8.9		12.01			
1720		X	6.36		0.315		-62.4		0.50		8.1		12.00			

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ±0.1 for pH; ±3% for Specific Conductivity and Temperature; ±10 mv for Redox Potential; and ±10% for Dissolved Oxygen and Turbidity.

APPENDIX C

HUMAN HEALTH RISK ASSESSMENT DATA

Table 1
Selection of Exposure Pathways
Former Skeet Range - Picatinny Arsenal

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/ Future	Surface Soil	Surface Soil	Former Skeet Range	Routine Worker	Adult	Incidental ingestion	Quant	Workers could contact surface soil at Former Skeet Range and be exposed to COPCs via incidental ingestion.
						Dermal	Quant	Workers could contact surface soil at Former Skeet Range and be exposed to COPCs via dermal absorption.
				Trespassers	Adult or Child	Incidental ingestion	None	Trespassers would be expected to have lower exposure than routine worker
						Dermal	None	Trespassers would be expected to have lower exposure than routine worker
				Maintenance Worker	Adult	Incidental ingestion	None	Maintenance workers would be expected to have lower exposure than routine worker
						Dermal	None	Maintenance workers would be expected to have lower exposure than routine worker
		Air	Particulates/volatiles released from surface soil at Former Skeet Range	Routine Worker	Adult	Inhalation	Quant	Workers could be exposed to COPCs released from surface soil at Former Skeet Range.
				Trespasser	Adult or Child	Inhalation	None	Trespassers would be expected to have lower exposure than routine worker
				Maintenance Worker	Adult	Inhalation	None	Maintenance workers would be expected to have lower exposure than routine worker
	Total Soil (Surface and Subsurface Soil)	Total Soil	Former Skeet Range	Construction Worker	Adult	Incidental ingestion	Quant	Construction workers could contact total soil at Former Skeet Range and be exposed to COPCs via incidental ingestion.
						Dermal	Quant	Construction workers could contact total soil at Former Skeet Range and be exposed to COPCs via dermal absorption.
		Air	Particulates/volatiles released from total soil at Former Skeet Range	Construction Worker	Adult	Inhalation	Quant	Construction workers could be exposed to COPCs released from total soil at Former Skeet Range.
			Volatiles from soil gas migrating into indoor air	Routine Worker	Adult	Inhalation	None	No VOCs were selected as COPCs for soil.
	Groundwater	Groundwater	Former Skeet Range	Routine Worker	Adult	Ingestion, Dermal	None	Groundwater is not currently being used. Therefore, there is no direct contact with groundwater (see Future).
				Construction Worker	Adult	Incidental ingestion	None	Due to the depth of the groundwater at the site, potential future construction/utility workers could contact the water table during excavation, construction, or utility-related activities in a trench or pit. However, the groundwater is assumed to be pooled at the bottom of the trench or pit. Therefore, exposures to COPCs in groundwater via incidental ingestion from splashing and hand-to-mouth contact are likely to be negligible.
						Dermal	None	Due to the depth of the groundwater at the site, potential future construction/utility workers could contact the water table during excavation, construction, or utility-related activities in a trench or pit. However, groundwater is assumed to be pooled at the bottom of the trench and dermal contact would be prevented by typical work clothes and boots. Therefore, exposures to COPCs in groundwater by dermal absorption are expected to be negligible.

Table 1
Selection of Exposure Pathways
Former Skeet Range - Picatinny Arsenal

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Groundwater	Air	Indoor Air	Routine Worker	Adult	Inhalation	None	No VOCs were selected as COPCs for groundwater.
			Trench Vapors	Construction Worker	Adult	Inhalation	None	No VOCs were selected as COPCs for groundwater.
	Surface Water	Surface Water	Former Skeet Range	Routine Worker	Adult	Incidental ingestion	Quant	Routine worker could contact surface water while wading in wetland.
						Dermal	Quant	Routine worker could contact surface water while wading in wetland.
	Sediment	Sediment	Former Skeet Range	Routine Worker	Adult	Incidental ingestion	Quant	Routine worker could contact sediment while wading in wetland.
						Dermal	Quant	Routine worker could contact sediment while wading in wetland.
Future	Surface Soil	Surface Soil	Former Skeet Range	Residential	Adult	Incidental ingestion	Quant	Residents could be exposed to COPCs in surface soil at Former Skeet Range via incidental ingestion.
						Dermal	Quant	Residents could contact surface soil at Former Skeet Range and be exposed to COPCs via dermal absorption.
					Child	Incidental ingestion	Quant	Residents could be exposed to COPCs in surface soil at Former Skeet Range via incidental ingestion.
						Dermal	Quant	Residents could contact surface soil at Former Skeet Range and be exposed to COPCs via dermal absorption.
		Air	Particulates/ volatiles released from surface soil at Former Skeet Range	Residential	Adult	Inhalation	Quant	Residents could be exposed to COPCs released from surface soil at Former Skeet Range.
					Child	Inhalation	Quant	Residents could be exposed to COPCs released from surface soil at Former Skeet Range.
			Volatiles from soil gas migrating into indoor air	Residential	Adult	inhalation	None	No residences currently exist and no VOC selected as COPCs in soil.
					Child	inhalation	None	No residences currently exist and no VOC selected as COPCs in soil.
	Groundwater	Groundwater	Former Skeet Range	Routine Worker	Adult	Incidental ingestion	Quant	No future use of groundwater is anticipated. Hypothetical exposures are considered due to the aquifer designation as a potable water supply.
						Dermal	Quant	No future use of groundwater is anticipated. Hypothetical exposures are considered due to the aquifer designation as a potable water supply.

Table 1
Selection of Exposure Pathways
Former Skeet Range - Picatinny Arsenal

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Former Skeet Range	Residential	Adult	Incidental ingestion	Quant	No future use of groundwater is anticipated. Hypothetical exposures are considered due to the aquifer designation as a potable water supply.
						Dermal	Quant	No future use of groundwater is anticipated. Hypothetical exposures are considered due to the aquifer designation as a potable water supply.
					Child	Incidental ingestion	Quant	No future use of groundwater is anticipated. Hypothetical exposures are considered due to the aquifer designation as a potable water supply.
						Dermal	Quant	No future use of groundwater is anticipated. Hypothetical exposures are considered due to the aquifer designation as a potable water supply.
		Air	Indoor Vapors	Routine Worker	Adult	Inhalation	None	No VOCs selected as COPCs in groundwater.
				Residential	Adult	Inhalation	None	No residences currently exist and no VOC selected as COPCs in groundwater.
					Child	Inhalation	None	No residences currently exist and no VOC selected as COPCs in groundwater.
			Household Use of Groundwater	Residential	Adult	Inhalation	None	No residences currently exist and no VOC selected as COPCs in groundwater.
					Child	Inhalation	None	No residences currently exist and no VOC selected as COPCs in groundwater.
			Washroom Use of Groundwater	Routine Worker	Adult	Inhalation	None	No VOC selected as COPCs in groundwater.
	Surface Water	Surface Water	Former Skeet Range	Residential	Adult	Ingestion	Quant	Residents could potentially incidentally ingest water.
						Dermal	Quant	Residents could contact surface water while wading in wetland.
					Child	Ingestion	Quant	Residents could potentially incidentally ingest water.
						Dermal	Quant	Residents could contact surface water while wading in wetland.
	Sediment	Sediment	Former Skeet Range	Residential	Adult	Incidental ingestion	Quant	Residents could contact sediment while wading in wetland.
						Dermal	Quant	Residents could contact sediment while wading in wetland.
					Child	Incidental ingestion	Quant	Residents could contact sediment while wading in wetland.
						Dermal	Quant	Residents could contact sediment while wading in wetland.

TABLE 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, SURFACE SOIL (0 - 1 FT)

FORMER SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	7440-36-0	Antimony	9.70E-01 J	3.94E+01	mg/kg	B1181SS-46-03162011	8/14	2.57E+00 - 9.24E+00	3.94E+01	N/A	3.10E+00 (N)	N/A	N/A	Yes	ASL
Surface Soil	7440-38-2	Arsenic	1.65E+00	2.41E+01	mg/kg	B1181SS-42-03162011	14/14	N/A	2.41E+01	N/A	3.90E-01 (C)	N/A	N/A	Yes	ASL
(0 - 1 ft. bgs)	7440-50-8	Copper	1.74E+01 J	7.12E+01 J	mg/kg	B1181SS-57-03162011	14/14	N/A	7.12E+01	N/A	3.10E+02 (N)	N/A	N/A	No	BSL
	7439-89-6	Iron	5.52E+03	3.09E+04 J	mg/kg	B1181SS-42-03162011	14/14	N/A	3.09E+04	N/A	5.50E+03 (N)	N/A	N/A	Yes	ASL
	7439-92-1	Lead	1.08E+01	8.47E+04	mg/kg	B1181SS-32	35/35	N/A	8.47E+04	N/A	4.00E+02 (N)	N/A	N/A	Yes	ASL
	7440-66-6	Zinc	2.35E+01 J	1.55E+02 J	mg/kg	B1181SS-54-03162011	14/14	N/A	1.55E+02	N/A	2.30E+03 (N)	N/A	N/A	No	BSL
	7440-44-0	Total Organic Carbon	2.03E+04 J	4.12E+05	mg/kg	B1181SS-37	17/17	N/A	4.12E+05	N/A	N/A	N/A	N/A	No	NTX
	91-57-6	2-Methylnaphthalene	5.99E-02 J	4.36E-01 J	mg/kg	B1181SS-23	7/13	1.95E-01 - 9.93E-01	4.36E-01	N/A	3.10E+01 (N)	N/A	N/A	No	BSL
	83-32-9	Acenaphthene	8.25E-02 J	3.79E+00	mg/kg	B1181SS-23	5/26	2.25E-01 - 2.10E+00	3.79E+00	N/A	3.40E+02 (N)	N/A	N/A	No	BSL
	208-96-8	Acenaphthylene	1.53E-01 J	2.53E-01 J	mg/kg	B1181SS-27	2/26	2.25E-01 - 2.10E+00	2.53E-01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	120-12-7	Anthracene	8.30E-02 J	7.88E+00	mg/kg	B1181SS-23	7/26	2.25E-01 - 2.10E+00	7.88E+00	N/A	1.70E+03 (N)	N/A	N/A	No	BSL
	56-55-3	Benzo(a)anthracene	2.30E-01 J	2.76E+01	mg/kg	B1181SS-23	6/26	9.37E-02 - 2.10E+00	2.76E+01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	50-32-8	Benzo(a)pyrene	2.00E-01 J	2.16E+01	mg/kg	B1181SS-23	14/26	2.35E-01 - 2.10E+00	2.16E+01	N/A	1.50E-02 (C)	N/A	N/A	Yes	ASL
	205-99-2	Benzo(b)fluoranthene	1.20E-01 J	2.71E+01	mg/kg	B1181SS-23	16/26	4.70E-01 - 2.10E+00	2.71E+01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	191-24-2	Benzo(ghi)perylene	1.20E-01 J	1.42E+01	mg/kg	B1181SS-23	7/26	2.44E-01 - 2.10E+00	1.42E+01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	207-08-9	Benzo(k)fluoranthene	8.80E-02 J	1.22E+01	mg/kg	B1181SS-23	15/26	4.70E-01 - 2.10E+00	1.22E+01	N/A	1.50E+00 (C)	N/A	N/A	Yes	ASL
	218-01-9	Chrysene	8.30E-02 J	2.62E+01	mg/kg	B1181SS-23	9/26	9.37E-02 - 2.10E+00	2.62E+01	N/A	1.50E+01 (C)	N/A	N/A	Yes	ASL
	53-70-3	Dibenzo(a,h)anthracene	2.03E-01 J	4.88E+00	mg/kg	B1181SS-23	9/26	2.25E-01 - 2.10E+00	4.88E+00	N/A	1.50E-02 (C)	N/A	N/A	Yes	ASL
	206-44-0	Fluoranthene	7.60E-02 J	3.84E+01	mg/kg	B1181SS-23	16/26	4.70E-01 - 2.10E+00	3.84E+01	N/A	2.30E+02 (N)	N/A	N/A	No	BSL
	86-73-7	Fluorene	7.30E-02 J	3.70E+00	mg/kg	B1181SS-23	7/26	2.25E-01 - 2.10E+00	3.70E+00	N/A	2.30E+02 (N)	N/A	N/A	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	8.70E-02 J	1.65E+01	mg/kg	B1181SS-23	13/26	2.34E-01 - 2.10E+00	1.65E+01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	91-20-3	Naphthalene	1.16E-01 J	7.67E-01 J	mg/kg	B1181SS-23	7/26	2.30E-01 - 2.10E+00	7.67E-01	N/A	3.60E+00 (C)	N/A	N/A	No	BSL
	85-01-8	Phenanthrene	6.55E-02 J	2.20E+01	mg/kg	B1181SS-23	15/26	4.70E-01 - 2.10E+00	2.20E+01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	129-00-0	Pyrene	7.20E-02 J	9.30E+00	mg/kg	B1181SS-35	15/25	4.70E-01 - 2.10E+00	9.30E+00	N/A	1.70E+02 (N)	N/A	N/A	No	BSL

(1) Maximum concentration used for screening.

(2) N/A - Background not used to deselect COPCs; see Risk Characterization Section

(3) Residential screening toxicity values from USEPA RSL Table (June, 2011). Cancer RSL based on 1.0E-06 and non-cancer RSL based on an HQ of 0.1. Lead RSL used "as-is" without the non-cancer adjustment.

(4) Rationale Codes

Selection Reason: Toxicity Information Available (TX)
Above Screening Levels (ASL)

Deletion Reason: Infrequent Detection (<= 5%, IFD)
No Toxicity Information (NTX)
Below or Equal to Screening and/or ARAR/TBC Level (BSL)
Nutrient (NUT)

Surrogate or alternate chemical screening values used:
pyrene used for acenaphthylene, benzo(ghi)perylene, and phenanthrene

Definitions: N/A = Not Applicable or Not Available
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
(C) = Carcinogenic
(N) = Non-Carcinogenic

Qualifier Definitions: J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, TOTAL SOIL (0 - 10 FT)

FORMER SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Total Soil (0-10 ft. bgs)	7440-36-0	Antimony	9.70E-01 J	3.94E+01	mg/kg	B1181SS-46-03162011	8/14	2.57E+00 - 9.24E+00	3.94E+01	N/A	3.10E+00 (N)	N/A	N/A	Yes	ASL
	7440-38-2	Arsenic	1.65E+00	2.41E+01	mg/kg	B1181SS-42-03162011	14/14	N/A	2.41E+01	N/A	3.90E-01 (C)	N/A	N/A	Yes	ASL
	7440-50-8	Copper	1.74E+01 J	7.12E+01 J	mg/kg	B1181SS-57-03162011	14/14	N/A	7.12E+01	N/A	3.10E+02 (N)	N/A	N/A	No	BSL
	7439-89-6	Iron	5.52E+03	3.09E+04 J	mg/kg	B1181SS-42-03162011	14/14	N/A	3.09E+04	N/A	5.50E+03 (N)	N/A	N/A	Yes	ASL
	7439-92-1	Lead	1.08E+01	8.47E+04	mg/kg	B1181SS-32	38/38	N/A	8.47E+04	N/A	4.00E+02 (N)	N/A	N/A	Yes	ASL
	7440-66-6	Zinc	2.35E+01 J	1.55E+02 J	mg/kg	B1181SS-54-03162011	14/14	N/A	1.55E+02	N/A	2.30E+03 (N)	N/A	N/A	No	BSL
	7440-44-0	Carbon	2.03E+04 J	4.12E+05	mg/kg	B1181SS-37	17/17	N/A	4.12E+05	N/A	N/A	N/A	N/A	No	NTX
	91-57-6	2-Methylnaphthalene	5.99E-02 J	4.36E-01 J	mg/kg	B1181SS-23	7/13	1.95E-01 - 9.93E-01	4.36E-01	N/A	3.10E+01 (N)	N/A	N/A	No	BSL
	83-32-9	Acenaphthene	8.25E-02 J	3.79E+00	mg/kg	B1181SS-23	6/28	2.25E-01 - 3.90E+00	3.79E+00	N/A	3.40E+02 (N)	N/A	N/A	No	BSL
	208-96-8	Acenaphthylene	1.53E-01 J	2.53E-01 J	mg/kg	B1181SS-27	2/28	2.25E-01 - 3.90E+00	2.53E-01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	120-12-7	Anthracene	8.30E-02 J	7.88E+00	mg/kg	B1181SS-23	9/28	2.25E-01 - 2.10E+00	7.88E+00	N/A	1.70E+03 (N)	N/A	N/A	No	BSL
	56-55-3	Benzo(a)anthracene	2.30E-01 J	2.76E+01	mg/kg	B1181SS-23	8/28	9.37E-02 - 2.10E+00	2.76E+01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	50-32-8	Benzo(a)pyrene	2.00E-01 J	2.16E+01	mg/kg	B1181SS-23	16/28	2.35E-01 - 2.10E+00	2.16E+01	N/A	1.50E-02 (C)	N/A	N/A	Yes	ASL
	205-99-2	Benzo(b)fluoranthene	1.20E-01 J	2.71E+01	mg/kg	B1181SS-23	18/28	4.70E-01 - 2.10E+00	2.71E+01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	191-24-2	Benzo(ghi)perylene	1.20E-01 J	1.42E+01	mg/kg	B1181SS-23	9/28	2.44E-01 - 2.10E+00	1.42E+01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	207-08-9	Benzo(k)fluoranthene	8.80E-02 J	1.22E+01	mg/kg	B1181SS-23	17/28	4.70E-01 - 2.10E+00	1.22E+01	N/A	1.50E+00 (C)	N/A	N/A	Yes	ASL
	218-01-9	Chrysene	8.30E-02 J	2.62E+01	mg/kg	B1181SS-23	11/28	9.37E-02 - 2.10E+00	2.62E+01	N/A	1.50E+01 (C)	N/A	N/A	Yes	ASL
	53-70-3	Dibenzo(a,h)anthracene	2.03E-01 J	4.88E+00	mg/kg	B1181SS-23	11/28	2.25E-01 - 2.10E+00	4.88E+00	N/A	1.50E-02 (C)	N/A	N/A	Yes	ASL
	206-44-0	Fluoranthene	7.60E-02 J	3.84E+01	mg/kg	B1181SS-23	18/28	4.70E-01 - 2.10E+00	3.84E+01	N/A	2.30E+02 (N)	N/A	N/A	No	BSL
	86-73-7	Fluorene	7.30E-02 J	3.70E+00	mg/kg	B1181SS-23	8/28	2.25E-01 - 3.90E+00	3.70E+00	N/A	2.30E+02 (N)	N/A	N/A	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	8.70E-02 J	1.65E+01	mg/kg	B1181SS-23	15/28	2.34E-01 - 2.10E+00	1.65E+01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	91-20-3	Naphthalene	1.16E-01 J	1.30E+00 J	mg/kg	B1181SS-23C-03162011	8/28	2.30E-01 - 3.90E+00	1.30E+00	N/A	3.60E+00 (C)	N/A	N/A	No	BSL
	85-01-8	Phenanthrene	6.55E-02 J	2.20E+01	mg/kg	B1181SS-23	17/28	4.70E-01 - 2.10E+00	2.20E+01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	129-00-0	Pyrene	7.20E-02 J	1.60E+01	mg/kg	B1181SS-23C-03162011	17/27	4.70E-01 - 2.10E+00	1.60E+01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL

(1) Maximum concentration used for screening.
(2) N/A - Background not used to deselect COPCs; see Risk Characterization Section
(3) Residential screening toxicity values from USEPA RSL Table (June, 2011). Cancer RSL based on 1.0E-06 and non-cancer RSL based on an HQ of 0.1. Lead RSL used "as-is" without the non-cancer adjustment.
(4) Rationale Codes

Selection Reason: Toxicity Information Available (TX)
Above Screening Levels (ASL)

Deletion Reason: Infrequent Detection (<= 5%, IFD)
No Toxicity Information (NTX)
Below or Equal to Screening and/or ARAR/TBC Level (BSL)
Nutrient (NUT)

Surrogate or alternate chemical screening values used:
pyrene used for acenaphthylene, benzo(ghi)perylene, and phenanthrene

Definitions: N/A = Not Applicable or Not Available
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
(C) = Carcinogenic
(N) = Non-Carcinogenic

Qualifier Definitions: J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2.3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, GROUNDWATER

FORMER SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Groundwater	7429-90-5	Aluminum	2.98E-01	1.11E+00	mg/l	C1-B 06172010	5/5	N/A	1.11E+00	N/A	3.70E+00 (N)	N/A	N/A	No	BSL
	7440-38-2	Arsenic	4.00E-03	1.32E-02	mg/l	DM19-3 06172010	4/10	5.90E-04 - 1.00E-02	1.32E-02	N/A	4.50E-05 (C)	N/A	N/A	Yes	ASL
	7440-39-3	Barium	3.97E-02 J	8.34E-02	mg/l	C1-A 06172010	5/5	N/A	8.34E-02	N/A	7.30E-01 (N)	N/A	N/A	No	BSL
	7440-43-9	Cadmium	1.28E-03 J	1.61E-03 J	mg/l	B1181MW-1 06172010	5/5	N/A	1.61E-03	N/A	1.80E-03 (N)	N/A	N/A	No	BSL
	7440-70-2	Calcium	2.24E+01	3.51E+01	mg/l	C1-A 06172010	5/5	N/A	3.51E+01	N/A	N/A	N/A	N/A	No	NUT
	7440-47-3	Chromium	2.79E-03 J	7.79E-03 J	mg/l	B1181MW-1 06172010	5/5	N/A	7.79E-03	N/A	4.30E-05 (C)	N/A	N/A	Yes	ASL
	7440-50-8	Copper	4.55E-03 J	9.97E-03 J	mg/l	B1181MW-1 06172010	5/10	1.80E-03 - 6.30E-03	9.97E-03	N/A	1.50E-01 (N)	N/A	N/A	No	BSL
	7439-89-6	Iron	2.09E-01	1.83E+01	mg/l	B1181MW-1 06172010	10/10	N/A	1.83E+01	N/A	2.60E+00 (N)	N/A	N/A	Yes	ASL
	7439-92-1	Lead	1.60E-03 J	3.63E-03	mg/l	B1181MW-1 06172010	5/10	4.90E-04 - 2.90E-03	3.63E-03	N/A	N/A	1.50E-02	MCL	No	BSL
	7439-95-4	Magnesium	6.04E+00	1.11E+01	mg/l	C1-A 06172010	5/5	N/A	1.11E+01	N/A	N/A	N/A	N/A	No	NUT
	7439-96-5	Manganese	1.40E+00 J	3.35E+00 J	mg/l	C1-A 06172010	5/5	N/A	3.35E+00	N/A	8.80E-02 (N)	N/A	N/A	Yes	ASL
	7440-02-0	Nickel	3.05E-03 J	5.94E-03 J	mg/l	C1-B 06172010	3/5	1.00E-02 - 1.00E-02	5.94E-03	N/A	7.30E-02 (N)	N/A	N/A	No	BSL
	7440-09-7	Potassium	1.07E+00 J	1.68E+00 J	mg/l	B1181MW-1 06172010	4/5	5.00E+00 - 5.00E+00	1.68E+00	N/A	N/A	N/A	N/A	No	NUT
	7440-23-5	Sodium	7.75E+00 J	1.91E+01 J	mg/l	C1-B 06172010	5/5	N/A	1.91E+01	N/A	N/A	N/A	N/A	No	NUT
	7440-62-2	Vanadium	6.93E-03 J	1.79E-02	mg/l	B1181MW-2 06172010	3/5	1.25E-02 - 1.25E-02	1.79E-02	N/A	1.80E-02 (N)	N/A	N/A	No	BSL

(1) Maximum concentration used for screening.
(2) N/A - Refer to supporting text information for background discussion.
(3) Screening toxicity values from USEPA RSL Table (June, 2011). Cancer RSL based on 1.0E-06 and non-cancer RSL based on an HQ of 0.1.

(4) Rationale Codes:
Selection Reason: Toxicity Information Potentially Available (TX)
Above Screening Levels (ASL)
Deletion Reason: Below Screening and/or ARAR/TBC Level (BSL)
Nutrient (NUT)

Surrogate or alternate chemical screening values used:
cadmium (water) used for cadmium
chromium-VI used for chromium
manganese (non-diet) used for manganese
nickel soluble salts used for nickel
vanadium and compounds used for vanadium

Definitions: N/A = Not Applicable or Not Available
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
(C) = Carcinogenic
(N) = Non-Carcinogenic

Qualifier Definitions: J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, SURFACE WATER

FORMER SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Surface Water	7440-36-0	Antimony	4.10E-03	7.34E-02	mg/L	B1181SW-10-03212011	3/5	3.50E-04 - 7.20E-04	7.34E-02	N/A	1.50E-03 (N)	N/A	N/A	Yes	ASL
	7440-38-2	Arsenic	7.95E-04 J	2.30E-02 J	mg/L	B1181SW-10-03212011	2/5	3.00E-04 - 1.00E-03	2.30E-02	N/A	4.50E-05 (C)	N/A	N/A	Yes	ASL
	7440-50-8	Copper	3.40E-03	2.21E-02	mg/L	B1181SW-10-03212011	3/5	2.80E-03 - 3.00E-03	2.21E-02	N/A	1.50E-01 (N)	N/A	N/A	No	BSL
	7439-89-6	Iron	3.12E-01	8.34E+00	mg/L	B1181SW-10-03212011	5/5	N/A	8.34E+00	N/A	2.60E+00 (N)	N/A	N/A	Yes	ASL
	7439-92-1	Lead	4.30E-03	7.53E+00	mg/L	B1181SW-10-03212011	5/5	N/A	7.53E+00	N/A	N/A	1.50E-02	MCL	Yes	ASL
	7440-66-6	Zinc	5.18E-02	6.63E-02	mg/L	B1181SW-10-03212011	3/5	1.29E-02 - 2.59E-02	6.63E-02	N/A	1.10E+00 (N)	N/A	N/A	No	BSL

(1) Maximum concentration used for screening.
(2) N/A - Refer to supporting text information for background discussion.
(3) Screening toxicity values from USEPA RSL Table (June, 2011). Cancer RSL based on 1.0E-06 and non-cancer RSL based on an HQ of 0.1.

(4) Rationale Codes:
Selection Reason: Toxicity Information Potentially Available (TX)
Above Screening Levels (ASL)
Deletion Reason: Below Screening and/or ARAR/TBC Level (BSL)
Nutrient (NUT)

Definitions: N/A = Not Applicable or Not Available
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
(C) = Carcinogenic
(N) = Non-Carcinogenic

Qualifier Definitions: J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2.5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, SEDIMENT

FORMER SKEET RANGE - PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Sediment	7440-36-0	Antimony	8.44E+01	6.25E+03	mg/kg	B1181SD-10-03212011	3/5	2.30E+00 - 3.47E+00	6.25E+03	N/A	3.10E+00 (N)	N/A	N/A	Yes	ASL
	7440-38-2	Arsenic	4.20E-01 J	8.51E+02	mg/kg	B1181SD-9-03212011	5/5	N/A	8.51E+02	N/A	3.90E-01 (C)	N/A	N/A	Yes	ASL
	7440-50-8	Copper	6.15E+00	5.14E+02	mg/kg	B1181SD-10-03212011	6/6	N/A	5.14E+02	N/A	3.10E+02 (N)	N/A	N/A	Yes	ASL
	7439-89-6	Iron	5.01E+03	1.99E+04	mg/kg	B1181SD-8-03192011	6/6	N/A	1.99E+04	N/A	5.50E+03 (N)	N/A	N/A	Yes	ASL
	7439-92-1	Lead	4.34E+00	1.86E+05	mg/kg	B1181SD-10-03212011	9/9	N/A	1.86E+05	N/A	4.00E+02 (N)	N/A	N/A	Yes	ASL
	7440-66-6	Zinc	2.30E+01	6.29E+02	mg/kg	B1181SD-3C-03162011	6/6	N/A	6.29E+02	N/A	2.30E+03 (N)	N/A	N/A	No	BSL
	7440-44-0	Total Organic Carbon	1.55E+04	3.68E+05	mg/kg	B1181SD-5	2/2	N/A	3.68E+05	N/A	N/A	N/A	N/A	No	NTX
	205-99-2	Benzo(b)fluoranthene	1.86E-01 J	1.86E-01 J	mg/kg	B1181SD-4	1/8	4.20E-01 - 2.10E+00	1.86E-01	N/A	1.50E-01 (C)	N/A	N/A	Yes	ASL
	191-24-2	Benzo(ghi)perylene	1.69E+00 J	1.69E+00 J	mg/kg	B1181SD-5	1/8	2.72E-01 - 2.10E+00	1.69E+00	N/A	1.70E+02 (N)	N/A	N/A	No	BSL
	207-08-9	Benzo(k)fluoranthene	2.16E-01 J	2.16E-01 J	mg/kg	B1181SD-4	1/8	4.20E-01 - 2.10E+00	2.16E-01	N/A	1.50E+00 (C)	N/A	N/A	No	BSL
	206-44-0	Fluoranthene	1.29E-01 J	2.90E-01 J	mg/kg	B1181SD-3C-03162011	2/8	4.20E-01 - 1.90E+00	2.90E-01	N/A	2.30E+02 (N)	N/A	N/A	No	BSL
	129-00-0	Pyrene	1.50E-01 J	4.67E-01 J	mg/kg	B1181SD-5	2/8	4.20E-01 - 2.10E+00	4.67E-01	N/A	1.70E+02 (N)	N/A	N/A	No	BSL

(1) Maximum concentration used for screening.
(2) N/A - Refer to supporting text information for background discussion.
(3) Residential screening toxicity values from USEPA RSL Table (June 2011). Cancer RSL based on 1.0E-06 and non-cancer RSL based on an HQ of 0.1. Lead RSL used "as-is" without the non-cancer adjustment.
(4) Rationale Codes:
Selection Reason: Toxicity Information Potentially Available (TX)
Above Screening Levels (ASL)
Deletion Reason: Below Screening and/or ARAR/TBC Level (BSL)
Nutrient (NUT)
No Toxicity Information Available (NTX)

Surrogate or alternate chemical screening values used:
pyrene used for benzo(ghi)perylene

Definitions: N/A = Not Applicable or Not Available
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
(C) = Carcinogenic
(N) = Non-Carcinogenic

Qualifier Definitions: J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 3.1
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE SOIL
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/kg	9.87E+00	Yes	1.16E+01 (G)	3.94E+01	1.16E+01	mg/kg	95% KM-BCA	Test (1)
Arsenic	mg/kg	7.51E+00	No	1.09E+01 (G)	2.41E+01	1.09E+01	mg/kg	95% Approx. Gamma	Test (6)
Iron	mg/kg	1.72E+04	No	2.09E+04 (N)	3.09E+04	2.09E+04	mg/kg	95% Student's-t	Test (4)
Lead	mg/kg	5.88E+03	No	2.52E+04 (NP)	8.47E+04	2.52E+04	mg/kg	97.5% Cheby, Mean, SD	Test (3)
Benzo(a)anthracene	mg/kg	7.36E+00	Yes	3.85E+00 (G)	2.76E+01	3.85E+00	mg/kg	95% KM-t	Test (1)
Benzo(a)pyrene	mg/kg	2.89E+00	Yes	7.10E+00 (L)	2.16E+01	7.10E+00	mg/kg	97.5% KM-Cheby	Test (1)
Benzo(b)fluoranthene	mg/kg	3.24E+00	Yes	1.28E+01 (NP)	2.71E+01	1.28E+01	mg/kg	99% KM-Cheby	Test (1)
Benzo(k)fluoranthene	mg/kg	1.62E+00	Yes	4.06E+00 (L)	1.22E+01	4.06E+00	mg/kg	97.5% KM-Cheby	Test (1)
Chrysene	mg/kg	5.26E+00	Yes	3.77E+00 (G)	2.62E+01	3.77E+00	mg/kg	95% KM-t	Test (1)
Dibenzo(a,h)anthracene	mg/kg	1.03E+00	Yes	9.19E-01 (L)	4.88E+00	9.19E-01	mg/kg	95% KM-% Btstrp	Test (1)
Indeno(1,2,3-cd)pyrene	mg/kg	2.35E+00	Yes	2.70E+00 (L)	1.65E+01	2.70E+00	mg/kg	95% KM-BCA	Test (1)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.

TABLE 3.2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR TOTAL SOIL
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Soil
Exposure Medium: Total Soil (0-10 feet)

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/kg	9.87E+00	Yes	1.13E+01 (G)	3.94E+01	1.13E+01	mg/kg	95% KM-BCA	Test (1)
Arsenic	mg/kg	7.51E+00	No	1.09E+01 (G)	2.41E+01	1.09E+01	mg/kg	95% Approx. Gamma	Test (6)
Iron	mg/kg	1.72E+04	No	2.09E+04 (N)	3.09E+04	2.09E+04	mg/kg	95% Student's-t	Test (4)
Lead	mg/kg	5.51E+03	No	2.33E+04 (NP)	8.47E+04	2.33E+04	mg/kg	97.5% Cheby, Mean, SD	Test (3)
Benzo(a)anthracene	mg/kg	7.19E+00	Yes	4.06E+00 (G)	2.76E+01	4.06E+00	mg/kg	95% KM-t	Test (1)
Benzo(a)pyrene	mg/kg	3.39E+00	Yes	3.65E+00 (G)	2.16E+01	3.65E+00	mg/kg	95% KM-BCA	Test (1)
Benzo(b)fluoranthene	mg/kg	3.53E+00	Yes	1.26E+01 (L)	2.71E+01	1.26E+01	mg/kg	99% KM-Cheby	Test (1)
Benzo(k)fluoranthene	mg/kg	1.72E+00	Yes	4.00E+00 (L)	1.22E+01	4.00E+00	mg/kg	97.5% KM-Cheby	Test (1)
Chrysene	mg/kg	5.56E+00	Yes	4.02E+00 (G)	2.62E+01	4.02E+00	mg/kg	95% KM-t	Test (1)
Dibenzo(a,h)anthracene	mg/kg	1.03E+00	Yes	9.17E-01 (G)	4.88E+00	9.17E-01	mg/kg	95% KM-t	Test (1)
Indeno(1,2,3-cd)pyrene	mg/kg	2.31E+00	Yes	5.17E+00 (L)	1.65E+01	5.17E+00	mg/kg	97.5% KM-Cheby	Test (1)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.

TABLE 3.3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR GROUNDWATER
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Groundwater
Exposure Medium: Groundwater

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Arsenic	mg/L	8.76E-03	Yes	1.09E-02 (N)	1.32E-02	1.09E-02	mg/L	95% KM-% Btstrp	Test (1)
Chromium	mg/L	5.28E-03	No	7.32E-03 (N)	7.79E-03	7.32E-03	mg/L	95% Student's-t	Test (4)
Iron	mg/L	7.62E+00	No	1.77E+01 (G)	1.83E+01	1.77E+01	mg/L	95% Approx. Gamma	Test (6)
Manganese	mg/L	2.04E+00	No	2.81E+00 (N)	3.35E+00	2.81E+00	mg/L	95% Student's-t	Test (4)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.

TABLE 3.4
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SURFACE WATER
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Surface Water
Exposure Medium: Surface Water

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/L	2.94E-02	Yes	7.34E-02 (N)	7.34E-02	7.34E-02	mg/L	Max	Test (2)
Arsenic	mg/L	1.19E-02	Yes	6.11E-02 (NP)	2.30E-02	2.30E-02	mg/L	Max	Test (2)
Iron	mg/L	2.19E+00	No	8.91E+00 (L)	8.34E+00	8.34E+00	mg/L	Max	Test (2)
Lead	mg/L	1.70E+00	No	4.62E+01 (G)	7.53E+00	7.53E+00	mg/L	Max	Test (2)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.

TABLE 3.5
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SEDIMENT
SKEET RANGE, PICATINNY ARSENAL, NEW JERSEY

Scenario Timeframe: Future/Current
Medium: Sediment
Exposure Medium: Sediment

Chemical of Potential Concern	Units	Arithmetic Mean of Detects	Multiple Detection Limits? (Yes/No) [1]	95% UCL (Distribution) [2]	Maximum Concentration	Exposure Point Concentration			
						EPC	Units	Statistic [3]	Rationale [4]
Antimony	mg/kg	3.51E+03	Yes	6.25E+03 (N)	6.25E+03	6.25E+03	mg/kg	Max	Test (2)
Arsenic	mg/kg	2.09E+02	No	5.43E+03 (G)	8.51E+02	8.51E+02	mg/kg	Max	Test (2)
Copper	mg/kg	2.03E+02	No	3.57E+02 (N)	5.14E+02	3.57E+02	mg/kg	95% Student's-t	Test (4)
Iron	mg/kg	1.23E+04	No	1.69E+04 (N)	1.99E+04	1.69E+04	mg/kg	95% Student's-t	Test (4)
Lead	mg/kg	3.09E+04	No	2.75E+05 (G)	1.86E+05	1.86E+05	mg/kg	Max	Test (2)
Benzo(b)fluoranthene	mg/kg	N/A	N/A	N/A	1.86E-01	1.86E-01	mg/kg	Max	Test (8)

Notes: N/A = Not applicable

[1] ProUCL software (version 4.1.00, USEPA, 2011) recommends use of Kaplan-Meier method if there are multiple detection limits.

[2] Statistical Distribution and 95% UCL as determined by ProUCL (unless otherwise noted): (G) the data were determined to follow gamma distribution; (L) the data were determined to follow lognormal distribution; (NP) the data were determined to be non-parametric; (N) the data were determined to be normally distributed.

[3] Statistic: Maximum Detected Value (Max); 95% KM Chebyshev (95% KM-Cheby); 97.5% KM Chebyshev (97.5% KM-Cheby); 99% KM Chebyshev (99% KM-Cheby); 95% KM Percentile Bootstrap (95% KM-% Btstrp); 95% KM-t (95% KM-t); 95% KM-BCA (95% KM-BCA); 95% H-UCL (95% H-UCL); 95% Chebyshev -Mean, SD- UCL (95% Cheby, Mean, SD); 97.5% Chebyshev -Mean, SD- UCL (97.5% Cheby, Mean, SD); 99% Chebyshev -Mean, SD- UCL (99% Cheby, Mean, SD); 95% UCL of Log-transformed Data (95% UCL-T) 95% Student's-t (95% Student's-t); 95% Modified-t (95% Modified-t); 95% UCL based on bootstrap statistic (95% UCL-Bst); 95% Approximate Gamma UCL (95% Approx. Gamma); 95% Adjusted Gamma UCL (95% Adjusted Gamma); 95% KM Chebyshev-MVUE (95% KM-Cheby-MVUE).

[4] Unless otherwise noted, ProUCL EPC selection rationale based on, detection limit values, distribution, standard deviation, and sample size (see ProUCL output in appendix for further details):

Test (1): Kaplan-Meier method recommended by ProUCL due to multiple detection limits.
Test (2): The 95% UCL exceeds or equals the maximum detected concentration, therefore, maximum concentration used for EPC.
Test (3): Shapiro-Wilk W test, Kolmogorov-Smirnov (K-S), and Anderson-Darling (A-D) tests, indicate data follow nonparametric distribution.
Test (4): Shapiro-Wilk W test indicates data are normally distributed.
Test (5): Shapiro-Wilk W test indicates data are log-normally distributed.
Test (6): Kolmogorov-Smirnov (K-S) and/or Anderson-Darling (A-D) tests indicate data follow gamma distribution.
Test (7): Sample size is less than 5, therefore, maximum concentration used for EPC.
Test (8):Infrequent detection resulted in ProUCL modeling uncertainty for this constituent, therefore statistical calculations from ProUCL are not available and the maximum concentration is used for EPC.

Table 4.1
Values Used for Daily Intake and Exposure Calculations - Current and Future Exposures to Surface Soil
Former Skeet Range

Scenario Timeframe:	Current/Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil
Exposure Point:	Surface Soil
Receptor Population:	Routine Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	100	USEPA, 2002	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	3,300	(1)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.1	USEPA, 2004 (2)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2004	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2004	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(3)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	0.33	8 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	250	USEPA, 2002	AT
	ED	Exposure Duration	years	25	USEPA, 2002	(4)
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED	

Notes:
(1) Assumes face, forearms, and hands are exposed (USEPA, 2004).
(2) Soil-to-skin adherence factor is based on value for commercial/industrial grounds keepers as given in Exhibit 3-3 (USEPA, 2004).
(3) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).
Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).
(4) RAGS-F (USEPA, 2009).
Sources:
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final

Table 4.2
Values Used for Daily Intake and Exposure Calculations - Current/Future Exposures to Total Soil
Former Skeet Range

Scenario Timeframe:	Current/Future
Medium:	Total Soil
Exposure Medium:	Total Soil
Exposure Point:	Total Soil
Receptor Population:	Construction Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	330	USEPA, 2002	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	125	(1)	
	ED	Exposure Duration	years	1	(1)	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	365	Based on ED	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	3,300	(2)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.3	USEPA, 2002	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	125	(1)	
	ED	Exposure Duration	years	1	(1)	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2004	
	AT-N	Averaging Time (Non-Cancer)	days	365	Based on ED	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(3)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	0.33	8 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	125	(1)	AT
	ED	Exposure Duration	years	1	(1)	(4)
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	365	Based on ED	

Notes:

(1) Based on assumed one-time construction project lasting 125 days.

(2) Assumes face, forearms, and hands are exposed (USEPA, 2004).

(3) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).

Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).

(4) RAGS-F (USEPA, 2009).

Sources:

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final

Table 4.3
Values Used for Daily Intake and Exposure Calculations - Future Exposures to Surface Soil
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil
Exposure Point:	Surface Soil
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	100	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration (Cancer)	years	24	USEPA, 2002 (1)	
	ED	Exposure Duration (Noncancer)	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (2)	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	3,300	(3)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.07	USEPA 2004	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA 2004	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration (Cancer)	years	24	USEPA, 2002 (1)	
	ED	Exposure Duration (Noncancer)	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (2)	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(4)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	1.0	24 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	350	USEPA, 2002	AT
	ED_c	Exposure Duration (Cancer)	years	24	USEPA, 2002 (1)	(5)
	ED	Exposure Duration (Noncancer)	years	30	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (2)	

Notes:
(1) For carcinogens, risks for adults and children are averaged over a lifetime of 70 years (USEPA, 2002)
(2) AT for chronic exposures = 30 years x 365 days/year.
(3) Assumes face, forearms, and hands are exposed (USEPA, 2004).
(4) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).
Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).
(5) RAGS-F (USEPA, 2009).

USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Fina
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final

Table 4.4
Values Used for Daily Intake and Exposure Calculations - Future Exposures to Surface Soil
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil
Exposure Point:	Surface Soil
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	200	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	2,800	(1)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 2004	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(2)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	1.00	24 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	350	USEPA, 2002	AT
	ED	Exposure Duration	years	6	USEPA, 2002	(3)
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	

Notes:

(1) Assumes face, forearms, and hands are exposed (USEPA, 2004).

(2) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).

Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).

(3) RAGS-F (USEPA, 2009).

Sources:

USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final

Table 4.5
Values Used for Daily Intake Calculations - Current/Future Exposures to On-Site Surface Water
Former Skeet Range

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water
Exposure Point:	On-Site Surface Water
Receptor Population:	Routine Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical concentration in Surface Water	mg/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-SW	Ingestion Rate of Surface Water	L/day	0.1	(1)	CSW*IR-SW*ED*EF
	EF	Exposure Frequency	days/year	39	(2)	BW*AT
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (3)	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(4)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	3,610	USEPA, 1997 (5)	DAevent*EV*ED*EF*SA
	EV	Event Frequency	events/day	1	Assumed	BW*AT
	EF	Exposure Frequency	days/year	39	(2)	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (3)	

Notes:
(1) Derived from the exposure parameters for the swimming scenario (USEPA, 1989) based on ingestion of 0.05 L/hour for two hours.
(2) Assumes exposure consists of one event per week during spring, summer, and fall.
(3) AT for chronic exposures = 30 years x 365 days/year
(4) Value based on chemical concentration in surface water and equations presented in USEPA, 2004.
(5) Hands, forearms, and feet assumed exposed to surface water (USEPA, 1997). This assumes water penetrates non-waterproof shoes.

Sources:
USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). EPA/540/1-89/002.
USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Soil Screening Level Guidance. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.6
Values Used for Daily Intake Calculations - Future Exposures to On-Site Surface Water
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Surface Water
Exposure Medium:	Surface Water
Exposure Point:	On-Site Surface Water
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical concentration in Surface Water	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-GW	Ingestion Rate of Surface Water	L/day	0.1	(1)	CSW*IR-SW*ED*EF*CF*FI
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	FI	Fraction Ingested	unitless	1.0	Assumed	
	EF	Exposure Frequency	days/year	350	USEPA, 1989 (1)	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Noncancer)	days	2,190	Based on ED	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(2)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	3,700	USEPA, 1997 (3)	DAevent*EV*ED*EF*SA
	EV	Event Frequency	events/day	1	Assumed	BW*AT
	EF	Exposure Frequency	days/year	78	See text Section 5.2.1	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Noncancer)	days	2,190	Based on ED	

Notes:
(1) Derived from the exposure parameters for the swimming scenario (USEPA, 1989) based on ingestion of 0.05 L/hour for two hours.
(2) Value based on chemical concentration in surface water and equations presented in USEPA, 2004.
(3) Value based on arms, hands, legs, and feet exposure.
Sources:
USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). EPA/540/1-89-002.
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.7
Values Used for Daily Intake Calculations - Future Exposures to On-Site Surface Water
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Surface Water
Exposure Medium:	Surface Water
Exposure Point:	On-Site Surface Water
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical concentration in Surface Water	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-SW	Ingestion Rate of Surface Water	L/day	0.1	(1)	CSW*IR-SW*ED*EF*CF*FI
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	FI	Fraction Ingested	unitless	1.0	Assumed	
	EF	Exposure Frequency	days/year	350	USEPA, 1989 (1)	
	ED_c	Exposure Duration	years	24	USEPA, 2002 (2)	
	ED	Exposure Duration	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (3)	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(4)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	3,610	USEPA, 1997 (5)	DAevent*EV*ED*EF*SA
	EV	Event Frequency	events/day	1	Assumed	BW*AT
	EF	Exposure Frequency	days/year	78	See text Section 5.2.1	
	ED_c	Exposure Duration	years	24	USEPA, 2002 (2)	
	ED	Exposure Duration	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (3)	

Notes:
(1) Derived from the exposure parameters for the swimming scenario (USEPA, 1989) based on ingestion of 0.05 L/hour for two hours.
(2) For carcinogens, risks for adults and children are averaged over a lifetime (USEPA, 2002).
(3) AT for chronic exposures = 30 years x 365 days/year
(4) Value based on chemical concentration in surface water and equations presented in USEPA, 2004.
(5) Value based on hands, feet, forearms exposure.

Sources:
USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). EPA/540/1-89/002.
USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Soil Screening Level Guidance. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.8
Values Used for Daily Intake Calculations - Current/Future Exposures to On-Site Sediment
Former Skeet Range

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment
Exposure Point:	On-Site Sediment
Receptor Population:	Routine Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	50	USEPA, 2002	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	39	(1)	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (2)	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	2077	USEPA, 2004 (3)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 2004 (4)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	39	(1)	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (2)	

Notes:
(1) Assumes exposure consists of one event per week during spring, summer, and fall.
(2) AT for chronic exposures = 25 years x 365 days/year.
(3) Assumes forearms and hands contact sediment (USEPA, 2004).
(4) Value is based on the geometric mean soil adherence factor for "children playing (wet soil)" from Exhibit C-3 in USEPA, 2004.
Sources:

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.

Table 4.9
Values Used for Daily Intake Calculations - Future Exposures to On-Site Sediment
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment
Exposure Point:	On-Site Sediment
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	100	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	78	See text Section 5.2.1	
	EDc	Exposure Duration	years	24	USEPA, 2002 (1)	
	ED	Exposure Duration	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED	
Dermal	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	1900	USEPA, 1997 (2)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 2004 (3)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	78	See text Section 5.2.1	
	EDc	Exposure Duration	years	24	USEPA, 2002 (1)	
	ED	Exposure Duration	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED	

Notes:
(1) For carcinogens, risks for adults and children are averaged over a lifetime of 70 years (USEPA, 2002).
(2) Assumes forearms and hands contact sediment (USEPA, 1997).
(3) Value is based on the geometric mean soil adherence factor for "children playing (wet soil)" from Exhibit C-3 in USEPA, 2004.
Sources:
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.10
Values Used for Daily Intake Calculations - Future Exposures to On-Site Sediment
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment
Exposure Point:	On-Site Sediment
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	200	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	78	See text Section 5.2.1	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	
Dermal	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	3,200	(1)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 1997 (2)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	78	See text Section 5.2.1	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	

Notes:
(1) Assumes arms, hands, and legs contact sediment (USEPA, 1997).
(2) Value is based on the geometric mean soil adherence factor for "children playing (wet soil)" from Exhibit C-3 in USEPA, 2004.
Sources:
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.11
Values Used for Daily Intake Calculations - Future Exposures to On-Site Groundwater Assuming Potable Use
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	On-Site Groundwater
Exposure Point:	Potable Use
Receptor Population:	Routine Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CGW	Chemical concentration in groundwater	mg/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-GW	Ingestion Rate of Groundwater	L/day	2	USEPA, 2002	CGW*IR-GW*ED*EF
	EF	Exposure Frequency	days/year	250	USEPA, 2002	BW*AT
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (1)	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(2)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	4,123	USEPA, 1997 (3)	DAevent*ED*EF*SA
	EV	Event Frequency	events/day	1	USEPA, 2004	BW*AT
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (1)	

Notes:

(1) AT for chronic exposures = 25 years x 365 days/year.

(2) Value based on chemical concentration in groundwater and equations presented in USEPA, 2004.

(3) Value based on face, hands, and arms exposed to groundwater during washing in washroom.

Sources:

USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.12
Values Used for Daily Intake Calculations - Future Exposures to On-Site Groundwater Assuming Potable Use
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	On-Site Groundwater
Exposure Point:	Potable Use
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CGW	Chemical concentration in groundwater	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-GW	Ingestion Rate of Groundwater	L/day	2	USEPA, 1997	CGW*IR-GW*ED*EF*CF*FI
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	FI	Fraction Ingested	unitless	1.0	Assumed	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration (Cancer)	years	24	USEPA, 2002 (1)	
	ED	Exposure Duration (Noncancer)	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (2)	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(3)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	18,000	USEPA, 2004	DAevent*ED*EF*SA
	EF	Exposure Frequency	days/year	350	USEPA, 2002	BW*AT
	ED_c	Exposure Duration (Cancer)	years	24	USEPA, 2002 (1)	
	ED	Exposure Duration (Noncancer)	years	30	USEPA, 2002	
	BW	Body Weight	kg	70	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	Based on ED (2)	

Notes:

(1) For carcinogens, risks for adults and children are averaged over a lifetime of 70 years (USEPA, 2002).

(2) AT for chronic exposures = 30 years x 365 days/year.

(3) Value based on chemical concentration in groundwater and equations presented in USEPA, 2004.

If surface water not present at an OU-2 Site, then FI = 1.0 for ingestion of groundwater.

Sources:

USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

Table 4.13
Values Used for Daily Intake Calculations - Future Exposures to On-Site Groundwater Assuming Potable Use
Former Skeet Range

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	On-Site Groundwater
Exposure Point:	Potable Use
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CGW	Chemical concentration in groundwater	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-GW	Ingestion Rate of Groundwater	L/day	1	USEPA, 1997	CGW*IR-GW*ED*EF*CF*FI
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	FI	Fraction Ingested	unitless	1.0	Assumed	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Noncancer)	days	2,190	Based on ED	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(1)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	6,600	USEPA, 2004	DAevent*ED*EF*SA
	EF	Exposure Frequency	days/year	350	USEPA, 2002	BW*AT
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 2002	
	AT-N	Averaging Time (Noncancer)	days	2,190	Based on ED	

Notes:
(1) Value based on chemical concentration in groundwater and equations presented in USEPA, 2004.
If surface water not present at an OU-2 Site, then FI = 1.0 for ingestion of groundwater.
Sources:
USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

PICATINNY ARSENAL, NEW JERSEY, SKEET RANGE

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty Modifying Factors	Sources of RfD: Target Organ (3)	Dates of RfD: Target Organ (MM/DD/YY)
Organics										
Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chrysene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dibenzo(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inorganics										
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood Chemistry	1,000	IRIS	08/12/11
Arsenic	Chronic	3.0E-04	mg/kg-day	100%	3.0E-04	mg/kg-day	Skin, Vascular System	3	IRIS	03/23/11
Chromium	Chronic	1.5E+00	mg/kg-day	1.3%	2.0E-02	mg/kg-day	No Observable Effects	1,000	IRIS	03/23/11
Copper	Chronic	4.0E-02	mg/kg-day	100%	4.0E-02	mg/kg-day	GI Tract	N/A	HEAST	1997
Iron	Chronic	7.0E-01	mg/kg-day	100%	7.0E-01	mg/kg-day	GI Tract	1.5	PPRTV (EPA, 11-2006)	03/23/11
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	Chronic	2.4E-02	mg/kg-day	4%	9.6E-04	mg/kg-day	CNS	1	IRIS, RSL-UG	03/23/11

(1) Oral to dermal adjustment factors are from the June 2011 RSL Table (USEPA, 2011).

(2) The adjusted Dermal RfD = Oral RfD X Oral-to-Dermal Adjustment Factor.

(3) Information provided is from the following sources:

ATSDR = Agency for Toxic Substances Disease Registry (with date of latest publication in parentheses and date of website search in the date column).

Cal EPA = California Environmental Protection Agency/OEHHA Toxicity Criteria Database (with date of website search provided in the date column).

HEAST = Health Effects Assessment Tables (with the date of the HEAST publication in the date column).

IRIS = Integrated Risk Information System (with date of website search provided in date column).

PPRTV = Provisional Pier Reviewed Toxicity Data from USEPA RSL-UG (with date of latest published data in parentheses and date of website search in the date column).

Definitions: N/A = Not Available or Not Applicable

RfD = Reference Dose

RSL-UG = Regional Screening Level (USEPA) on-line User's Guide

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
PICATINNY ARSENAL, NEW JERSEY, SKEET RANGE

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfC: Target Organ (1)	Dates (MM/DD/YY)
Organics							
Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chrysene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dibenzo(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inorganics							
Antimony	N/A	N/A	N/A	N/A	N/A	PPRTV (EPA, 7-2008)	08/12/11
Arsenic	Chronic	1.5E-05	mg/m^3	Developmental, Cardiovascular, CNS	N/A	Cal EPA	03/23/11
Chromium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Copper	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	Chronic	5.0E-05	mg/m^3	CNS	1,000	IRIS	03/23/11

(1) Information provided is from the following sources:

ATSDR = Agency for Toxic Substances Disease Registry (with date of latest publication in parentheses and date of website search in the date column).

Cal EPA = California Environmental Protection Agency/OEHHA Toxicity Criteria Database (with date of website search provided in the date column).

HEAST = Health Effects Assessment Tables (with the date of the HEAST publication in the date column).

IRIS = Integrated Risk Information System (with date of website search provided in date column).

NYSDOH = New York State Department of Health (with date of the NYSDOH publication provided in the date column).

PPRTV = Provisional Pier Reviewed Toxicity Data from USEPA RSL-UG (with date of latest published data in parentheses and date of website search in the date column).

Definitions: N/A = Not Available or Not Applicable

RfC = Reference Concentration

RSL-UG = Regional Screening Level (USEPA) on-line User's Guide

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

PICATINNY ARSENAL, NEW JERSEY, SKEET RANGE

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Weight of Evidence/ Cancer Guideline Description	Source (3)	Date (MM/DD/YY)
Organics							
Benzo(a)anthracene	7.3E-01	100%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	04/06/11
Benzo(a)pyrene	7.3E+00	100%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	04/06/11
Benzo(b)fluoranthene	7.3E-01	100%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	04/06/11
Benzo(k)fluoranthene	7.3E-02	100%	7.3E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	05/10/11
Chrysene	7.3E-03	100%	7.3E-03	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	09/23/11
Dibenzo(a,h)anthracene	7.3E+00	100%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	05/10/11
Indeno(1,2,3-cd)pyrene	7.3E-01	100%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	04/06/11
Inorganics							
Antimony	N/A	N/A	N/A	N/A	Inadequate	PPRTV (EPA, 07-2008)	08/12/11
Arsenic	1.5E+00	100%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	03/23/11
Chromium III	N/A	N/A	N/A	N/A	Inadequate	IRIS	03/23/11
Copper	N/A	N/A	N/A	N/A	D	IRIS	03/23/11
Iron	N/A	N/A	N/A	N/A	Inadequate	PPRTV (EPA, 11-2006)	03/23/11
Lead	N/A	N/A	N/A	N/A	B2	IRIS	04/06/11
Manganese	N/A	N/A	N/A	N/A	D	IRIS	03/23/11

(1) Oral to dermal adjustment factors are from the June 2011 RSL Table (USEPA, 2011).

(2) The adjusted Dermal RfD = Oral RfD / Oral-to-Dermal Adjustment Factor.

(3) Information provided is from the following sources:

ATSDR = Agency for Toxic Substances Disease Registry (with date of latest publication in parentheses and date of website search in the date column).

Cal EPA = California Environmental Protection Agency/OEHHA Toxicity Criteria Database (with date of website search provided in the date column).

HEAST = Health Effects Assessment Tables (with the date of the HEAST publication in the date column).

IRIS = Integrated Risk Information System (with date of website search provided in date column).

NJDEP = New Jersey Department of Environmental Protection (with date of the NJDEP publication provided in the date column).

PPRTV = Provisional Pier Reviewed Toxicity Data from USEPA RSL-UG (with date of latest published data in parentheses and date of website search in the date column).

Definitions: N/A = Not Available or Not Applicable

RSL-UG = Regional Screening Level (USEPA) on-line User's Guide

EPA Carcinogenic Weight of Evidence Description:

A - Known human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Inadequate - Inadequate information to assess carcinogenic potential

Likely - Likely to be carcinogenic to humans

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
PICATINNY ARSENAL, NEW JERSEY, SKEET RANGE

Chemical of Potential Concern (1)	Unit Risk	Units	Weight of Evidence/ Cancer Guideline Description	Source (1)	Date (MM/DD/YY)
Organics					
Benzo(a)anthracene	1.1E-04	$(ug/m^3)^{-1}$	B2	Cal EPA	04/06/11
Benzo(a)pyrene	1.1E-03	$(ug/m^3)^{-1}$	B2	Cal EPA	04/06/11
Benzo(b)fluoranthene	1.1E-04	$(ug/m^3)^{-1}$	B2	Cal EPA	04/06/11
Benzo(k)fluoranthene	1.1E-04	$(ug/m^3)^{-1}$	B2	Cal EPA	05/10/11
Chrysene	1.1E-05	$(ug/m^3)^{-1}$	B2	Cal EPA	09/23/11
Dibenzo(a,h)anthracene	1.2E-03	$(ug/m^3)^{-1}$	B2	Cal EPA	05/10/11
Indeno(1,2,3-cd)pyrene	1.1E-04	$(ug/m^3)^{-1}$	B2	Cal EPA	04/06/11
Inorganics					
Antimony	N/A	N/A	Inadequate	PPRTV (EPA, 07-2008)	08/12/11
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	A	IRIS	03/23/11
Chromium	N/A	N/A	Inadequate	IRIS	03/23/11
Copper	N/A	N/A	D	IRIS	09/27/11
Iron	N/A	N/A	Inadequate	PPRTV (EPA, 11-2006)	03/23/11
Lead	N/A	N/A	B2	IRIS	04/06/11
Manganese	N/A	N/A	D	IRIS	03/23/11

(1) Information provided is from the following sources:
ATSDR = Agency for Toxic Substances Disease Registry (with date of latest publication in parentheses and date of website search in the date column).
Cal EPA = California Environmental Protection Agency/OEHHA Toxicity Criteria Database (with date of website search provided in the date column).
HEAST = Health Effects Assessment Tables (with the date of the HEAST publication in the date column).
IRIS = Integrated Risk Information System (with date of website search provided in date column).
NJDEP = New Jersey Department of Environmental Protection (with date of the NJDEP publication provided in the date column).
PPRTV = Provisional Pier Reviewed Toxicity Data from USEPA RSL-UG (with date of latest published data in parentheses and date of website search in the date column).

Definitions: N/A = Not Available or Not Applicable
RSL-UG = Regional Screening Level (USEPA) on-line User's Guide

EPA Carcinogenic Weight of Evidence Description:
A - Known human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity
Inadequate - Inadequate information to assess carcinogenic potential
Likely - Likely to be carcinogenic to humans

Notes: Surrogates were used as follows:
p-Cresol (4-Methylphenol) for 3+4-Methylphenol

Table 7.1
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Surface Soil	Surface Soil	Skeet Range	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	1.3E-06	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	9.8E-07
				Benzo(a)pyrene	7.10E+00	mg/kg	2.5E-06	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.8E-05
				Benzo(b)fluoranthene	1.28E+01	mg/kg	4.5E-06	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	3.3E-06
				Benzo(k)fluoranthene	4.06E+00	mg/kg	1.4E-06	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	1.0E-07
				Chrysene	3.77E+00	mg/kg	1.3E-06	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	9.6E-09
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	3.2E-07	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2.3E-06
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	9.4E-07	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	6.9E-07
				Inorganics							
				Antimony	1.16E+01	mg/kg	4.0E-06	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	3.8E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	5.7E-06
				Iron	2.09E+04	mg/kg	7.3E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.52E+04	mg/kg	8.8E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								3.1E-05
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	5.8E-07	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	4.2E-07
				Benzo(a)pyrene	7.10E+00	mg/kg	1.1E-06	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	7.8E-06
				Benzo(b)fluoranthene	1.28E+01	mg/kg	1.9E-06	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	1.4E-06
				Benzo(k)fluoranthene	4.06E+00	mg/kg	6.1E-07	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	4.4E-08
				Chrysene	3.77E+00	mg/kg	5.7E-07	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	4.1E-09
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	1.4E-07	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.0E-06
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	4.0E-07	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	2.9E-07
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	3.8E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	5.7E-07
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.2E-05
		Exposure Point Total									4.3E-05
	Exposure Media Total										4.3E-05
	Air (Particulates)	Skeet Range	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	4.1E-07	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	4.5E-11
				Benzo(a)pyrene	9.35E-09	mg/m^3	7.5E-07	$\mu g/m^3$	1.1E-03	$(\mu g/m^3)^{-1}$	8.3E-10
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	1.4E-06	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	1.5E-10
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	4.3E-07	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	4.7E-11
				Chrysene	4.97E-09	mg/m^3	4.0E-07	$\mu g/m^3$	1.1E-05	$(\mu g/m^3)^{-1}$	4.4E-12
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	9.8E-08	$\mu g/m^3$	1.2E-03	$(\mu g/m^3)^{-1}$	1.2E-10
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	2.9E-07	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	3.2E-11
				Inorganics							
				Antimony	1.53E-08	mg/m^3	1.2E-06	$\mu g/m^3$	N/A	$(\mu g/m^3)^{-1}$	---
				Arsenic	1.44E-08	mg/m^3	1.2E-06	$\mu g/m^3$	4.3E-03	$(\mu g/m^3)^{-1}$	5.0E-09
				Iron	2.75E-05	mg/m^3	2.2E-03	$\mu g/m^3$	N/A	$(\mu g/m^3)^{-1}$	---
				Lead	3.32E-05	mg/m^3	2.7E-03	$\mu g/m^3$	N/A	$(\mu g/m^3)^{-1}$	---
			Exp. Route Total								6.2E-09
		Exposure Point Total									6.2E-09
	Exposure Media Total										

Table 7.1
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Surface Soil	Air (Volatiles)	Skeet Range	**Inhalation**	**Organics**							
				No COPCs							
			Exp. Route Total								0.0E+00
		Exposure Point Total									0.0E+00
	Exposure Media Total										6.2E-09
Surface Soil Total											4.3E-05
Sediment	Sediment	Skeet Range	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	5.1E-09	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	3.7E-09
				Inorganics							
				Antimony	6.25E+03	mg/kg	1.7E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	8.51E+02	mg/kg	2.3E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.5E-05
				Copper	3.57E+02	mg/kg	9.7E-06	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.69E+04	mg/kg	4.6E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	1.86E+05	mg/kg	5.1E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								3.5E-05
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	5.5E-09	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	4.0E-09
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	8.51E+02	mg/kg	5.8E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	8.7E-06
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								8.7E-06
		Exposure Point Total									4.3E-05
	Exposure Media Total										4.3E-05
Sediment Total											4.3E-05
Surface Water	Surface Water	Skeet Range Surface Water	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	4.0E-06	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	2.30E-02	mg/L	1.3E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.9E-06
				Iron	8.34E+00	mg/L	4.5E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	7.53E+00	mg/L	4.1E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.9E-06
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	5.8E-07	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	2.30E-02	mg/L	1.8E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.7E-07
				Iron	8.34E+00	mg/L	6.6E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	7.53E+00	mg/L	5.9E-06	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
			Exp. Route Total								2.7E-07
		Exposure Point Total									2.2E-06
	Exposure Media Total										2.2E-06
Surface Water Total											2.2E-06
Groundwater	Groundwater	Skeet Range	**Ingestion[a]**	**Inorganics**							
				Arsenic	1.09E-02	mg/L	7.6E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.1E-04
				Chromium	7.32E-03	mg/L	5.1E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	1.2E-01	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Manganese	2.81E+00	mg/L	2.0E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.1E-04

Table 7.1
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
	Groundwater		**Dermal Absorption**[a]	**Inorganics**							
				Arsenic	1.09E-02	mg/L	3.9E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	NV
				Chromium	7.32E-03	mg/L	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
				Iron	1.77E+01	mg/L	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
				Manganese	2.81E+00	mg/L	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
			Exp. Route Total								0.0E+00
		Exposure Point Total									1.1E-04
	Exposure Media Total										1.1E-04
	Air	Skeet Range	**Inhalation** (Indoor Air)	**Organics** No COPCs							
			Exp. Route Total								0.0E+00
		Exposure Point Total									0.0E+00
	Exposure Media Total										0.0E+00
Groundwater Total											1.1E-04
Total of Receptor Risks Across All Media - Current[b]											8.8E-05
Total of Receptor Risks Across All Media - Future[c]											2.0E-04

[a] Future only (groundwater exposure).

[b] Current risks for a routine worker include only exposure to soil, surface water, and sediment.

[c] Future risks for a routine worker include exposure to soil, groundwater, surface water, and sediment.

N/A = Not Applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Table 7.2
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		
					Value	Units	Value	Units	Value	Units	Hazard Quotient
Surface Soil	Surface Soil	Skeet Range	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	3.8E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	7.10E+00	mg/kg	6.9E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.28E+01	mg/kg	1.3E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.06E+00	mg/kg	4.0E-06	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	3.77E+00	mg/kg	3.7E-06	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	9.0E-07	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	2.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.16E+01	mg/kg	1.1E-05	mg/kg-day	4.0E-04	mg/kg-day	2.8E-02
				Arsenic	1.09E+01	mg/kg	1.1E-05	mg/kg-day	3.0E-04	mg/kg-day	3.6E-02
				Iron	2.09E+04	mg/kg	2.0E-02	mg/kg-day	7.0E-01	mg/kg-day	2.9E-02
				Lead	2.52E+04	mg/kg	2.5E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								9.3E-02
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	1.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	7.10E+00	mg/kg	3.0E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.28E+01	mg/kg	5.4E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.06E+00	mg/kg	1.7E-06	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	3.77E+00	mg/kg	1.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	3.9E-07	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	1.1E-06	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	1.09E+01	mg/kg	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	3.5E-03
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								3.5E-03
		Exposure Point Total									9.7E-02
	Exposure Media Total										9.7E-02
	Air (Particulates)	Skeet Range	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	1.1E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(a)pyrene	9.35E-09	mg/m^3	2.1E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	3.8E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	1.2E-09	mg/m^3	N/A	mg/m^3	---
				Chrysene	4.97E-09	mg/m^3	1.1E-09	mg/m^3	N/A	mg/m^3	---
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	2.7E-10	mg/m^3	N/A	mg/m^3	---
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	8.0E-10	mg/m^3	N/A	mg/m^3	---
				Inorganics							
				Antimony	1.53E-08	mg/m^3	3.4E-09	mg/m^3	N/A	mg/m^3	---
				Arsenic	1.44E-08	mg/m^3	3.3E-09	mg/m^3	1.5E-05	mg/m^3	2.2E-04
				Iron	2.75E-05	mg/m^3	6.2E-06	mg/m^3	N/A	mg/m^3	---
				Lead	3.32E-05	mg/m^3	7.5E-06	mg/m^3	N/A	mg/m^3	---
			Exp. Route Total								2.2E-04
		Exposure Point Total									2.2E-04
	Exposure Media Total										2.2E-04
Surface Soil Total											9.7E-02

Table 7.2
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		
					Value	Units	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Skeet Range	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	1.4E-08	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	6.25E+03	mg/kg	4.8E-04	mg/kg-day	4.0E-04	mg/kg-day	1.2E+00
				Arsenic	8.51E+02	mg/kg	6.5E-05	mg/kg-day	3.0E-04	mg/kg-day	2.2E-01
				Copper	3.57E+02	mg/kg	2.7E-05	mg/kg-day	4.0E-02	mg/kg-day	6.8E-04
				Iron	1.69E+04	mg/kg	1.3E-03	mg/kg-day	7.0E-01	mg/kg-day	1.8E-03
				Lead	1.86E+05	mg/kg	1.4E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								1.4E+00
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	1.5E-08	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	8.51E+02	mg/kg	1.6E-05	mg/kg-day	3.0E-04	mg/kg-day	5.4E-02
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	4.0E-02	mg/kg-day	0.0E+00
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								5.4E-02
		Exposure Point Total									1.5E+00
	Exposure Media Total										1.5E+00
Sediment Total											1.5E+00
Surface Water	Surface Water	Skeet Range Surface Water	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	1.1E-05	mg/kg-day	5.0E-04	mg/kg-day	2.2E-02
				Arsenic	2.30E-02	mg/L	3.5E-06	mg/kg-day	1.5E+00	mg/kg-day	2.3E-06
				Iron	8.34E+00	mg/L	1.3E-03	mg/kg-day	7.0E-01	mg/kg-day	1.8E-03
				Lead	7.53E+00	mg/L	1.1E-03	mg/kg-day	2.4E-02	mg/kg-day	4.8E-02
			Exp. Route Total								7.2E-02
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	1.6E-06	mg/kg-day	6.0E-05	mg/kg-day	2.7E-02
				Arsenic	2.30E-02	mg/L	5.1E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Iron	8.34E+00	mg/L	1.8E-04	mg/kg-day	7.0E-01	mg/kg-day	2.6E-04
				Lead	7.53E+00	mg/L	1.7E-05	mg/kg-day	N/A	mg/kg-day	NV
			Exp. Route Total								2.9E-02
		Exposure Point Total									1.0E-01
	Exposure Media Total										1.0E-01
Surface Water Total											1.0E-01
Groundwater	Groundwater	Skeet Range	**Ingestion[a]**	**Inorganics**							
				Arsenic	1.09E-02	mg/L	2.1E-04	mg/kg-day	3.0E-04	mg/kg-day	7.1E-01
				Chromium	7.32E-03	mg/L	1.4E-04	mg/kg-day	1.5E+00	mg/kg-day	9.5E-05
				Iron	1.77E+01	mg/L	3.5E-01	mg/kg-day	7.0E-01	mg/kg-day	4.9E-01
				Manganese	2.81E+00	mg/L	5.5E-02	mg/kg-day	2.4E-02	mg/kg-day	2.3E+00
			Exp. Route Total								3.5E+00
			Dermal Absorption[a]	**Inorganics**							
				Arsenic	1.09E-02	mg/L	0.0E+00	mg/kg-day	3.0E-04	mg/kg-day	NV
				Chromium	7.32E-03	mg/L	0.0E+00	mg/kg-day	2.0E-02	mg/kg-day	NV
				Iron	1.77E+01	mg/L	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	NV
				Manganese	2.81E+00	mg/L	0.0E+00	mg/kg-day	9.6E-04	mg/kg-day	NV
			Exp. Route Total								0.0E+00
		Exposure Point Total									3.5E+00
	Exposure Media Total										3.5E+00

Table 7.2
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		
					Value	Units	Value	Units	Value	Units	Hazard Quotient
Groundwater	Air (Volatiles)	Skeet Range Groundwater	**Inhalation**[a]	**Organics** No COPCs							
		Potable Use	Exp. Route Total								0.0E+00
		Exposure Point Total									0.0E+00
	Exposure Media Total										0.0E+00
Groundwater Total											3.5E+00
Total of Receptor Hazards Across All Media - Current[b]											1.7E+00
Total of Receptor Hazards Across All Media - Future[c]											5.2E+00

[a] Future only (groundwater exposure).

[b] Current risks for a routine worker include only exposure to soil, surface water, and sediment.

[c] Future risks for a routine worker include exposure to soil, groundwater, surface water, and sediment.

N/A = Not Applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Table 7.3
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Current/Future Construction Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Total Soil	Total Soil	Skeet Range	**Ingestion**	**Organics**							
		Total Soil		Benzo(a)anthracene	4.06E+00	mg/kg	9.4E-08	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	6.8E-08
				Benzo(a)pyrene	3.65E+00	mg/kg	8.4E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	6.1E-07
				Benzo(b)fluoranthene	1.26E+01	mg/kg	2.9E-07	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	2.1E-07
				Benzo(k)fluoranthene	4.00E+00	mg/kg	9.2E-08	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	6.7E-09
				Chrysene	4.02E+00	mg/kg	9.3E-08	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	6.8E-10
				Dibenzo(a,h)anthracene	9.17E-01	mg/kg	2.1E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.5E-07
				Indeno(1,2,3-cd)pyrene	5.17E+00	mg/kg	1.2E-07	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	8.7E-08
				Inorganics							
				Antimony	1.13E+01	mg/kg	2.6E-07	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	2.5E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.8E-07
				Iron	2.09E+04	mg/kg	4.8E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.33E+04	mg/kg	5.4E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.5E-06
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	4.06E+00	mg/kg	3.6E-08	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	2.7E-08
				Benzo(a)pyrene	3.65E+00	mg/kg	3.3E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2.4E-07
				Benzo(b)fluoranthene	1.26E+01	mg/kg	1.1E-07	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	8.2E-08
				Benzo(k)fluoranthene	4.00E+00	mg/kg	3.6E-08	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	2.6E-09
				Chrysene	4.02E+00	mg/kg	3.6E-08	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	2.6E-10
				Dibenzo(a,h)anthracene	9.17E-01	mg/kg	8.2E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	6.0E-08
				Indeno(1,2,3-cd)pyrene	5.17E+00	mg/kg	4.7E-08	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	3.4E-08
				Inorganics							
				Antimony	1.13E+01	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	2.3E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.4E-08
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.33E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								4.8E-07
		Exposure Point Total									2.0E-06
	Exposure Media Total										2.0E-06

Table 7.3
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Current/Future Construction Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
	Air	Skeet Range	**Inhalation**	**Organics**							
	(Particulates)	Total Soil		Benzo(a)anthracene	5.34E-09	mg/m^3	8.6E-09	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	9.5E-13
				Benzo(a)pyrene	4.81E-09	mg/m^3	7.8E-09	µg/m^3	1.1E-03	(µg/m^3)$^{-1}$	8.5E-12
				Benzo(b)fluoranthene	1.65E-08	mg/m^3	2.7E-08	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	2.9E-12
				Benzo(k)fluoranthene	5.27E-09	mg/m^3	8.5E-09	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	9.4E-13
				Chrysene	5.30E-09	mg/m^3	8.6E-09	µg/m^3	1.1E-05	(µg/m^3)$^{-1}$	9.4E-14
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	2.0E-09	µg/m^3	1.2E-03	(µg/m^3)$^{-1}$	2.3E-12
				Indeno(1,2,3-cd)pyrene	6.81E-09	mg/m^3	1.1E-08	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	1.2E-12
				Inorganics							
				Antimony	1.48E-08	mg/m^3	2.4E-08	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
				Arsenic	1.44E-08	mg/m^3	2.3E-08	µg/m^3	4.3E-03	(µg/m^3)$^{-1}$	1.0E-10
				Iron	2.75E-05	mg/m^3	4.4E-05	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
				Lead	3.07E-05	mg/m^3	5.0E-05	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
			Exp. Route Total								1.2E-10
		Exposure Point Total									1.2E-10
	Exposure Media Total										1.2E-10
Total Soil Total											2.0E-06
Groundwater	Air	Skeet Range	**Inhalation**	**Organics**							
		Groundwater	(Trench Air)	No COPCs							
			Exp. Route Total								0.0E+00
		Exposure Point Total									0.0E+00
	Exposure Media Total										0.0E+00
Groundwater Total											0.0E+00
										Total of Receptor Risks Across All Media	2.0E-06

N/A = Not Applicable.

Table 7.4
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Current/Future Construction Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		
					Value	Units	Value	Units	Value	Units	Hazard Quotient
Total Soil	Total Soil	Skeet Range Total Soil	**Ingestion**	**Organics**							
				Benzo(a)anthracene	4.06E+00	mg/kg	6.5E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	3.65E+00	mg/kg	5.9E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.26E+01	mg/kg	2.0E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.00E+00	mg/kg	6.5E-06	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	4.02E+00	mg/kg	6.5E-06	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.17E-01	mg/kg	1.5E-06	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	5.17E+00	mg/kg	8.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.13E+01	mg/kg	1.8E-05	mg/kg-day	4.0E-04	mg/kg-day	4.5E-02
				Arsenic	1.09E+01	mg/kg	1.8E-05	mg/kg-day	3.0E-04	mg/kg-day	5.9E-02
				Iron	2.09E+04	mg/kg	3.4E-02	mg/kg-day	7.0E-01	mg/kg-day	4.8E-02
				Lead	2.33E+04	mg/kg	3.8E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								1.5E-01
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	4.06E+00	mg/kg	2.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	3.65E+00	mg/kg	2.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.26E+01	mg/kg	7.9E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.00E+00	mg/kg	2.5E-06	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	4.02E+00	mg/kg	2.5E-06	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.17E-01	mg/kg	5.8E-07	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	5.17E+00	mg/kg	3.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.13E+01	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	1.09E+01	mg/kg	1.6E-06	mg/kg-day	3.0E-04	mg/kg-day	5.3E-03
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	2.33E+04	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								5.3E-03
		Exposure Point Total									1.6E-01
	Exposure Media Total										1.6E-01

Table 7.4
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Current/Future Construction Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		
					Value	Units	Value	Units	Value	Units	Hazard Quotient
	Air (Particulates)	Skeet Range Total Soil	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.34E-09	mg/m^3	6.0E-10	mg/m^3	N/A	(mg/m^3)	---
				Benzo(a)pyrene	4.81E-09	mg/m^3	5.4E-10	mg/m^3	N/A	(mg/m^3)	---
				Benzo(b)fluoranthene	1.65E-08	mg/m^3	1.9E-09	mg/m^3	N/A	(mg/m^3)	---
				Benzo(k)fluoranthene	5.27E-09	mg/m^3	6.0E-10	mg/m^3	N/A	(mg/m^3)	---
				Chrysene	5.30E-09	mg/m^3	6.0E-10	mg/m^3	N/A	(mg/m^3)	---
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	1.4E-10	mg/m^3	N/A	(mg/m^3)	---
				Indeno(1,2,3-cd)pyrene	6.81E-09	mg/m^3	7.7E-10	mg/m^3	N/A	(mg/m^3)	---
				Inorganics							
				Antimony	1.48E-08	mg/m^3	1.7E-09	mg/m^3	N/A	(mg/m^3)	---
				Arsenic	1.44E-08	mg/m^3	1.6E-09	mg/m^3	1.5E-05	(mg/m^3)	1.1E-04
				Iron	2.75E-05	mg/m^3	3.1E-06	mg/m^3	N/A	(mg/m^3)	---
				Lead	3.07E-05	mg/m^3	3.5E-06	mg/m^3	N/A	(mg/m^3)	---
			Exp. Route Total								1.1E-04
		Exposure Point Total									1.1E-04
	Exposure Media Total										1.1E-04
Total Soil Total											1.6E-01
Groundwater	Air	Skeet Range Groundwater	**Inhalation** (Trench Air)	**Organics** No COPCs							
Groundwater Total											0.0E+00
										Total of Receptor Hazards Across All Media	1.6E-01

N/A = Not Applicable.

Table 7.5
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Surface Soil	Surface Soil	Skeet Range	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	(a)
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	(a)
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	(a)
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	(a)
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Inorganics							
				Antimony	1.16E+01	mg/kg	5.4E-06	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	5.1E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	7.7E-06
				Iron	2.09E+04	mg/kg	9.8E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.52E+04	mg/kg	1.2E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								7.7E-06
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	(a)
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	(a)
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	(a)
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	(a)
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	3.6E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	5.3E-07
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								5.3E-07
		Exposure Point Total									8.2E-06
	Exposure Media Total										8.2E-06

Table 7.5
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk
					Value	Units	Value	Units	Value	Units	
Surface Soil	Air (Particulates)	Skeet Range Surface Soil	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	ADAF	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	(a)
				Benzo(a)pyrene	9.35E-09	mg/m^3	ADAF	$\mu g/m^3$	1.1E-03	$(\mu g/m^3)^{-1}$	(a)
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	ADAF	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	(a)
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	ADAF	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	(a)
				Chrysene	4.97E-09	mg/m^3	ADAF	$\mu g/m^3$	1.1E-05	$(\mu g/m^3)^{-1}$	(a)
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	ADAF	$\mu g/m^3$	1.2E-03	$(\mu g/m^3)^{-1}$	(a)
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	ADAF	$\mu g/m^3$	1.1E-04	$(\mu g/m^3)^{-1}$	(a)
				Inorganics							
				Antimony	1.53E-08	mg/m^3	5.0E-06	$\mu g/m^3$	N/A	$(\mu g/m^3)^{-1}$	---
				Arsenic	1.44E-08	mg/m^3	4.7E-06	$\mu g/m^3$	4.3E-03	$(\mu g/m^3)^{-1}$	2.0E-08
				Iron	2.75E-05	mg/m^3	9.0E-03	$\mu g/m^3$	N/A	$(\mu g/m^3)^{-1}$	---
				Lead	3.32E-05	mg/m^3	1.1E-02	$\mu g/m^3$	N/A	$(\mu g/m^3)^{-1}$	---
			Exp. Route Total								2.0E-08
		Exposure Point Total									2.0E-08
	Exposure Media Total										2.0E-08
Surface Soil Total											8.2E-06

Table 7.5
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Sediment	Sediment	Skeet Range Sediment	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Inorganics							
				Antimony	6.25E+03	mg/kg	6.5E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	8.51E+02	mg/kg	8.9E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.3E-04
				Copper	3.57E+02	mg/kg	3.7E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.69E+04	mg/kg	1.8E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	1.86E+05	mg/kg	1.9E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.3E-04
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	(a)
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	8.51E+02	mg/kg	1.0E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.5E-05
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.5E-05
		Exposure Point Total									1.5E-04
	Exposure Media Total										1.5E-04
Sediment Total											1.5E-04
Surface Water	Surface Water	Skeet Range Surface Water	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	3.4E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	2.30E-02	mg/L	1.1E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.6E-05
				Iron	8.34E+00	mg/L	3.9E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	7.53E+00	mg/L	3.5E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.6E-05
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	1.1E-06	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	2.30E-02	mg/L	3.5E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	5.2E-07
				Iron	8.34E+00	mg/L	1.3E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	7.53E+00	mg/L	1.1E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
			Exp. Route Total								5.2E-07
		Exposure Point Total									1.7E-05
	Exposure Media Total										1.7E-05
Surface Water Total											1.7E-05

Table 7.5
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Ingestion**	**Inorganics**							
				Arsenic	1.09E-02	mg/L	1.0E-04	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.5E-04
				Chromium	7.32E-03	mg/L	6.9E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	1.7E-01	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Manganese	2.81E+00	mg/L	2.6E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.5E-04
			Dermal Absorption	**Inorganics**							
				Arsenic	1.09E-02	mg/L	5.4E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	NV
				Chromium	7.32E-03	mg/L	3.6E-07	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	8.7E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
				Manganese	2.81E+00	mg/L	1.4E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								0.0E+00
		Exposure Point Total									1.5E-04
	Exposure Media Total										1.5E-04
Groundwater Total											1.5E-04
Total of Receptor Risks Across All Media											3.3E-04

N/A = Not Applicable.

NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

(a) The Adult Resident ADAF risk associated with this COPC is included in the Lifetime Resident ADAF risk calculations. See Attachment Table F-2.

Table 7.6
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
Surface Soil	Surface Soil	Skeet Range Surface Soil	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	5.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	7.10E+00	mg/kg	9.7E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.28E+01	mg/kg	1.8E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.06E+00	mg/kg	5.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	3.77E+00	mg/kg	5.2E-06	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	1.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	3.7E-06	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.16E+01	mg/kg	1.6E-05	mg/kg-day	4.0E-04	mg/kg-day	4.0E-02
				Arsenic	1.09E+01	mg/kg	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	5.0E-02
				Iron	2.09E+04	mg/kg	2.9E-02	mg/kg-day	7.0E-01	mg/kg-day	4.1E-02
				Lead	2.52E+04	mg/kg	3.4E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								1.3E-01
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	1.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	7.10E+00	mg/kg	2.9E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.28E+01	mg/kg	5.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.06E+00	mg/kg	1.7E-06	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	3.77E+00	mg/kg	1.6E-06	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	3.8E-07	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	1.1E-06	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	1.09E+01	mg/kg	1.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.5E-03
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								3.5E-03
		Exposure Point Total									1.3E-01
	Exposure Media Total										1.3E-01

Table 7.6
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
	Air (Particulates)	Skeet Range Surface Soil	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	4.9E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(a)pyrene	9.35E-09	mg/m^3	9.0E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	1.6E-08	mg/m^3	N/A	mg/m^3	---
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	5.1E-09	mg/m^3	N/A	mg/m^3	---
				Chrysene	4.97E-09	mg/m^3	4.8E-09	mg/m^3	N/A	mg/m^3	---
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	1.2E-09	mg/m^3	N/A	mg/m^3	---
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	3.4E-09	mg/m^3	N/A	mg/m^3	---
				Inorganics							
				Antimony	1.53E-08	mg/m^3	1.5E-08	mg/m^3	N/A	mg/m^3	---
				Arsenic	1.44E-08	mg/m^3	1.4E-08	mg/m^3	1.5E-05	mg/m^3	9.2E-04
				Iron	2.75E-05	mg/m^3	2.6E-05	mg/m^3	N/A	mg/m^3	---
				Lead	3.32E-05	mg/m^3	3.2E-05	mg/m^3	N/A	mg/m^3	---
			Exp. Route Total								9.2E-04
		Exposure Point Total									9.2E-04
	Exposure Media Total										9.2E-04
Surface Soil Total											1.3E-01
Sediment	Sediment	Skeet Range	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	5.7E-08	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	6.25E+03	mg/kg	1.9E-03	mg/kg-day	4.0E-04	mg/kg-day	4.8E+00
				Arsenic	8.51E+02	mg/kg	2.6E-04	mg/kg-day	3.0E-04	mg/kg-day	8.7E-01
				Copper	3.57E+02	mg/kg	1.1E-04	mg/kg-day	4.0E-02	mg/kg-day	2.7E-03
				Iron	1.69E+04	mg/kg	5.2E-03	mg/kg-day	7.0E-01	mg/kg-day	7.4E-03
				Lead	1.86E+05	mg/kg	5.7E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								5.6E+00

Table 7.6
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	2.8E-08	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	8.51E+02	mg/kg	3.0E-05	mg/kg-day	3.0E-04	mg/kg-day	9.9E-02
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	4.0E-02	mg/kg-day	0.0E+00
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								9.9E-02
		Exposure Point Total									5.7E+00
	Exposure Media Total										5.7E+00
Sediment Total											5.7E+00
Surface Water	Surface Water	Skeet Range	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	1.0E-04	mg/kg-day	6.0E-05	mg/kg-day	1.7E+00
				Arsenic	2.30E-02	mg/L	3.2E-05	mg/kg-day	3.0E-04	mg/kg-day	1.1E-01
				Iron	8.34E+00	mg/L	1.1E-02	mg/kg-day	7.0E-01	mg/kg-day	1.6E-02
				Lead	7.53E+00	mg/L	1.0E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								1.8E+00
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	3.2E-06	mg/kg-day	6.0E-05	mg/kg-day	5.4E-02
				Arsenic	2.30E-02	mg/L	1.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.4E-03
				Iron	8.34E+00	mg/L	3.7E-04	mg/kg-day	7.0E-01	mg/kg-day	5.3E-04
				Lead	7.53E+00	mg/L	3.3E-05	mg/kg-day	N/A	mg/kg-day	NV
			Exp. Route Total								5.8E-02
		Exposure Point Total									1.9E+00
	Exposure Media Total										1.9E+00
Surface Water Total											1.9E+00

Table 7.6
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Adult Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Ingestion**	**Inorganics**							
				Arsenic	1.09E-02	mg/L	3.0E-04	mg/kg-day	3.0E-04	mg/kg-day	1.0E+00
				Chromium	7.32E-03	mg/L	2.0E-04	mg/kg-day	1.5E+00	mg/kg-day	1.3E-04
				Iron	1.77E+01	mg/L	4.8E-01	mg/kg-day	7.0E-01	mg/kg-day	6.9E-01
				Manganese	2.81E+00	mg/L	7.7E-02	mg/kg-day	2.4E-02	mg/kg-day	3.2E+00
			Exp. Route Total								4.9E+00
			Dermal Absorption	**Inorganics**							
				Arsenic	1.09E-02	mg/L	1.6E-06	mg/kg-day	3.0E-04	mg/kg-day	NV
				Chromium	7.32E-03	mg/L	1.1E-06	mg/kg-day	2.0E-02	mg/kg-day	5.4E-05
				Iron	1.77E+01	mg/L	2.5E-03	mg/kg-day	7.0E-01	mg/kg-day	NV
				Manganese	2.81E+00	mg/L	4.0E-04	mg/kg-day	9.6E-04	mg/kg-day	4.2E-01
			Exp. Route Total								4.2E-01
		Exposure Point Total									5.3E+00
	Exposure Media Total										5.3E+00
Groundwater Total											5.3E+00
Total of Receptor Hazards Across All Media											1.3E+01

N/A = Not Applicable.

NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Table 7.7
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Surface Soil	Surface Soil	Skeet Range Surface Soil	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.6E-05
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	3.0E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	5.5E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	(mg/kg-day)$^{-1}$	1.7E-06
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	(mg/kg-day)$^{-1}$	1.6E-07
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	3.9E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.1E-05
				Inorganics							
				Antimony	1.16E+01	mg/kg	1.3E-05	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	1.09E+01	mg/kg	1.2E-05	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.8E-05
				Iron	2.09E+04	mg/kg	2.3E-02	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	2.52E+04	mg/kg	2.8E-02	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								4.4E-04
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	6.0E-06
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.1E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	2.0E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	(mg/kg-day)$^{-1}$	6.3E-07
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	(mg/kg-day)$^{-1}$	5.9E-08
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.4E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	4.2E-06
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	1.09E+01	mg/kg	1.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.5E-06
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								1.6E-04
		Exposure Point Total									6.0E-04
	Exposure Media Total										6.0E-04

Table 7.7
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
	Air (Particulates)	Skeet Range Surface Soil	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	2.4E-10
				Benzo(a)pyrene	9.35E-09	mg/m^3	ADAF	µg/m^3	1.1E-03	(µg/m^3)$^{-1}$	4.5E-09
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	8.1E-10
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	2.6E-10
				Chrysene	4.97E-09	mg/m^3	ADAF	µg/m^3	1.1E-05	(µg/m^3)$^{-1}$	2.4E-11
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	ADAF	µg/m^3	1.2E-03	(µg/m^3)$^{-1}$	6.4E-10
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	1.7E-10
				Inorganics							
				Antimony	1.53E-08	mg/m^3	1.3E-06	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
				Arsenic	1.44E-08	mg/m^3	1.2E-06	µg/m^3	4.3E-03	(µg/m^3)$^{-1}$	5.1E-09
				Iron	2.75E-05	mg/m^3	2.3E-03	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
				Lead	3.32E-05	mg/m^3	2.7E-03	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
			Exp. Route Total								1.2E-08
		Exposure Point Total									1.2E-08
	Exposure Media Total										1.2E-08
Surface Soil Total											6.0E-04

Table 7.7
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Sediment	Sediment	Skeet Range Sediment	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.8E-07
				Inorganics							
				Antimony	6.25E+03	mg/kg	1.5E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	8.51E+02	mg/kg	2.1E-04	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	3.1E-04
				Copper	3.57E+02	mg/kg	8.7E-05	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Iron	1.69E+04	mg/kg	4.1E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	1.86E+05	mg/kg	4.5E-02	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								3.1E-04
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	7.4E-08
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	8.51E+02	mg/kg	2.0E-05	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	3.0E-05
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								3.0E-05
		Exposure Point Total									3.4E-04
	Exposure Media Total										3.4E-04
Sediment Total											3.4E-04
Surface Water	Surface Water	Skeet Range Surface Water	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	4.0E-05	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	2.30E-02	mg/L	1.3E-05	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.9E-05
				Iron	8.34E+00	mg/L	4.6E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	7.53E+00	mg/L	4.1E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								1.9E-05
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	1.3E-06	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	2.30E-02	mg/L	4.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	6.2E-07
				Iron	8.34E+00	mg/L	1.5E-04	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	7.53E+00	mg/L	1.4E-05	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	NV
			Exp. Route Total								6.2E-07
		Exposure Point Total									2.0E-05
	Exposure Media Total										2.0E-05
Surface Water Total											2.0E-05

Table 7.7
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Ingestion**	**Organics**							
				Arsenic	1.09E-02	mg/L	6.0E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	9.0E-05
				Chromium	7.32E-03	mg/L	4.0E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	9.7E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Manganese	2.81E+00	mg/L	1.5E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								9.0E-05
			Dermal Absorption	**Inorganics**							
				Arsenic	1.09E-02	mg/L	4.0E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	NV
				Chromium	7.32E-03	mg/L	2.6E-07	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	6.5E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
				Manganese	2.81E+00	mg/L	1.0E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								0.0E+00
		Exposure Point Total									9.0E-05
	Exposure Media Total										9.0E-05
Groundwater Total											9.0E-05
Total of Receptor Risks Across All Media											1.1E-03

N/A = Not Applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Table 7.8
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
Surface Soil	Surface Soil	Skeet Range Surface Soil	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	4.9E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	7.10E+00	mg/kg	9.1E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.28E+01	mg/kg	1.6E-04	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.06E+00	mg/kg	5.2E-05	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	3.77E+00	mg/kg	4.8E-05	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	1.2E-05	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	3.4E-05	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.16E+01	mg/kg	1.5E-04	mg/kg-day	4.0E-04	mg/kg-day	3.7E-01
				Arsenic	1.09E+01	mg/kg	1.4E-04	mg/kg-day	3.0E-04	mg/kg-day	4.7E-01
				Iron	2.09E+04	mg/kg	2.7E-01	mg/kg-day	7.0E-01	mg/kg-day	3.8E-01
				Lead	2.52E+04	mg/kg	3.2E-01	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								1.2E+00
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	1.8E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(a)pyrene	7.10E+00	mg/kg	3.3E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(b)fluoranthene	1.28E+01	mg/kg	6.0E-05	mg/kg-day	N/A	mg/kg-day	---
				Benzo(k)fluoranthene	4.06E+00	mg/kg	1.9E-05	mg/kg-day	N/A	mg/kg-day	---
				Chrysene	3.77E+00	mg/kg	1.8E-05	mg/kg-day	N/A	mg/kg-day	---
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	4.3E-06	mg/kg-day	N/A	mg/kg-day	---
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	1.3E-05	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	1.09E+01	mg/kg	1.2E-05	mg/kg-day	3.0E-04	mg/kg-day	3.9E-02
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								3.9E-02
		Exposure Point Total									1.3E+00
	Exposure Media Total										1.3E+00

Table 7.8
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
	Air (Particulates)	Skeet Range Surface Soil	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	4.9E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(a)pyrene	9.35E-09	mg/m^3	9.0E-09	mg/m^3	N/A	mg/m^3	---
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	1.6E-08	mg/m^3	N/A	mg/m^3	---
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	5.1E-09	mg/m^3	N/A	mg/m^3	---
				Chrysene	4.97E-09	mg/m^3	4.8E-09	mg/m^3	N/A	mg/m^3	---
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	1.2E-09	mg/m^3	N/A	mg/m^3	---
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	3.4E-09	mg/m^3	N/A	mg/m^3	---
				Inorganics							
				Antimony	1.53E-08	mg/m^3	1.5E-08	mg/m^3	N/A	mg/m^3	---
				Arsenic	1.44E-08	mg/m^3	1.4E-08	mg/m^3	1.5E-05	mg/m^3	9.2E-04
				Iron	2.75E-05	mg/m^3	2.6E-05	mg/m^3	N/A	mg/m^3	---
				Lead	3.32E-05	mg/m^3	3.2E-05	mg/m^3	N/A	mg/m^3	---
			Exp. Route Total								9.2E-04
		Exposure Point Total									9.2E-04
	Exposure Media Total										9.2E-04
	Air (Volatiles)	Skeet Range Surface Soil	**Inhalation**	**Organics**							
				No COPCs							
			Exp. Route Total								0.0E+00
		Exposure Point Total									0.0E+00
	Exposure Media Total										9.2E-04
Surface Soil Total											1.3E+00
Sediment	Sediment	Skeet Range	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	5.3E-07	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	6.25E+03	mg/kg	1.8E-02	mg/kg-day	4.0E-04	mg/kg-day	4.5E+01
				Arsenic	8.51E+02	mg/kg	2.4E-03	mg/kg-day	3.0E-04	mg/kg-day	8.1E+00
				Copper	3.57E+02	mg/kg	1.0E-03	mg/kg-day	4.0E-02	mg/kg-day	2.5E-02
				Iron	1.69E+04	mg/kg	4.8E-02	mg/kg-day	7.0E-01	mg/kg-day	6.9E-02
				Lead	1.86E+05	mg/kg	5.3E-01	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								5.3E+01

Table 7.8
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	2.2E-07	mg/kg-day	N/A	mg/kg-day	---
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00
				Arsenic	8.51E+02	mg/kg	2.3E-04	mg/kg-day	3.0E-04	mg/kg-day	7.8E-01
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	4.0E-02	mg/kg-day	0.0E+00
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	7.0E-01	mg/kg-day	0.0E+00
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								7.8E-01
		Exposure Point Total									5.3E+01
	Exposure Media Total										5.3E+01
Sediment Total											5.3E+01
Surface Water	Surface Water	Skeet Range	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	4.7E-04	mg/kg-day	6.0E-05	mg/kg-day	7.8E+00
				Arsenic	2.30E-02	mg/L	1.5E-04	mg/kg-day	3.0E-04	mg/kg-day	4.9E-01
				Iron	8.34E+00	mg/L	5.3E-02	mg/kg-day	7.0E-01	mg/kg-day	7.6E-02
				Lead	7.53E+00	mg/L	4.8E-02	mg/kg-day	N/A	mg/kg-day	---
			Exp. Route Total								8.4E+00
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	1.5E-05	mg/kg-day	6.0E-05	mg/kg-day	2.6E-01
				Arsenic	2.30E-02	mg/L	4.8E-06	mg/kg-day	3.0E-04	mg/kg-day	1.6E-02
				Iron	8.34E+00	mg/L	1.8E-03	mg/kg-day	7.0E-01	mg/kg-day	2.5E-03
				Lead	7.53E+00	mg/L	1.6E-04	mg/kg-day	N/A	mg/kg-day	NV
			Exp. Route Total								2.8E-01
		Exposure Point Total									8.7E+00
	Exposure Media Total										8.7E+00
Surface Water Total											8.7E+00

Table 7.8
(Standard RAGS D Table 7B)
Calculation of Noncancer Hazards
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units	
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Ingestion**	**Inorganics**							
				Arsenic	1.09E-02	mg/L	7.0E-04	mg/kg-day	3.0E-04	mg/kg-day	2.3E+00
				Chromium	7.32E-03	mg/L	4.7E-04	mg/kg-day	1.5E+00	mg/kg-day	3.1E-04
				Iron	1.77E+01	mg/L	1.1E+00	mg/kg-day	7.0E-01	mg/kg-day	1.6E+00
				Manganese	2.81E+00	mg/L	1.8E-01	mg/kg-day	2.4E-02	mg/kg-day	7.5E+00
			Exp. Route Total								1.1E+01
			Dermal Absorption	**Inorganics**							
				Arsenic	1.09E-02	mg/L	4.6E-06	mg/kg-day	3.0E-04	mg/kg-day	NV
				Chromium	7.32E-03	mg/L	3.1E-06	mg/kg-day	2.0E-02	mg/kg-day	1.6E-04
				Iron	1.77E+01	mg/L	7.6E-03	mg/kg-day	7.0E-01	mg/kg-day	NV
				Manganese	2.81E+00	mg/L	1.2E-03	mg/kg-day	9.6E-04	mg/kg-day	1.2E+00
			Exp. Route Total								1.2E+00
		Exposure Point Total									1.3E+01
	Exposure Media Total										1.3E+01
Groundwater Total											1.3E+01
										Total of Receptor Hazards Across All Media	7.6E+01

N/A = Not Applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Table 7.9
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Surface Soil	Surface soil	Skeet Range Surface Soil	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	1.9E-05
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	3.5E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	6.3E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	2.0E-06
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	1.8E-07
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.5E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	1.3E-05
				Inorganics							
				Antimony	1.16E+01	mg/kg	1.8E-05	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	1.7E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.6E-05
				Iron	2.09E+04	mg/kg	3.3E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.52E+04	mg/kg	3.9E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								5.1E-04
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	6.7E-06
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.2E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	2.2E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	$(mg/kg\text{-}day)^{-1}$	7.1E-07
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	$(mg/kg\text{-}day)^{-1}$	6.6E-08
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.6E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	$(mg/kg\text{-}day)^{-1}$	4.7E-06
				Inorganics							
				Antimony	1.16E+01	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Arsenic	1.09E+01	mg/kg	1.4E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.0E-06
				Iron	2.09E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Lead	2.52E+04	mg/kg	0.0E+00	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								1.8E-04
		Exposure Point Total									6.9E-04
	Exposure Media Total										6.9E-04

Table 7.9
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Surface Soil	Air (Particulates)	Skeet Range	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-09	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	5.8E-10
				Benzo(a)pyrene	9.35E-09	mg/m^3	ADAF	µg/m^3	1.1E-03	(µg/m^3)$^{-1}$	1.1E-08
				Benzo(b)fluoranthene	1.69E-08	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	1.9E-09
				Benzo(k)fluoranthene	5.34E-09	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	6.1E-10
				Chrysene	4.97E-09	mg/m^3	ADAF	µg/m^3	1.1E-05	(µg/m^3)$^{-1}$	5.7E-11
				Dibenzo(a,h)anthracene	1.21E-09	mg/m^3	ADAF	µg/m^3	1.2E-03	(µg/m^3)$^{-1}$	1.5E-09
				Indeno(1,2,3-cd)pyrene	3.55E-09	mg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	4.1E-10
				Inorganics							
				Antimony	1.53E-08	mg/m^3	6.3E-06	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
				Arsenic	1.44E-08	mg/m^3	5.9E-06	µg/m^3	4.3E-03	(µg/m^3)$^{-1}$	2.5E-08
				Iron	2.75E-05	mg/m^3	1.1E-02	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
				Lead	3.32E-05	mg/m^3	1.4E-02	µg/m^3	N/A	(µg/m^3)$^{-1}$	---
			Exp. Route Total								4.1E-08
		Exposure Point Total									4.1E-08
	Air (Volatiles)	Skeet Range	**Inhalation**	**Organics**							
				No COPCs							0.0E+00
			Exp. Route Total								0.0E+00
		Exposure Point Total									0.0E+00
	Exposure Media Total										4.1E-08
Surface Soil Total											6.9E-04

Table 7.9
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Sediment	Sediment	Skeet Range	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	2.0E-07
				Inorganics							
				Antimony	6.25E+03	mg/kg	2.2E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	8.51E+02	mg/kg	3.0E-04	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	4.5E-04
				Copper	3.57E+02	mg/kg	1.2E-04	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Iron	1.69E+04	mg/kg	5.9E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	1.86E+05	mg/kg	6.5E-02	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								4.5E-04
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	8.6E-08
				Inorganics							
				Antimony	6.25E+03	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	8.51E+02	mg/kg	3.0E-05	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	4.5E-05
				Copper	3.57E+02	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Iron	1.69E+04	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	1.86E+05	mg/kg	0.0E+00	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								4.5E-05
		Exposure Point Total									4.9E-04
	Exposure Media Total										4.9E-04
Sediment Total											4.9E-04
Surface Water	Surface Water	Skeet Range Surface Water	**Ingestion**	**Inorganics**							
				Antimony	7.34E-02	mg/L	7.5E-05	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	2.30E-02	mg/L	2.3E-05	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	3.5E-05
				Iron	8.34E+00	mg/L	8.5E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	7.53E+00	mg/L	7.7E-03	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
			Exp. Route Total								3.5E-05
			Dermal Absorption	**Inorganics**							
				Antimony	7.34E-02	mg/L	2.4E-06	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Arsenic	2.30E-02	mg/L	7.6E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.1E-06
				Iron	8.34E+00	mg/L	2.8E-04	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	---
				Lead	7.53E+00	mg/L	2.5E-05	mg/kg-day	N/A	(mg/kg-day)$^{-1}$	NV
			Exp. Route Total								1.1E-06
		Exposure Point Total									3.6E-05
	Exposure Media Total										3.6E-05
Surface Water Total											3.6E-05

Table 7.9
(Standard RAGS D Table 7A)
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		
					Value	Units	Value	Units	Value	Units	Cancer Risk
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Ingestion**	**Inorganics**							
				Arsenic	1.09E-02	mg/L	1.6E-04	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.4E-04
				Chromium	7.32E-03	mg/L	1.1E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	2.6E-01	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Manganese	2.81E+00	mg/L	4.2E-02	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								2.4E-04
			Dermal Absorption	**Inorganics**							
				Arsenic	1.09E-02	mg/L	9.4E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	NV
				Chromium	7.32E-03	mg/L	6.2E-07	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
				Iron	1.77E+01	mg/L	1.5E-03	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	NV
				Manganese	2.81E+00	mg/L	2.4E-04	mg/kg-day	N/A	$(mg/kg\text{-}day)^{-1}$	---
			Exp. Route Total								0.0E+00
		Exposure Point Total									2.4E-04
	Exposure Media Total										2.4E-04
Groundwater Total											2.4E-04
Total of Receptor Risks Across All Media											1.5E-03

N/A = Not Applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.
Note: the Lifetime Resident cancer risk is the sum of the Adult Resident and the Child Resident cancer risk

Table 9.1
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Skeet Range Surface Soil	**Organics**									
			Benzo(a)anthracene	9.8E-07	---	4.2E-07	1.4E-06	N/A	---	---	---	---
			Benzo(a)pyrene	1.8E-05	---	7.8E-06	2.6E-05	N/A	---	---	---	---
			Benzo(b)fluoranthene	3.3E-06	---	1.4E-06	4.7E-06	N/A	---	---	---	---
			Benzo(k)fluoranthene	1.0E-07	---	4.4E-08	1.5E-07	N/A	---	---	---	---
			Chrysene	9.6E-09	---	4.1E-09	1.4E-08	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	2.3E-06	---	1.0E-06	3.4E-06	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	6.9E-07	---	2.9E-07	9.8E-07	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	2.8E-02	---	0.0E+00	2.8E-02
			Arsenic	5.7E-06	---	5.7E-07	6.3E-06	Skin, Vascular System	3.6E-02	---	3.5E-03	3.9E-02
			Iron	---	---	---	---	GI Tract	2.9E-02	---	0.0E+00	2.9E-02
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	3.1E-05	---	1.2E-05	4.3E-05		0.093	---	0.0035	0.097
		Exposure Point Total					4.3E-05					0.10
	Exposure Media Total						4.3E-05					0.10
	Air (Particulates and Volatiles)	Skeet Range Surface Soil	**Organics**									
			Benzo(a)anthracene	---	4.5E-11	---	4.5E-11	N/A	---	---	---	---
			Benzo(a)pyrene	---	8.3E-10	---	8.3E-10	N/A	---	---	---	---
			Benzo(b)fluoranthene	---	1.5E-10	---	1.5E-10	N/A	---	---	---	---
			Benzo(k)fluoranthene	---	4.7E-11	---	4.7E-11	N/A	---	---	---	---
			Chrysene	---	4.4E-12	---	4.4E-12	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	---	1.2E-10	---	1.2E-10	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	---	3.2E-11	---	3.2E-11	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	---	---	---	---
			Arsenic	---	5.0E-09	---	5.0E-09	Skin, Vascular System	---	2.2E-04	---	2.2E-04
			Iron	---	---	---	---	GI Tract	---	---	---	---
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	---	6.2E-09	---	6.2E-09		---	0.00022	---	0.00022
		Exposure Point Total					6.2E-09					0.00022
	Exposure Media Total						6.2E-09					0.00022
Surface Soil Total							4.3E-05					0.10

Table 9.1
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Skeet Range Sediment	**Organics**									
			Benzo(b)fluoranthene	3.7E-09	---	4.0E-09	7.7E-09	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	1.2E+00	---	0.0E+00	1.2E+00
			Arsenic	3.5E-05	---	8.7E-06	4.3E-05	Skin, Vascular System	2.2E-01	---	5.4E-02	2.7E-01
			Copper	---	---	---	---	GI Tract	6.8E-04	---	0.0E+00	6.8E-04
			Iron	---	---	---	---	GI Tract	1.8E-03	---	0.0E+00	1.8E-03
			Lead	---	---	---	---	N/A	---	---	---	---
				3.5E-05	---	8.7E-06	4.3E-05		1.4	---	0.054	1.5
		Exposure Point Total					4.3E-05					1.5
	Exposure Media Total						4.3E-05					1.5
Sediment Total							4.3E-05					1.5
Surface Water	Surface Water	Skeet Range Surface Water	**Inorganics**									
			Antimony	---	---	---	---	Blood Chemistry	2.2E-02	---	2.7E-02	4.9E-02
			Arsenic	1.9E-06	---	2.7E-07	2.2E-06	Skin, Vascular System	2.3E-06	---	1.7E-03	1.7E-03
			Iron	---	---	---	---	GI Tract	1.8E-03	---	2.6E-04	2.1E-03
			Lead	---	---	NV	---	N/A	4.8E-02	---	NV	4.8E-02
			Chemical Total	1.9E-06	---	2.7E-07	2.2E-06		0.072	---	0.029	0.10
		Exposure Point Total					2.2E-06					0.10
	Exposure Media Total						2.2E-06					0.10
Surface Water Total							2.2E-06					0.10
Groundwater	Groundwater	Skeet Range	**Inorganics**									
			Arsenic	1.1E-04	---	NV	1.1E-04	Skin, Vascular System	7.1E-01	---	NV	7.1E-01
			Chromium	---	---	NV	---	No Observable Effects	9.5E-05	---	NV	9.5E-05
			Iron	---	---	NV	---	GI Tract	4.9E-01	---	NV	4.9E-01
			Manganese	---	---	NV	---	CNS	2.3E+00	---	NV	2.3E+00
			Chemical Total	1.1E-04	---	0.0E+00	1.1E-04		3.5	---	0	3.5
		Exposure Point Total					1.1E-04					3.5
	Exposure Media Total						1.1E-04					3.5
Groundwater Total							1.1E-04					3.5
Receptor Total - Current (a)							8.8E-05					1.7
Receptor Total - Future (b)							2.0E-04					5.2

Total Risk Across All Media = 2E-04

Total Hazard Across All Media = 5

GI = Gastrointestinal.
N/A = Not Available.
(a) Current risks for a routine worker include only exposure to soil, sediment, and surface water.
(b) Future risks for a routine worker include exposure to soil, sediment, surface water, and groundwater.

Total CNS HI Across All Media =	2.3
Total Skin HI Across All Media =	1.0
Total Vascular System HI Across All Media =	1.0
Total GI Tract HI Across All Media =	0.5
Total Kidney HI Across All Media =	0.5
Total No Observable Effects HI Across All Media =	0.0001
Total Blood HI Across All Media =	1.3

Table 9.2
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Current/Future Construction Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Skeet Range Total Soil	**Organics**									
			Benzo(a)anthracene	6.8E-08	---	2.7E-08	9.5E-08	N/A	---	---	---	---
			Benzo(a)pyrene	6.1E-07	---	2.4E-07	8.5E-07	N/A	---	---	---	---
			Benzo(b)fluoranthene	2.1E-07	---	8.2E-08	2.9E-07	N/A	---	---	---	---
			Benzo(k)fluoranthene	6.7E-09	---	2.6E-09	9.4E-09	N/A	---	---	---	---
			Chrysene	6.8E-10	---	2.6E-10	9.4E-10	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	1.5E-07	---	6.0E-08	2.1E-07	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	8.7E-08	---	3.4E-08	1.2E-07	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	4.5E-02	---	0.0E+00	4.5E-02
			Arsenic	3.8E-07	---	3.4E-08	4.1E-07	Skin, Vascular System	5.9E-02	---	5.3E-03	6.4E-02
			Iron	---	---	---	---	GI Tract	4.8E-02	---	0.0E+00	4.8E-02
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	1.5E-06	---	4.8E-07	2.0E-06		0.15	---	0.0053	0.16
		Exposure Point Total					2.0E-06					0.16
	Exposure Media Total						2.0E-06					0.16
	Air (Particulates and Volatiles)	Skeet Range Total Soil	**Organics**									
			Benzo(a)anthracene	---	9.5E-13	---	9.5E-13	N/A	---	---	---	---
			Benzo(a)pyrene	---	8.5E-12	---	8.5E-12	N/A	---	---	---	---
			Benzo(b)fluoranthene	---	2.9E-12	---	2.9E-12	N/A	---	---	---	---
			Benzo(k)fluoranthene	---	9.4E-13	---	9.4E-13	N/A	---	---	---	---
			Chrysene	---	9.4E-14	---	9.4E-14	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	---	2.3E-12	---	2.3E-12	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	---	1.2E-12	---	1.2E-12	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	---	---	---	---
			Arsenic	---	1.0E-10	---	1.0E-10	Skin, Vascular System	---	1.1E-04	---	1.1E-04
			Iron	---	---	---	---	GI Tract	---	---	---	---
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	---	1.2E-10	---	1.2E-10		---	0.00011	---	0.00011
		Exposure Point Total					1.2E-10					0.00011
	Exposure Media Total						1.2E-10					0.00011
Total Soil Total							2.0E-06					0.16
Receptor Total							2.0E-06					0.2

GI = Gastrointestinal.
N/A

Total Risk Across All Media = 2.0E-06

Total Hazard Across All Media = 0.2

Table 9.3
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Adult/Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult / Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Skeet Range Surface Soil	**Organics**									
			Benzo(a)anthracene	1.9E-05	---	6.7E-06	2.6E-05	N/A	---	---	---	---
			Benzo(a)pyrene	3.5E-04	---	1.2E-04	4.7E-04	N/A	---	---	---	---
			Benzo(b)fluoranthene	6.3E-05	---	2.2E-05	8.5E-05	N/A	---	---	---	---
			Benzo(k)fluoranthene	2.0E-06	---	7.1E-07	2.7E-06	N/A	---	---	---	---
			Chrysene	1.8E-07	---	6.6E-08	2.5E-07	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	4.5E-05	---	1.6E-05	6.1E-05	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	1.3E-05	---	4.7E-06	1.8E-05	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	4.0E-02	---	0.0E+00	4.0E-02
			Arsenic	2.6E-05	---	2.0E-06	2.8E-05	Skin, Vascular System	5.0E-02	---	3.5E-03	5.3E-02
			Iron	---	---	---	---	GI Tract	4.1E-02	---	0.0E+00	4.1E-02
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	5.1E-04	---	1.8E-04	6.9E-04		0.13		0.0035	0.13
		Exposure Point Total					6.9E-04					0.13
	Exposure Media Total						6.9E-04					0.13
	Air (Particulates and Volatiles)	Skeet Range Surface Soil	**Organics**									
			Benzo(a)anthracene	---	5.8E-10	---	5.8E-10	N/A	---	---	---	---
			Benzo(a)pyrene	---	1.1E-08	---	1.1E-08	N/A	---	---	---	---
			Benzo(b)fluoranthene	---	1.9E-09	---	1.9E-09	N/A	---	---	---	---
			Benzo(k)fluoranthene	---	6.1E-10	---	6.1E-10	N/A	---	---	---	---
			Chrysene	---	5.7E-11	---	5.7E-11	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	---	1.5E-09	---	1.5E-09	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	---	4.1E-10	---	4.1E-10	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	---	---	---	---
			Arsenic	---	2.5E-08	---	2.5E-08	Skin, Vascular System	---	9.2E-04	---	9.2E-04
			Iron	---	---	---	---	GI Tract	---	---	---	---
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	---	4.1E-08	---	4.1E-08		---	0.00092	---	0.00092
		Exposure Point Total					4.1E-08					0.00092
	Exposure Media Total						4.1E-08					0.00092
Surface Soil Total							6.9E-04					0.13

Table 9.3
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Adult/Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult / Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Skeet Range Sediment	**Organics**									
			Benzo(b)fluoranthene	2.0E-07	---	8.6E-08	2.9E-07	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	4.8E+00	---	0.0E+00	4.8E+00
			Arsenic	4.5E-04	---	4.5E-05	4.9E-04	Skin, Vascular System	8.7E-01	---	9.9E-02	9.6E-01
			Copper	---	---	---	---	GI Tract	2.7E-03	---	0.0E+00	2.7E-03
			Iron	---	---	---	---	GI Tract	7.4E-03	---	0.0E+00	7.4E-03
			Lead	---	---	---	---	N/A	---	---	---	---
				4.5E-04	---	4.5E-05	4.9E-04		5.6		0.099	5.7
		Exposure Point Total					4.9E-04					5.7
	Exposure Media Total						4.9E-04					5.7
Sediment Total							4.9E-04					5.7
Surface Water	Surface Water	Skeet Range Surface Water	**Inorganics**									
			Antimony	---	---	---	---	Blood Chemistry	1.7E+00	---	5.4E-02	1.7E+00
			Arsenic	3.5E-05	---	1.1E-06	3.6E-05	Skin, Vascular System	1.1E-01	---	3.4E-03	1.1E-01
			Iron	---	---	---	---	GI Tract	1.6E-02	---	5.3E-04	1.7E-02
			Lead	---	---	NV	---	N/A	---	---	NV	---
			Chemical Total	3.5E-05	---	1.1E-06	3.6E-05		1.8	---	0.058	1.9
		Exposure Point Total					3.6E-05					1.9
	Exposure Media Total						3.6E-05					1.9
Surface Water Total							3.6E-05					1.9

Table 9.3
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Adult/Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult / Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Inorganics**									
			Arsenic	2.4E-04	---	NV	2.4E-04	Skin, Vascular System	1.0E+00	---	NV	1.0E+00
			Chromium	---	---	---	---	No Observable Effects	1.3E-04	---	5.4E-05	1.9E-04
			Iron	---	---	NV	---	GI Tract	6.9E-01	---	NV	6.9E-01
			Manganese	---	---	---	---	CNS	3.2E+00	---	4.2E-01	3.6E+00
			Chemical Total	2.4E-04	---	0.0E+00	2.4E-04		4.9	---	0.42	5.3
		Exposure Point Total					2.4E-04					5.3
	Exposure Media Total						2.4E-04					5.3
Groundwater Total							2.4E-04					5.3
Receptor Total							1.5E-03					13.1

Total Risk Across All Media = 1.5E-03

Total Hazard Across All Media = 13

CNS = Central nervous system.
GI = Gastrointestinal.
N/A = Not Available.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.
Note: the Lifetime Resident cancer risk is the sum of the Adult Resident and the Child Resident cancer risk

Total CNS HI Across All Media =	3.6
Total Skin HI Across All Media =	2.1
Total Vascular System HI Across All Media =	2.1
Total GI Tract HI Across All Media =	0.8
Total No Observable Effects HI Across All Media =	0.00019
Total Blood HI Across All Media =	6.5

Table 9.4
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Skeet Range Surface Soil	**Organics**									
			Benzo(a)anthracene	1.6E-05	---	6.0E-06	2.2E-05	N/A	---	---	---	---
			Benzo(a)pyrene	3.0E-04	---	1.1E-04	4.1E-04	N/A	---	---	---	---
			Benzo(b)fluoranthene	5.5E-05	---	2.0E-05	7.5E-05	N/A	---	---	---	---
			Benzo(k)fluoranthene	1.7E-06	---	6.3E-07	2.4E-06	N/A	---	---	---	---
			Chrysene	1.6E-07	---	5.9E-08	2.2E-07	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	3.9E-05	---	1.4E-05	5.3E-05	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	1.1E-05	---	4.2E-06	1.6E-05	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	3.7E-01	---	0.0E+00	3.7E-01
			Arsenic	1.8E-05	---	1.5E-06	1.9E-05	Skin, Vascular System	4.7E-01	---	3.9E-02	5.0E-01
			Iron	---	---	---	---	GI Tract	3.8E-01	---	0.0E+00	3.8E-01
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	4.4E-04	---	1.6E-04	6.0E-04		1.2	---	0.039	1.3
		Exposure Point Total					6.0E-04					1.3
	Exposure Media Total						6.0E-04					1.3
	Air (Particulates and Volatiles)	Skeet Range Surface Soil	**Organics**									
			Benzo(a)anthracene	---	2.4E-10	---	2.4E-10	N/A	---	---	---	---
			Benzo(a)pyrene	---	4.5E-09	---	4.5E-09	N/A	---	---	---	---
			Benzo(b)fluoranthene	---	8.1E-10	---	8.1E-10	N/A	---	---	---	---
			Benzo(k)fluoranthene	---	2.6E-10	---	2.6E-10	N/A	---	---	---	---
			Chrysene	---	2.4E-11	---	2.4E-11	N/A	---	---	---	---
			Dibenzo(a,h)anthracene	---	6.4E-10	---	6.4E-10	N/A	---	---	---	---
			Indeno(1,2,3-cd)pyrene	---	1.7E-10	---	1.7E-10	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	---	---	---	---
			Arsenic	---	5.1E-09	---	5.1E-09	Skin, Vascular System	---	9.2E-04	---	9.2E-04
			Iron	---	---	---	---	GI Tract	---	---	---	---
			Lead	---	---	---	---	N/A	---	---	---	---
			Chemical Total	---	1.2E-08	---	1.2E-08		---	0.00092	---	0.00092
		Exposure Point Total					1.2E-08					0.0009
	Exposure Media Total						1.2E-08					0.0009
Surface Soil Total							6.0E-04					1.3

Table 9.4
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Skeet Range	**Organics**									
			Benzo(b)fluoranthene	1.8E-07	---	7.4E-08	2.5E-07	N/A	---	---	---	---
			Inorganics									
			Antimony	---	---	---	---	Blood Chemistry	4.5E+01	---	0.0E+00	4.5E+01
			Arsenic	3.1E-04	---	3.0E-05	3.4E-04	Skin, Vascular System	8.1E+00	---	7.8E-01	8.9E+00
			Copper	---	---	---	---	GI Tract	2.5E-02	---	0.0E+00	2.5E-02
			Iron	---	---	---	---	GI Tract	6.9E-02	---	0.0E+00	6.9E-02
			Lead	---	---	---	---	N/A	---	---	---	---
				3.1E-04		3.0E-05	3.4E-04		52.7		0.78	53.5
		Exposure Point Total										
	Exposure Media Total						3.4E-04					53.5
Sediment Total							3.4E-04					53.5
Surface Water	Surface Water	Skeet Range	**Inorganics**									
			Antimony	---	---	---	---	Blood Chemistry	7.8E+00	---	2.6E-01	8.1E+00
			Arsenic	1.9E-05	---	6.2E-07	2.0E-05	Skin, Vascular System	4.9E-01	---	1.6E-02	5.1E-01
			Iron	---	---	---	---	GI Tract	7.6E-02	---	2.5E-03	7.9E-02
			Lead	---	---	NV	---	N/A	---	---	NV	---
			Chemical Total	1.9E-05	---	6.2E-07	2.0E-05		8.4	---	0.28	8.7
		Exposure Point Total					2.0E-05					8.7
	Exposure Media Total						2.0E-05					8.7
Surface Water Total							2.0E-05					8.7

Table 9.4
(Standard RAGS Part D Table 9)
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	**Inorganics**									
			Arsenic	9.0E-05	---	NV	9.0E-05	Skin, Vascular System	2.3E+00	---	NV	2.3E+00
			Chromium	---	---	---	---	No Observable Effects	3.1E-04	---	1.6E-04	4.7E-04
			Iron	---	---	NV	---	GI Tract	1.6E+00	---	NV	1.6E+00
			Manganese	---	---	---	---	CNS	7.5E+00	---	1.2E+00	8.7E+00
			Chemical Total	9.0E-05	---	---	9.0E-05		11.4	---	1.2	12.7
		Exposure Point Total					9.0E-05					12.7
	Exposure Media Total						9.0E-05					12.7
Groundwater Total							9.0E-05					12.7
Receptor Total							1.1E-03					76.0

Total Risk Across All Media = 1.1E-03

Total Hazard Across All Media = 76

CNS = Central nervous system.
GI = Gastrointestinal.
N/A = Not Available.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Total CNS HI Across All Media =	8.7
Total Skin HI Across All Media =	12.2
Total Vascular System HI Across All Media =	12.2
Total GI Tract HI Across All Media =	2.2
Total No Observable Effects HI Across All Media =	0.00047
Total Blood HI Across All Media =	53.0

Table 10.1
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Skeet Range Surface Soil										
			Benzo(a)anthracene	9.8E-07	---	4.2E-07	1.4E-06	---	---	---	---	---
			Benzo(a)pyrene	1.8E-05	---	7.8E-06	2.6E-05	---	---	---	---	---
			Benzo(b)fluoranthene	3.3E-06	---	1.4E-06	4.7E-06	---	---	---	---	---
			Dibenzo(a,h)anthracene	2.3E-06	---	1.0E-06	3.4E-06	---	---	---	---	---
			Arsenic	5.7E-06	---	5.7E-07	6.3E-06	N/A	<1	---	<1	<1
			Chemical Total	3.0E-05	---	1.1E-05	4.2E-05		<1	---	<1	<1
		Exposure Point Total					4.2E-05					<1
	Exposure Media Total						4.2E-05					<1
	Air (Particulates and Volatiles)	Skeet Range Surface Soil										
			Chemical Total				<1.0E-06					<1
		Exposure Point Total					<1.0E-06					<1
	Exposure Media Total						<1.0E-06					<1
Surface Soil Total							4.2E-05					<1
Sediment	Sediment	Skeet Range Sediment										
			Antimony	---	---	---	---	Blood Chemistry	1.2E+00	---	0.0E+00	1.2E+00
			Arsenic	3.5E-05	---	8.7E-06	4.3E-05	N/A	<1	---	<1	<1
				3.5E-05	---	8.7E-06	4.3E-05		1.2	---	0	1.2
		Exposure Point Total					4.3E-05					1.2
	Exposure Media Total						4.3E-05					1.2
Sediment Total							4.3E-05					1.2
Surface Water	Surface Water	Skeet Range Surface Water										
			Arsenic	1.9E-06	---	2.7E-07	2.2E-06	N/A	<1	---	<1	<1
			Chemical Total	1.9E-06	---	2.7E-07	2.2E-06		<1	---	<1	<1
		Exposure Point Total					2.2E-06					<1
	Exposure Media Total						2.2E-06					<1
Surface Water Total							2.2E-06					<1

Table 10.1
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Current/Future Routine Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Routine Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Skeet Range	Arsenic	1.1E-04	---	NV	1.1E-04	N/A	<1	---	<1	<1
			Manganese	---	---	NV	---	CNS	2.3E+00	---	NV	2.3E+00
			Chemical Total	1.1E-04	---	0.0E+00	1.1E-04		2.3	---	0	2.3
		Exposure Point Total					1.1E-04					2.3
	Exposure Media Total						1.1E-04					2.3
Groundwater Total							1.1E-04					2.3
Receptor Total - Current (a)							8.7E-05					1.2
Receptor Total - Future (b)							2.0E-04					3.5

Total Risk Across All Media = 2E-04

Total Hazard Across All Media = 3

Total CNS HI Across All Media = 2.3
Total Blood HI Across All Media = 1.2

CNS = Central nervous system.
GI = Gastrointestinal.
N/A = Not available or not applicable.
(a) Current risks for a routine worker include only exposure to soil, sediment, and surface water.
(b) Future risks for a routine worker include exposure to soil, sediment, surface water, and groundwater.

Table 10.2
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Current/Future Construction Worker, Skeet Range

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Skeet Range Total Soil										
			Chemical Total	1.5E-06	---	4.8E-07	2.0E-06					<1
		Exposure Point Total					2.0E-06					<1
	Exposure Media Total						2.0E-06					<1
	Air (Particulates and Volatiles)	Skeet Range Total Soil										
			Chemical Total				<1.0E-06					<1
		Exposure Point Total					<1.0E-06					<1
	Exposure Media Total						<1.0E-06					<1
Total Soil Total							2.0E-06					<1
Receptor Total							2.0E-06					<1

Total Risk Across All Media = 2.0E-06

Total Hazard Across All Media = <1

CNS = Central nervous system.
GI = Gastrointestinal.
NOAEL = No Observable Adverse Effects Level.
N/A = Not available or not applicable.

Table 10.3
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Future - Adult/Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult / Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Skeet Range Surface Soil	Benzo(a)anthracene	1.9E-05	---	6.7E-06	2.6E-05	---	---	---	---	---
			Benzo(a)pyrene	3.5E-04	---	1.2E-04	4.7E-04	---	---	---	---	---
			Benzo(b)fluoranthene	6.3E-05	---	2.2E-05	8.5E-05	---	---	---	---	---
			Benzo(k)fluoranthene	2.0E-06	---	7.1E-07	2.7E-06	---	---	---	---	---
			Dibenzo(a,h)anthracene	4.5E-05	---	1.6E-05	6.1E-05	---	---	---	---	---
			Indeno(1,2,3-cd)pyrene	1.3E-05	---	4.7E-06	1.8E-05	---	---	---	---	---
			Arsenic	2.6E-05	---	2.0E-06	2.8E-05	---	---	---	---	---
			Chemical Total	5.1E-04	---	1.8E-04	6.9E-04		<1	---	<1	<1
		Exposure Point Total					6.9E-04					<1
	Exposure Media Total						6.9E-04					<1
	Air (Particulates and Volatiles)	Skeet Range Surface Soil	Chemical Total				<1.0E-06					<1
		Exposure Point Total					<1.0E-06					<1
	Exposure Media Total						<1.0E-06					<1
Surface Soil Total							6.9E-04					<1
Sediment	Sediment	Skeet Range Sediment	Antimony	---	---	---	---	Blood Chemistry	4.8E+00	---	0.0E+00	4.8E+00
			Arsenic	4.5E-04	---	4.5E-05	4.9E-04	N/A	<1	---	<1	<1
			Chemical Total	4.5E-04	---	4.5E-05	4.9E-04		4.8		0.0	4.8
		Exposure Point Total					4.9E-04					4.8
	Exposure Media Total						4.9E-04					4.8
Sediment Total							4.9E-04					4.8
Surface Water	Surface Water	Skeet Range Surface Water	Antimony	---	---	---	---	Blood Chemistry	1.7E+00	---	5.4E-02	1.7E+00
			Arsenic	3.5E-05	---	1.1E-06	3.6E-05	N/A	<1	---	<1	<1
			Chemical Total	3.5E-05	---	1.1E-06	3.6E-05		1.7	---	0.05	1.7
		Exposure Point Total					3.6E-05					1.7
	Exposure Media Total						3.6E-05					1.7
Surface Water Total							3.6E-05					1.7

Table 10.3
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Future - Adult/Lifetime Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult / Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	Arsenic	2.4E-04	---	NV	2.4E-04	Skin, Vascular System	1.0E+00	---	NV	1.0E+00
			Manganese	---	---	---	---	CNS	3.2E+00	---	4.2E-01	3.6E+00
			Chemical Total	2.4E-04	---	0.0E+00	2.4E-04		4.2	---	0.42	4.6
		Exposure Point Total					2.4E-04					4.6
	Exposure Media Total						2.4E-04					4.6
Groundwater Total							2.4E-04					4.6
Receptor Total							1.5E-03					11.1

Total Risk Across All Media = 1.5E-03

Total Hazard Across All Media = 11

N/A = Not available or not applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.
Note: the Lifetime Resident cancer risk is the sum of the Adult Resident and the Child Resident cancer risk

Total CNS HI Across All Media = 3.6
Total Skin HI Across All Media = 1.0
Total Vascular System HI Across All Media = 1.0
Total Blood HI Across All Media = 6.5

Table 10.4
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Skeet Range Surface Soil	Benzo(a)anthracene	1.6E-05	---	6.0E-06	2.2E-05	---	---	---	---	---
			Benzo(a)pyrene	3.0E-04	---	1.1E-04	4.1E-04	---	---	---	---	---
			Benzo(b)fluoranthene	5.5E-05	---	2.0E-05	7.5E-05	---	---	---	---	---
			Benzo(k)fluoranthene	1.7E-06	---	6.3E-07	2.4E-06	---	---	---	---	---
			Dibenzo(a,h)anthracene	3.9E-05	---	1.4E-05	5.3E-05	---	---	---	---	---
			Indeno(1,2,3-cd)pyrene	1.1E-05	---	4.2E-06	1.6E-05	---	---	---	---	---
			Arsenic	1.8E-05	---	1.5E-05	1.9E-05	---	---	---	---	---
			Chemical Total	4.4E-04	---	1.6E-04	6.0E-04		1.2E+00	---	<1	1.3E+00
		Exposure Point Total					6.0E-04					1.3
	Exposure Media Total						6.0E-04					1.3
	Air (Particulates and Volatiles)	Skeet Range Surface Soil	Chemical Total				<1.0E-06					<1
		Exposure Point Total					<1.0E-06					<1
	Exposure Media Total						<1.0E-06					<1
Surface Soil Total							6.0E-04					1.3
Sediment	Sediment	Skeet Range	Antimony	---	---	---	---	Blood Chemistry	4.5E+01	---	0.0E+00	4.5E+01
			Arsenic	3.1E-04	---	3.0E-05	3.4E-04	Skin, Vascular System	8.1E+00	---	7.8E-01	8.9E+00
			Chemical Total	3.1E-04		3.0E-05	3.4E-04		52.6		0.78	53.4
		Exposure Point Total					3.4E-04					53.4
	Exposure Media Total						3.4E-04					53.4
Sediment Total							3.4E-04					53.4
Surface Water	Surface Water	Skeet Range	Antimony	---	---	---	---	Blood Chemistry	7.8E+00	---	2.6E-01	8.1E+00
			Arsenic	1.9E-05	---	6.2E-07	2.0E-05	N/A	<1	---	<1	<1
			Chemical Total	1.9E-05	---	6.2E-07	2.0E-05		7.8	---	0.3	8.1
		Exposure Point Total					2.0E-05					8.1
	Exposure Media Total						2.0E-05					8.1
Surface Water Total							2.0E-05					8.1

Table 10.4
(Standard RAGS Part D Table 10)
Risk Assessment Summary
Reasonable Maximum Exposure
Future Child Resident, Skeet Range

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Skeet Range Groundwater Potable Use	Arsenic	9.0E-05	---	NV	9.0E-05	Skin, Vascular System	2.3E+00	---	NV	2.3E+00
			Iron	---	---	NV	---	GI Tract	1.6E+00	---	NV	1.6E+00
			Manganese	---	---	---	---	CNS	7.5E+00	---	1.2E+00	8.7E+00
			Chemical Total	9.0E-05	---	---	9.0E-05		11.4	---	1.2	12.7
		Exposure Point Total					9.0E-05					12.7
	Exposure Media Total						9.0E-05					12.7
Groundwater Total							9.0E-05					12.7
Receptor Total							1.1E-03					74.1

Total Risk Across All Media = 1.1E-03

Total Hazard Across All Media = 74

CNS = Central nervous system.
GI = Gastrointestinal.
N/A = Not available or not applicable.
NV = No dermal exposure value calculated. As per USEPA Dermal Exposure spreadsheet, this chemical is not assessed.

Total CNS HI Across All Media =	8.7
Total Skin HI Across All Media =	11.2
Total Vascular System HI Across All Media =	11.2
Total GI Tract HI Across All Media =	1.6
Total Blood HI Across All Media =	52.6

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1				**General UCL Statistics for Data Sets with Non-Detects**								
2		**User Selected Options**		**Skeet Range, SS**								
3		From File		input.wst								
4		Full Precision		OFF								
5		Confidence Coefficient		95%								
6		Number of Bootstrap Operations		2000								
7												
8												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
9	**Antimony**											
10												
11						**General Statistics**						
12					Number of Valid Data	14				Number of Detected Data		8
13					Number of Distinct Detected Data	8				Number of Non-Detect Data		6
14										Percent Non-Detects		42.86%
15												
16				**Raw Statistics**						**Log-transformed Statistics**		
17					Minimum Detected	0.97				Minimum Detected		-0.0305
18					Maximum Detected	39.4				Maximum Detected		3.674
19					Mean of Detected	9.869				Mean of Detected		1.49
20					SD of Detected	13.54				SD of Detected		1.342
21					Minimum Non-Detect	2.57				Minimum Non-Detect		0.944
22					Maximum Non-Detect	9.24				Maximum Non-Detect		2.224
23												
24	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		11
25	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		3
26	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		78.57%
27												
28					**Warning: There are only 8 Detected Values in this data**							
29					**Note: It should be noted that even though bootstrap may be performed on this data set**							
30					**the resulting calculations may not be reliable enough to draw conclusions**							
31												
32					**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**							
33												
34												
35						**UCL Statistics**						
36				**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**		
37					Shapiro Wilk Test Statistic	0.726				Shapiro Wilk Test Statistic		0.918
38					5% Shapiro Wilk Critical Value	0.818				5% Shapiro Wilk Critical Value		0.818
39				**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**		
40												
41				**Assuming Normal Distribution**						**Assuming Lognormal Distribution**		
42					DL/2 Substitution Method					DL/2 Substitution Method		
43					Mean	6.627				Mean		1.144
44					SD	10.71				SD		1.127
45					95% DL/2 (t) UCL	11.7				95% H-Stat (DL/2) UCL		15.18
46												
47					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
48				**MLE yields a negative mean**						Mean in Log Scale		1.081
49										SD in Log Scale		1.101
50										Mean in Original Scale		6.375
51										SD in Original Scale		10.79
52										95% t UCL		11.48
53										95% Percentile Bootstrap UCL		11.29
54										95% BCA Bootstrap UCL		14.17
55										95% H-UCL		13.36
56												
57				**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**		
58					k star (bias corrected)	0.551				**Data appear Gamma Distributed at 5% Significance Level**		
59					Theta Star	17.9						
60					nu star	8.823						
61												
62					A-D Test Statistic	0.529				**Nonparametric Statistics**		
63					5% A-D Critical Value	0.745				Kaplan-Meier (KM) Method		
64					K-S Test Statistic	0.745				Mean		6.347
65					5% K-S Critical Value	0.304				SD		10.41
66				**Data appear Gamma Distributed at 5% Significance Level**						SE of Mean		2.979
67										95% KM (t) UCL		11.62
68				**Assuming Gamma Distribution**						95% KM (z) UCL		11.25
69					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		11.47
70					Minimum	0.000001				95% KM (bootstrap t) UCL		25.5
71					Maximum	39.4				95% KM (BCA) UCL		11.58
72					Mean	5.77				95% KM (Percentile Bootstrap) UCL		11.55
73					Median	1.199				95% KM (Chebyshev) UCL		19.33
74					SD	11.09				97.5% KM (Chebyshev) UCL		24.95
75					k star	0.171				99% KM (Chebyshev) UCL		35.99
76					Theta star	33.74						
77					Nu star	4.788				**Potential UCLs to Use**		
78					AppChi2	1.056				95% KM (BCA) UCL		11.58
79					95% Gamma Approximate UCL	26.17						
80					95% Adjusted Gamma UCL	32.67						
81	**Note: DL/2 is not a recommended method.**											
82												
83				**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**								
84				**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**								
85				**For additional insight, the user may want to consult a statistician.**								
86												
87												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
88	**Arsenic**											
89												
90	**General Statistics**											
91					Number of Valid Observations	14				Number of Distinct Observations		14
92												
93	**Raw Statistics**						**Log-transformed Statistics**					
94					Minimum	1.65				Minimum of Log Data		0.501
95					Maximum	24.1				Maximum of Log Data		3.182
96					Mean	7.506				Mean of log Data		1.757
97					Median	6.585				SD of log Data		0.755
98					SD	5.892						
99					Std. Error of Mean	1.575						
100					Coefficient of Variation	0.785						
101					Skewness	1.803						
102												
103	**Relevant UCL Statistics**											
104	**Normal Distribution Test**						**Lognormal Distribution Test**					
105					Shapiro Wilk Test Statistic	0.828				Shapiro Wilk Test Statistic		0.976
106					Shapiro Wilk Critical Value	0.874				Shapiro Wilk Critical Value		0.874
107	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
108												
109	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
110					95% Student's-t UCL	10.29				95% H-UCL		12.77
111	**95% UCLs (Adjusted for Skewness)**									95% Chebyshev (MVUE) UCL		14.5
112					95% Adjusted-CLT UCL (Chen-1995)	10.91				97.5% Chebyshev (MVUE) UCL		17.52
113					95% Modified-t UCL (Johnson-1978)	10.42				99% Chebyshev (MVUE) UCL		23.46
114												
115	**Gamma Distribution Test**						**Data Distribution**					
116					k star (bias corrected)	1.687	**Data appear Gamma Distributed at 5% Significance Level**					
117					Theta Star	4.449						
118					MLE of Mean	7.506						
119					MLE of Standard Deviation	5.779						
120					nu star	47.24						
121					Approximate Chi Square Value (.05)	32.47	**Nonparametric Statistics**					
122					Adjusted Level of Significance	0.0312				95% CLT UCL		10.1
123					Adjusted Chi Square Value	30.85				95% Jackknife UCL		10.29
124										95% Standard Bootstrap UCL		9.971
125					Anderson-Darling Test Statistic	0.251				95% Bootstrap-t UCL		11.81
126					Anderson-Darling 5% Critical Value	0.746				95% Hall's Bootstrap UCL		21.41
127					Kolmogorov-Smirnov Test Statistic	0.127				95% Percentile Bootstrap UCL		10.25
128					Kolmogorov-Smirnov 5% Critical Value	0.232				95% BCA Bootstrap UCL		10.79
129	**Data appear Gamma Distributed at 5% Significance Level**									95% Chebyshev(Mean, Sd) UCL		14.37
130										97.5% Chebyshev(Mean, Sd) UCL		17.34
131	**Assuming Gamma Distribution**									99% Chebyshev(Mean, Sd) UCL		23.17
132					95% Approximate Gamma UCL	10.92						
133					95% Adjusted Gamma UCL	11.49						
134												
135	**Potential UCL to Use**									Use 95% Approximate Gamma UCL		10.92
136												
137	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
138	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
139	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
140												
141												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
142	**Benz(a)anthracene**											
143												
144						**General Statistics**						
145					Number of Valid Data	26				Number of Detected Data		6
146					Number of Distinct Detected Data	6				Number of Non-Detect Data		20
147										Percent Non-Detects		76.92%
148												
149					**Raw Statistics**					**Log-transformed Statistics**		
150					Minimum Detected	0.23				Minimum Detected		-1.47
151					Maximum Detected	27.6				Maximum Detected		3.318
152					Mean of Detected	7.355				Mean of Detected		1.181
153					SD of Detected	10.15				SD of Detected		1.579
154					Minimum Non-Detect	0.0937				Minimum Non-Detect		-2.368
155					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
156												
157	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		22
158	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		4
159	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		84.62%
160												
161					**Warning: There are only 6 Detected Values in this data**							
162					**Note: It should be noted that even though bootstrap may be performed on this data set**							
163					**the resulting calculations may not be reliable enough to draw conclusions**							
164												
165					**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**							
166												
167												
168						**UCL Statistics**						
169					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
170					Shapiro Wilk Test Statistic	0.7				Shapiro Wilk Test Statistic		0.951
171					5% Shapiro Wilk Critical Value	0.788				5% Shapiro Wilk Critical Value		0.788
172					**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
173												
174					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
175					DL/2 Substitution Method					DL/2 Substitution Method		
176					Mean	1.983				Mean		-0.814
177					SD	5.45				SD		1.585
178					95% DL/2 (t) UCL	3.808				95% H-Stat (DL/2) UCL		4.491
179												
180					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
181					**MLE yields a negative mean**					Mean in Log Scale		-2.955
182										SD in Log Scale		2.512
183										Mean in Original Scale		1.713
184										SD in Original Scale		5.528
185										95% t UCL		3.565
186										95% Percentile Bootstrap UCL		3.783
187										95% BCA Bootstrap UCL		5.165
188										95% H-UCL		14.07
189												
190					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
191					k star (bias corrected)	0.479				**Data appear Gamma Distributed at 5% Significance Level**		
192					Theta Star	15.34						
193					nu star	5.753						
194												
195					A-D Test Statistic	0.296				**Nonparametric Statistics**		
196					5% A-D Critical Value	0.722				Kaplan-Meier (KM) Method		
197					K-S Test Statistic	0.722				Mean		1.877
198					5% K-S Critical Value	0.344				SD		5.37
199					**Data appear Gamma Distributed at 5% Significance Level**					SE of Mean		1.154
200										95% KM (t) UCL		3.848
201					**Assuming Gamma Distribution**					95% KM (z) UCL		3.775
202					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		3.54
203					Minimum	0.000001				95% KM (bootstrap t) UCL		7.06
204					Maximum	27.6				95% KM (BCA) UCL		6.73
205					Mean	1.697				95% KM (Percentile Bootstrap) UCL		5.31
206					Median	0.000001				95% KM (Chebyshev) UCL		6.907
207					SD	5.533				97.5% KM (Chebyshev) UCL		9.083
208					k star	0.0937				99% KM (Chebyshev) UCL		13.36
209					Theta star	18.11						
210					Nu star	4.874				**Potential UCLs to Use**		
211					AppChi2	1.095				95% KM (t) UCL		3.848
212					95% Gamma Approximate UCL	7.559						
213					95% Adjusted Gamma UCL	8.414						
214	**Note: DL/2 is not a recommended method.**											
215												
216					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
217					**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**							
218					**For additional insight, the user may want to consult a statistician.**							
219												
220												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
221	**Benzo(a)pyrene**											
222												
223						**General Statistics**						
224					Number of Valid Data	26				Number of Detected Data		14
225					Number of Distinct Detected Data	14				Number of Non-Detect Data		12
226										Percent Non-Detects		46.15%
227												
228				**Raw Statistics**						**Log-transformed Statistics**		
229					Minimum Detected	0.2				Minimum Detected		-1.609
230					Maximum Detected	21.6				Maximum Detected		3.073
231					Mean of Detected	2.885				Mean of Detected		-0.0346
232					SD of Detected	5.703				SD of Detected		1.394
233					Minimum Non-Detect	0.235				Minimum Non-Detect		-1.448
234					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
235												
236	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		22
237	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		4
238	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		84.62%
239												
240						**UCL Statistics**						
241				**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**		
242					Shapiro Wilk Test Statistic	0.521				Shapiro Wilk Test Statistic		0.881
243					5% Shapiro Wilk Critical Value	0.874				5% Shapiro Wilk Critical Value		0.874
244				**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**		
245												
246				**Assuming Normal Distribution**						**Assuming Lognormal Distribution**		
247					DL/2 Substitution Method					DL/2 Substitution Method		
248					Mean	1.804				Mean		-0.385
249					SD	4.286				SD		1.168
250					95% DL/2 (t) UCL	3.239				95% H-Stat (DL/2) UCL		2.545
251												
252					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
253				**MLE yields a negative mean**						Mean in Log Scale		-0.546
254										SD in Log Scale		1.216
255										Mean in Original Scale		1.722
256										SD in Original Scale		4.309
257										95% t UCL		3.166
258										95% Percentile Bootstrap UCL		3.288
259										95% BCA Bootstrap UCL		4.27
260										95% H-UCL		2.396
261												
262				**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**		
263					k star (bias corrected)	0.495				**Data appear Lognormal at 5% Significance Level**		
264					Theta Star	5.83						
265					nu star	13.86						
266												
267					A-D Test Statistic	1.269				**Nonparametric Statistics**		
268					5% A-D Critical Value	0.787				Kaplan-Meier (KM) Method		
269					K-S Test Statistic	0.787				Mean		1.72
270					5% K-S Critical Value	0.241				SD		4.227
271				**Data not Gamma Distributed at 5% Significance Level**						SE of Mean		0.861
272										95% KM (t) UCL		3.19
273				**Assuming Gamma Distribution**						95% KM (z) UCL		3.136
274					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		3.157
275					Minimum	0.000001				95% KM (bootstrap t) UCL		8.272
276					Maximum	21.6				95% KM (BCA) UCL		3.315
277					Mean	1.66				95% KM (Percentile Bootstrap) UCL		3.37
278					Median	0.334				95% KM (Chebyshev) UCL		5.472
279					SD	4.344				97.5% KM (Chebyshev) UCL		7.095
280					k star	0.144				99% KM (Chebyshev) UCL		10.28
281					Theta star	11.5						
282					Nu star	7.508				**Potential UCLs to Use**		
283					AppChi2	2.453				97.5% KM (Chebyshev) UCL		7.095
284					95% Gamma Approximate UCL	5.08						
285					95% Adjusted Gamma UCL	5.499						
286	**Note: DL/2 is not a recommended method.**											
287												
288				**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**								
289				**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**								
290				**For additional insight, the user may want to consult a statistician.**								
291												
292												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
293	**Benzo(b)fluoranthene**											
294												
295						**General Statistics**						
296						Number of Valid Data	26				Number of Detected Data	16
297						Number of Distinct Detected Data	16				Number of Non-Detect Data	10
298											Percent Non-Detects	38.46%
299												
300						**Raw Statistics**					**Log-transformed Statistics**	
301						Minimum Detected	0.12				Minimum Detected	-2.12
302						Maximum Detected	27.1				Maximum Detected	3.3
303						Mean of Detected	3.235				Mean of Detected	-0.0785
304						SD of Detected	6.724				SD of Detected	1.516
305						Minimum Non-Detect	0.47				Minimum Non-Detect	-0.755
306						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
307												
308	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	21
309	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	5
310	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	80.77%
311												
312						**UCL Statistics**						
313						**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**	
314						Shapiro Wilk Test Statistic	0.5				Shapiro Wilk Test Statistic	0.877
315						5% Shapiro Wilk Critical Value	0.887				5% Shapiro Wilk Critical Value	0.887
316						**Data not Normal at 5% Significance Level**					**Data not Lognormal at 5% Significance Level**	
317												
318						**Assuming Normal Distribution**					**Assuming Lognormal Distribution**	
319						DL/2 Substitution Method					DL/2 Substitution Method	
320						Mean	2.227				Mean	-0.28
321						SD	5.371				SD	1.245
322						95% DL/2 (t) UCL	4.026				95% H-Stat (DL/2) UCL	3.325
323												
324						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
325						**MLE yields a negative mean**					Mean in Log Scale	-0.39
326											SD in Log Scale	1.271
327											Mean in Original Scale	2.166
328											SD in Original Scale	5.39
329											95% t UCL	3.971
330											95% Percentile Bootstrap UCL	4.131
331											95% BCA Bootstrap UCL	5.247
332											95% H-UCL	3.157
333												
334						**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**	
335						k star (bias corrected)	0.453				**Data do not follow a Discernable Distribution (0.05)**	
336						Theta Star	7.143					
337						nu star	14.49					
338												
339						A-D Test Statistic	1.535				**Nonparametric Statistics**	
340						5% A-D Critical Value	0.796				Kaplan-Meier (KM) Method	
341						K-S Test Statistic	0.796				Mean	2.137
342						5% K-S Critical Value	0.227				SD	5.294
343						**Data not Gamma Distributed at 5% Significance Level**					SE of Mean	1.073
344											95% KM (t) UCL	3.969
345						**Assuming Gamma Distribution**					95% KM (z) UCL	3.901
346						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	3.946
347						Minimum	0.000001				95% KM (bootstrap t) UCL	7.797
348						Maximum	27.1				95% KM (BCA) UCL	4.148
349						Mean	2.137				95% KM (Percentile Bootstrap) UCL	4.022
350						Median	0.359				95% KM (Chebyshev) UCL	6.812
351						SD	5.421				97.5% KM (Chebyshev) UCL	8.835
352						k star	0.161				99% KM (Chebyshev) UCL	12.81
353						Theta star	13.28					
354						Nu star	8.367				**Potential UCLs to Use**	
355						AppChi2	2.95				99% KM (Chebyshev) UCL	12.81
356						95% Gamma Approximate UCL	6.063					
357						95% Adjusted Gamma UCL	6.526					
358	**Note: DL/2 is not a recommended method.**											
359												
360						**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**					
361						**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**					
362						**For additional insight, the user may want to consult a statistician.**						
363												
364												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
365	**Benzo(k)fluoranthene**											
366												
367						**General Statistics**						
368					Number of Valid Data	26				Number of Detected Data		15
369					Number of Distinct Detected Data	15				Number of Non-Detect Data		11
370										Percent Non-Detects		42.31%
371												
372					**Raw Statistics**					**Log-transformed Statistics**		
373					Minimum Detected	0.088				Minimum Detected		-2.43
374					Maximum Detected	12.2				Maximum Detected		2.501
375					Mean of Detected	1.624				Mean of Detected		-0.369
376					SD of Detected	3.057				SD of Detected		1.215
377					Minimum Non-Detect	0.47				Minimum Non-Detect		-0.755
378					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
379												
380	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		24
381	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		2
382	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		92.31%
383												
384						**UCL Statistics**						
385					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
386					Shapiro Wilk Test Statistic	0.499				Shapiro Wilk Test Statistic		0.91
387					5% Shapiro Wilk Critical Value	0.881				5% Shapiro Wilk Critical Value		0.881
388					**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
389												
390					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
391					DL/2 Substitution Method					DL/2 Substitution Method		
392					Mean	1.182				Mean		-0.497
393					SD	2.354				SD		0.988
394					95% DL/2 (t) UCL	1.971				95% H-Stat (DL/2) UCL		1.62
395												
396					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
397					**MLE method failed to converge properly**					Mean in Log Scale		-0.654
398										SD in Log Scale		0.996
399										Mean in Original Scale		1.095
400										SD in Original Scale		2.374
401										95% t UCL		1.89
402										95% Percentile Bootstrap UCL		1.98
403										95% BCA Bootstrap UCL		2.459
404										95% H-UCL		1.406
405												
406					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
407					k star (bias corrected)	0.61				**Data appear Lognormal at 5% Significance Level**		
408					Theta Star	2.662						
409					nu star	18.3						
410												
411					A-D Test Statistic	1.316				**Nonparametric Statistics**		
412					5% A-D Critical Value	0.778				Kaplan-Meier (KM) Method		
413					K-S Test Statistic	0.778				Mean		1.094
414					5% K-S Critical Value	0.231				SD		2.331
415					**Data not Gamma Distributed at 5% Significance Level**					SE of Mean		0.474
416										95% KM (t) UCL		1.904
417					**Assuming Gamma Distribution**					95% KM (z) UCL		1.874
418					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		1.892
419					Minimum	0.000001				95% KM (bootstrap t) UCL		4.308
420					Maximum	12.2				95% KM (BCA) UCL		1.966
421					Mean	1.078				95% KM (Percentile Bootstrap) UCL		1.967
422					Median	0.368				95% KM (Chebyshev) UCL		3.161
423					SD	2.398				97.5% KM (Chebyshev) UCL		4.056
424					k star	0.207				99% KM (Chebyshev) UCL		5.813
425					Theta star	5.203						
426					Nu star	10.78				**Potential UCLs to Use**		
427					AppChi2	4.434				97.5% KM (Chebyshev) UCL		4.056
428					95% Gamma Approximate UCL	2.622						
429					95% Adjusted Gamma UCL	2.789						
430	**Note: DL/2 is not a recommended method.**											
431												
432					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
433					**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**							
434					**For additional insight, the user may want to consult a statistician.**							
435												
436												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
437	Chrysene											
438												
439						General Statistics						
440						Number of Valid Data	26				Number of Detected Data	9
441						Number of Distinct Detected Data	9				Number of Non-Detect Data	17
442											Percent Non-Detects	65.38%
443												
444					Raw Statistics					Log-transformed Statistics		
445						Minimum Detected	0.083				Minimum Detected	-2.489
446						Maximum Detected	26.2				Maximum Detected	3.266
447						Mean of Detected	5.264				Mean of Detected	0.459
448						SD of Detected	8.344				SD of Detected	1.86
449						Minimum Non-Detect	0.0937				Minimum Non-Detect	-2.368
450						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
451												
452	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	21
453	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	5
454	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	80.77%
455												
456						Warning: There are only 9 Detected Values in this data						
457						Note: It should be noted that even though bootstrap may be performed on this data set						
458						the resulting calculations may not be reliable enough to draw conclusions						
459												
460						It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.						
461												
462												
463						UCL Statistics						
464					Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only		
465						Shapiro Wilk Test Statistic	0.657				Shapiro Wilk Test Statistic	0.959
466						5% Shapiro Wilk Critical Value	0.829				5% Shapiro Wilk Critical Value	0.829
467						Data not Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level	
468												
469						Assuming Normal Distribution					Assuming Lognormal Distribution	
470						DL/2 Substitution Method					DL/2 Substitution Method	
471						Mean	2.088				Mean	-0.688
472						SD	5.282				SD	1.566
473						95% DL/2 (t) UCL	3.857				95% H-Stat (DL/2) UCL	4.842
474												
475						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
476						MLE yields a negative mean					Mean in Log Scale	-1.586
477											SD in Log Scale	1.921
478											Mean in Original Scale	1.88
479											SD in Original Scale	5.347
480											95% t UCL	3.671
481											95% Percentile Bootstrap UCL	3.781
482											95% BCA Bootstrap UCL	4.926
483											95% H-UCL	5.747
484												
485					Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only		
486						k star (bias corrected)	0.424			Data appear Gamma Distributed at 5% Significance Level		
487						Theta Star	12.42					
488						nu star	7.626					
489												
490						A-D Test Statistic	0.333			Nonparametric Statistics		
491						5% A-D Critical Value	0.769				Kaplan-Meier (KM) Method	
492						K-S Test Statistic	0.769				Mean	1.91
493						5% K-S Critical Value	0.294				SD	5.234
494						Data appear Gamma Distributed at 5% Significance Level					SE of Mean	1.089
495											95% KM (t) UCL	3.77
496						Assuming Gamma Distribution					95% KM (z) UCL	3.701
497						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	3.641
498						Minimum	0.000001				95% KM (bootstrap t) UCL	8.097
499						Maximum	26.2				95% KM (BCA) UCL	4.282
500						Mean	1.822				95% KM (Percentile Bootstrap) UCL	3.907
501						Median	0.000001				95% KM (Chebyshev) UCL	6.656
502						SD	5.367				97.5% KM (Chebyshev) UCL	8.71
503						k star	0.103				99% KM (Chebyshev) UCL	12.74
504						Theta star	17.73					
505						Nu star	5.343			Potential UCLs to Use		
506						AppChi2	1.314				95% KM (t) UCL	3.77
507						95% Gamma Approximate UCL	7.41					
508						95% Adjusted Gamma UCL	8.194					
509	Note: DL/2 is not a recommended method.											
510												
511						Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.						
512						These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).						
513						For additional insight, the user may want to consult a statistician.						
514												
515												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
516	**Dibenz(a,h)anthracene**											
517												
518						**General Statistics**						
519						Number of Valid Data	26				Number of Detected Data	9
520						Number of Distinct Detected Data	9				Number of Non-Detect Data	17
521											Percent Non-Detects	65.38%
522												
523						**Raw Statistics**					**Log-transformed Statistics**	
524						Minimum Detected	0.203				Minimum Detected	-1.596
525						Maximum Detected	4.88				Maximum Detected	1.585
526						Mean of Detected	1.029				Mean of Detected	-0.454
527						SD of Detected	1.467				SD of Detected	0.895
528						Minimum Non-Detect	0.225				Minimum Non-Detect	-1.492
529						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
530												
531	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	25
532	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	1
533	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	96.15%
534												
535						**Warning: There are only 9 Detected Values in this data**						
536						**Note: It should be noted that even though bootstrap may be performed on this data set**						
537						**the resulting calculations may not be reliable enough to draw conclusions**						
538												
539						**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**						
540												
541												
542						**UCL Statistics**						
543						**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**	
544						Shapiro Wilk Test Statistic	0.544				Shapiro Wilk Test Statistic	0.859
545						5% Shapiro Wilk Critical Value	0.829				5% Shapiro Wilk Critical Value	0.829
546						**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**	
547												
548						**Assuming Normal Distribution**					**Assuming Lognormal Distribution**	
549						DL/2 Substitution Method					DL/2 Substitution Method	
550						Mean	0.651				Mean	-0.848
551						SD	0.909				SD	0.856
552						95% DL/2 (t) UCL	0.956				95% H-Stat (DL/2) UCL	0.921
553												
554						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
555						**MLE method failed to converge properly**					Mean in Log Scale	-1.131
556											SD in Log Scale	0.781
557											Mean in Original Scale	0.516
558											SD in Original Scale	0.918
559											95% t UCL	0.823
560											95% Percentile Bootstrap UCL	0.855
561											95% BCA Bootstrap UCL	1.061
562											95% H-UCL	0.621
563												
564						**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**	
565						k star (bias corrected)	0.858				**Data appear Lognormal at 5% Significance Level**	
566						Theta Star	1.2					
567						nu star	15.44					
568												
569						A-D Test Statistic	1.089				**Nonparametric Statistics**	
570						5% A-D Critical Value	0.74				Kaplan-Meier (KM) Method	
571						K-S Test Statistic	0.74				Mean	0.558
572						5% K-S Critical Value	0.286				SD	0.896
573						**Data not Gamma Distributed at 5% Significance Level**					SE of Mean	0.19
574											95% KM (t) UCL	0.883
575						**Assuming Gamma Distribution**					95% KM (z) UCL	0.871
576						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	0.836
577						Minimum	0.000001				95% KM (bootstrap t) UCL	1.615
578						Maximum	4.88				95% KM (BCA) UCL	1.005
579						Mean	0.449				95% KM (Percentile Bootstrap) UCL	0.919
580						Median	0.162				95% KM (Chebyshev) UCL	1.387
581						SD	0.964				97.5% KM (Chebyshev) UCL	1.746
582						k star	0.151				99% KM (Chebyshev) UCL	2.451
583						Theta star	2.981					
584						Nu star	7.827				**Potential UCLs to Use**	
585						AppChi2	2.635				95% KM (t) UCL	0.883
586						95% Gamma Approximate UCL	1.333				95% KM (% Bootstrap) UCL	0.919
587						95% Adjusted Gamma UCL	1.439					
588	**Note: DL/2 is not a recommended method.**											
589												
590						**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**						
591						**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**						
592						**For additional insight, the user may want to consult a statistician.**						
593												
594												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A–E	F	G–K	L
595	**Indeno(1,2,3-c,d)pyrene**			
596				
597	**General Statistics**			
598	Number of Valid Data	26	Number of Detected Data	13
599	Number of Distinct Detected Data	13	Number of Non-Detect Data	13
600			Percent Non-Detects	50.00%
601				
602	**Raw Statistics**		**Log-transformed Statistics**	
603	Minimum Detected	0.087	Minimum Detected	-2.442
604	Maximum Detected	16.5	Maximum Detected	2.803
605	Mean of Detected	2.353	Mean of Detected	-0.0463
606	SD of Detected	4.417	SD of Detected	1.298
607	Minimum Non-Detect	0.234	Minimum Non-Detect	-1.452
608	Maximum Non-Detect	2.1	Maximum Non-Detect	0.742
609				
610	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	23
611	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
612	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	88.46%
613				
614	**UCL Statistics**			
615	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
616	Shapiro Wilk Test Statistic	0.513	Shapiro Wilk Test Statistic	0.94
617	5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
618	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
619				
620	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
621	DL/2 Substitution Method		DL/2 Substitution Method	
622	Mean	1.431	Mean	-0.472
623	SD	3.209	SD	1.126
624	95% DL/2 (t) UCL	2.506	95% H-Stat (DL/2) UCL	2.148
625				
626	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
627	**MLE yields a negative mean**		Mean in Log Scale	-0.716
628			SD in Log Scale	1.217
629			Mean in Original Scale	1.329
630			SD in Original Scale	3.237
631			95% t UCL	2.414
632			95% Percentile Bootstrap UCL	2.474
633			95% BCA Bootstrap UCL	3.568
634			95% H-UCL	2.027
635				
636	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
637	k star (bias corrected)	0.569	**Data appear Lognormal at 5% Significance Level**	
638	Theta Star	4.133		
639	nu star	14.8		
640				
641	A-D Test Statistic	1.024	**Nonparametric Statistics**	
642	5% A-D Critical Value	0.776	Kaplan-Meier (KM) Method	
643	K-S Test Statistic	0.776	Mean	1.361
644	5% K-S Critical Value	0.247	SD	3.17
645	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.649
646			95% KM (t) UCL	2.47
647	**Assuming Gamma Distribution**		95% KM (z) UCL	2.429
648	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.401
649	Minimum	0.000001	95% KM (bootstrap t) UCL	5.898
650	Maximum	16.5	95% KM (BCA) UCL	2.695
651	Mean	1.293	95% KM (Percentile Bootstrap) UCL	2.628
652	Median	0.425	95% KM (Chebyshev) UCL	4.191
653	SD	3.273	97.5% KM (Chebyshev) UCL	5.416
654	k star	0.14	99% KM (Chebyshev) UCL	7.822
655	Theta star	9.264		
656	Nu star	7.257	**Potential UCLs to Use**	
657	AppChi2	2.313	95% KM (BCA) UCL	2.695
658	95% Gamma Approximate UCL	4.057		
659	95% Adjusted Gamma UCL	4.399		
660	**Note: DL/2 is not a recommended method.**			
661				
662	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
663	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
664	**For additional insight, the user may want to consult a statistician.**			
665				
666				

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
667	**Iron**											
668												
669					**General Statistics**							
670					Number of Valid Observations	14				Number of Distinct Observations		13
671												
672					**Raw Statistics**					**Log-transformed Statistics**		
673					Minimum	5520				Minimum of Log Data		8.616
674					Maximum	30900				Maximum of Log Data		10.34
675					Mean	17168				Mean of log Data		9.645
676					Median	14000				SD of log Data		0.495
677					SD	7832						
678					Std. Error of Mean	2093						
679					Coefficient of Variation	0.456						
680					Skewness	0.454						
681												
682					**Relevant UCL Statistics**							
683					**Normal Distribution Test**					**Lognormal Distribution Test**		
684					Shapiro Wilk Test Statistic	0.933				Shapiro Wilk Test Statistic		0.949
685					Shapiro Wilk Critical Value	0.874				Shapiro Wilk Critical Value		0.874
686					**Data appear Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
687												
688					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
689					95% Student's-t UCL	20875				95% H-UCL		23006
690					**95% UCLs (Adjusted for Skewness)**					95% Chebyshev (MVUE) UCL		27545
691					95% Adjusted-CLT UCL (Chen-1995)	20882				97.5% Chebyshev (MVUE) UCL		31983
692					95% Modified-t UCL (Johnson-1978)	20917				99% Chebyshev (MVUE) UCL		40698
693												
694					**Gamma Distribution Test**					**Data Distribution**		
695					k star (bias corrected)	3.882				**Data appear Normal at 5% Significance Level**		
696					Theta Star	4422						
697					MLE of Mean	17168						
698					MLE of Standard Deviation	8713						
699					nu star	108.7						
700					Approximate Chi Square Value (.05)	85.64				**Nonparametric Statistics**		
701					Adjusted Level of Significance	0.0312				95% CLT UCL		20611
702					Adjusted Chi Square Value	82.93				95% Jackknife UCL		20875
703										95% Standard Bootstrap UCL		20504
704					Anderson-Darling Test Statistic	0.334				95% Bootstrap-t UCL		21315
705					Anderson-Darling 5% Critical Value	0.738				95% Hall's Bootstrap UCL		20874
706					Kolmogorov-Smirnov Test Statistic	0.166				95% Percentile Bootstrap UCL		20539
707					Kolmogorov-Smirnov 5% Critical Value	0.229				95% BCA Bootstrap UCL		20971
708					**Data appear Gamma Distributed at 5% Significance Level**					95% Chebyshev(Mean, Sd) UCL		26292
709										97.5% Chebyshev(Mean, Sd) UCL		30240
710					**Assuming Gamma Distribution**					99% Chebyshev(Mean, Sd) UCL		37996
711					95% Approximate Gamma UCL	21791						
712					95% Adjusted Gamma UCL	22504						
713												
714					**Potential UCL to Use**					Use 95% Student's-t UCL		20875
715												
716	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
717	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
718	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
719												
720												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
721	**Lead**											
722												
723	**General Statistics**											
724	Number of Valid Observations					35	Number of Distinct Observations					34
725												
726	**Raw Statistics**						**Log-transformed Statistics**					
727	Minimum					10.77	Minimum of Log Data					2.377
728	Maximum					84700	Maximum of Log Data					11.35
729	Mean					5883	Mean of log Data					5.604
730	Median					161	SD of log Data					2.2
731	SD					18282						
732	Std. Error of Mean					3090						
733	Coefficient of Variation					3.107						
734	Skewness					3.466						
735												
736	**Relevant UCL Statistics**											
737	**Normal Distribution Test**						**Lognormal Distribution Test**					
738	Shapiro Wilk Test Statistic					0.369	Shapiro Wilk Test Statistic					0.886
739	Shapiro Wilk Critical Value					0.934	Shapiro Wilk Critical Value					0.934
740	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
741												
742	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
743	95% Student's-t UCL					11109	95% H-UCL					14907
744	**95% UCLs (Adjusted for Skewness)**						95% Chebyshev (MVUE) UCL					8183
745	95% Adjusted-CLT UCL (Chen-1995)					12901	97.5% Chebyshev (MVUE) UCL					10645
746	95% Modified-t UCL (Johnson-1978)					11411	99% Chebyshev (MVUE) UCL					15480
747												
748	**Gamma Distribution Test**						**Data Distribution**					
749	k star (bias corrected)					0.233	**Data do not follow a Discernable Distribution (0.05)**					
750	Theta Star					25303						
751	MLE of Mean					5883						
752	MLE of Standard Deviation					12201						
753	nu star					16.28						
754	Approximate Chi Square Value (.05)					8.157	**Nonparametric Statistics**					
755	Adjusted Level of Significance					0.0425	95% CLT UCL					10966
756	Adjusted Chi Square Value					7.885	95% Jackknife UCL					11109
757							95% Standard Bootstrap UCL					10904
758	Anderson-Darling Test Statistic					5.239	95% Bootstrap-t UCL					15848
759	Anderson-Darling 5% Critical Value					0.885	95% Hall's Bootstrap UCL					10422
760	Kolmogorov-Smirnov Test Statistic					0.318	95% Percentile Bootstrap UCL					11560
761	Kolmogorov-Smirnov 5% Critical Value					0.164	95% BCA Bootstrap UCL					13708
762	**Data not Gamma Distributed at 5% Significance Level**						95% Chebyshev(Mean, Sd) UCL					19353
763							97.5% Chebyshev(Mean, Sd) UCL					25182
764	**Assuming Gamma Distribution**						99% Chebyshev(Mean, Sd) UCL					36631
765	95% Approximate Gamma UCL					11739						
766	95% Adjusted Gamma UCL					12145						
767												
768	**Potential UCL to Use**						Use 97.5% Chebyshev (Mean, Sd) UCL					25182
769												
770	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
771	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
772	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
773												
774												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
775	**Copper**											
776												
777					**General Statistics**							
778					Number of Valid Observations	14				Number of Distinct Observations		14
779												
780					**Raw Statistics**					**Log-transformed Statistics**		
781					Minimum	17.4				Minimum of Log Data		2.856
782					Maximum	71.2				Maximum of Log Data		4.265
783					Mean	47.65				Mean of log Data		3.785
784					Median	47.5				SD of log Data		0.432
785					SD	18.17						
786					Std. Error of Mean	4.855						
787					Coefficient of Variation	0.381						
788					Skewness	-0.11						
789												
790					**Relevant UCL Statistics**							
791					**Normal Distribution Test**					**Lognormal Distribution Test**		
792					Shapiro Wilk Test Statistic	0.9				Shapiro Wilk Test Statistic		0.895
793					Shapiro Wilk Critical Value	0.874				Shapiro Wilk Critical Value		0.874
794					**Data appear Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
795												
796					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
797					95% Student's-t UCL	56.25				95% H-UCL		61.41
798					**95% UCLs (Adjusted for Skewness)**					95% Chebyshev (MVUE) UCL		72.65
799					95% Adjusted-CLT UCL (Chen-1995)	55.49				97.5% Chebyshev (MVUE) UCL		83.32
800					95% Modified-t UCL (Johnson-1978)	56.23				99% Chebyshev (MVUE) UCL		104.3
801												
802					**Gamma Distribution Test**					**Data Distribution**		
803					k star (bias corrected)	5.144				**Data appear Normal at 5% Significance Level**		
804					Theta Star	9.264						
805					MLE of Mean	47.65						
806					MLE of Standard Deviation	21.01						
807					nu star	144						
808					Approximate Chi Square Value (.05)	117.3				**Nonparametric Statistics**		
809					Adjusted Level of Significance	0.0312				95% CLT UCL		55.64
810					Adjusted Chi Square Value	114.1				95% Jackknife UCL		56.25
811										95% Standard Bootstrap UCL		55.42
812					Anderson-Darling Test Statistic	0.647				95% Bootstrap-t UCL		55.98
813					Anderson-Darling 5% Critical Value	0.737				95% Hall's Bootstrap UCL		55.31
814					Kolmogorov-Smirnov Test Statistic	0.222				95% Percentile Bootstrap UCL		55.34
815					Kolmogorov-Smirnov 5% Critical Value	0.229				95% BCA Bootstrap UCL		55.03
816					**Data appear Gamma Distributed at 5% Significance Level**					95% Chebyshev(Mean, Sd) UCL		68.82
817										97.5% Chebyshev(Mean, Sd) UCL		77.97
818					**Assuming Gamma Distribution**					99% Chebyshev(Mean, Sd) UCL		95.96
819					95% Approximate Gamma UCL	58.51						
820					95% Adjusted Gamma UCL	60.16						
821												
822					**Potential UCL to Use**					Use 95% Student's-t UCL		56.25
823												
824					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
825					**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**							
826					**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**							
827												
828					**Note: For highly negative-skewed data, confidence limits**							
829					**(e.g., Chen, Johnson, Lognormal, and Gamma) may not be**							
830					**reliable. Chen's and Johnson's methods provide**							
831					**adjustments for positvely skewed data sets.**							
832												
833												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
834	Zinc											
835												
836					**General Statistics**							
837					Number of Valid Observations	14				Number of Distinct Observations		14
838												
839					**Raw Statistics**					**Log-transformed Statistics**		
840					Minimum	23.5				Minimum of Log Data		3.157
841					Maximum	154.5				Maximum of Log Data		5.04
842					Mean	77.75				Mean of log Data		4.271
843					Median	73.05				SD of log Data		0.44
844					SD	32.02						
845					Std. Error of Mean	8.557						
846					Coefficient of Variation	0.412						
847					Skewness	0.975						
848												
849					**Relevant UCL Statistics**							
850					**Normal Distribution Test**					**Lognormal Distribution Test**		
851					Shapiro Wilk Test Statistic	0.923				Shapiro Wilk Test Statistic		0.925
852					Shapiro Wilk Critical Value	0.874				Shapiro Wilk Critical Value		0.874
853					**Data appear Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
854												
855					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
856					95% Student's-t UCL	92.9				95% H-UCL		100.7
857					**95% UCLs (Adjusted for Skewness)**					95% Chebyshev (MVUE) UCL		119.3
858					95% Adjusted-CLT UCL (Chen-1995)	94.2				97.5% Chebyshev (MVUE) UCL		137.1
859					95% Modified-t UCL (Johnson-1978)	93.27				99% Chebyshev (MVUE) UCL		172
860												
861					**Gamma Distribution Test**					**Data Distribution**		
862					k star (bias corrected)	4.938				**Data appear Normal at 5% Significance Level**		
863					Theta Star	15.74						
864					MLE of Mean	77.75						
865					MLE of Standard Deviation	34.99						
866					nu star	138.3						
867					Approximate Chi Square Value (.05)	112.1				**Nonparametric Statistics**		
868					Adjusted Level of Significance	0.0312				95% CLT UCL		91.82
869					Adjusted Chi Square Value	109				95% Jackknife UCL		92.9
870										95% Standard Bootstrap UCL		91.13
871					Anderson-Darling Test Statistic	0.366				95% Bootstrap-t UCL		96.09
872					Anderson-Darling 5% Critical Value	0.737				95% Hall's Bootstrap UCL		106.1
873					Kolmogorov-Smirnov Test Statistic	0.145				95% Percentile Bootstrap UCL		92.3
874					Kolmogorov-Smirnov 5% Critical Value	0.229				95% BCA Bootstrap UCL		93.76
875					**Data appear Gamma Distributed at 5% Significance Level**					95% Chebyshev(Mean, Sd) UCL		115
876										97.5% Chebyshev(Mean, Sd) UCL		131.2
877					**Assuming Gamma Distribution**					99% Chebyshev(Mean, Sd) UCL		162.9
878					95% Approximate Gamma UCL	95.9						
879					95% Adjusted Gamma UCL	98.65						
880												
881					**Potential UCL to Use**					Use 95% Student's-t UCL		92.9
882												
883					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
884					**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**							
885					**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**							
886												
887												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
888	2-Methylnaphthalene											
889												
890						General Statistics						
891					Number of Valid Data	13				Number of Detected Data		7
892					Number of Distinct Detected Data	7				Number of Non-Detect Data		6
893										Percent Non-Detects		46.15%
894												
895					Raw Statistics					Log-transformed Statistics		
896					Minimum Detected	0.0599				Minimum Detected		-2.815
897					Maximum Detected	0.436				Maximum Detected		-0.83
898					Mean of Detected	0.196				Mean of Detected		-1.844
899					SD of Detected	0.134				SD of Detected		0.723
900					Minimum Non-Detect	0.195				Minimum Non-Detect		-1.635
901					Maximum Non-Detect	0.993				Maximum Non-Detect		-0.00702
902												
903	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		13
904	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		0
905	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		100.00%
906												
907					Warning: There are only 7 Detected Values in this data							
908					Note: It should be noted that even though bootstrap may be performed on this data set							
909					the resulting calculations may not be reliable enough to draw conclusions							
910												
911					It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.							
912												
913												
914						UCL Statistics						
915					Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only		
916					Shapiro Wilk Test Statistic	0.914				Shapiro Wilk Test Statistic		0.963
917					5% Shapiro Wilk Critical Value	0.803				5% Shapiro Wilk Critical Value		0.803
918					Data appear Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level		
919												
920					Assuming Normal Distribution					Assuming Lognormal Distribution		
921					DL/2 Substitution Method					DL/2 Substitution Method		
922					Mean	0.191				Mean		-1.862
923					SD	0.138				SD		0.65
924					95% DL/2 (t) UCL	0.259				95% H-Stat (DL/2) UCL		0.295
925												
926					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
927					MLE method failed to converge properly					Mean in Log Scale		-2.008
928										SD in Log Scale		0.548
929										Mean in Original Scale		0.157
930										SD in Original Scale		0.105
931										95% t UCL		0.209
932										95% Percentile Bootstrap UCL		0.207
933										95% BCA Bootstrap UCL		0.225
934										95% H-UCL		0.22
935												
936					Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only		
937					k star (bias corrected)	1.525				Data appear Normal at 5% Significance Level		
938					Theta Star	0.128						
939					nu star	21.35						
940												
941					A-D Test Statistic	0.202				Nonparametric Statistics		
942					5% A-D Critical Value	0.714				Kaplan-Meier (KM) Method		
943					K-S Test Statistic	0.714				Mean		0.164
944					5% K-S Critical Value	0.314				SD		0.109
945					Data appear Gamma Distributed at 5% Significance Level					SE of Mean		0.0371
946										95% KM (t) UCL		0.23
947					Assuming Gamma Distribution					95% KM (z) UCL		0.225
948					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		0.231
949					Minimum	0.0599				95% KM (bootstrap t) UCL		0.25
950					Maximum	0.436				95% KM (BCA) UCL		0.223
951					Mean	0.17				95% KM (Percentile Bootstrap) UCL		0.224
952					Median	0.14				95% KM (Chebyshev) UCL		0.326
953					SD	0.1				97.5% KM (Chebyshev) UCL		0.396
954					k star	3.055				99% KM (Chebyshev) UCL		0.533
955					Theta star	0.0558						
956					Nu star	79.43				Potential UCLs to Use		
957					AppChi2	59.9				95% KM (t) UCL		0.23
958					95% Gamma Approximate UCL	0.226				95% KM (Percentile Bootstrap) UCL		0.224
959					95% Adjusted Gamma UCL	0.235						
960	Note: DL/2 is not a recommended method.											
961												
962					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
963					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
964					For additional insight, the user may want to consult a statistician.							
965												
966												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
967	**Acenaphthene**											
968												
969						**General Statistics**						
970						Number of Valid Data	26				Number of Detected Data	5
971						Number of Distinct Detected Data	5				Number of Non-Detect Data	21
972											Percent Non-Detects	80.77%
973												
974					**Raw Statistics**					**Log-transformed Statistics**		
975						Minimum Detected	0.0825				Minimum Detected	-2.496
976						Maximum Detected	3.79				Maximum Detected	1.332
977						Mean of Detected	1.082				Mean of Detected	-0.741
978						SD of Detected	1.544				SD of Detected	1.465
979						Minimum Non-Detect	0.225				Minimum Non-Detect	-1.492
980						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
981												
982	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	25
983	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	1
984	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	96.15%
985												
986						**Warning: There are only 5 Detected Values in this data**						
987						**Note: It should be noted that even though bootstrap may be performed on this data set**						
988						**the resulting calculations may not be reliable enough to draw conclusions**						
989												
990						**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**						
991												
992												
993						**UCL Statistics**						
994					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
995						Shapiro Wilk Test Statistic	0.724				Shapiro Wilk Test Statistic	0.987
996						5% Shapiro Wilk Critical Value	0.762				5% Shapiro Wilk Critical Value	0.762
997						**Data not Normal at 5% Significance Level**				**Data appear Lognormal at 5% Significance Level**		
998												
999					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
1000						DL/2 Substitution Method					DL/2 Substitution Method	
1001						Mean	0.512				Mean	-1.164
1002						SD	0.73				SD	0.928
1003						95% DL/2 (t) UCL	0.757				95% H-Stat (DL/2) UCL	0.753
1004												
1005						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
1006						**MLE method failed to converge properly**					Mean in Log Scale	-1.821
1007											SD in Log Scale	0.85
1008											Mean in Original Scale	0.315
1009											SD in Original Scale	0.728
1010											95% t UCL	0.559
1011											95% Percentile Bootstrap UCL	0.593
1012											95% BCA Bootstrap UCL	0.759
1013											95% H-UCL	0.345
1014												
1015					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
1016						k star (bias corrected)	0.426			**Data appear Gamma Distributed at 5% Significance Level**		
1017						Theta Star	2.537					
1018						nu star	4.264					
1019												
1020						A-D Test Statistic	0.301			**Nonparametric Statistics**		
1021						5% A-D Critical Value	0.699			Kaplan-Meier (KM) Method		
1022						K-S Test Statistic	0.699				Mean	0.338
1023						5% K-S Critical Value	0.367				SD	0.715
1024					**Data appear Gamma Distributed at 5% Significance Level**						SE of Mean	0.163
1025											95% KM (t) UCL	0.616
1026					**Assuming Gamma Distribution**						95% KM (z) UCL	0.606
1027						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	0.607
1028						Minimum	0.000001				95% KM (bootstrap t) UCL	0.974
1029						Maximum	3.79				95% KM (BCA) UCL	1.207
1030						Mean	0.26				95% KM (Percentile Bootstrap) UCL	0.858
1031						Median	0.000001				95% KM (Chebyshev) UCL	1.047
1032						SD	0.762				97.5% KM (Chebyshev) UCL	1.354
1033						k star	0.118				99% KM (Chebyshev) UCL	1.957
1034						Theta star	2.212					
1035						Nu star	6.121			**Potential UCLs to Use**		
1036						AppChi2	1.702				95% KM (t) UCL	0.616
1037						95% Gamma Approximate UCL	0.936					
1038						95% Adjusted Gamma UCL	1.026					
1039	**Note: DL/2 is not a recommended method.**											
1040												
1041						**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**						
1042						**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**						
1043						**For additional insight, the user may want to consult a statistician.**						
1044												
1045												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1046	**Acenaphthylene**											
1047												
1048						**General Statistics**						
1049					Number of Valid Data	26				Number of Detected Data		2
1050					Number of Distinct Detected Data	2				Number of Non-Detect Data		24
1051										Percent Non-Detects		92.31%
1052												
1053					**Raw Statistics**					**Log-transformed Statistics**		
1054					Minimum Detected	0.153				Minimum Detected		-1.877
1055					Maximum Detected	0.253				Maximum Detected		-1.374
1056					Mean of Detected	0.203				Mean of Detected		-1.626
1057					SD of Detected	0.0707				SD of Detected		0.356
1058					Minimum Non-Detect	0.225				Minimum Non-Detect		-1.492
1059					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1060												
1061	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		26
1062	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		0
1063	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		100.00%
1064												
1065	**Warning: Data set has only 2 Distinct Detected Values.**											
1066	**This may not be adequate enough to compute meaningful and reliable test statistics and estimates.**											
1067	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1068												
1069	**Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.**											
1070												
1071	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
1072	**Those methods will return a 'N/A' value on your output display!**											
1073												
1074	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
1075	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
1076	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
1077												
1078												
1079						**UCL Statistics**						
1080					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
1081					Shapiro Wilk Test Statistic	N/A				Shapiro Wilk Test Statistic		N/A
1082					5% Shapiro Wilk Critical Value	N/A				5% Shapiro Wilk Critical Value		N/A
1083					**Data not Normal at 5% Significance Level**					**Data not Lognormal at 5% Significance Level**		
1084												
1085					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
1086					DL/2 Substitution Method					DL/2 Substitution Method		
1087					Mean	0.374				Mean		-1.244
1088					SD	0.278				SD		0.736
1089					95% DL/2 (t) UCL	0.468				95% H-Stat (DL/2) UCL		0.522
1090												
1091					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
1092					**MLE method failed to converge properly**					Mean in Log Scale		N/A
1093										SD in Log Scale		N/A
1094										Mean in Original Scale		N/A
1095										SD in Original Scale		N/A
1096										95% t UCL		N/A
1097										95% Percentile Bootstrap UCL		N/A
1098										95% BCA Bootstrap UCL		N/A
1099										95% H-UCL		N/A
1100												
1101					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
1102					k star (bias corrected)	N/A				**Data do not follow a Discernable Distribution (0.05)**		
1103					Theta Star	N/A						
1104					nu star	N/A						
1105												
1106					A-D Test Statistic	N/A				**Nonparametric Statistics**		
1107					5% A-D Critical Value	N/A				Kaplan-Meier (KM) Method		
1108					K-S Test Statistic	N/A				Mean		0.167
1109					5% K-S Critical Value	N/A				SD		0.035
1110					**Data not Gamma Distributed at 5% Significance Level**					SE of Mean		0.0187
1111										95% KM (t) UCL		0.199
1112					**Assuming Gamma Distribution**					95% KM (z) UCL		0.198
1113					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		0.23
1114					Minimum	N/A				95% KM (bootstrap t) UCL		N/A
1115					Maximum	N/A				95% KM (BCA) UCL		N/A
1116					Mean	N/A				95% KM (Percentile Bootstrap) UCL		0.253
1117					Median	N/A				95% KM (Chebyshev) UCL		0.249
1118					SD	N/A				97.5% KM (Chebyshev) UCL		0.284
1119					k star	N/A				99% KM (Chebyshev) UCL		0.353
1120					Theta star	N/A						
1121					Nu star	N/A				**Potential UCLs to Use**		
1122					AppChi2	N/A				95% KM (t) UCL		0.199
1123					95% Gamma Approximate UCL	N/A				95% KM (% Bootstrap) UCL		0.253
1124					95% Adjusted Gamma UCL	N/A						
1125	**Note: DL/2 is not a recommended method.**											
1126												
1127	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1128	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1129	**For additional insight, the user may want to consult a statistician.**											
1130												
1131												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1132	**Anthracene**											
1133												
1134					**General Statistics**							
1135					Number of Valid Data	26				Number of Detected Data		7
1136					Number of Distinct Detected Data	7				Number of Non-Detect Data		19
1137										Percent Non-Detects		73.08%
1138												
1139				**Raw Statistics**					**Log-transformed Statistics**			
1140					Minimum Detected	0.083				Minimum Detected		-2.489
1141					Maximum Detected	7.88				Maximum Detected		2.064
1142					Mean of Detected	1.658				Mean of Detected		-0.511
1143					SD of Detected	2.781				SD of Detected		1.581
1144					Minimum Non-Detect	0.225				Minimum Non-Detect		-1.492
1145					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1146												
1147	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		25
1148	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		1
1149	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		96.15%
1150												
1151					**Warning: There are only 7 Detected Values in this data**							
1152					**Note: It should be noted that even though bootstrap may be performed on this data set**							
1153					**the resulting calculations may not be reliable enough to draw conclusions**							
1154												
1155					**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**							
1156												
1157												
1158					**UCL Statistics**							
1159				**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**			
1160					Shapiro Wilk Test Statistic	0.604				Shapiro Wilk Test Statistic		0.933
1161					5% Shapiro Wilk Critical Value	0.803				5% Shapiro Wilk Critical Value		0.803
1162				**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**			
1163												
1164				**Assuming Normal Distribution**					**Assuming Lognormal Distribution**			
1165					DL/2 Substitution Method					DL/2 Substitution Method		
1166					Mean	0.738				Mean		-1.021
1167					SD	1.499				SD		1.07
1168					95% DL/2 (t) UCL	1.24				95% H-Stat (DL/2) UCL		1.115
1169												
1170					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
1171				**MLE method failed to converge properly**						Mean in Log Scale		-1.73
1172										SD in Log Scale		1.155
1173										Mean in Original Scale		0.541
1174										SD in Original Scale		1.53
1175										95% t UCL		1.053
1176										95% Percentile Bootstrap UCL		1.109
1177										95% BCA Bootstrap UCL		1.451
1178										95% H-UCL		0.646
1179												
1180				**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**			
1181					k star (bias corrected)	0.442			**Data appear Gamma Distributed at 5% Significance Level**			
1182					Theta Star	3.751						
1183					nu star	6.187						
1184												
1185					A-D Test Statistic	0.473			**Nonparametric Statistics**			
1186					5% A-D Critical Value	0.745				Kaplan-Meier (KM) Method		
1187					K-S Test Statistic	0.745				Mean		0.571
1188					5% K-S Critical Value	0.325				SD		1.504
1189				**Data appear Gamma Distributed at 5% Significance Level**						SE of Mean		0.323
1190										95% KM (t) UCL		1.122
1191				**Assuming Gamma Distribution**						95% KM (z) UCL		1.101
1192					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		1.092
1193					Minimum	0.000001				95% KM (bootstrap t) UCL		2.298
1194					Maximum	7.88				95% KM (BCA) UCL		1.472
1195					Mean	0.516				95% KM (Percentile Bootstrap) UCL		1.252
1196					Median	0.000001				95% KM (Chebyshev) UCL		1.977
1197					SD	1.556				97.5% KM (Chebyshev) UCL		2.585
1198					k star	0.11				99% KM (Chebyshev) UCL		3.78
1199					Theta star	4.672						
1200					Nu star	5.741			**Potential UCLs to Use**			
1201					AppChi2	1.509				95% KM (t) UCL		1.122
1202					95% Gamma Approximate UCL	1.962						
1203					95% Adjusted Gamma UCL	2.159						
1204	**Note: DL/2 is not a recommended method.**											
1205												
1206				**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**								
1207				**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**								
1208				**For additional insight, the user may want to consult a statistician.**								
1209												
1210												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1211	**Benzo(g,h,i)perylene**											
1212												
1213						**General Statistics**						
1214						Number of Valid Data	26				Number of Detected Data	7
1215						Number of Distinct Detected Data	7				Number of Non-Detect Data	19
1216											Percent Non-Detects	73.08%
1217												
1218						**Raw Statistics**					**Log-transformed Statistics**	
1219						Minimum Detected	0.12				Minimum Detected	-2.12
1220						Maximum Detected	14.2				Maximum Detected	2.653
1221						Mean of Detected	3.585				Mean of Detected	0.495
1222						SD of Detected	4.914				SD of Detected	1.484
1223						Minimum Non-Detect	0.244				Minimum Non-Detect	-1.411
1224						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
1225												
1226						Note: Data have multiple DLs - Use of KM Method is recommended					Number treated as Non-Detect	23
1227						For all methods (except KM, DL/2, and ROS Methods),					Number treated as Detected	3
1228						Observations < Largest ND are treated as NDs					Single DL Non-Detect Percentage	88.46%
1229												
1230						**Warning: There are only 7 Detected Values in this data**						
1231						**Note: It should be noted that even though bootstrap may be performed on this data set**						
1232						**the resulting calculations may not be reliable enough to draw conclusions**						
1233												
1234						**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**						
1235												
1236												
1237						**UCL Statistics**						
1238						**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**	
1239						Shapiro Wilk Test Statistic	0.706				Shapiro Wilk Test Statistic	0.964
1240						5% Shapiro Wilk Critical Value	0.803				5% Shapiro Wilk Critical Value	0.803
1241						**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**	
1242												
1243						**Assuming Normal Distribution**					**Assuming Lognormal Distribution**	
1244						DL/2 Substitution Method					DL/2 Substitution Method	
1245						Mean	1.274				Mean	-0.652
1246						SD	2.811				SD	1.164
1247						95% DL/2 (t) UCL	2.216				95% H-Stat (DL/2) UCL	1.935
1248												
1249						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
1250						**MLE yields a negative mean**					Mean in Log Scale	-1.442
1251											SD in Log Scale	1.461
1252											Mean in Original Scale	1.061
1253											SD in Original Scale	2.871
1254											95% t UCL	2.023
1255											95% Percentile Bootstrap UCL	2.102
1256											95% BCA Bootstrap UCL	2.699
1257											95% H-UCL	1.727
1258												
1259						**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**	
1260						k star (bias corrected)	0.532				**Data appear Gamma Distributed at 5% Significance Level**	
1261						Theta Star	6.743					
1262						nu star	7.443					
1263												
1264						A-D Test Statistic	0.29				**Nonparametric Statistics**	
1265						5% A-D Critical Value	0.736				Kaplan-Meier (KM) Method	
1266						K-S Test Statistic	0.736				Mean	1.091
1267						5% K-S Critical Value	0.322				SD	2.811
1268						**Data appear Gamma Distributed at 5% Significance Level**					SE of Mean	0.597
1269											95% KM (t) UCL	2.111
1270						**Assuming Gamma Distribution**					95% KM (z) UCL	2.073
1271						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	1.936
1272						Minimum	0.000001				95% KM (bootstrap t) UCL	4.024
1273						Maximum	14.2				95% KM (BCA) UCL	3.001
1274						Mean	0.987				95% KM (Percentile Bootstrap) UCL	2.563
1275						Median	0.000001				95% KM (Chebyshev) UCL	3.694
1276						SD	2.897				97.5% KM (Chebyshev) UCL	4.82
1277						k star	0.103				99% KM (Chebyshev) UCL	7.032
1278						Theta star	9.583					
1279						Nu star	5.356				**Potential UCLs to Use**	
1280						AppChi2	1.32				95% KM (t) UCL	2.111
1281						95% Gamma Approximate UCL	4.005					
1282						95% Adjusted Gamma UCL	4.428					
1283	**Note: DL/2 is not a recommended method.**											
1284												
1285						**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**						
1286						**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**						
1287						**For additional insight, the user may want to consult a statistician.**						
1288												
1289												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1290	**Fluoranthene**											
1291												
1292					**General Statistics**							
1293					Number of Valid Data	26				Number of Detected Data		16
1294					Number of Distinct Detected Data	16				Number of Non-Detect Data		10
1295										Percent Non-Detects		38.46%
1296												
1297					**Raw Statistics**					**Log-transformed Statistics**		
1298					Minimum Detected	0.076				Minimum Detected		-2.577
1299					Maximum Detected	38.4				Maximum Detected		3.648
1300					Mean of Detected	4.131				Mean of Detected		-0.28
1301					SD of Detected	9.577				SD of Detected		1.816
1302					Minimum Non-Detect	0.47				Minimum Non-Detect		-0.755
1303					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1304												
1305	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		22
1306	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		4
1307	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		84.62%
1308												
1309					**UCL Statistics**							
1310					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
1311					Shapiro Wilk Test Statistic	0.467				Shapiro Wilk Test Statistic		0.904
1312					5% Shapiro Wilk Critical Value	0.887				5% Shapiro Wilk Critical Value		0.887
1313					**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
1314												
1315					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
1316					DL/2 Substitution Method					DL/2 Substitution Method		
1317					Mean	2.778				Mean		-0.404
1318					SD	7.623				SD		1.452
1319					95% DL/2 (t) UCL	5.332				95% H-Stat (DL/2) UCL		4.766
1320												
1321					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
1322					**MLE method failed to converge properly**					Mean in Log Scale		-0.638
1323										SD in Log Scale		1.525
1324										Mean in Original Scale		2.68
1325										SD in Original Scale		7.653
1326										95% t UCL		5.243
1327										95% Percentile Bootstrap UCL		5.365
1328										95% BCA Bootstrap UCL		7.248
1329										95% H-UCL		4.566
1330												
1331					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
1332					k star (bias corrected)	0.358				**Data appear Lognormal at 5% Significance Level**		
1333					Theta Star	11.55						
1334					nu star	11.45						
1335												
1336					A-D Test Statistic	1.484				**Nonparametric Statistics**		
1337					5% A-D Critical Value	0.819				Kaplan-Meier (KM) Method		
1338					K-S Test Statistic	0.819				Mean		2.675
1339					5% K-S Critical Value	0.23				SD		7.506
1340					**Data not Gamma Distributed at 5% Significance Level**					SE of Mean		1.521
1341										95% KM (t) UCL		5.273
1342					**Assuming Gamma Distribution**					95% KM (z) UCL		5.177
1343					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		5.241
1344					Minimum	0.000001				95% KM (bootstrap t) UCL		13
1345					Maximum	38.4				95% KM (BCA) UCL		5.572
1346					Mean	2.711				95% KM (Percentile Bootstrap) UCL		5.433
1347					Median	0.272				95% KM (Chebyshev) UCL		9.305
1348					SD	7.665				97.5% KM (Chebyshev) UCL		12.17
1349					k star	0.153				99% KM (Chebyshev) UCL		17.81
1350					Theta star	17.71						
1351					Nu star	7.961				**Potential UCLs to Use**		
1352					AppChi2	2.712				99% KM (Chebyshev) UCL		17.81
1353					95% Gamma Approximate UCL	7.957						
1354					95% Adjusted Gamma UCL	8.586						
1355	**Note: DL/2 is not a recommended method.**											
1356												
1357	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1358	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1359	**For additional insight, the user may want to consult a statistician.**											
1360												
1361												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1362	**Fluorene**											
1363												
1364						**General Statistics**						
1365					Number of Valid Data	26				Number of Detected Data		7
1366					Number of Distinct Detected Data	7				Number of Non-Detect Data		19
1367										Percent Non-Detects		73.08%
1368												
1369				**Raw Statistics**						**Log-transformed Statistics**		
1370					Minimum Detected	0.073				Minimum Detected		-2.617
1371					Maximum Detected	3.7				Maximum Detected		1.308
1372					Mean of Detected	0.807				Mean of Detected		-1.164
1373					SD of Detected	1.305				SD of Detected		1.474
1374					Minimum Non-Detect	0.225				Minimum Non-Detect		-1.492
1375					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1376												
1377	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		25
1378	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		1
1379	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		96.15%
1380												
1381					**Warning: There are only 7 Detected Values in this data**							
1382					**Note: It should be noted that even though bootstrap may be performed on this data set**							
1383					**the resulting calculations may not be reliable enough to draw conclusions**							
1384												
1385					**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**							
1386												
1387												
1388						**UCL Statistics**						
1389				**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**		
1390					Shapiro Wilk Test Statistic	0.628				Shapiro Wilk Test Statistic		0.883
1391					5% Shapiro Wilk Critical Value	0.803				5% Shapiro Wilk Critical Value		0.803
1392				**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**		
1393												
1394				**Assuming Normal Distribution**						**Assuming Lognormal Distribution**		
1395					DL/2 Substitution Method					DL/2 Substitution Method		
1396					Mean	0.508				Mean		-1.199
1397					SD	0.714				SD		0.985
1398					95% DL/2 (t) UCL	0.747				95% H-Stat (DL/2) UCL		0.799
1399												
1400					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
1401					**MLE method failed to converge properly**					Mean in Log Scale		-1.988
1402										SD in Log Scale		0.939
1403										Mean in Original Scale		0.297
1404										SD in Original Scale		0.714
1405										95% t UCL		0.536
1406										95% Percentile Bootstrap UCL		0.557
1407										95% BCA Bootstrap UCL		0.722
1408										95% H-UCL		0.336
1409												
1410				**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**		
1411					k star (bias corrected)	0.463				**Data appear Gamma Distributed at 5% Significance Level**		
1412					Theta Star	1.743						
1413					nu star	6.484						
1414												
1415					A-D Test Statistic	0.568				**Nonparametric Statistics**		
1416					5% A-D Critical Value	0.743				Kaplan-Meier (KM) Method		
1417					K-S Test Statistic	0.743				Mean		0.305
1418					5% K-S Critical Value	0.325				SD		0.706
1419				**Data appear Gamma Distributed at 5% Significance Level**						SE of Mean		0.152
1420										95% KM (t) UCL		0.566
1421				**Assuming Gamma Distribution**						95% KM (z) UCL		0.556
1422					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		0.552
1423					Minimum	0.000001				95% KM (bootstrap t) UCL		1.02
1424					Maximum	3.7				95% KM (BCA) UCL		0.629
1425					Mean	0.269				95% KM (Percentile Bootstrap) UCL		0.589
1426					Median	0.000001				95% KM (Chebyshev) UCL		0.969
1427					SD	0.739				97.5% KM (Chebyshev) UCL		1.257
1428					k star	0.129				99% KM (Chebyshev) UCL		1.821
1429					Theta star	2.089						
1430					Nu star	6.695				**Potential UCLs to Use**		
1431					AppChi2	2.005				95% KM (t) UCL		0.566
1432					95% Gamma Approximate UCL	0.898						
1433					95% Adjusted Gamma UCL	0.979						
1434	**Note: DL/2 is not a recommended method.**											
1435												
1436				**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**								
1437				**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**								
1438				**For additional insight, the user may want to consult a statistician.**								
1439												
1440												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1441	**Naphthalene**											
1442												
1443						**General Statistics**						
1444					Number of Valid Data	26				Number of Detected Data		7
1445					Number of Distinct Detected Data	7				Number of Non-Detect Data		19
1446										Percent Non-Detects		73.08%
1447												
1448					**Raw Statistics**					**Log-transformed Statistics**		
1449					Minimum Detected	0.116				Minimum Detected		-2.154
1450					Maximum Detected	0.767				Maximum Detected		-0.265
1451					Mean of Detected	0.299				Mean of Detected		-1.409
1452					SD of Detected	0.226				SD of Detected		0.658
1453					Minimum Non-Detect	0.23				Minimum Non-Detect		-1.472
1454					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1455												
1456	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		26
1457	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		0
1458	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		100.00%
1459												
1460					**Warning: There are only 7 Detected Values in this data**							
1461					**Note: It should be noted that even though bootstrap may be performed on this data set**							
1462					**the resulting calculations may not be reliable enough to draw conclusions**							
1463												
1464					**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**							
1465												
1466												
1467						**UCL Statistics**						
1468					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
1469					Shapiro Wilk Test Statistic	0.803				Shapiro Wilk Test Statistic		0.949
1470					5% Shapiro Wilk Critical Value	0.803				5% Shapiro Wilk Critical Value		0.803
1471					**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
1472												
1473					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
1474					DL/2 Substitution Method					DL/2 Substitution Method		
1475					Mean	0.387				Mean		-1.212
1476					SD	0.284				SD		0.74
1477					95% DL/2 (t) UCL	0.482				95% H-Stat (DL/2) UCL		0.542
1478												
1479					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
1480					**MLE method failed to converge properly**					Mean in Log Scale		-1.636
1481										SD in Log Scale		0.385
1482										Mean in Original Scale		0.214
1483										SD in Original Scale		0.126
1484										95% t UCL		0.256
1485										95% Percentile Bootstrap UCL		0.26
1486										95% BCA Bootstrap UCL		0.275
1487										95% H-UCL		0.242
1488												
1489					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
1490					k star (bias corrected)	1.61				**Data appear Gamma Distributed at 5% Significance Level**		
1491					Theta Star	0.186						
1492					nu star	22.54						
1493												
1494					A-D Test Statistic	0.327				**Nonparametric Statistics**		
1495					5% A-D Critical Value	0.713				Kaplan-Meier (KM) Method		
1496					K-S Test Statistic	0.713				Mean		0.226
1497					5% K-S Critical Value	0.314				SD		0.152
1498					**Data appear Gamma Distributed at 5% Significance Level**					SE of Mean		0.0434
1499										95% KM (t) UCL		0.3
1500					**Assuming Gamma Distribution**					95% KM (z) UCL		0.297
1501					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		0.301
1502					Minimum	0.095				95% KM (bootstrap t) UCL		0.332
1503					Maximum	0.767				95% KM (BCA) UCL		0.314
1504					Mean	0.248				95% KM (Percentile Bootstrap) UCL		0.301
1505					Median	0.238				95% KM (Chebyshev) UCL		0.415
1506					SD	0.127				97.5% KM (Chebyshev) UCL		0.497
1507					k star	5.068				99% KM (Chebyshev) UCL		0.658
1508					Theta star	0.049						
1509					Nu star	263.5				**Potential UCLs to Use**		
1510					AppChi2	227				95% KM (t) UCL		0.3
1511					95% Gamma Approximate UCL	0.288						
1512					95% Adjusted Gamma UCL	0.291						
1513	**Note: DL/2 is not a recommended method.**											
1514												
1515					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
1516					**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**							
1517					**For additional insight, the user may want to consult a statistician.**							
1518												
1519												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1520	**Phenanthrene**											
1521												
1522						**General Statistics**						
1523					Number of Valid Data	26				Number of Detected Data		15
1524					Number of Distinct Detected Data	15				Number of Non-Detect Data		11
1525										Percent Non-Detects		42.31%
1526												
1527				**Raw Statistics**					**Log-transformed Statistics**			
1528					Minimum Detected	0.0655				Minimum Detected		-2.726
1529					Maximum Detected	22				Maximum Detected		3.091
1530					Mean of Detected	2.647				Mean of Detected		-0.555
1531					SD of Detected	5.689				SD of Detected		1.714
1532					Minimum Non-Detect	0.47				Minimum Non-Detect		-0.755
1533					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1534												
1535	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		22
1536	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		4
1537	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		84.62%
1538												
1539						**UCL Statistics**						
1540				**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**			
1541					Shapiro Wilk Test Statistic	0.509				Shapiro Wilk Test Statistic		0.898
1542					5% Shapiro Wilk Critical Value	0.881				5% Shapiro Wilk Critical Value		0.881
1543				**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**			
1544												
1545				**Assuming Normal Distribution**					**Assuming Lognormal Distribution**			
1546					DL/2 Substitution Method					DL/2 Substitution Method		
1547					Mean	1.773				Mean		-0.605
1548					SD	4.386				SD		1.331
1549					95% DL/2 (t) UCL	3.242				95% H-Stat (DL/2) UCL		2.919
1550												
1551					Maximum Likelihood Estimate(MLE) Method					Log ROS Method		
1552					Mean	12.19				Mean in Log Scale		-0.911
1553					SD	7.479				SD in Log Scale		1.389
1554					95% MLE (t) UCL	14.69				Mean in Original Scale		1.646
1555					95% MLE (Tiku) UCL	18.34				SD in Original Scale		4.422
1556										95% t UCL		3.127
1557										95% Percentile Bootstrap UCL		3.212
1558										95% BCA Bootstrap UCL		4.323
1559										95% H UCL		2.46
1560												
1561				**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**			
1562					k star (bias corrected)	0.385			**Data appear Lognormal at 5% Significance Level**			
1563					Theta Star	6.869						
1564					nu star	11.56						
1565												
1566					A-D Test Statistic	1.387			**Nonparametric Statistics**			
1567					5% A-D Critical Value	0.809				Kaplan-Meier (KM) Method		
1568					K-S Test Statistic	0.809				Mean		1.632
1569					5% K-S Critical Value	0.236				SD		4.341
1570				**Data not Gamma Distributed at 5% Significance Level**						SE of Mean		0.882
1571										95% KM (t) UCL		3.138
1572				**Assuming Gamma Distribution**						95% KM (z) UCL		3.082
1573					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		3.116
1574					Minimum	0.000001				95% KM (bootstrap t) UCL		7.388
1575					Maximum	22				95% KM (BCA) UCL		3.415
1576					Mean	1.648				95% KM (Percentile Bootstrap) UCL		3.213
1577					Median	0.164				95% KM (Chebyshev) UCL		5.475
1578					SD	4.441				97.5% KM (Chebyshev) UCL		7.137
1579					k star	0.149				99% KM (Chebyshev) UCL		10.4
1580					Theta star	11.06						
1581					Nu star	7.747			**Potential UCLs to Use**			
1582					AppChi2	2.589				99% KM (Chebyshev) UCL		10.4
1583					95% Gamma Approximate UCL	4.931						
1584					95% Adjusted Gamma UCL	5.328						
1585	**Note: DL/2 is not a recommended method.**											
1586												
1587	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1588	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1589	**For additional insight, the user may want to consult a statistician.**											
1590												
1591												

Attachment A-1
Surface Soil EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1592	**Pyrene**											
1593												
1594					**General Statistics**							
1595					Number of Valid Data	25				Number of Detected Data		15
1596					Number of Distinct Detected Data	15				Number of Non-Detect Data		10
1597										Percent Non-Detects		40.00%
1598												
1599				**Raw Statistics**					**Log-transformed Statistics**			
1600					Minimum Detected	0.072				Minimum Detected		-2.631
1601					Maximum Detected	9.3				Maximum Detected		2.23
1602					Mean of Detected	2.146				Mean of Detected		-0.344
1603					SD of Detected	3.19				SD of Detected		1.549
1604					Minimum Non-Detect	0.47				Minimum Non-Detect		-0.755
1605					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
1606												
1607	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		21
1608	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		4
1609	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		84.00%
1610												
1611					**UCL Statistics**							
1612			**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**			
1613					Shapiro Wilk Test Statistic	0.665				Shapiro Wilk Test Statistic		0.906
1614					5% Shapiro Wilk Critical Value	0.881				5% Shapiro Wilk Critical Value		0.881
1615			**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**			
1616												
1617			**Assuming Normal Distribution**						**Assuming Lognormal Distribution**			
1618					DL/2 Substitution Method					DL/2 Substitution Method		
1619					Mean	1.533				Mean		-0.447
1620					SD	2.559				SD		1.235
1621					95% DL/2 (t) UCL	2.409				95% H-Stat (DL/2) UCL		2.78
1622												
1623					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
1624			**MLE yields a negative mean**							Mean in Log Scale		-0.678
1625										SD in Log Scale		1.295
1626										Mean in Original Scale		1.427
1627										SD in Original Scale		2.599
1628										95% t UCL		2.317
1629										95% Percentile Bootstrap UCL		2.316
1630										95% BCA Bootstrap UCL		2.64
1631										95% H-UCL		2.52
1632												
1633			**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**			
1634					k star (bias corrected)	0.495			**Data appear Lognormal at 5% Significance Level**			
1635					Theta Star	4.335						
1636					nu star	14.85						
1637												
1638					A-D Test Statistic	1.216			**Nonparametric Statistics**			
1639					5% A-D Critical Value	0.788				Kaplan-Meier (KM) Method		
1640					K-S Test Statistic	0.788				Mean		1.423
1641					5% K-S Critical Value	0.233				SD		2.549
1642			**Data not Gamma Distributed at 5% Significance Level**							SE of Mean		0.529
1643										95% KM (t) UCL		2.328
1644			**Assuming Gamma Distribution**							95% KM (z) UCL		2.293
1645					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		2.315
1646					Minimum	0.000001				95% KM (bootstrap t) UCL		2.85
1647					Maximum	9.3				95% KM (BCA) UCL		2.358
1648					Mean	1.449				95% KM (Percentile Bootstrap) UCL		2.322
1649					Median	0.268				95% KM (Chebyshev) UCL		3.728
1650					SD	2.621				97.5% KM (Chebyshev) UCL		4.726
1651					k star	0.212				99% KM (Chebyshev) UCL		6.686
1652					Theta star	6.845						
1653					Nu star	10.58			**Potential UCLs to Use**			
1654					AppChi2	4.309				99% KM (Chebyshev) UCL		6.686
1655					95% Gamma Approximate UCL	3.558						
1656					95% Adjusted Gamma UCL	3.796						
1657	**Note: DL/2 is not a recommended method.**											
1658												
1659			**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**									
1660			**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**									
1661			**For additional insight, the user may want to consult a statistician.**									
1662												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1				**General UCL Statistics for Data Sets with Non-Detects**								
2			**User Selected Options**	**Skeet Range, TS**								
3			From File	input.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
9	Antimony											
10												
11						General Statistics						
12					Number of Valid Data	14				Number of Detected Data		8
13					Number of Distinct Detected Data	8				Number of Non-Detect Data		6
14										Percent Non-Detects		42.86%
15												
16					Raw Statistics					Log-transformed Statistics		
17					Minimum Detected	0.97				Minimum Detected		-0.0305
18					Maximum Detected	39.4				Maximum Detected		3.674
19					Mean of Detected	9.869				Mean of Detected		1.49
20					SD of Detected	13.54				SD of Detected		1.342
21					Minimum Non-Detect	2.57				Minimum Non-Detect		0.944
22					Maximum Non-Detect	9.24				Maximum Non-Detect		2.224
23												
24	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		11
25	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		3
26	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		78.57%
27												
28					Warning: There are only 8 Detected Values in this data							
29					Note: It should be noted that even though bootstrap may be performed on this data set							
30					the resulting calculations may not be reliable enough to draw conclusions							
31												
32					It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.							
33												
34												
35						UCL Statistics						
36					Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only		
37					Shapiro Wilk Test Statistic	0.726				Shapiro Wilk Test Statistic		0.918
38					5% Shapiro Wilk Critical Value	0.818				5% Shapiro Wilk Critical Value		0.818
39					Data not Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level		
40												
41					Assuming Normal Distribution					Assuming Lognormal Distribution		
42					DL/2 Substitution Method					DL/2 Substitution Method		
43					Mean	6.627				Mean		1.144
44					SD	10.71				SD		1.127
45					95% DL/2 (t) UCL	11.7				95% H-Stat (DL/2) UCL		15.18
46												
47					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
48					MLE yields a negative mean					Mean in Log Scale		1.081
49										SD in Log Scale		1.101
50										Mean in Original Scale		6.375
51										SD in Original Scale		10.79
52										95% t UCL		11.48
53										95% Percentile Bootstrap UCL		11.56
54										95% BCA Bootstrap UCL		14.01
55										95% H-UCL		13.36
56												
57					Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only		
58					k star (bias corrected)	0.551				Data appear Gamma Distributed at 5% Significance Level		
59					Theta Star	17.9						
60					nu star	8.823						
61												
62					A-D Test Statistic	0.529				Nonparametric Statistics		
63					5% A-D Critical Value	0.745				Kaplan-Meier (KM) Method		
64					K-S Test Statistic	0.745				Mean		6.347
65					5% K-S Critical Value	0.304				SD		10.41
66					Data appear Gamma Distributed at 5% Significance Level					SE of Mean		2.979
67										95% KM (t) UCL		11.62
68					Assuming Gamma Distribution					95% KM (z) UCL		11.25
69					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		11.47
70					Minimum	0.000001				95% KM (bootstrap t) UCL		25
71					Maximum	39.4				95% KM (BCA) UCL		11.27
72					Mean	5.77				95% KM (Percentile Bootstrap) UCL		11.52
73					Median	1.199				95% KM (Chebyshev) UCL		19.33
74					SD	11.09				97.5% KM (Chebyshev) UCL		24.95
75					k star	0.171				99% KM (Chebyshev) UCL		35.99
76					Theta star	33.74						
77					Nu star	4.788				Potential UCLs to Use		
78					AppChi2	1.056				95% KM (BCA) UCL		11.27
79					95% Gamma Approximate UCL	26.17						
80					95% Adjusted Gamma UCL	32.67						
81	Note: DL/2 is not a recommended method.											
82												
83					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
84					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
85					For additional insight, the user may want to consult a statistician.							
86												
87												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
88	**Arsenic**											
89												
90					**General Statistics**							
91					Number of Valid Observations	14			Number of Distinct Observations			14
92												
93					**Raw Statistics**				**Log-transformed Statistics**			
94					Minimum	1.65			Minimum of Log Data			0.501
95					Maximum	24.1			Maximum of Log Data			3.182
96					Mean	7.506			Mean of log Data			1.757
97					Median	6.585			SD of log Data			0.755
98					SD	5.892						
99					Std. Error of Mean	1.575						
100					Coefficient of Variation	0.785						
101					Skewness	1.803						
102												
103					**Relevant UCL Statistics**							
104					**Normal Distribution Test**				**Lognormal Distribution Test**			
105					Shapiro Wilk Test Statistic	0.828			Shapiro Wilk Test Statistic			0.976
106					Shapiro Wilk Critical Value	0.874			Shapiro Wilk Critical Value			0.874
107					**Data not Normal at 5% Significance Level**				**Data appear Lognormal at 5% Significance Level**			
108												
109					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
110					95% Student's-t UCL	10.29			95% H-UCL			12.77
111					**95% UCLs (Adjusted for Skewness)**				95% Chebyshev (MVUE) UCL			14.5
112					95% Adjusted-CLT UCL (Chen-1995)	10.91			97.5% Chebyshev (MVUE) UCL			17.52
113					95% Modified-t UCL (Johnson-1978)	10.42			99% Chebyshev (MVUE) UCL			23.46
114												
115					**Gamma Distribution Test**				**Data Distribution**			
116					k star (bias corrected)	1.687			**Data appear Gamma Distributed at 5% Significance Level**			
117					Theta Star	4.449						
118					MLE of Mean	7.506						
119					MLE of Standard Deviation	5.779						
120					nu star	47.24						
121					Approximate Chi Square Value (.05)	32.47			**Nonparametric Statistics**			
122					Adjusted Level of Significance	0.0312			95% CLT UCL			10.1
123					Adjusted Chi Square Value	30.85			95% Jackknife UCL			10.29
124									95% Standard Bootstrap UCL			9.948
125					Anderson-Darling Test Statistic	0.251			95% Bootstrap-t UCL			11.58
126					Anderson-Darling 5% Critical Value	0.746			95% Hall's Bootstrap UCL			21.23
127					Kolmogorov-Smirnov Test Statistic	0.127			95% Percentile Bootstrap UCL			10.16
128					Kolmogorov-Smirnov 5% Critical Value	0.232			95% BCA Bootstrap UCL			11.01
129					**Data appear Gamma Distributed at 5% Significance Level**				95% Chebyshev(Mean, Sd) UCL			14.37
130									97.5% Chebyshev(Mean, Sd) UCL			17.34
131					**Assuming Gamma Distribution**				99% Chebyshev(Mean, Sd) UCL			23.17
132					95% Approximate Gamma UCL	10.92						
133					95% Adjusted Gamma UCL	11.49						
134												
135					**Potential UCL to Use**				Use 95% Approximate Gamma UCL			10.92
136												
137					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
138					**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**							
139					**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**							
140												
141												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
142	Benz(a)anthracene											
143												
144						General Statistics						
145					Number of Valid Data	28				Number of Detected Data		8
146					Number of Distinct Detected Data	8				Number of Non-Detect Data		20
147										Percent Non-Detects		71.43%
148												
149					Raw Statistics					Log-transformed Statistics		
150					Minimum Detected	0.23				Minimum Detected		-1.47
151					Maximum Detected	27.6				Maximum Detected		3.318
152					Mean of Detected	7.191				Mean of Detected		1.356
153					SD of Detected	8.616				SD of Detected		1.377
154					Minimum Non-Detect	0.0937				Minimum Non-Detect		-2.368
155					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
156												
157	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		22
158	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		6
159	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		78.57%
160												
161					Warning: There are only 8 Detected Values in this data							
162					Note: It should be noted that even though bootstrap may be performed on this data set							
163					the resulting calculations may not be reliable enough to draw conclusions							
164												
165					It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.							
166												
167												
168						UCL Statistics						
169					Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only		
170					Shapiro Wilk Test Statistic	0.703				Shapiro Wilk Test Statistic		0.91
171					5% Shapiro Wilk Critical Value	0.818				5% Shapiro Wilk Critical Value		0.818
172					Data not Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level		
173												
174					Assuming Normal Distribution					Assuming Lognormal Distribution		
175					DL/2 Substitution Method					DL/2 Substitution Method		
176					Mean	2.32				Mean		-0.621
177					SD	5.4				SD		1.682
178					95% DL/2 (t) UCL	4.058				95% H-Stat (DL/2) UCL		6.635
179												
180					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
181					MLE yields a negative mean					Mean in Log Scale		-1.689
182										SD in Log Scale		2.146
183										Mean in Original Scale		2.102
184										SD in Original Scale		5.477
185										95% t UCL		3.865
186										95% Percentile Bootstrap UCL		3.983
187										95% BCA Bootstrap UCL		5.322
188										95% H-UCL		10.09
189												
190					Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only		
191					k star (bias corrected)	0.673				Data appear Gamma Distributed at 5% Significance Level		
192					Theta Star	10.69						
193					nu star	10.76						
194												
195					A-D Test Statistic	0.332				Nonparametric Statistics		
196					5% A-D Critical Value	0.738				Kaplan-Meier (KM) Method		
197					K-S Test Statistic	0.738				Mean		2.222
198					5% K-S Critical Value	0.302				SD		5.333
199					Data appear Gamma Distributed at 5% Significance Level					SE of Mean		1.078
200										95% KM (t) UCL		4.057
201					Assuming Gamma Distribution					95% KM (z) UCL		3.994
202					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		3.805
203					Minimum	0.000001				95% KM (bootstrap t) UCL		6.034
204					Maximum	27.6				95% KM (BCA) UCL		6.426
205					Mean	2.055				95% KM (Percentile Bootstrap) UCL		5.324
206					Median	0.000001				95% KM (Chebyshev) UCL		6.919
207					SD	5.495				97.5% KM (Chebyshev) UCL		8.951
208					k star	0.0967				99% KM (Chebyshev) UCL		12.94
209					Theta star	21.26						
210					Nu star	5.413				Potential UCLs to Use		
211					AppChi2	1.348				95% KM (t) UCL		4.057
212					95% Gamma Approximate UCL	8.253						
213					95% Adjusted Gamma UCL	9.059						
214	Note: DL/2 is not a recommended method.											
215												
216					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
217					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
218					For additional insight, the user may want to consult a statistician.							
219												
220												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
221	**Benzo(a)pyrene**											
222												
223						**General Statistics**						
224					Number of Valid Data	28				Number of Detected Data		16
225					Number of Distinct Detected Data	16				Number of Non-Detect Data		12
226										Percent Non-Detects		42.86%
227												
228					**Raw Statistics**					**Log-transformed Statistics**		
229					Minimum Detected	0.2				Minimum Detected		-1.609
230					Maximum Detected	21.6				Maximum Detected		3.073
231					Mean of Detected	3.393				Mean of Detected		0.212
232					SD of Detected	5.488				SD of Detected		1.462
233					Minimum Non-Detect	0.235				Minimum Non-Detect		-1.448
234					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
235												
236	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		22
237	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		6
238	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		78.57%
239												
240						**UCL Statistics**						
241					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
242					Shapiro Wilk Test Statistic	0.62				Shapiro Wilk Test Statistic		0.898
243					5% Shapiro Wilk Critical Value	0.887				5% Shapiro Wilk Critical Value		0.887
244					**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
245												
246					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
247					DL/2 Substitution Method					DL/2 Substitution Method		
248					Mean	2.171				Mean		-0.219
249					SD	4.34				SD		1.278
250					95% DL/2 (t) UCL	3.568				95% H-Stat (DL/2) UCL		3.635
251												
252					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
253					**MLE yields a negative mean**					Mean in Log Scale		-0.36
254										SD in Log Scale		1.34
255										Mean in Original Scale		2.101
256										SD in Original Scale		4.365
257										95% t UCL		3.506
258										95% Percentile Bootstrap UCL		3.558
259										95% BCA Bootstrap UCL		4.258
260										95% H-UCL		3.619
261												
262					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
263					k star (bias corrected)	0.538				**Data Follow Appr. Gamma Distribution at 5% Significance Level**		
264					Theta Star	6.312						
265					nu star	17.2						
266												
267					A-D Test Statistic	0.994				**Nonparametric Statistics**		
268					5% A-D Critical Value	0.787				Kaplan-Meier (KM) Method		
269					K-S Test Statistic	0.787				Mean		2.093
270					5% K-S Critical Value	0.225				SD		4.29
271					**Data follow Appr. Gamma Distribution at 5% Significance Level**					SE of Mean		0.838
272										95% KM (t) UCL		3.52
273					**Assuming Gamma Distribution**					95% KM (z) UCL		3.472
274					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		3.493
275					Minimum	0.000001				95% KM (bootstrap t) UCL		5.304
276					Maximum	21.6				95% KM (BCA) UCL		3.649
277					Mean	2.029				95% KM (Percentile Bootstrap) UCL		3.639
278					Median	0.379				95% KM (Chebyshev) UCL		5.745
279					SD	4.406				97.5% KM (Chebyshev) UCL		7.326
280					k star	0.15				99% KM (Chebyshev) UCL		10.43
281					Theta star	13.57						
282					Nu star	8.374				**Potential UCLs to Use**		
283					AppChi2	2.953				95% KM (BCA) UCL		3.649
284					95% Gamma Approximate UCL	5.752						
285					95% Adjusted Gamma UCL	6.161						
286	**Note: DL/2 is not a recommended method.**											
287												
288					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
289					**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**							
290					**For additional insight, the user may want to consult a statistician.**							
291												
292												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
293	**Benzo(b)fluoranthene**											
294												
295						**General Statistics**						
296						Number of Valid Data	28				Number of Detected Data	18
297						Number of Distinct Detected Data	18				Number of Non-Detect Data	10
298											Percent Non-Detects	35.71%
299												
300						**Raw Statistics**					**Log-transformed Statistics**	
301						Minimum Detected	0.12				Minimum Detected	-2.12
302						Maximum Detected	27.1				Maximum Detected	3.3
303						Mean of Detected	3.526				Mean of Detected	0.113
304						SD of Detected	6.442				SD of Detected	1.538
305						Minimum Non-Detect	0.47				Minimum Non-Detect	-0.755
306						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
307												
308	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	21
309	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	7
310	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	75.00%
311												
312						**UCL Statistics**						
313						**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**	
314						Shapiro Wilk Test Statistic	0.559				Shapiro Wilk Test Statistic	0.904
315						5% Shapiro Wilk Critical Value	0.897				5% Shapiro Wilk Critical Value	0.897
316						**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**	
317												
318						**Assuming Normal Distribution**					**Assuming Lognormal Distribution**	
319						DL/2 Substitution Method					DL/2 Substitution Method	
320						Mean	2.486				Mean	-0.143
321						SD	5.308				SD	1.307
322						95% DL/2 (t) UCL	4.194				95% H-Stat (DL/2) UCL	4.177
323												
324						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
325						**MLE yields a negative mean**					Mean in Log Scale	-0.24
326											SD in Log Scale	1.339
327											Mean in Original Scale	2.431
328											SD in Original Scale	5.328
329											95% t UCL	4.146
330											95% Percentile Bootstrap UCL	4.259
331											95% BCA Bootstrap UCL	5.195
332											95% H-UCL	4.072
333												
334						**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**	
335						k star (bias corrected)	0.492				**Data appear Lognormal at 5% Significance Level**	
336						Theta Star	7.164					
337						nu star	17.72					
338												
339						A-D Test Statistic	1.214				**Nonparametric Statistics**	
340						5% A-D Critical Value	0.796				Kaplan-Meier (KM) Method	
341						K-S Test Statistic	0.796				Mean	2.402
342						5% K-S Critical Value	0.214				SD	5.242
343						**Data not Gamma Distributed at 5% Significance Level**					SE of Mean	1.02
344											95% KM (t) UCL	4.139
345						**Assuming Gamma Distribution**					95% KM (z) UCL	4.079
346						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	4.121
347						Minimum	0.000001				95% KM (bootstrap t) UCL	6.561
348						Maximum	27.1				95% KM (BCA) UCL	4.544
349						Mean	2.382				95% KM (Percentile Bootstrap) UCL	4.262
350						Median	0.379				95% KM (Chebyshev) UCL	6.847
351						SD	5.361				97.5% KM (Chebyshev) UCL	8.77
352						k star	0.168				99% KM (Chebyshev) UCL	12.55
353						Theta star	14.19					
354						Nu star	9.403				**Potential UCLs to Use**	
355						AppChi2	3.572				99% KM (Chebyshev) UCL	12.55
356						95% Gamma Approximate UCL	6.27					
357						95% Adjusted Gamma UCL	6.681					
358	**Note: DL/2 is not a recommended method.**											
359												
360	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
361	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
362	**For additional insight, the user may want to consult a statistician.**											
363												
364												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
365	**Chrysene**											
366												
367						**General Statistics**						
368						Number of Valid Data	28				Number of Detected Data	11
369						Number of Distinct Detected Data	11				Number of Non-Detect Data	17
370											Percent Non-Detects	60.71%
371												
372						**Raw Statistics**					**Log-transformed Statistics**	
373						Minimum Detected	0.083				Minimum Detected	-2.489
374						Maximum Detected	26.2				Maximum Detected	3.266
375						Mean of Detected	5.562				Mean of Detected	0.726
376						SD of Detected	7.493				SD of Detected	1.767
377						Minimum Non-Detect	0.0937				Minimum Non-Detect	-2.368
378						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
379												
380	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	21
381	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	7
382	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	75.00%
383												
384						**UCL Statistics**						
385						**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**	
386						Shapiro Wilk Test Statistic	0.706				Shapiro Wilk Test Statistic	0.932
387						5% Shapiro Wilk Critical Value	0.85				5% Shapiro Wilk Critical Value	0.85
388						**Data not Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**	
389												
390						**Assuming Normal Distribution**					**Assuming Lognormal Distribution**	
391						DL/2 Substitution Method					DL/2 Substitution Method	
392						Mean	2.432				Mean	-0.501
393						SD	5.237				SD	1.656
394						95% DL/2 (t) UCL	4.118				95% H-Stat (DL/2) UCL	6.967
395												
396						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
397						**MLE yields a negative mean**					Mean in Log Scale	-1.206
398											SD in Log Scale	1.974
399											Mean in Original Scale	2.249
400											SD in Original Scale	5.307
401											95% t UCL	3.958
402											95% Percentile Bootstrap UCL	3.94
403											95% BCA Bootstrap UCL	5.13
404											95% H-UCL	9.04
405												
406						**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**	
407						k star (bias corrected)	0.512				**Data appear Gamma Distributed at 5% Significance Level**	
408						Theta Star	10.85					
409						nu star	11.27					
410												
411						A-D Test Statistic	0.307				**Nonparametric Statistics**	
412						5% A-D Critical Value	0.772				Kaplan-Meier (KM) Method	
413						K-S Test Statistic	0.772				Mean	2.266
414						5% K-S Critical Value	0.267				SD	5.205
415						**Data appear Gamma Distributed at 5% Significance Level**					SE of Mean	1.032
416											95% KM (t) UCL	4.024
417						**Assuming Gamma Distribution**					95% KM (z) UCL	3.963
418						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	3.921
419						Minimum	0.000001				95% KM (bootstrap t) UCL	5.732
420						Maximum	26.2				95% KM (BCA) UCL	4.513
421						Mean	2.185				95% KM (Percentile Bootstrap) UCL	4.247
422						Median	0.000001				95% KM (Chebyshev) UCL	6.764
423						SD	5.333				97.5% KM (Chebyshev) UCL	8.71
424						k star	0.106				99% KM (Chebyshev) UCL	12.53
425						Theta star	20.57					
426						Nu star	5.949				**Potential UCLs to Use**	
427						AppChi2	1.614				95% KM (t) UCL	4.024
428						95% Gamma Approximate UCL	8.054					
429						95% Adjusted Gamma UCL	8.787					
430	**Note: DL/2 is not a recommended method.**											
431												
432	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
433	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
434	**For additional insight, the user may want to consult a statistician.**											
435												
436												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
437	Dibenz(a,h)anthracene											
438												
439						General Statistics						
440						Number of Valid Data	28				Number of Detected Data	11
441						Number of Distinct Detected Data	11				Number of Non-Detect Data	17
442											Percent Non-Detects	60.71%
443												
444						Raw Statistics					Log-transformed Statistics	
445						Minimum Detected	0.203				Minimum Detected	-1.596
446						Maximum Detected	4.88				Maximum Detected	1.585
447						Mean of Detected	1.033				Mean of Detected	-0.363
448						SD of Detected	1.313				SD of Detected	0.826
449						Minimum Non-Detect	0.225				Minimum Non-Detect	-1.492
450						Maximum Non-Detect	2.1				Maximum Non-Detect	0.742
451												
452	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	27
453	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	1
454	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	96.43%
455												
456						UCL Statistics						
457						Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only	
458						Shapiro Wilk Test Statistic	0.562				Shapiro Wilk Test Statistic	0.912
459						5% Shapiro Wilk Critical Value	0.85				5% Shapiro Wilk Critical Value	0.85
460						Data not Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level	
461												
462						Assuming Normal Distribution					Assuming Lognormal Distribution	
463						DL/2 Substitution Method					DL/2 Substitution Method	
464						Mean	0.679				Mean	-0.784
465						SD	0.881				SD	0.857
466						95% DL/2 (t) UCL	0.963				95% H-Stat (DL/2) UCL	0.961
467												
468						Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method	
469						MLE method failed to converge properly					Mean in Log Scale	-0.98
470											SD in Log Scale	0.785
471											Mean in Original Scale	0.574
472											SD in Original Scale	0.889
473											95% t UCL	0.86
474											95% Percentile Bootstrap UCL	0.866
475											95% BCA Bootstrap UCL	1.102
476											95% H-UCL	0.713
477												
478						Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only	
479						k star (bias corrected)	1.086				Data Follow Appr. Gamma Distribution at 5% Significance Level	
480						Theta Star	0.951					
481						nu star	23.89					
482												
483						A-D Test Statistic	0.894				Nonparametric Statistics	
484						5% A-D Critical Value	0.744				Kaplan-Meier (KM) Method	
485						K-S Test Statistic	0.744				Mean	0.613
486						5% K-S Critical Value	0.26				SD	0.875
487						Data follow Appr. Gamma Distribution at 5% Significance Level					SE of Mean	0.178
488											95% KM (t) UCL	0.917
489						Assuming Gamma Distribution					95% KM (z) UCL	0.907
490						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	0.877
491						Minimum	0.000001				95% KM (bootstrap t) UCL	1.323
492						Maximum	4.88				95% KM (BCA) UCL	0.988
493						Mean	0.519				95% KM (Percentile Bootstrap) UCL	0.956
494						Median	0.301				95% KM (Chebyshev) UCL	1.39
495						SD	0.938				97.5% KM (Chebyshev) UCL	1.727
496						k star	0.159				99% KM (Chebyshev) UCL	2.387
497						Theta star	3.273					
498						Nu star	8.88				Potential UCLs to Use	
499						AppChi2	3.255				95% KM (t) UCL	0.917
500						95% Gamma Approximate UCL	1.416					
501						95% Adjusted Gamma UCL	1.512					
502	Note: DL/2 is not a recommended method.											
503												
504	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
505	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
506	For additional insight, the user may want to consult a statistician.											
507												
508												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
509	indeno(1,2,3-c,d)pyrene											
510												
511	General Statistics											
512					Number of Valid Data	28				Number of Detected Data		15
513					Number of Distinct Detected Data	14				Number of Non-Detect Data		13
514										Percent Non-Detects		46.43%
515												
516	Raw Statistics						Log-transformed Statistics					
517					Minimum Detected	0.087				Minimum Detected		-2.442
518					Maximum Detected	16.5				Maximum Detected		2.803
519					Mean of Detected	2.306				Mean of Detected		0.0435
520					SD of Detected	4.1				SD of Detected		1.233
521					Minimum Non-Detect	0.234				Minimum Non-Detect		-1.452
522					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
523												
524	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		24
525	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		4
526	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		85.71%
527												
528	UCL Statistics											
529	Normal Distribution Test with Detected Values Only						Lognormal Distribution Test with Detected Values Only					
530					Shapiro Wilk Test Statistic	0.513				Shapiro Wilk Test Statistic		0.953
531					5% Shapiro Wilk Critical Value	0.881				5% Shapiro Wilk Critical Value		0.881
532	Data not Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level					
533												
534	Assuming Normal Distribution						Assuming Lognormal Distribution					
535					DL/2 Substitution Method					DL/2 Substitution Method		
536					Mean	1.472				Mean		-0.394
537					SD	3.097				SD		1.126
538					95% DL/2 (t) UCL	2.469				95% H-Stat (DL/2) UCL		2.24
539												
540					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
541	MLE yields a negative mean									Mean in Log Scale		-0.592
542										SD in Log Scale		1.204
543										Mean in Original Scale		1.384
544										SD in Original Scale		3.123
545										95% t UCL		2.389
546										95% Percentile Bootstrap UCL		2.505
547										95% BCA Bootstrap UCL		3.204
548										95% H-UCL		2.143
549												
550	Gamma Distribution Test with Detected Values Only						Data Distribution Test with Detected Values Only					
551					k star (bias corrected)	0.649	Data appear Lognormal at 5% Significance Level					
552					Theta Star	3.556						
553					nu star	19.46						
554												
555					A-D Test Statistic	0.926	Nonparametric Statistics					
556					5% A-D Critical Value	0.775				Kaplan-Meier (KM) Method		
557					K-S Test Statistic	0.775				Mean		1.414
558					5% K-S Critical Value	0.23				SD		3.063
559	Data not Gamma Distributed at 5% Significance Level									SE of Mean		0.601
560										95% KM (t) UCL		2.439
561	Assuming Gamma Distribution									95% KM (z) UCL		2.404
562					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		2.379
563					Minimum	0.000001				95% KM (bootstrap t) UCL		4.699
564					Maximum	16.5				95% KM (BCA) UCL		2.666
565					Mean	1.334				95% KM (Percentile Bootstrap) UCL		2.463
566					Median	0.454				95% KM (Chebyshev) UCL		4.036
567					SD	3.161				97.5% KM (Chebyshev) UCL		5.17
568					k star	0.17				99% KM (Chebyshev) UCL		7.398
569					Theta star	7.847						
570					Nu star	9.517	Potential UCLs to Use					
571					AppChi2	3.642				97.5% KM (Chebyshev) UCL		5.17
572					95% Gamma Approximate UCL	3.485						
573					95% Adjusted Gamma UCL	3.711						
574	Note: DL/2 is not a recommended method.											
575												
576	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
577	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
578	For additional insight, the user may want to consult a statistician.											
579												
580												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
581	iron											
582												
583						General Statistics						
584					Number of Valid Observations	14					Number of Distinct Observations	13
585												
586					Raw Statistics						Log-transformed Statistics	
587					Minimum	5520					Minimum of Log Data	8.616
588					Maximum	30900					Maximum of Log Data	10.34
589					Mean	17168					Mean of log Data	9.645
590					Median	14000					SD of log Data	0.495
591					SD	7832						
592					Std. Error of Mean	2093						
593					Coefficient of Variation	0.456						
594					Skewness	0.454						
595												
596						Relevant UCL Statistics						
597					Normal Distribution Test						Lognormal Distribution Test	
598					Shapiro Wilk Test Statistic	0.933					Shapiro Wilk Test Statistic	0.949
599					Shapiro Wilk Critical Value	0.874					Shapiro Wilk Critical Value	0.874
600					Data appear Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level	
601												
602					Assuming Normal Distribution						Assuming Lognormal Distribution	
603					95% Student's-t UCL	20875					95% H-UCL	23006
604					95% UCLs (Adjusted for Skewness)						95% Chebyshev (MVUE) UCL	27545
605					95% Adjusted-CLT UCL (Chen-1995)	20882					97.5% Chebyshev (MVUE) UCL	31983
606					95% Modified-t UCL (Johnson-1978)	20917					99% Chebyshev (MVUE) UCL	40698
607												
608					Gamma Distribution Test						Data Distribution	
609					k star (bias corrected)	3.882					Data appear Normal at 5% Significance Level	
610					Theta Star	4422						
611					MLE of Mean	17168						
612					MLE of Standard Deviation	8713						
613					nu star	108.7						
614					Approximate Chi Square Value (.05)	85.64					Nonparametric Statistics	
615					Adjusted Level of Significance	0.0312					95% CLT UCL	20611
616					Adjusted Chi Square Value	82.93					95% Jackknife UCL	20875
617											95% Standard Bootstrap UCL	20501
618					Anderson-Darling Test Statistic	0.334					95% Bootstrap-t UCL	21193
619					Anderson-Darling 5% Critical Value	0.738					95% Hall's Bootstrap UCL	20705
620					Kolmogorov-Smirnov Test Statistic	0.166					95% Percentile Bootstrap UCL	20657
621					Kolmogorov-Smirnov 5% Critical Value	0.229					95% BCA Bootstrap UCL	20774
622					Data appear Gamma Distributed at 5% Significance Level						95% Chebyshev(Mean, Sd) UCL	26292
623											97.5% Chebyshev(Mean, Sd) UCL	30240
624					Assuming Gamma Distribution						99% Chebyshev(Mean, Sd) UCL	37996
625					95% Approximate Gamma UCL	21791						
626					95% Adjusted Gamma UCL	22504						
627												
628					Potential UCL to Use						Use 95% Student's-t UCL	20875
629												
630					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
631					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
632					and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.							
633												
634												

Attachment A-2
Total Soil EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
635	**Lead**											
636												
637					**General Statistics**							
638					Number of Valid Observations	38			Number of Distinct Observations			37
639												
640				**Raw Statistics**					**Log-transformed Statistics**			
641					Minimum	10.77			Minimum of Log Data			2.377
642					Maximum	84700			Maximum of Log Data			11.35
643					Mean	5509			Mean of log Data			5.637
644					Median	163.5			SD of log Data			2.155
645					SD	17577						
646					Std. Error of Mean	2851						
647					Coefficient of Variation	3.191						
648					Skewness	3.632						
649												
650					**Relevant UCL Statistics**							
651				**Normal Distribution Test**					**Lognormal Distribution Test**			
652					Shapiro Wilk Test Statistic	0.359			Shapiro Wilk Test Statistic			0.895
653					Shapiro Wilk Critical Value	0.938			Shapiro Wilk Critical Value			0.938
654				**Data not Normal at 5% Significance Level**					**Data not Lognormal at 5% Significance Level**			
655												
656				**Assuming Normal Distribution**					**Assuming Lognormal Distribution**			
657					95% Student's-t UCL	10319			95% H-UCL			11681
658				**95% UCLs (Adjusted for Skewness)**					95% Chebyshev (MVUE) UCL			7598
659					95% Adjusted-CLT UCL (Chen-1995)	11994			97.5% Chebyshev (MVUE) UCL			9848
660					95% Modified-t UCL (Johnson-1978)	10599			99% Chebyshev (MVUE) UCL			14269
661												
662				**Gamma Distribution Test**					**Data Distribution**			
663					k star (bias corrected)	0.239			**Data do not follow a Discernable Distribution (0.05)**			
664					Theta Star	23078						
665					MLE of Mean	5509						
666					MLE of Standard Deviation	11275						
667					nu star	18.14						
668					Approximate Chi Square Value (.05)	9.493			**Nonparametric Statistics**			
669					Adjusted Level of Significance	0.0434			95% CLT UCL			10199
670					Adjusted Chi Square Value	9.233			95% Jackknife UCL			10319
671									95% Standard Bootstrap UCL			10188
672					Anderson-Darling Test Statistic	5.502			95% Bootstrap-t UCL			14795
673					Anderson-Darling 5% Critical Value	0.884			95% Hall's Bootstrap UCL			9685
674					Kolmogorov-Smirnov Test Statistic	0.314			95% Percentile Bootstrap UCL			10301
675					Kolmogorov-Smirnov 5% Critical Value	0.157			95% BCA Bootstrap UCL			12073
676				**Data not Gamma Distributed at 5% Significance Level**					95% Chebyshev(Mean, Sd) UCL			17938
677									97.5% Chebyshev(Mean, Sd) UCL			23316
678				**Assuming Gamma Distribution**					99% Chebyshev(Mean, Sd) UCL			33880
679					95% Approximate Gamma UCL	10527						
680					95% Adjusted Gamma UCL	10824						
681												
682				**Potential UCL to Use**					Use 97.5% Chebyshev (Mean, Sd) UCL			23316
683												
684	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
685	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
686	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
687												

Attachment A-3
Groundwater EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1				**General UCL Statistics for Data Sets with Non-Detects**								
2			**User Selected Options**	**Skeet Range, GW**								
3			From File	input.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												

Attachment A-3
Groundwater EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
9	Arsenic											
10												
11						General Statistics						
12					Number of Valid Data	10				Number of Detected Data		4
13					Number of Distinct Detected Data	4				Number of Non-Detect Data		6
14										Percent Non-Detects		60.00%
15												
16					Raw Statistics					Log-transformed Statistics		
17					Minimum Detected	0.004				Minimum Detected		-5.521
18					Maximum Detected	0.0132				Maximum Detected		-4.328
19					Mean of Detected	0.00876				Mean of Detected		-4.828
20					SD of Detected	0.00392				SD of Detected		0.516
21					Minimum Non-Detect	0.00059				Minimum Non-Detect		-7.435
22					Maximum Non-Detect	0.01				Maximum Non-Detect		-4.605
23												
24	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		8
25	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		2
26	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		80.00%
27												
28					Warning: There are only 4 Distinct Detected Values in this data							
29					Note: It should be noted that even though bootstrap may be performed on this data set							
30					the resulting calculations may not be reliable enough to draw conclusions							
31												
32					It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.							
33												
34												
35						UCL Statistics						
36					Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only		
37					Shapiro Wilk Test Statistic	0.996				Shapiro Wilk Test Statistic		0.954
38					5% Shapiro Wilk Critical Value	0.748				5% Shapiro Wilk Critical Value		0.748
39					Data appear Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level		
40												
41					Assuming Normal Distribution					Assuming Lognormal Distribution		
42					DL/2 Substitution Method					DL/2 Substitution Method		
43					Mean	0.00513				Mean		-5.854
44					SD	0.00429				SD		1.383
45					95% DL/2 (t) UCL	0.00762				95% H-Stat (DL/2) UCL		0.0459
46												
47					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
48					MLE method failed to converge properly					Mean in Log Scale		-5.503
49										SD in Log Scale		0.713
50										Mean in Original Scale		0.00517
51										SD in Original Scale		0.00393
52										95% t UCL		0.00745
53										95% Percentile Bootstrap UCL		0.00722
54										95% BCA Bootstrap UCL		0.00758
55										95% H-UCL		0.00964
56												
57					Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only		
58					k star (bias corrected)	1.589				Data appear Normal at 5% Significance Level		
59					Theta Star	0.00551						
60					nu star	12.71						
61												
62					A-D Test Statistic	0.236				Nonparametric Statistics		
63					5% A-D Critical Value	0.659				Kaplan-Meier (KM) Method		
64					K-S Test Statistic	0.659				Mean		0.00612
65					5% K-S Critical Value	0.396				SD		0.00316
66					Data appear Gamma Distributed at 5% Significance Level					SE of Mean		0.00121
67										95% KM (t) UCL		0.00833
68					Assuming Gamma Distribution					95% KM (z) UCL		0.0081
69					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		0.00869
70					Minimum	0.000001				95% KM (bootstrap t) UCL		0.00754
71					Maximum	0.0132				95% KM (BCA) UCL		N/A
72					Mean	0.00397				95% KM (Percentile Bootstrap) UCL		0.0109
73					Median	0.002				95% KM (Chebyshev) UCL		0.0114
74					SD	0.00491				97.5% KM (Chebyshev) UCL		0.0137
75					k star	0.201				99% KM (Chebyshev) UCL		0.0181
76					Theta star	0.0197						
77					Nu star	4.028				Potential UCLs to Use		
78					AppChi2	0.733				95% KM (t) UCL		0.00833
79					95% Gamma Approximate UCL	0.0218				95% KM (Percentile Bootstrap) UCL		0.0109
80					95% Adjusted Gamma UCL	N/A						
81	Note: DL/2 is not a recommended method.											
82												
83					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
84					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
85					For additional insight, the user may want to consult a statistician.							
86												
87												

Attachment A-3
Groundwater EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
88	Chromium											
89												
90	General Statistics											
91					Number of Valid Observations	5			Number of Distinct Observations			5
92												
93			Raw Statistics						Log-transformed Statistics			
94					Minimum	0.00279			Minimum of Log Data			-5.882
95					Maximum	0.00779			Maximum of Log Data			-4.855
96					Mean	0.00528			Mean of log Data			-5.319
97					Median	0.00617			SD of log Data			0.448
98					SD	0.00214						
99					Std. Error of Mean	0.0009549						
100					Coefficient of Variation	0.404						
101					Skewness	-0.227						
102												
103												
104	Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!											
105												
106	It is suggested to collect at least 8 to 10 observations using these statistical methods!											
107	If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.											
108												
109												
110	Warning: There are only 5 Values in this data											
111	Note: It should be noted that even though bootstrap methods may be performed on this data set,											
112	the resulting calculations may not be reliable enough to draw conclusions											
113												
114	The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.											
115												
116	Relevant UCL Statistics											
117			Normal Distribution Test						Lognormal Distribution Test			
118					Shapiro Wilk Test Statistic	0.899			Shapiro Wilk Test Statistic			0.876
119					Shapiro Wilk Critical Value	0.762			Shapiro Wilk Critical Value			0.762
120			Data appear Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level			
121												
122			Assuming Normal Distribution						Assuming Lognormal Distribution			
123					95% Student's-t UCL	0.00732			95% H-UCL			0.0101
124			95% UCLs (Adjusted for Skewness)						95% Chebyshev (MVUE) UCL			0.0099
125					95% Adjusted-CLT UCL (Chen-1995)	0.00675			97.5% Chebyshev (MVUE) UCL			0.0119
126					95% Modified-t UCL (Johnson-1978)	0.0073			99% Chebyshev (MVUE) UCL			0.0158
127												
128			Gamma Distribution Test						Data Distribution			
129					k star (bias corrected)	2.859			Data appear Normal at 5% Significance Level			
130					Theta Star	0.00185						
131					MLE of Mean	0.00528						
132					MLE of Standard Deviation	0.00312						
133					nu star	28.59						
134					Approximate Chi Square Value (.05)	17.39			Nonparametric Statistics			
135					Adjusted Level of Significance	0.0086			95% CLT UCL			0.00685
136					Adjusted Chi Square Value	13.72			95% Jackknife UCL			0.00732
137									95% Standard Bootstrap UCL			0.00667
138					Anderson-Darling Test Statistic	0.447			95% Bootstrap-t UCL			0.00748
139					Anderson-Darling 5% Critical Value	0.68			95% Hall's Bootstrap UCL			0.00625
140					Kolmogorov-Smirnov Test Statistic	0.307			95% Percentile Bootstrap UCL			0.00659
141					Kolmogorov-Smirnov 5% Critical Value	0.358			95% BCA Bootstrap UCL			0.00659
142			Data appear Gamma Distributed at 5% Significance Level						95% Chebyshev(Mean, Sd) UCL			0.00944
143									97.5% Chebyshev(Mean, Sd) UCL			0.0112
144			Assuming Gamma Distribution						99% Chebyshev(Mean, Sd) UCL			0.0148
145					95% Approximate Gamma UCL	0.00868						
146					95% Adjusted Gamma UCL	0.011						
147												
148			Potential UCL to Use						Use 95% Student's-t UCL			0.00732
149												
150	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
151	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
152	and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											
153												
154	Note: For highly negative-skewed data, confidence limits											
155	(e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
156	reliable. Chen's and Johnson's methods provide											
157	adjustments for positvely skewed data sets.											
158												
159												

Attachment A-3
Groundwater EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
160	iron											
161												
162					**General Statistics**							
163					Number of Valid Observations	10			Number of Distinct Observations			10
164												
165					**Raw Statistics**				**Log-transformed Statistics**			
166					Minimum	0.209			Minimum of Log Data			-1.565
167					Maximum	18.3			Maximum of Log Data			2.907
168					Mean	7.621			Mean of log Data			1.227
169					Median	2.9			SD of log Data			1.562
170					SD	7.773						
171					Std. Error of Mean	2.458						
172					Coefficient of Variation	1.02						
173					Skewness	0.474						
174												
175					**Relevant UCL Statistics**							
176					**Normal Distribution Test**				**Lognormal Distribution Test**			
177					Shapiro Wilk Test Statistic	0.774			Shapiro Wilk Test Statistic			0.899
178					Shapiro Wilk Critical Value	0.842			Shapiro Wilk Critical Value			0.842
179					**Data not Normal at 5% Significance Level**				**Data appear Lognormal at 5% Significance Level**			
180												
181					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
182					95% Student's-t UCL	12.13			95% H-UCL			111.2
183					**95% UCLs (Adjusted for Skewness)**				95% Chebyshev (MVUE) UCL			30.54
184					95% Adjusted-CLT UCL (Chen-1995)	12.06			97.5% Chebyshev (MVUE) UCL			39.71
185					95% Modified-t UCL (Johnson-1978)	12.19			99% Chebyshev (MVUE) UCL			57.73
186												
187					**Gamma Distribution Test**				**Data Distribution**			
188					k star (bias corrected)	0.588			**Data appear Gamma Distributed at 5% Significance Level**			
189					Theta Star	12.96						
190					MLE of Mean	7.621						
191					MLE of Standard Deviation	9.938						
192					nu star	11.76						
193					Approximate Chi Square Value (.05)	5.071			**Nonparametric Statistics**			
194					Adjusted Level of Significance	0.0267			95% CLT UCL			11.66
195					Adjusted Chi Square Value	4.333			95% Jackknife UCL			12.13
196									95% Standard Bootstrap UCL			11.44
197					Anderson-Darling Test Statistic	0.605			95% Bootstrap-t UCL			13.48
198					Anderson-Darling 5% Critical Value	0.757			95% Hall's Bootstrap UCL			10.53
199					Kolmogorov-Smirnov Test Statistic	0.247			95% Percentile Bootstrap UCL			11.76
200					Kolmogorov-Smirnov 5% Critical Value	0.276			95% BCA Bootstrap UCL			11.7
201					**Data appear Gamma Distributed at 5% Significance Level**				95% Chebyshev(Mean, Sd) UCL			18.34
202									97.5% Chebyshev(Mean, Sd) UCL			22.97
203					**Assuming Gamma Distribution**				99% Chebyshev(Mean, Sd) UCL			32.08
204					95% Approximate Gamma UCL	17.68						
205					95% Adjusted Gamma UCL	20.69						
206												
207					**Potential UCL to Use**				Use 95% Approximate Gamma UCL			17.68
208												
209					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
210					**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**							
211					**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**							
212												
213												

Attachment A-3
Groundwater EPCs (ProUCL Output) for COPCs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
214	Manganese											
215												
216					General Statistics							
217					Number of Valid Observations	5			Number of Distinct Observations			5
218												
219					Raw Statistics				Log-transformed Statistics			
220					Minimum	1.4			Minimum of Log Data			0.336
221					Maximum	3.35			Maximum of Log Data			1.209
222					Mean	2.044			Mean of log Data			0.66
223					Median	1.73			SD of log Data			0.359
224					SD	0.804						
225					Std. Error of Mean	0.359						
226					Coefficient of Variation	0.393						
227					Skewness	1.413						
228												
229												
230					Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!							
231												
232					It is suggested to collect at least 8 to 10 observations using these statistical methods!							
233					If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.							
234												
235												
236					Warning: There are only 5 Values in this data							
237					Note: It should be noted that even though bootstrap methods may be performed on this data set,							
238					the resulting calculations may not be reliable enough to draw conclusions							
239												
240					The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.							
241												
242					Relevant UCL Statistics							
243					Normal Distribution Test				Lognormal Distribution Test			
244					Shapiro Wilk Test Statistic	0.853			Shapiro Wilk Test Statistic			0.904
245					Shapiro Wilk Critical Value	0.762			Shapiro Wilk Critical Value			0.762
246					Data appear Normal at 5% Significance Level				Data appear Lognormal at 5% Significance Level			
247												
248					Assuming Normal Distribution				Assuming Lognormal Distribution			
249					95% Student's-t UCL	2.81			95% H-UCL			3.256
250					95% UCLs (Adjusted for Skewness)				95% Chebyshev (MVUE) UCL			3.454
251					95% Adjusted-CLT UCL (Chen-1995)	2.878			97.5% Chebyshev (MVUE) UCL			4.067
252					95% Modified-t UCL (Johnson-1978)	2.848			99% Chebyshev (MVUE) UCL			5.272
253												
254					Gamma Distribution Test				Data Distribution			
255					k star (bias corrected)	3.854			Data appear Normal at 5% Significance Level			
256					Theta Star	0.53						
257					MLE of Mean	2.044						
258					MLE of Standard Deviation	1.041						
259					nu star	38.54						
260					Approximate Chi Square Value (.05)	25.32			Nonparametric Statistics			
261					Adjusted Level of Significance	0.0086			95% CLT UCL			2.635
262					Adjusted Chi Square Value	20.76			95% Jackknife UCL			2.81
263									95% Standard Bootstrap UCL			2.558
264					Anderson-Darling Test Statistic	0.381			95% Bootstrap-t UCL			4.474
265					Anderson-Darling 5% Critical Value	0.679			95% Hall's Bootstrap UCL			5.855
266					Kolmogorov-Smirnov Test Statistic	0.249			95% Percentile Bootstrap UCL			2.59
267					Kolmogorov-Smirnov 5% Critical Value	0.358			95% BCA Bootstrap UCL			2.742
268					Data appear Gamma Distributed at 5% Significance Level				95% Chebyshev(Mean, Sd) UCL			3.611
269									97.5% Chebyshev(Mean, Sd) UCL			4.289
270					Assuming Gamma Distribution				99% Chebyshev(Mean, Sd) UCL			5.62
271					95% Approximate Gamma UCL	3.111						
272					95% Adjusted Gamma UCL	3.794						
273												
274					Potential UCL to Use				Use 95% Student's-t UCL			2.81
275												
276					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
277					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
278					and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.							
279												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1				**General UCL Statistics for Data Sets with Non-Detects**								
2			**User Selected Options**	**Skeet Range, SW**								
3			From File	input.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
9	Antimony											
10												
11					General Statistics							
12					Number of Valid Data	5			Number of Detected Data			3
13					Number of Distinct Detected Data	3			Number of Non-Detect Data			2
14									Percent Non-Detects			40.00%
15												
16				Raw Statistics					Log-transformed Statistics			
17					Minimum Detected	0.0041			Minimum Detected			-5.497
18					Maximum Detected	0.0734			Maximum Detected			-2.612
19					Mean of Detected	0.0294			Mean of Detected			-4.219
20					SD of Detected	0.0383			SD of Detected			1.47
21					Minimum Non-Detect	0.00035			Minimum Non-Detect			-7.958
22					Maximum Non-Detect	0.00072			Maximum Non-Detect			-7.236
23												
24	Note: Data have multiple DLs - Use of KM Method is recommended								Number treated as Non-Detect			2
25	For all methods (except KM, DL/2, and ROS Methods),								Number treated as Detected			3
26	Observations < Largest ND are treated as NDs								Single DL Non-Detect Percentage			40.00%
27												
28					Warning: There are only 3 Distinct Detected Values in this data set							
29					The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.							
30					Those methods will return a 'N/A' value on your output display!							
31												
32					It is necessary to have 4 or more Distinct Values for bootstrap methods.							
33					However, results obtained using 4 to 9 distinct values may not be reliable.							
34					It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.							
35												
36												
37					UCL Statistics							
38				Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only			
39					Shapiro Wilk Test Statistic	0.82			Shapiro Wilk Test Statistic			0.963
40					5% Shapiro Wilk Critical Value	0.767			5% Shapiro Wilk Critical Value			0.767
41				Data appear Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level			
42												
43				Assuming Normal Distribution					Assuming Lognormal Distribution			
44					DL/2 Substitution Method				DL/2 Substitution Method			
45					Mean	0.0177			Mean			-5.847
46					SD	0.0314			SD			2.474
47					95% DL/2 (t) UCL	0.0477			95% H-Stat (DL/2) UCL			98463
48												
49					Maximum Likelihood Estimate(MLE) Method				Log ROS Method			
50					Mean	0.0056			Mean in Log Scale			-6.013
51					SD	0.0407			SD in Log Scale			2.668
52					95% MLE (t) UCL	0.0444			Mean in Original Scale			0.0177
53					95% MLE (Tiku) UCL	0.0492			SD in Original Scale			0.0314
54									95% t UCL			0.0477
55									95% Percentile Bootstrap UCL			0.0441
56									95% BCA Bootstrap UCL			0.0462
57									95% H UCL			1390149
58												
59				Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only			
60					k star (bias corrected)	N/A			Data appear Normal at 5% Significance Level			
61					Theta Star	N/A						
62					nu star	N/A						
63												
64					A-D Test Statistic	N/A			Nonparametric Statistics			
65					5% A-D Critical Value	N/A			Kaplan-Meier (KM) Method			
66					K-S Test Statistic	N/A			Mean			0.0193
67					5% K-S Critical Value	N/A			SD			0.0272
68				Data not Gamma Distributed at 5% Significance Level					SE of Mean			0.0149
69									95% KM (t) UCL			0.051
70				Assuming Gamma Distribution					95% KM (z) UCL			0.0438
71					Gamma ROS Statistics using Extrapolated Data				95% KM (jackknife) UCL			0.0476
72					Minimum	N/A			95% KM (bootstrap t) UCL			0.173
73					Maximum	N/A			95% KM (BCA) UCL			0.0734
74					Mean	N/A			95% KM (Percentile Bootstrap) UCL			0.0734
75					Median	N/A			95% KM (Chebyshev) UCL			0.0842
76					SD	N/A			97.5% KM (Chebyshev) UCL			0.112
77					k star	N/A			99% KM (Chebyshev) UCL			0.167
78					Theta star	N/A						
79					Nu star	N/A			Potential UCLs to Use			
80					AppChi2	N/A			95% KM (t) UCL			0.051
81					95% Gamma Approximate UCL	N/A			95% KM (Percentile Bootstrap) UCL			0.0734
82					95% Adjusted Gamma UCL	N/A						
83	Note: DL/2 is not a recommended method.											
84												
85					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
86					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
87					For additional insight, the user may want to consult a statistician.							
88												
89												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
90	**Arsenic**											
91												
92					**General Statistics**							
93					Number of Valid Data	5			Number of Detected Data			2
94					Number of Distinct Detected Data	2			Number of Non-Detect Data			3
95									Percent Non-Detects			60.00%
96												
97					**Raw Statistics**				**Log-transformed Statistics**			
98					Minimum Detected	0.000795			Minimum Detected			-7.137
99					Maximum Detected	0.023			Maximum Detected			-3.772
100					Mean of Detected	0.0119			Mean of Detected			-5.455
101					SD of Detected	0.0157			SD of Detected			2.379
102					Minimum Non-Detect	0.0003			Minimum Non-Detect			-8.112
103					Maximum Non-Detect	0.001			Maximum Non-Detect			-6.908
104												
105	Note: Data have multiple DLs - Use of KM Method is recommended								Number treated as Non-Detect			4
106	For all methods (except KM, DL/2, and ROS Methods),								Number treated as Detected			1
107	Observations < Largest ND are treated as NDs								Single DL Non-Detect Percentage			80.00%
108												
109	**Warning: Data set has only 2 Distinct Detected Values.**											
110	**This may not be adequate enough to compute meaningful and reliable test statistics and estimates.**											
111	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
112												
113	**Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.**											
114												
115	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
116	**Those methods will return a 'N/A' value on your output display!**											
117												
118	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
119	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
120	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
121												
122												
123					**UCL Statistics**							
124					**Normal Distribution Test with Detected Values Only**				**Lognormal Distribution Test with Detected Values Only**			
125					Shapiro Wilk Test Statistic	N/A			Shapiro Wilk Test Statistic			N/A
126					5% Shapiro Wilk Critical Value	N/A			5% Shapiro Wilk Critical Value			N/A
127					**Data not Normal at 5% Significance Level**				**Data not Lognormal at 5% Significance Level**			
128												
129					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
130					DL/2 Substitution Method				DL/2 Substitution Method			
131					Mean	0.00493			Mean			-7.157
132					SD	0.0101			SD			2.006
133					95% DL/2 (t) UCL	0.0146			95% H-Stat (DL/2) UCL			73.18
134												
135					Maximum Likelihood Estimate(MLE) Method	N/A			Log ROS Method			
136					**MLE method failed to converge properly**				Mean in Log Scale			N/A
137									SD in Log Scale			N/A
138									Mean in Original Scale			N/A
139									SD in Original Scale			N/A
140									95% t UCL			N/A
141									95% Percentile Bootstrap UCL			N/A
142									95% BCA Bootstrap UCL			N/A
143									95% H-UCL			N/A
144												
145					**Gamma Distribution Test with Detected Values Only**				**Data Distribution Test with Detected Values Only**			
146					k star (bias corrected)	N/A			**Data do not follow a Discernable Distribution (0.05)**			
147					Theta Star	N/A						
148					nu star	N/A						
149												
150					A-D Test Statistic	N/A			**Nonparametric Statistics**			
151					5% A-D Critical Value	N/A			Kaplan-Meier (KM) Method			
152					K-S Test Statistic	N/A			Mean			0.00524
153					5% K-S Critical Value	N/A			SD			0.00888
154					**Data not Gamma Distributed at 5% Significance Level**				SE of Mean			0.00562
155									95% KM (t) UCL			0.0172
156					**Assuming Gamma Distribution**				95% KM (z) UCL			0.0145
157					Gamma ROS Statistics using Extrapolated Data				95% KM (jackknife) UCL			0.024
158					Minimum	N/A			95% KM (bootstrap t) UCL			N/A
159					Maximum	N/A			95% KM (BCA) UCL			0.023
160					Mean	N/A			95% KM (Percentile Bootstrap) UCL			0.023
161					Median	N/A			95% KM (Chebyshev) UCL			0.0297
162					SD	N/A			97.5% KM (Chebyshev) UCL			0.0403
163					k star	N/A			99% KM (Chebyshev) UCL			0.0611
164					Theta star	N/A						
165					Nu star	N/A			**Potential UCLs to Use**			
166					AppChi2	N/A			99% KM (Chebyshev) UCL			0.0611
167					95% Gamma Approximate UCL	N/A						
168					95% Adjusted Gamma UCL	N/A						
169					**Warning: Recommended UCL exceeds the maximum observation**							
170	**Note: DL/2 is not a recommended method.**											
171												
172	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
173	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
174	**For additional insight, the user may want to consult a statistician.**											
175												
176												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
177	Iron											
178												
179	General Statistics											
180					Number of Valid Observations	5			Number of Distinct Observations			5
181												
182	Raw Statistics						Log-transformed Statistics					
183					Minimum	0.312			Minimum of Log Data			-1.165
184					Maximum	8.34			Maximum of Log Data			2.121
185					Mean	2.191			Mean of log Data			0.0168
186					Median	0.831			SD of log Data			1.252
187					SD	3.446						
188					Std. Error of Mean	1.541						
189					Coefficient of Variation	1.573						
190					Skewness	2.208						
191												
192												
193	Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!											
194												
195	It is suggested to collect at least 8 to 10 observations using these statistical methods!											
196	If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.											
197												
198												
199	Warning: There are only 5 Values in this data											
200	Note: It should be noted that even though bootstrap methods may be performed on this data set,											
201	the resulting calculations may not be reliable enough to draw conclusions											
202												
203	The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.											
204												
205	Relevant UCL Statistics											
206	Normal Distribution Test						Lognormal Distribution Test					
207					Shapiro Wilk Test Statistic	0.62			Shapiro Wilk Test Statistic			0.853
208					Shapiro Wilk Critical Value	0.762			Shapiro Wilk Critical Value			0.762
209	Data not Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level					
210												
211	Assuming Normal Distribution						Assuming Lognormal Distribution					
212					95% Student's-t UCL	5.476			95% H-UCL			95.65
213	95% UCLs (Adjusted for Skewness)								95% Chebyshev (MVUE) UCL			5.902
214					95% Adjusted-CLT UCL (Chen-1995)	6.352			97.5% Chebyshev (MVUE) UCL			7.676
215					95% Modified-t UCL (Johnson-1978)	5.73			99% Chebyshev (MVUE) UCL			11.16
216												
217	Gamma Distribution Test						Data Distribution					
218					k star (bias corrected)	0.444	Data appear Lognormal at 5% Significance Level					
219					Theta Star	4.934						
220					MLE of Mean	2.191						
221					MLE of Standard Deviation	3.288						
222					nu star	4.44						
223					Approximate Chi Square Value (.05)	0.903	Nonparametric Statistics					
224					Adjusted Level of Significance	0.0086			95% CLT UCL			4.726
225					Adjusted Chi Square Value	0.393			95% Jackknife UCL			5.476
226									95% Standard Bootstrap UCL			4.425
227					Anderson-Darling Test Statistic	0.733			95% Bootstrap-t UCL			32.81
228					Anderson-Darling 5% Critical Value	0.698			95% Hall's Bootstrap UCL			33.93
229					Kolmogorov-Smirnov Test Statistic	0.404			95% Percentile Bootstrap UCL			5.175
230					Kolmogorov-Smirnov 5% Critical Value	0.366			95% BCA Bootstrap UCL			5.298
231	Data not Gamma Distributed at 5% Significance Level								95% Chebyshev(Mean, Sd) UCL			8.908
232									97.5% Chebyshev(Mean, Sd) UCL			11.82
233	Assuming Gamma Distribution								99% Chebyshev(Mean, Sd) UCL			17.53
234					95% Approximate Gamma UCL	10.77						
235					95% Adjusted Gamma UCL	24.75						
236												
237	Potential UCL to Use								Use 95% Chebyshev (Mean, Sd) UCL			8.908
238	Recommended UCL exceeds the maximum observation											
239												
240	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
241	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
242	and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											
243												
244												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
245	**Lead**											
246												
247					**General Statistics**							
248					Number of Valid Observations	5			Number of Distinct Observations			5
249												
250					**Raw Statistics**				**Log-transformed Statistics**			
251					Minimum	0.0043			Minimum of Log Data			-5.449
252					Maximum	7.53			Maximum of Log Data			2.019
253					Mean	1.7			Mean of log Data			-2.038
254					Median	0.0706			SD of log Data			2.993
255					SD	3.28						
256					Std. Error of Mean	1.467						
257					Coefficient of Variation	1.93						
258					Skewness	2.169						
259												
260												
261	**Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!**											
262												
263	**It is suggested to collect at least 8 to 10 observations using these statistical methods!**											
264	**If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.**											
265												
266												
267	**Warning: There are only 5 Values in this data**											
268	**Note: It should be noted that even though bootstrap methods may be performed on this data set,**											
269	**the resulting calculations may not be reliable enough to draw conclusions**											
270												
271	**The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.**											
272												
273					**Relevant UCL Statistics**							
274					**Normal Distribution Test**				**Lognormal Distribution Test**			
275					Shapiro Wilk Test Statistic	0.63			Shapiro Wilk Test Statistic			0.968
276					Shapiro Wilk Critical Value	0.762			Shapiro Wilk Critical Value			0.762
277					**Data not Normal at 5% Significance Level**				**Data appear Lognormal at 5% Significance Level**			
278												
279					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
280					95% Student's-t UCL	4.826			95% H-UCL			1.32E+10
281					**95% UCLs (Adjusted for Skewness)**				95% Chebyshev (MVUE) UCL			8.051
282					95% Adjusted-CLT UCL (Chen-1995)	5.633			97.5% Chebyshev (MVUE) UCL			10.82
283					95% Modified-t UCL (Johnson-1978)	5.064			99% Chebyshev (MVUE) UCL			16.27
284												
285					**Gamma Distribution Test**				**Data Distribution**			
286					k star (bias corrected)	0.242			**Data appear Gamma Distributed at 5% Significance Level**			
287					Theta Star	7.011						
288					MLE of Mean	1.7						
289					MLE of Standard Deviation	3.452						
290					nu star	2.424						
291					Approximate Chi Square Value (.05)	0.224			**Nonparametric Statistics**			
292					Adjusted Level of Significance	0.0086			95% CLT UCL			4.112
293					Adjusted Chi Square Value	0.0893			95% Jackknife UCL			4.826
294									95% Standard Bootstrap UCL			3.894
295					Anderson-Darling Test Statistic	0.363			95% Bootstrap-t UCL			174.4
296					Anderson-Darling 5% Critical Value	0.749			95% Hall's Bootstrap UCL			92.03
297					Kolmogorov-Smirnov Test Statistic	0.274			95% Percentile Bootstrap UCL			4.523
298					Kolmogorov-Smirnov 5% Critical Value	0.382			95% BCA Bootstrap UCL			4.707
299					**Data appear Gamma Distributed at 5% Significance Level**				95% Chebyshev(Mean, Sd) UCL			8.093
300									97.5% Chebyshev(Mean, Sd) UCL			10.86
301					**Assuming Gamma Distribution**				99% Chebyshev(Mean, Sd) UCL			16.29
302					95% Approximate Gamma UCL	18.35						
303					95% Adjusted Gamma UCL	46.15						
304												
305					**Potential UCL to Use**				Use 95% Adjusted Gamma UCL			46.15
306					**Recommended UCL exceeds the maximum observation**							
307												
308	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
309	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
310	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
311												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
312	**Copper**											
313												
314						**General Statistics**						
315						Number of Valid Data	5				Number of Detected Data	3
316						Number of Distinct Detected Data	3				Number of Non-Detect Data	2
317											Percent Non-Detects	40.00%
318												
319					**Raw Statistics**				**Log-transformed Statistics**			
320						Minimum Detected	0.0034				Minimum Detected	-5.684
321						Maximum Detected	0.0221				Maximum Detected	-3.812
322						Mean of Detected	0.00975				Mean of Detected	-5.027
323						SD of Detected	0.0107				SD of Detected	1.054
324						Minimum Non-Detect	0.0028				Minimum Non-Detect	-5.878
325						Maximum Non-Detect	0.003				Maximum Non-Detect	-5.809
326												
327	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	2
328	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	3
329	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	40.00%
330												
331					**Warning: There are only 3 Distinct Detected Values in this data set**							
332					**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**							
333					**Those methods will return a 'N/A' value on your output display!**							
334												
335					**It is necessary to have 4 or more Distinct Values for bootstrap methods.**							
336					**However, results obtained using 4 to 9 distinct values may not be reliable.**							
337					**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**							
338												
339												
340						**UCL Statistics**						
341					**Normal Distribution Test with Detected Values Only**				**Lognormal Distribution Test with Detected Values Only**			
342						Shapiro Wilk Test Statistic	0.764				Shapiro Wilk Test Statistic	0.789
343						5% Shapiro Wilk Critical Value	0.767				5% Shapiro Wilk Critical Value	0.767
344					**Data not Normal at 5% Significance Level**				**Data appear Lognormal at 5% Significance Level**			
345												
346					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
347						DL/2 Substitution Method					DL/2 Substitution Method	
348						Mean	0.00643				Mean	-5.631
349						SD	0.00882				SD	1.113
350						95% DL/2 (t) UCL	0.0148				95% H-Stat (DL/2) UCL	0.134
351												
352						Maximum Likelihood Estimate(MLE) Method					Log ROS Method	
353						Mean	0.00369				Mean in Log Scale	-6.218
354						SD	0.0108				SD in Log Scale	1.793
355						95% MLE (t) UCL	0.014				Mean in Original Scale	0.00598
356						95% MLE (Tiku) UCL	0.0153				SD in Original Scale	0.00915
357											95% t UCL	0.0147
358											95% Percentile Bootstrap UCL	0.0134
359											95% BCA Bootstrap UCL	0.014
360											95% H UCL	19.22
361												
362					**Gamma Distribution Test with Detected Values Only**				**Data Distribution Test with Detected Values Only**			
363						k star (bias corrected)	N/A		**Data appear Lognormal at 5% Significance Level**			
364						Theta Star	N/A					
365						nu star	N/A					
366												
367						A-D Test Statistic	N/A			**Nonparametric Statistics**		
368						5% A-D Critical Value	N/A				Kaplan-Meier (KM) Method	
369						K-S Test Statistic	N/A				Mean	0.00721
370						5% K-S Critical Value	N/A				SD	0.00745
371					**Data not Gamma Distributed at 5% Significance Level**						SE of Mean	0.00408
372											95% KM (t) UCL	0.0159
373					**Assuming Gamma Distribution**						95% KM (z) UCL	0.0139
374						Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL	0.0151
375						Minimum	N/A				95% KM (bootstrap t) UCL	0.218
376						Maximum	N/A				95% KM (BCA) UCL	0.0221
377						Mean	N/A				95% KM (Percentile Bootstrap) UCL	0.0221
378						Median	N/A				95% KM (Chebyshev) UCL	0.025
379						SD	N/A				97.5% KM (Chebyshev) UCL	0.0327
380						k star	N/A				99% KM (Chebyshev) UCL	0.0478
381						Theta star	N/A					
382						Nu star	N/A			**Potential UCLs to Use**		
383						AppChi2	N/A				97.5% KM (Chebyshev) UCL	0.0327
384						95% Gamma Approximate UCL	N/A					
385						95% Adjusted Gamma UCL	N/A					
386					**Warning: Recommended UCL exceeds the maximum observation**							
387	**Note: DL/2 is not a recommended method.**											
388												
389					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
390					**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**							
391					**For additional insight, the user may want to consult a statistician.**							
392												
393												

Attachment A-4
Surface Water EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
394	Zinc											
395												
396					General Statistics							
397					Number of Valid Data	5			Number of Detected Data			3
398					Number of Distinct Detected Data	3			Number of Non-Detect Data			2
399									Percent Non-Detects			40.00%
400												
401				Raw Statistics					Log-transformed Statistics			
402					Minimum Detected	0.0518			Minimum Detected			-2.961
403					Maximum Detected	0.0663			Maximum Detected			-2.714
404					Mean of Detected	0.0591			Mean of Detected			-2.834
405					SD of Detected	0.00728			SD of Detected			0.124
406					Minimum Non-Detect	0.0129			Minimum Non-Detect			-4.351
407					Maximum Non-Detect	0.0259			Maximum Non-Detect			-3.654
408												
409	Note: Data have multiple DLs - Use of KM Method is recommended								Number treated as Non-Detect			2
410	For all methods (except KM, DL/2, and ROS Methods),								Number treated as Detected			3
411	Observations < Largest ND are treated as NDs								Single DL Non-Detect Percentage			40.00%
412												
413	Warning: There are only 3 Distinct Detected Values in this data set											
414	The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.											
415	Those methods will return a 'N/A' value on your output display!											
416												
417	It is necessary to have 4 or more Distinct Values for bootstrap methods.											
418	However, results obtained using 4 to 9 distinct values may not be reliable.											
419	It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.											
420												
421												
422					UCL Statistics							
423				Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only			
424					Shapiro Wilk Test Statistic	1			Shapiro Wilk Test Statistic			0.998
425					5% Shapiro Wilk Critical Value	0.767			5% Shapiro Wilk Critical Value			0.767
426				Data appear Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level			
427												
428				Assuming Normal Distribution					Assuming Lognormal Distribution			
429					DL/2 Substitution Method				DL/2 Substitution Method			
430					Mean	0.0393			Mean			-3.578
431					SD	0.0276			SD			1.052
432					95% DL/2 (t) UCL	0.0657			95% H-Stat (DL/2) UCL			0.723
433												
434					Maximum Likelihood Estimate(MLE) Method				Log ROS Method			
435					Mean	0.039			Mean in Log Scale			-2.985
436					SD	0.0265			SD in Log Scale			0.225
437					95% MLE (t) UCL	0.0643			Mean in Original Scale			0.0516
438					95% MLE (Tiku) UCL	0.068			SD in Original Scale			0.0115
439									95% t UCL			0.0625
440									95% Percentile Bootstrap UCL			0.0591
441									95% BCA Bootstrap UCL			0.0591
442									95% H UCL			0.0667
443												
444				Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only			
445					k star (bias corrected)	N/A			Data appear Normal at 5% Significance Level			
446					Theta Star	N/A						
447					nu star	N/A						
448												
449					A-D Test Statistic	N/A			Nonparametric Statistics			
450					5% A-D Critical Value	N/A			Kaplan-Meier (KM) Method			
451					K-S Test Statistic	N/A			Mean			0.0562
452					5% K-S Critical Value	N/A			SD			0.00584
453				Data not Gamma Distributed at 5% Significance Level					SE of Mean			0.0032
454									95% KM (t) UCL			0.063
455				Assuming Gamma Distribution					95% KM (z) UCL			0.0614
456					Gamma ROS Statistics using Extrapolated Data				95% KM (jackknife) UCL			0.0636
457					Minimum	N/A			95% KM (bootstrap t) UCL			0.0622
458					Maximum	N/A			95% KM (BCA) UCL			0.0663
459					Mean	N/A			95% KM (Percentile Bootstrap) UCL			0.0663
460					Median	N/A			95% KM (Chebyshev) UCL			0.0701
461					SD	N/A			97.5% KM (Chebyshev) UCL			0.0761
462					k star	N/A			99% KM (Chebyshev) UCL			0.088
463					Theta star	N/A						
464					Nu star	N/A			Potential UCLs to Use			
465					AppChi2	N/A			95% KM (t) UCL			0.063
466					95% Gamma Approximate UCL	N/A			95% KM (Percentile Bootstrap) UCL			0.0663
467					95% Adjusted Gamma UCL	N/A						
468	Note: DL/2 is not a recommended method.											
469												
470	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
471	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
472	For additional insight, the user may want to consult a statistician.											
473												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
1				**General UCL Statistics for Data Sets with Non-Detects**								
2			**User Selected Options**	**Skeet Range, SD**								
3			From File	input.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
9	Benzo(b)fluoranthene											
10												
11						General Statistics						
12					Number of Valid Data	8				Number of Detected Data		1
13					Number of Distinct Detected Data	1				Number of Non-Detect Data		7
14										Percent Non-Detects		87.50%
15												
16					Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!							
17	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV)											
18												
19					The data set for variable Benzo(b)fluoranthene was not processed!							
20												
21												
22												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
23	Iron											
24												
25					General Statistics							
26					Number of Valid Observations	6				Number of Distinct Observations		6
27												
28					Raw Statistics					Log-transformed Statistics		
29					Minimum	5010				Minimum of Log Data		8.519
30					Maximum	19900				Maximum of Log Data		9.898
31					Mean	12290				Mean of log Data		9.313
32					Median	12575				SD of log Data		0.521
33					SD	5611						
34					Std. Error of Mean	2291						
35					Coefficient of Variation	0.457						
36					Skewness	0.00395						
37												
38												
39	Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!											
40												
41	It is suggested to collect at least 8 to 10 observations using these statistical methods!											
42	If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.											
43												
44												
45	Warning: There are only 6 Values in this data											
46	Note: It should be noted that even though bootstrap methods may be performed on this data set,											
47	the resulting calculations may not be reliable enough to draw conclusions											
48												
49	The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.											
50												
51					Relevant UCL Statistics							
52					Normal Distribution Test					Lognormal Distribution Test		
53					Shapiro Wilk Test Statistic	0.976				Shapiro Wilk Test Statistic		0.948
54					Shapiro Wilk Critical Value	0.788				Shapiro Wilk Critical Value		0.788
55					Data appear Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level		
56												
57					Assuming Normal Distribution					Assuming Lognormal Distribution		
58					95% Student's-t UCL	16906				95% H-UCL		23781
59					95% UCLs (Adjusted for Skewness)					95% Chebyshev (MVUE) UCL		23876
60					95% Adjusted-CLT UCL (Chen-1995)	16062				97.5% Chebyshev (MVUE) UCL		28844
61					95% Modified-t UCL (Johnson-1978)	16906				99% Chebyshev (MVUE) UCL		38603
62												
63					Gamma Distribution Test					Data Distribution		
64					k star (bias corrected)	2.616				Data appear Normal at 5% Significance Level		
65					Theta Star	4697						
66					MLE of Mean	12290						
67					MLE of Standard Deviation	7598						
68					nu star	31.4						
69					Approximate Chi Square Value (.05)	19.59				Nonparametric Statistics		
70					Adjusted Level of Significance	0.0122				95% CLT UCL		16058
71					Adjusted Chi Square Value	16.32				95% Jackknife UCL		16906
72										95% Standard Bootstrap UCL		15717
73					Anderson-Darling Test Statistic	0.22				95% Bootstrap-t UCL		17369
74					Anderson-Darling 5% Critical Value	0.698				95% Hall's Bootstrap UCL		15988
75					Kolmogorov-Smirnov Test Statistic	0.175				95% Percentile Bootstrap UCL		15655
76					Kolmogorov-Smirnov 5% Critical Value	0.333				95% BCA Bootstrap UCL		15808
77					Data appear Gamma Distributed at 5% Significance Level					95% Chebyshev(Mean, Sd) UCL		22275
78										97.5% Chebyshev(Mean, Sd) UCL		26595
79					Assuming Gamma Distribution					99% Chebyshev(Mean, Sd) UCL		35082
80					95% Approximate Gamma UCL	19693						
81					95% Adjusted Gamma UCL	23646						
82												
83					Potential UCL to Use					Use 95% Student's-t UCL		16906
84												
85	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
86	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
87	and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											
88												
89												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
90	**Lead**											
91												
92					**General Statistics**							
93					Number of Valid Observations	9			Number of Distinct Observations			9
94												
95					**Raw Statistics**				**Log-transformed Statistics**			
96					Minimum	4.34			Minimum of Log Data			1.468
97					Maximum	186000			Maximum of Log Data			12.13
98					Mean	30938			Mean of log Data			6.805
99					Median	780			SD of log Data			3.755
100					SD	62602						
101					Std. Error of Mean	20867						
102					Coefficient of Variation	2.023						
103					Skewness	2.373						
104												
105												
106					**Warning: There are only 9 Values in this data**							
107					**Note: It should be noted that even though bootstrap methods may be performed on this data set,**							
108					**the resulting calculations may not be reliable enough to draw conclusions**							
109												
110					**The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.**							
111												
112					**Relevant UCL Statistics**							
113					**Normal Distribution Test**				**Lognormal Distribution Test**			
114					Shapiro Wilk Test Statistic	0.592			Shapiro Wilk Test Statistic			0.951
115					Shapiro Wilk Critical Value	0.829			Shapiro Wilk Critical Value			0.829
116					**Data not Normal at 5% Significance Level**				**Data appear Lognormal at 5% Significance Level**			
117												
118					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
119					95% Student's-t UCL	69742			95% H-UCL			9.91E+11
120					**95% UCLs (Adjusted for Skewness)**				95% Chebyshev (MVUE) UCL			390129
121					95% Adjusted-CLT UCL (Chen-1995)	82897			97.5% Chebyshev (MVUE) UCL			525684
122					95% Modified-t UCL (Johnson-1978)	72492			99% Chebyshev (MVUE) UCL			791956
123												
124					**Gamma Distribution Test**				**Data Distribution**			
125					k star (bias corrected)	0.212			**Data appear Gamma Distributed at 5% Significance Level**			
126					Theta Star	145846						
127					MLE of Mean	30938						
128					MLE of Standard Deviation	67172						
129					nu star	3.818						
130					Approximate Chi Square Value (.05)	0.651			**Nonparametric Statistics**			
131					Adjusted Level of Significance	0.0231			95% CLT UCL			65262
132					Adjusted Chi Square Value	0.43			95% Jackknife UCL			69742
133									95% Standard Bootstrap UCL			63676
134					Anderson-Darling Test Statistic	0.409			95% Bootstrap-t UCL			334377
135					Anderson-Darling 5% Critical Value	0.842			95% Hall's Bootstrap UCL			381151
136					Kolmogorov-Smirnov Test Statistic	0.211			95% Percentile Bootstrap UCL			66136
137					Kolmogorov-Smirnov 5% Critical Value	0.307			95% BCA Bootstrap UCL			85917
138					**Data appear Gamma Distributed at 5% Significance Level**				95% Chebyshev(Mean, Sd) UCL			121897
139									97.5% Chebyshev(Mean, Sd) UCL			161255
140					**Assuming Gamma Distribution**				99% Chebyshev(Mean, Sd) UCL			238566
141					95% Approximate Gamma UCL	181391						
142					95% Adjusted Gamma UCL	274984						
143												
144					**Potential UCL to Use**				Use 95% Adjusted Gamma UCL			274984
145					**Recommended UCL exceeds the maximum observation**							
146												
147					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
148					**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**							
149					**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**							
150												
151												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
152	Antimony											
153												
154						General Statistics						
155					Number of Valid Data	5				Number of Detected Data		3
156					Number of Distinct Detected Data	3				Number of Non-Detect Data		2
157										Percent Non-Detects		40.00%
158												
159					Raw Statistics					Log-transformed Statistics		
160					Minimum Detected	84.4				Minimum Detected		4.436
161					Maximum Detected	6250				Maximum Detected		8.74
162					Mean of Detected	3508				Mean of Detected		7.172
163					SD of Detected	3139				SD of Detected		2.378
164					Minimum Non-Detect	2.3				Minimum Non-Detect		0.833
165					Maximum Non-Detect	3.47				Maximum Non-Detect		1.244
166												
167	Note: Data have multiple DLs - Use of KM Method is recommended									Number treated as Non-Detect		2
168	For all methods (except KM, DL/2, and ROS Methods),									Number treated as Detected		3
169	Observations < Largest ND are treated as NDs									Single DL Non-Detect Percentage		40.00%
170												
171					Warning: There are only 3 Distinct Detected Values in this data set							
172					The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.							
173					Those methods will return a 'N/A' value on your output display!							
174												
175					It is necessary to have 4 or more Distinct Values for bootstrap methods.							
176					However, results obtained using 4 to 9 distinct values may not be reliable.							
177					It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.							
178												
179												
180						UCL Statistics						
181					Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only		
182					Shapiro Wilk Test Statistic	0.965				Shapiro Wilk Test Statistic		0.819
183					5% Shapiro Wilk Critical Value	0.767				5% Shapiro Wilk Critical Value		0.767
184					Data appear Normal at 5% Significance Level					Data appear Lognormal at 5% Significance Level		
185												
186					Assuming Normal Distribution					Assuming Lognormal Distribution		
187					DL/2 Substitution Method					DL/2 Substitution Method		
188					Mean	2105				Mean		4.441
189					SD	2935				SD		4.103
190					95% DL/2 (t) UCL	4904				95% H-Stat (DL/2) UCL		3.6E+22
191												
192					Maximum Likelihood Estimate(MLE) Method					Log ROS Method		
193					Mean	986.1				Mean in Log Scale		4.621
194					SD	3925				SD in Log Scale		3.877
195					95% MLE (t) UCL	4728				Mean in Original Scale		2106
196					95% MLE (Tiku) UCL	5207				SD in Original Scale		2935
197										95% t UCL		4904
198										95% Percentile Bootstrap UCL		4176
199										95% BCA Bootstrap UCL		3767
200										95% H UCL		2.72E+20
201												
202					Gamma Distribution Test with Detected Values Only					Data Distribution Test with Detected Values Only		
203					k star (bias corrected)	N/A				Data appear Normal at 5% Significance Level		
204					Theta Star	N/A						
205					nu star	N/A						
206												
207					A-D Test Statistic	N/A				Nonparametric Statistics		
208					5% A-D Critical Value	N/A				Kaplan-Meier (KM) Method		
209					K-S Test Statistic	N/A				Mean		2139
210					5% K-S Critical Value	N/A				SD		2599
211					Data not Gamma Distributed at 5% Significance Level					SE of Mean		1423
212										95% KM (t) UCL		5173
213					Assuming Gamma Distribution					95% KM (z) UCL		4480
214					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		5750
215					Minimum	N/A				95% KM (bootstrap t) UCL		3087
216					Maximum	N/A				95% KM (BCA) UCL		6250
217					Mean	N/A				95% KM (Percentile Bootstrap) UCL		6250
218					Median	N/A				95% KM (Chebyshev) UCL		8343
219					SD	N/A				97.5% KM (Chebyshev) UCL		11028
220					k star	N/A				99% KM (Chebyshev) UCL		16302
221					Theta star	N/A						
222					Nu star	N/A				Potential UCLs to Use		
223					AppChi2	N/A				95% KM (t) UCL		5173
224					95% Gamma Approximate UCL	N/A				95% KM (Percentile Bootstrap) UCL		6250
225					95% Adjusted Gamma UCL	N/A						
226	Note: DL/2 is not a recommended method.											
227												
228					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
229					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
230					For additional insight, the user may want to consult a statistician.							
231												
232												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
233	Arsenic											
234												
235					General Statistics							
236					Number of Valid Observations	5			Number of Distinct Observations			5
237												
238					Raw Statistics				Log-transformed Statistics			
239					Minimum	0.42			Minimum of Log Data			-0.868
240					Maximum	851			Maximum of Log Data			6.746
241					Mean	209.4			Mean of log Data			3.135
242					Median	12.4			SD of log Data			2.941
243					SD	366						
244					Std. Error of Mean	163.7						
245					Coefficient of Variation	1.748						
246					Skewness	2.033						
247												
248												
249					Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!							
250												
251					It is suggested to collect at least 8 to 10 observations using these statistical methods!							
252					If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.							
253												
254												
255					Warning: There are only 5 Values in this data							
256					Note: It should be noted that even though bootstrap methods may be performed on this data set,							
257					the resulting calculations may not be reliable enough to draw conclusions							
258												
259					The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.							
260												
261					Relevant UCL Statistics							
262					Normal Distribution Test				Lognormal Distribution Test			
263					Shapiro Wilk Test Statistic	0.684			Shapiro Wilk Test Statistic			0.971
264					Shapiro Wilk Critical Value	0.762			Shapiro Wilk Critical Value			0.762
265					Data not Normal at 5% Significance Level				Data appear Lognormal at 5% Significance Level			
266												
267					Assuming Normal Distribution				Assuming Lognormal Distribution			
268					95% Student's-t UCL	558.3			95% H-UCL			9.76E+11
269					95% UCLs (Adjusted for Skewness)				95% Chebyshev (MVUE) UCL			1320
270					95% Adjusted-CLT UCL (Chen-1995)	637.6			97.5% Chebyshev (MVUE) UCL			1775
271					95% Modified-t UCL (Johnson-1978)	583.1			99% Chebyshev (MVUE) UCL			2667
272												
273					Gamma Distribution Test				Data Distribution			
274					k star (bias corrected)	0.258			Data appear Gamma Distributed at 5% Significance Level			
275					Theta Star	813.3						
276					MLE of Mean	209.4						
277					MLE of Standard Deviation	412.7						
278					nu star	2.575						
279					Approximate Chi Square Value (.05)	0.259			Nonparametric Statistics			
280					Adjusted Level of Significance	0.0086			95% CLT UCL			478.6
281					Adjusted Chi Square Value	0.0994			95% Jackknife UCL			558.3
282									95% Standard Bootstrap UCL			449.1
283					Anderson-Darling Test Statistic	0.293			95% Bootstrap-t UCL			14175
284					Anderson-Darling 5% Critical Value	0.738			95% Hall's Bootstrap UCL			5168
285					Kolmogorov-Smirnov Test Statistic	0.279			95% Percentile Bootstrap UCL			512.3
286					Kolmogorov-Smirnov 5% Critical Value	0.379			95% BCA Bootstrap UCL			547.3
287					Data appear Gamma Distributed at 5% Significance Level				95% Chebyshev(Mean, Sd) UCL			922.8
288									97.5% Chebyshev(Mean, Sd) UCL			1232
289					Assuming Gamma Distribution				99% Chebyshev(Mean, Sd) UCL			1838
290					95% Approximate Gamma UCL	2086						
291					95% Adjusted Gamma UCL	5425						
292												
293					Potential UCL to Use				Use 95% Adjusted Gamma UCL			5425
294					Recommended UCL exceeds the maximum observation							
295												
296					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
297					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
298					and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.							
299												
300												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
301	**Copper**											
302												
303					**General Statistics**							
304					Number of Valid Observations	6				Number of Distinct Observations		6
305												
306					**Raw Statistics**					**Log-transformed Statistics**		
307					Minimum	6.15				Minimum of Log Data		1.816
308					Maximum	514				Maximum of Log Data		6.242
309					Mean	203.3				Mean of log Data		4.478
310					Median	224.8				SD of log Data		1.834
311					SD	186.7						
312					Std. Error of Mean	76.22						
313					Coefficient of Variation	0.918						
314					Skewness	0.711						
315												
316												
317	**Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!**											
318												
319	**It is suggested to collect at least 8 to 10 observations using these statistical methods!**											
320	**If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.**											
321												
322												
323	**Warning: There are only 6 Values in this data**											
324	**Note: It should be noted that even though bootstrap methods may be performed on this data set,**											
325	**the resulting calculations may not be reliable enough to draw conclusions**											
326												
327	**The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.**											
328												
329					**Relevant UCL Statistics**							
330					**Normal Distribution Test**					**Lognormal Distribution Test**		
331					Shapiro Wilk Test Statistic	0.882				Shapiro Wilk Test Statistic		0.808
332					Shapiro Wilk Critical Value	0.788				Shapiro Wilk Critical Value		0.788
333					**Data appear Normal at 5% Significance Level**					**Data appear Lognormal at 5% Significance Level**		
334												
335					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
336					95% Student's-t UCL	356.9				95% H-UCL		158895
337					**95% UCLs (Adjusted for Skewness)**					95% Chebyshev (MVUE) UCL		1150
338					95% Adjusted-CLT UCL (Chen-1995)	352.3				97.5% Chebyshev (MVUE) UCL		1521
339					95% Modified-t UCL (Johnson-1978)	360.6				99% Chebyshev (MVUE) UCL		2250
340												
341					**Gamma Distribution Test**					**Data Distribution**		
342					k star (bias corrected)	0.471				**Data appear Normal at 5% Significance Level**		
343					Theta Star	431.8						
344					MLE of Mean	203.3						
345					MLE of Standard Deviation	296.3						
346					nu star	5.65						
347					Approximate Chi Square Value (.05)	1.464				**Nonparametric Statistics**		
348					Adjusted Level of Significance	0.0122				95% CLT UCL		328.7
349					Adjusted Chi Square Value	0.828				95% Jackknife UCL		356.9
350										95% Standard Bootstrap UCL		317.5
351					Anderson-Darling Test Statistic	0.603				95% Bootstrap-t UCL		390.5
352					Anderson-Darling 5% Critical Value	0.723				95% Hall's Bootstrap UCL		376.3
353					Kolmogorov-Smirnov Test Statistic	0.335				95% Percentile Bootstrap UCL		325.3
354					Kolmogorov-Smirnov 5% Critical Value	0.344				95% BCA Bootstrap UCL		337.1
355					**Data appear Gamma Distributed at 5% Significance Level**					95% Chebyshev(Mean, Sd) UCL		535.6
356										97.5% Chebyshev(Mean, Sd) UCL		679.3
357					**Assuming Gamma Distribution**					99% Chebyshev(Mean, Sd) UCL		961.7
358					95% Approximate Gamma UCL	784.9						
359					95% Adjusted Gamma UCL	1387						
360												
361					**Potential UCL to Use**					Use 95% Student's-t UCL		356.9
362												
363	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
364	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
365	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
366												
367												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
368	Zinc											
369												
370					General Statistics							
371					Number of Valid Observations	6			Number of Distinct Observations			6
372												
373					Raw Statistics				Log-transformed Statistics			
374					Minimum	23			Minimum of Log Data			3.135
375					Maximum	629			Maximum of Log Data			6.444
376					Mean	167.7			Mean of log Data			4.398
377					Median	56.53			SD of log Data			1.263
378					SD	236.4						
379					Std. Error of Mean	96.5						
380					Coefficient of Variation	1.41						
381					Skewness	2.041						
382												
383												
384					Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!							
385												
386					It is suggested to collect at least 8 to 10 observations using these statistical methods!							
387					If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.							
388												
389												
390					Warning: There are only 6 Values in this data							
391					Note: It should be noted that even though bootstrap methods may be performed on this data set,							
392					the resulting calculations may not be reliable enough to draw conclusions							
393												
394					The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.							
395												
396					Relevant UCL Statistics							
397					Normal Distribution Test				Lognormal Distribution Test			
398					Shapiro Wilk Test Statistic	0.697			Shapiro Wilk Test Statistic			0.908
399					Shapiro Wilk Critical Value	0.788			Shapiro Wilk Critical Value			0.788
400					Data not Normal at 5% Significance Level				Data appear Lognormal at 5% Significance Level			
401												
402					Assuming Normal Distribution				Assuming Lognormal Distribution			
403					95% Student's-t UCL	362.1			95% H-UCL			3104
404					95% UCLs (Adjusted for Skewness)				95% Chebyshev (MVUE) UCL			475
405					95% Adjusted-CLT UCL (Chen-1995)	412.3			97.5% Chebyshev (MVUE) UCL			615.6
406					95% Modified-t UCL (Johnson-1978)	375.5			99% Chebyshev (MVUE) UCL			891.9
407												
408					Gamma Distribution Test				Data Distribution			
409					k star (bias corrected)	0.52			Data appear Gamma Distributed at 5% Significance Level			
410					Theta Star	322.4						
411					MLE of Mean	167.7						
412					MLE of Standard Deviation	232.5						
413					nu star	6.241						
414					Approximate Chi Square Value (.05)	1.764			Nonparametric Statistics			
415					Adjusted Level of Significance	0.0122			95% CLT UCL			326.4
416					Adjusted Chi Square Value	1.038			95% Jackknife UCL			362.1
417									95% Standard Bootstrap UCL			316.5
418					Anderson-Darling Test Statistic	0.529			95% Bootstrap-t UCL			2002
419					Anderson-Darling 5% Critical Value	0.719			95% Hall's Bootstrap UCL			1342
420					Kolmogorov-Smirnov Test Statistic	0.317			95% Percentile Bootstrap UCL			337.2
421					Kolmogorov-Smirnov 5% Critical Value	0.343			95% BCA Bootstrap UCL			428.2
422					Data appear Gamma Distributed at 5% Significance Level				95% Chebyshev(Mean, Sd) UCL			588.3
423									97.5% Chebyshev(Mean, Sd) UCL			770.3
424					Assuming Gamma Distribution				99% Chebyshev(Mean, Sd) UCL			1128
425					95% Approximate Gamma UCL	593.1						
426					95% Adjusted Gamma UCL	1008						
427												
428					Potential UCL to Use				Use 95% Approximate Gamma UCL			593.1
429												
430					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
431					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
432					and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.							
433												
434												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
435	Benzo(g,h,i)perylene											
436												
437						General Statistics						
438					Number of Valid Data	8				Number of Detected Data		1
439					Number of Distinct Detected Data	1				Number of Non-Detect Data		7
440										Percent Non-Detects		87.50%
441												
442					Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!							
443	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV)											
444												
445					The data set for variable Benzo(g,h,i)perylene was not processed!							
446												
447												
448												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
449	**Pyrene**											
450												
451						**General Statistics**						
452					Number of Valid Data	8				Number of Detected Data		2
453					Number of Distinct Detected Data	2				Number of Non-Detect Data		6
454										Percent Non-Detects		75.00%
455												
456					**Raw Statistics**					**Log-transformed Statistics**		
457					Minimum Detected	0.223				Minimum Detected		-1.501
458					Maximum Detected	0.467				Maximum Detected		-0.761
459					Mean of Detected	0.345				Mean of Detected		-1.131
460					SD of Detected	0.173				SD of Detected		0.523
461					Minimum Non-Detect	0.42				Minimum Non-Detect		-0.868
462					Maximum Non-Detect	2.1				Maximum Non-Detect		0.742
463												
464			Note: Data have multiple DLs - Use of KM Method is recommended							Number treated as Non-Detect		8
465			For all methods (except KM, DL/2, and ROS Methods),							Number treated as Detected		0
466			Observations < Largest ND are treated as NDs							Single DL Non-Detect Percentage		100.00%
467												
468					**Warning: Data set has only 2 Distinct Detected Values.**							
469					**This may not be adequate enough to compute meaningful and reliable test statistics and estimates.**							
470					**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**							
471												
472					**Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.**							
473												
474					**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**							
475					**Those methods will return a 'N/A' value on your output display!**							
476												
477					**It is necessary to have 4 or more Distinct Values for bootstrap methods.**							
478					**However, results obtained using 4 to 9 distinct values may not be reliable.**							
479					**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**							
480												
481												
482						**UCL Statistics**						
483					**Normal Distribution Test with Detected Values Only**					**Lognormal Distribution Test with Detected Values Only**		
484					Shapiro Wilk Test Statistic	N/A				Shapiro Wilk Test Statistic		N/A
485					5% Shapiro Wilk Critical Value	N/A				5% Shapiro Wilk Critical Value		N/A
486					**Data not Normal at 5% Significance Level**					**Data not Lognormal at 5% Significance Level**		
487												
488					**Assuming Normal Distribution**					**Assuming Lognormal Distribution**		
489					DL/2 Substitution Method					DL/2 Substitution Method		
490					Mean	0.569				Mean		-0.727
491					SD	0.327				SD		0.629
492					95% DL/2 (t) UCL	0.788				95% H-Stat (DL/2) UCL		1.091
493												
494					Maximum Likelihood Estimate(MLE) Method	N/A				Log ROS Method		
495					**MLE method failed to converge properly**					Mean in Log Scale		N/A
496										SD in Log Scale		N/A
497										Mean in Original Scale		N/A
498										SD in Original Scale		N/A
499										95% t UCL		N/A
500										95% Percentile Bootstrap UCL		N/A
501										95% BCA Bootstrap UCL		N/A
502										95% H-UCL		N/A
503												
504					**Gamma Distribution Test with Detected Values Only**					**Data Distribution Test with Detected Values Only**		
505					k star (bias corrected)	N/A				**Data do not follow a Discernable Distribution (0.05)**		
506					Theta Star	N/A						
507					nu star	N/A						
508												
509					A-D Test Statistic	N/A				**Nonparametric Statistics**		
510					5% A-D Critical Value	N/A				Kaplan-Meier (KM) Method		
511					K-S Test Statistic	N/A				Mean		0.304
512					5% K-S Critical Value	N/A				SD		0.115
513					**Data not Gamma Distributed at 5% Significance Level**					SE of Mean		0.0939
514										95% KM (t) UCL		0.482
515					**Assuming Gamma Distribution**					95% KM (z) UCL		0.459
516					Gamma ROS Statistics using Extrapolated Data					95% KM (jackknife) UCL		0.519
517					Minimum	N/A				95% KM (bootstrap t) UCL		N/A
518					Maximum	N/A				95% KM (BCA) UCL		0.467
519					Mean	N/A				95% KM (Percentile Bootstrap) UCL		0.467
520					Median	N/A				95% KM (Chebyshev) UCL		0.714
521					SD	N/A				97.5% KM (Chebyshev) UCL		0.891
522					k star	N/A				99% KM (Chebyshev) UCL		1.239
523					Theta star	N/A						
524					Nu star	N/A				**Potential UCLs to Use**		
525					AppChi2	N/A				95% KM (t) UCL		0.482
526					95% Gamma Approximate UCL	N/A				95% KM (% Bootstrap) UCL		0.467
527					95% Adjusted Gamma UCL	N/A						
528					**Warning: Recommended UCL exceeds the maximum observation**							
529	**Note: DL/2 is not a recommended method.**											
530												
531					**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**							
532					**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**							
533					**For additional insight, the user may want to consult a statistician.**							
534												
535												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
536	**Fluoranthene**											
537												
538					**General Statistics**							
539					Number of Valid Data	8			Number of Detected Data			2
540					Number of Distinct Detected Data	2			Number of Non-Detect Data			6
541									Percent Non-Detects			75.00%
542												
543					**Raw Statistics**				**Log-transformed Statistics**			
544					Minimum Detected	0.202			Minimum Detected			-1.599
545					Maximum Detected	0.29			Maximum Detected			-1.238
546					Mean of Detected	0.246			Mean of Detected			-1.419
547					SD of Detected	0.0622			SD of Detected			0.256
548					Minimum Non-Detect	0.42			Minimum Non-Detect			-0.868
549					Maximum Non-Detect	1.9			Maximum Non-Detect			0.642
550												
551	Note: Data have multiple DLs - Use of KM Method is recommended								Number treated as Non-Detect			8
552	For all methods (except KM, DL/2, and ROS Methods),								Number treated as Detected			0
553	Observations < Largest ND are treated as NDs								Single DL Non-Detect Percentage			100.00%
554												
555	**Warning: Data set has only 2 Distinct Detected Values.**											
556	**This may not be adequate enough to compute meaningful and reliable test statistics and estimates.**											
557	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
558												
559	**Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.**											
560												
561	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
562	**Those methods will return a 'N/A' value on your output display!**											
563												
564	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
565	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
566	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
567												
568												
569					**UCL Statistics**							
570					**Normal Distribution Test with Detected Values Only**				**Lognormal Distribution Test with Detected Values Only**			
571					Shapiro Wilk Test Statistic	N/A			Shapiro Wilk Test Statistic			N/A
572					5% Shapiro Wilk Critical Value	N/A			5% Shapiro Wilk Critical Value			N/A
573					**Data not Normal at 5% Significance Level**				**Data not Lognormal at 5% Significance Level**			
574												
575					**Assuming Normal Distribution**				**Assuming Lognormal Distribution**			
576					DL/2 Substitution Method				DL/2 Substitution Method			
577					Mean	0.519			Mean			-0.825
578					SD	0.307			SD			0.636
579					95% DL/2 (t) UCL	0.725			95% H-Stat (DL/2) UCL			1.003
580												
581					Maximum Likelihood Estimate(MLE) Method	N/A			Log ROS Method			
582					**MLE method failed to converge properly**				Mean in Log Scale			N/A
583									SD in Log Scale			N/A
584									Mean in Original Scale			N/A
585									SD in Original Scale			N/A
586									95% t UCL			N/A
587									95% Percentile Bootstrap UCL			N/A
588									95% BCA Bootstrap UCL			N/A
589									95% H-UCL			N/A
590												
591					**Gamma Distribution Test with Detected Values Only**				**Data Distribution Test with Detected Values Only**			
592					k star (bias corrected)	N/A			**Data do not follow a Discernable Distribution (0.05)**			
593					Theta Star	N/A						
594					nu star	N/A						
595												
596					A-D Test Statistic	N/A			**Nonparametric Statistics**			
597					5% A-D Critical Value	N/A			Kaplan-Meier (KM) Method			
598					K-S Test Statistic	N/A			Mean			0.246
599					5% K-S Critical Value	N/A			SD			0.044
600					**Data not Gamma Distributed at 5% Significance Level**				SE of Mean			0.044
601									95% KM (t) UCL			0.329
602					**Assuming Gamma Distribution**				95% KM (z) UCL			0.318
603					Gamma ROS Statistics using Extrapolated Data				95% KM (jackknife) UCL			0.356
604					Minimum	N/A			95% KM (bootstrap t) UCL			N/A
605					Maximum	N/A			95% KM (BCA) UCL			N/A
606					Mean	N/A			95% KM (Percentile Bootstrap) UCL			0.29
607					Median	N/A			95% KM (Chebyshev) UCL			0.438
608					SD	N/A			97.5% KM (Chebyshev) UCL			0.521
609					k star	N/A			99% KM (Chebyshev) UCL			0.684
610					Theta star	N/A						
611					Nu star	N/A			**Potential UCLs to Use**			
612					AppChi2	N/A			95% KM (t) UCL			0.329
613					95% Gamma Approximate UCL	N/A			95% KM (% Bootstrap) UCL			0.29
614					95% Adjusted Gamma UCL	N/A						
615					**Warning: Recommended UCL exceeds the maximum observation**							
616	**Note: DL/2 is not a recommended method.**											
617												
618	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
619	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
620	**For additional insight, the user may want to consult a statistician.**											
621												
622												

Attachment A-5
Sediment EPCs (ProUCL Output) for COPCs and COPECs
Picatinny Arsenal, Skeet Range

	A	B	C	D	E	F	G	H	I	J	K	L
623	Benzo(k)fluoranthene											
624												
625						General Statistics						
626					Number of Valid Data	8				Number of Detected Data		1
627					Number of Distinct Detected Data	1				Number of Non-Detect Data		7
628										Percent Non-Detects		87.50%
629												
630					Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!							
631	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV)											
632												
633					The data set for variable Benzo(k)fluoranthene was not processed!							
634												
635												

Estimation of the Particulate Emission Factor for Soil
Picatinny Arsenal, Skeet Range

Attachment Table B-1. Ambient Air Concentration (mg/m^3) for nonvolatile particulates = C_s / PEF

Estimation of the Particulate Emission Factor for Picatinny Arsenal, Skeet Range

PEF =	Particulate emission fac Q/C x 3600 s/h\0.036 x (1-V) x (U_m/U_t)3 x F(x) -- (m^3/kg)	=	7.59E+08
Where:	Q/C = inverse of mean conc/ at center of square source (g/m^2-s\kg/m^3) (site-specific)	=	5.24E+01
	V = fraction of vegetative cover (unitless)	=	5.00E-01
	U_m = mean annual windspeed (m/s)	=	4.69E+00
	U_t = equivalent threshold value of windspeed at 7 m (m/s)	=	11.32
	F(x)/function dependent on U_m/U_t derived using Cowherd et al. (unitless)	=	1.94E-01

Estimation of the Q/C_{wind} for Picatinny Arsenal, Skeet Range

Exhibit D-2 (EPA, 2002)

$Q/C_{wind} = A \times \exp[(\ln A_{site} - B)^2 / C]$

Philadelphia, PA

A= 14.0111
B= 19.6154
C= 225.3397
A_{site}= 10.8 acres Skeet Range Area (based on soil area of site)

Q/C_{wind} = 52.362531

Table C-1
Estimation of Dermal Absorbed Dose for Inorganic COPCs in Groundwater
Adult Resident, Picatinny Arsenal, Skeet Range

FOR INORGANIC CHEMICALS IN WATER (latest version 04/01)

Worksheet to Calculate Dermal Absorption of Inorganic Chemicals from Aqueous Media

Enter the Following Exposure Conditions: for site specific conditions, change values for A through AT (Given are default values from Table 8-6)

Conc =	0.001	mg/cm3 (default value for purpose of illustration)
SA=	18000	cm2
t_event =	0.58	hr/event (35 minutes/event)
EV =	1	event/day
EF =	350	days/yr
ED =	24	years
BW =	70	kg
AT =	25550	days

Default conditions for screening purposes:

Compare Dermal to Drinking: Adults showering for 35 minutes/day, compared to drinking 2L water/day

Dermal (mg/day) = DA_event * A * EV
Drinking (mg/day) = Conc * IR * ABSIG

IR: Ingestion rate of drinking water	IR =	2000	(cm3/day = L/day * 1000 cm3/L)
ABSIG: Absorption fraction in GI tract	Chemical specific		

Condition for screening: "Y" when Dermal is 10% of Drinking

Compare Dermal to Total dose exposed during adult showering assuming 5 gal/min of water flow rate

Total dose (mg/day) = Q * T_event * EV

Q: Shower flow rate (5-15 gal/min; here using 5 gal/n Q = 1135500 (cm3/hr = gal/min * 3.785 gal/l * 60 min/hr *1000 cm3/hr)

Refer to Appendix A for equations to evaluate DA_event and DAD

CHEMICAL	Kp (cm/hr)	Source of Kp (exp or default)	Conc (mg/cm3)	DA_event (mg/cm2-event)	DAD (mg/kg-day)	ABSGI (chemical specific)	Screening	Chemicals to be assessed	Derm/ Total Dose
Arsenic (arsenite)	1.0E-03	default	1.1E-05	6.4E-09	5.4E-07	100%	0.53%	N	0.00%
Chromium (III)	1.0E-03	experimental	7.32E-06	4.3E-09	3.6E-07	1.3%	40.38%	Y	0.00%
Manganese	1.0E-03	default	2.81E-03	1.6E-06	1.4E-04	4%	13.13%	Y	0.00%
added metals									
Iron	1.0E-03	default	1.8E-02	1.0E-05	8.7E-04	100.0%	0.53%	N	0.00%

Table C-2
Estimation of Dermal Absorbed Dose for Inorganic COPCs in Groundwater
Child Resident, Picatinny Arsenal, Skeet Range

FOR INORGANIC CHEMICALS IN WATER (latest version 04/01)

Worksheet to Calculate Dermal Absorption of Inorganic Chemicals from Aqueous Media

Enter the Following Exposure Conditions: for site specific conditions, change values for A through AT (Given are default values from Table 8-6)

Conc =	0.001	mg/cm3 (default value for purpose of illustration)
SA=	6600	cm2
t_event =	1.00	hr/event (1 hour/event)
EV =	1	event/day
EF =	350	days/yr
ED =	6	years
BW =	15	kg
AT =	25550	days

Default conditions for screening purposes:

Compare Dermal to Drinking: Adults showering for 35 minutes/day, compared to drinking 2L water/day

Dermal (mg/day) = DA_event * A * EV
Drinking (mg/day) = Conc * IR * ABSIG

IR: Ingestion rate of drinking water	IR =	1000	(cm3/day = L/day * 1000 cm3/L)
ABSIG: Absorption fraction in GI tract	Chemical specific		

Condition for screening: "Y" when Dermal is 10% of Drinking

Compare Dermal to Total dose exposed during adult showering assuming 5 gal/min of water flow rate

Total dose (mg/day) = Q * T_event * EV

Q: Shower flow rate (5-15 gal/min; here using 5 gal/n Q = 1135500 (cm3/hr = gal/min * 3.785 gal/l * 60 min/hr *1000 cm3/hr)

Refer to Appendix A for equations to evaluate DA_event and DAD

CHEMICAL	Kp (cm/hr)	Source of Kp (exp or default)	Conc (mg/cm3)	DA_event (mg/cm2-event)	DAD (mg/kg-day)	ABSGI (chemical specific)	Screening	Chemicals to be assessed	Derm/ Total Dose
Arsenic (arsenite)	1.0E-03	default	1.1E-05	1.1E-08	3.9E-07	100%	0.66%	N	0.00%
Chromium (III)	1.0E-03	experimental	7.32E-06	7.3E-09	2.6E-07	1.3%	50.77%	Y	0.00%
Manganese	1.0E-03	default	2.81E-03	2.8E-06	1.0E-04	4%	16.50%	Y	0.00%
added metals									
Iron	1.0E-03	default	1.8E-02	1.8E-05	6.4E-04	100.0%	0.66%	N	0.00%

Table C-3
Estimation of Dermal Absorbed Dose for Inorganic COPCs in Groundwater
Routine Worker, Picatinny Arsenal, Skeet Range

FOR INORGANIC CHEMICALS IN WATER (latest version 04/01)

Worksheet to Calculate Dermal Absorption of Inorganic Chemicals from Aqueous Media

Enter the Following Exposure Conditions: for site specific conditions, change values for A through AT (Given are default values from Table 8-6)

Conc =	0.001	mg/cm3 (default value for purpose of illustration)
SA=	4123	cm2
t_event =	0.25	hr/event (15 minutes/event)
EV =	1	event/day
EF =	250	days/yr
ED =	25	years
BW =	70	kg
AT =	25550	days

Default conditions for screening purposes:

Compare Dermal to Drinking: Adults showering for 35 minutes/day, compared to drinking 2L water/day

Dermal (mg/day) = DA_event * A * EV
Drinking (mg/day) = Conc * IR * ABSIG

IR: Ingestion rate of drinking water	IR =	2000	(cm3/day = L/day * 1000 cm3/L)
ABSIG: Absorption fraction in GI tract	Chemical specific		

Condition for screening: "Y" when Dermal is 10% of Drinking

Compare Dermal to Total dose exposed during adult showering assuming 5 gal/min of water flow rate

Total dose (mg/day) = Q * T_event * EV

Q: Shower flow rate (5-15 gal/min; here using 5 gal/n Q = 1135500 (cm3/hr = gal/min * 3.785 gal/l * 60 min/hr *1000 cm3/hr)

Refer to Appendix A for equations to evaluate DA_event and DAD

CHEMICAL	Kp (cm/hr)	Source of Kp (exp or default)	Conc (mg/cm3)	DA_event (mg/cm2-event)	DAD (mg/kg-day)	ABSGI (chemical specific)	Screening	Chemicals to be assessed	Derm/ Total Dose
Arsenic (arsenite)	1.0E-03	default	1.1E-05	2.7E-09	3.9E-08	100%	0.05%	N	0.00%
Chromium (III)	1.0E-03	experimental	7.32E-06	1.8E-09	2.6E-08	1.3%	3.96%	N	0.00%
Manganese	1.0E-03	default	2.81E-03	7.0E-07	1.0E-05	4%	1.29%	N	0.00%
added metals									
Iron	1.0E-03	default	1.8E-02	4.4E-06	6.4E-05	100.0%	0.05%	N	0.00%

Table C-4
Estimation of Dermal Absorbed Dose for Inorganic COPCs in Surface Water
Adult Resident, Picatinny Arsenal, Skeet Range

FOR INORGANIC CHEMICALS IN WATER (latest version 04/01)

Worksheet to Calculate Dermal Absorption of Inorganic Chemicals from Aqueous Media

Enter the Following Exposure Conditions: for site specific conditions, change values for A through AT (Given are default values from Table 8-6)

Conc =	0.001	mg/cm3 (default value for purpose of illustration)
SA=	3610	cm2
t_event =	4.00	hr/event (4 hours/event)
EV =	1	event/day
EF =	78	days/yr
ED =	24	years
BW =	70	kg
AT =	25550	days

Default conditions for screening purposes:

Compare Dermal to Drinking: Adults showering for 35 minutes/day, compared to drinking 2L water/day

Dermal (mg/day) = DA_event * A * EV
Drinking (mg/day) = Conc * IR * ABSIG

IR: Ingestion rate of drinking water IR = 100 (cm3/day = L/day * 1000 cm3/L)
ABSIG: Absorption fraction in GI tract Chemical specific
Condition for screening: "Y" when Dermal is 10% of Drinking

Compare Dermal to Total dose exposed during adult showering assuming 5 gal/min of water flow rate

Total dose (mg/day) = Q * T_event * EV

Q: Shower flow rate (5-15 gal/min; here using 5 gal/ Q = 1135500 (cm3/hr = gal/min * 3.785 gal/l * 60 min/hr *1000 cm3/hr)

Refer to Appendix A for equations to evaluate DA_event and DAD

CHEMICAL	Kp (cm/hr)	Source of Kp (exp or default)	Conc (mg/cm3)	DA_event (mg/cm2-event)	DAD (mg/kg-day)	ABSGI (chemical specific)	Screening	Chemicals to be assessed	Derm/ Total Dose
Antimony	1.0E-03	default	7.3E-05	2.9E-07	1.1E-06	15%	96.27%	Y	0.00%
Arsenic (arsenite)	1.0E-03	default	2.3E-05	9.2E-08	3.5E-07	100%	14.44%	Y	0.00%
Iron	1.0E-03	default	8.3E-03	3.3E-05	1.3E-04	100%	14.44%	Y	0.00%
Lead	1.0E-04	experimental	7.5E-03	3.0E-06	1.1E-05	100%	1.44%	N	0.00%

Table C-5
Estimation of Dermal Absorbed Dose for Inorganic COPCs in Surface Water
Child Resident, Picatinny Arsenal, Skeet Range

FOR INORGANIC CHEMICALS IN WATER (latest version 04/01)

Worksheet to Calculate Dermal Absorption of Inorganic Chemicals from Aqueous Media

Enter the Following Exposure Conditions: for site specific conditions, change values for A through AT (Given are default values from Table 8-6)

Conc =	0.001	mg/cm3 (default value for purpose of illustration)
SA=	3700	cm2
t_event =	4	hr/event (4 hours/event)
EV =	1	event/day
EF =	78	days/yr
ED =	6	years
BW =	15	kg
AT =	25550	days

Default conditions for screening purposes:

Compare Dermal to Drinking: Adults showering for 35 minutes/day, compared to drinking 2L water/day

Dermal (mg/day) = DA_event * A * EV
Drinking (mg/day) = Conc * IR * ABSIG

IR: Ingestion rate of drinking water IR = 100 (cm3/day = L/day * 1000 cm3/L)
ABSIG: Absorption fraction in GI tract Chemical specific
Condition for screening: "Y" when Dermal is 10% of Drinking

Compare Dermal to Total dose exposed during adult showering assuming 5 gal/min of water flow rate

Total dose (mg/day) = Q * T_event * EV

Q: Shower flow rate (5-15 gal/min; here using 5 gal/ Q = 1135500 (cm3/hr = gal/min * 3.785 gal/l * 60 min/hr *1000 cm3/hr)

Refer to Appendix A for equations to evaluate DA_event and DAD

CHEMICAL	Kp (cm/hr)	Source of Kp (exp or default)	Conc (mg/cm3)	DA_event (mg/cm2-event)	DAD (mg/kg-day)	ABSGI (chemical specific)	Screening	Chemicals to be assessed	Derm/ Total Dose
Antimony	1.0E-03	default	7.3E-05	2.9E-07	1.3E-06	15%	98.67%	Y	0.00%
Arsenic (arsenite)	1.0E-03	default	2.3E-05	9.2E-08	4.2E-07	100%	14.80%	Y	0.00%
Iron	1.0E-03	default	8.3E-03	3.3E-05	1.5E-04	100%	14.80%	Y	0.00%
Lead	1.0E-04	experimental	7.5E-03	3.0E-06	1.4E-05	100%	1.48%	N	0.00%

Table C-6
Estimation of Dermal Absorbed Dose for Inorganic COPCs in Surface Water
Routine Worker, Picatinny Arsenal, Skeet Range

FOR INORGANIC CHEMICALS IN WATER (latest version 04/01)

Worksheet to Calculate Dermal Absorption of Inorganic Chemicals from Aqueous Media

Enter the Following Exposure Conditions: for site specific conditions, change values for A through AT (Given are default values from Table 8-6)

Conc =	0.001	mg/cm3 (default value for purpose of illustration)
SA=	3610	cm2
t_event =	4	hr/event (4 hours/event)
EV =	1	event/day
EF =	39	days/yr
ED =	25	years
BW =	70	kg
AT =	25550	days

Default conditions for screening purposes:

Compare Dermal to Drinking: Adults showering for 35 minutes/day, compared to drinking 2L water/day

Dermal (mg/day) = DA_event * A * EV
Drinking (mg/day) = Conc * IR * ABSIG

IR: Ingestion rate of drinking water IR = 100 (cm3/day = L/day * 1000 cm3/L)
ABSIG: Absorption fraction in GI tract Chemical specific
Condition for screening: "Y" when Dermal is 10% of Drinking

Compare Dermal to Total dose exposed during adult showering assuming 5 gal/min of water flow rate

Total dose (mg/day) = Q * T_event * EV

Q: Shower flow rate (5-15 gal/min; here using 5 gal/ Q = 1135500 (cm3/hr = gal/min * 3.785 gal/l * 60 min/hr *1000 cm3/hr)

Refer to Appendix A for equations to evaluate DA_event and DAD

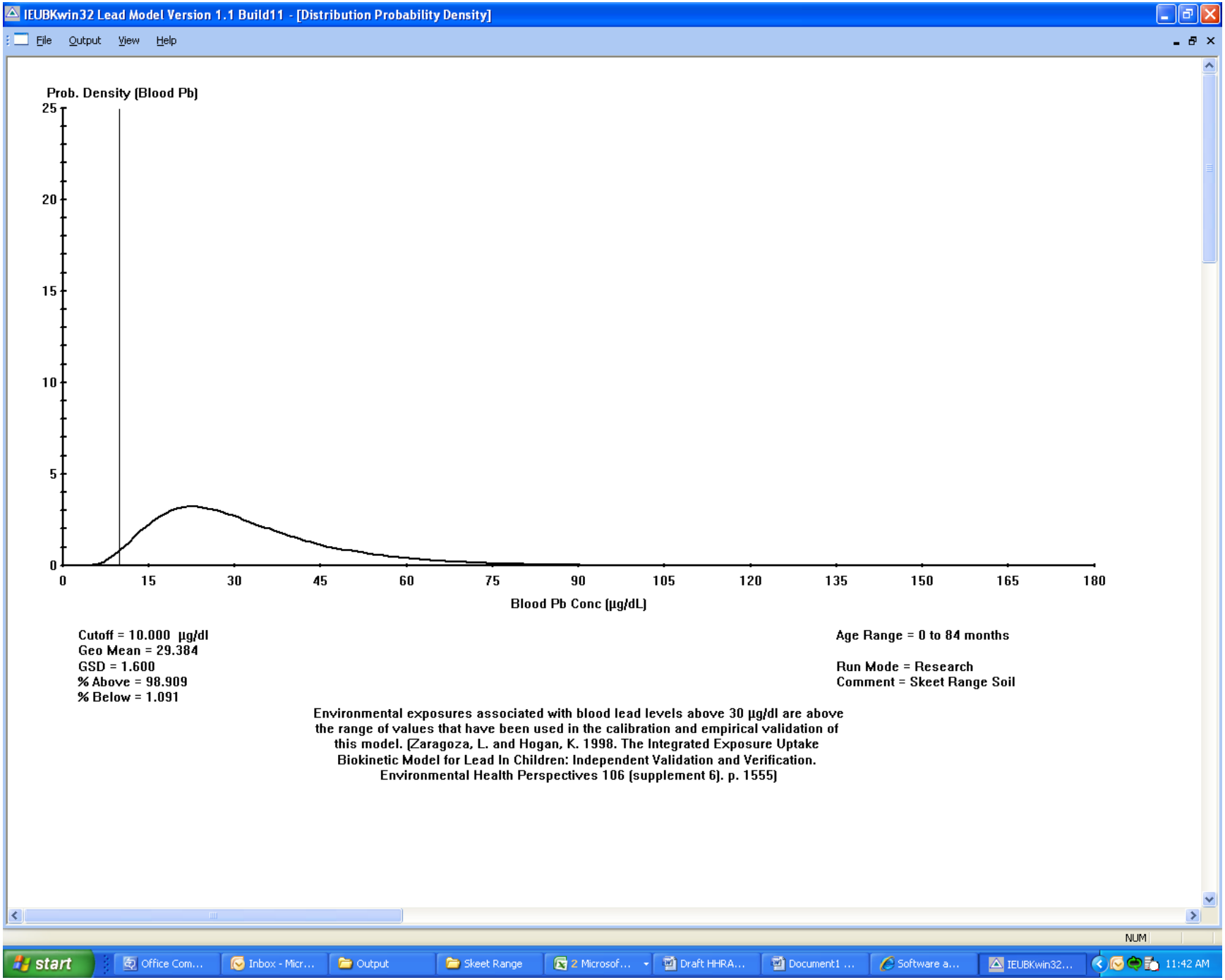
CHEMICAL	Kp (cm/hr)	Source of Kp (exp or default)	Conc (mg/cm3)	DA_event (mg/cm2-event)	DAD (mg/kg-day)	ABSGI (chemical specific)	Screening	Chemicals to be assessed	Derm/ Total Dose
Antimony	1.0E-03	default	7.3E-05	2.9E-07	5.8E-07	15%	96.27%	Y	0.00%
Arsenic (arsenite)	1.0E-03	default	2.3E-05	9.2E-08	1.8E-07	100%	14.44%	Y	0.00%
Iron	1.0E-03	default	8.3E-03	3.3E-05	6.6E-05	100%	14.44%	Y	0.00%
Lead	1.0E-04	experimental	7.5E-03	3.0E-06	5.9E-06	100%	1.44%	N	0.00%

Attachment D
Soil Dermal Absorption Factors for Constituents of Potential Concern
Picatinny Arsenal, New Jersey, Skeet Range

DERMAL ABSORPTION FACTORS	
Chemical	**Dermal Absorption Factors**
Organics:	
Benzo(a)anthracene	13%
Benzo(a)pyrene	13%
Benzo(b)fluoranthene	13%
Benzo(k)fluoranthene	13%
Chrysene	13%
Dibenzo(a,h)anthracene	13%
Indeno(1,2,3-cd)pyrene	13%
Inorganics:	
Aluminum	0%
Antimony	0%
Arsenic	3%
Copper	0%
Iron	0%
Lead	0%

Dermal Absorption Factors are from the USEPA Regional Screening Level Table, June 2011.

Attachment E-1.



Attachment E-1.

LEAD MODEL FOR WINDOWS Version 1.1

==========

Model Version: 1.1 Build11
User Name: Weisberg
Date: 9/27/2011
Site Name: Picatinny Arsenal Skeet Range
Operable Unit:
Run Mode: Soil Lead: Arithmetic Average = 5883 mg/kg.
==========

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

Attachment E-1.

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 4128.100 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000

Attachment E-1.

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	5883.000	4128.100
1-2	5883.000	4128.100
2-3	5883.000	4128.100
3-4	5883.000	4128.100
4-5	5883.000	4128.100
5-6	5883.000	4128.100
6-7	5883.000	4128.100

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

Attachment E-1.

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

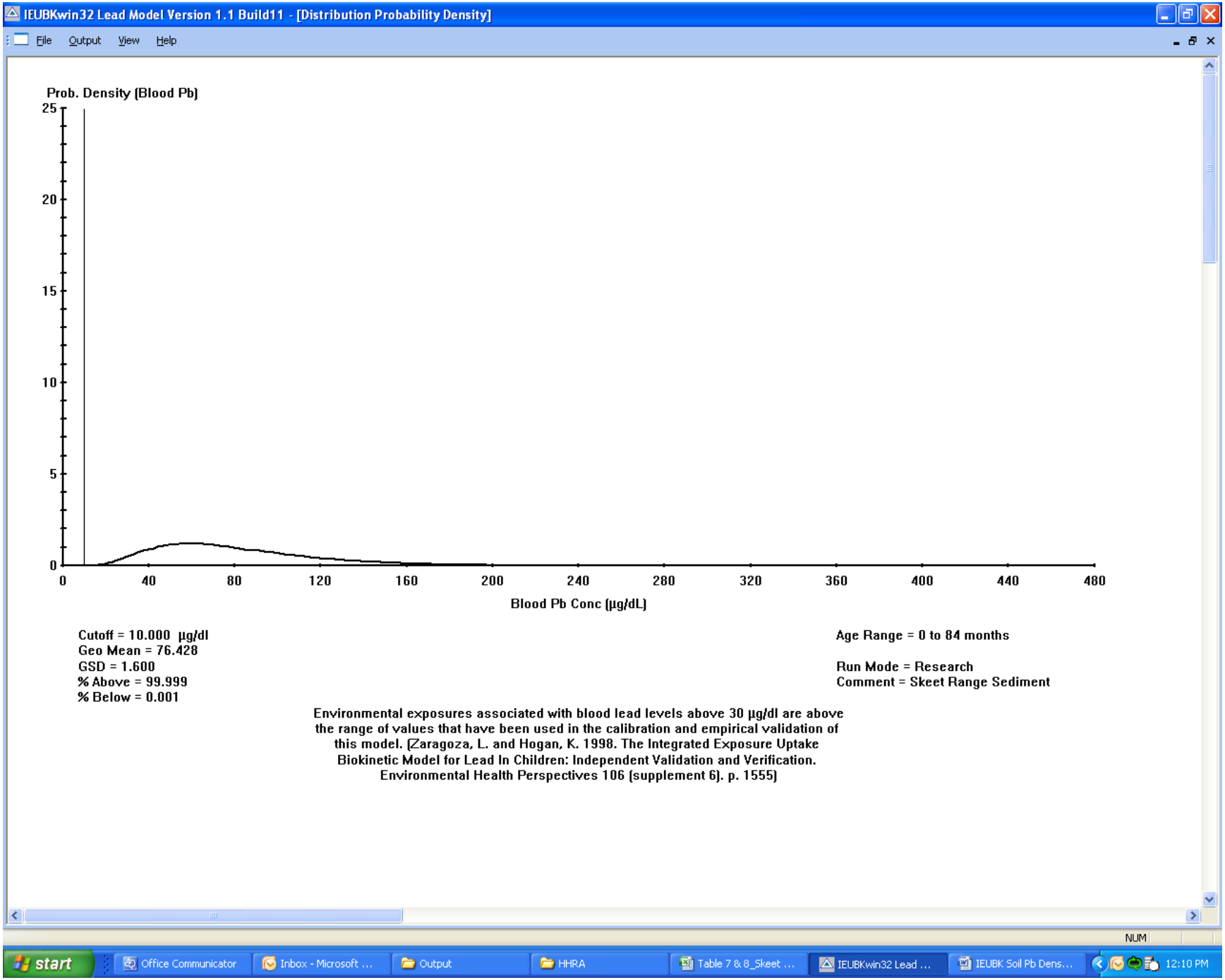
****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	0.552	0.000	0.196
1-2	0.034	0.444	0.000	0.453
2-3	0.062	0.513	0.000	0.500
3-4	0.067	0.521	0.000	0.541
4-5	0.067	0.583	0.000	0.657
5-6	0.093	0.658	0.000	0.744
6-7	0.093	0.743	0.000	0.790

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	61.305	62.074	30.4
1-2	90.144	91.074	34.9
2-3	95.846	96.921	33.4
3-4	101.678	102.806	33.1
4-5	88.157	89.464	29.3
5-6	85.216	86.712	25.9
6-7	83.951	85.577	23.5

Environmental exposures associated with blood lead levels above 30 µg/dl are above the range of values that have been used in the calibration and empirical validation of this model. (Zaragoza, L. and Hogan, K. 1998. The Integrated Exposure Uptake Biokinetic Model for Lead In Children: Independent Validation and Verification. Environmental Health Perspectives 106 (supplement 6). p. 1555)

Attachment E-2.



Attachment E-2.

LEAD MODEL FOR WINDOWS Version 1.1

==========
Model Version: 1.1 Build11
User Name: Weisberg
Date: 9/27/2011
Site Name: Picatinny Arsenal Skeet Range
Operable Unit:
Run Mode: Sediment Lead: Arithmetic Average = 30900 mg/kg.
==========

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

Attachment E-2.

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 21640.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000

Attachment E-2.

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	30900.000	21640.000
1-2	30900.000	21640.000
2-3	30900.000	21640.000
3-4	30900.000	21640.000
4-5	30900.000	21640.000
5-6	30900.000	21640.000
6-7	30900.000	21640.000

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

Attachment E-2.

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	0.315	0.000	0.111
1-2	0.034	0.260	0.000	0.265
2-3	0.062	0.293	0.000	0.287
3-4	0.067	0.293	0.000	0.304
4-5	0.067	0.320	0.000	0.361
5-6	0.093	0.363	0.000	0.411
6-7	0.093	0.413	0.000	0.439

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	183.386	183.833	80.3
1-2	277.159	277.718	90.7
2-3	287.968	288.610	86.6
3-4	299.934	300.597	84.9
4-5	253.935	254.682	74.7
5-6	246.597	247.463	66.7
6-7	245.055	246.001	61.5

Environmental exposures associated with blood lead levels above 30 µg/dl are above the range of values that have been used in the calibration and empirical validation of this model. (Zaragoza, L. and Hogan, K. 1998. The Integrated Exposure Uptake Biokinetic Model for Lead In Children: Independent Validation and Verification. Environmental Health Perspectives 106 (supplement 6). p. 1555)

Attachment E-3. Calculations of Blood Lead Concentrations (PbBs) for Picatinny Skeet Range Soil

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	GSDi and PbBo from Analysis of NHANES III (Phases 1&2)
PbS	Soil lead concentration	ug/g or ppm	5883	5883
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	Baseline PbB	ug/dL	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	219	219
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**9.5**	**10.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	22.4	30.4
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**39.3%**	**44.2%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Attachment E-4. Calculations of Blood Lead Concentrations (PbBs) for Picatinny Skeet Range Sediment

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	GSDi and PbBo from Analysis of NHANES III (Phases 1&2)
PbS	Soil lead concentration	ug/g or ppm	30900	30900
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	Baseline PbB	ug/dL	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	219	219
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**45.5**	**46.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	107.7	140.3
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**99.2%**	**97.2%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Attachment Table F-1.
Dose Calculations for Mutagenic PAHs using Age Dependent Adjustment Factors, Future Child Resident

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF/Unit Risk Value	CSF/Unit Risk Units	Cancer Risk	Age 0 - 2	Age 2 - 6	Age 6 - 16	Age 16 - 30	Total
							Cancer Risk Calculations									
Surface Soil	Surface Soil	Former Skeet Range	**Ingestion**	**Organics**												
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.6E-05	1.0E-05	6.2E-06	0.0E+00	0.0E+00	1.6E-05
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	3.0E-04	1.9E-04	1.1E-04	0.0E+00	0.0E+00	3.0E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	5.5E-05	3.4E-05	2.0E-05	0.0E+00	0.0E+00	5.5E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	(mg/kg-day)$^{-1}$	1.7E-06	1.1E-06	6.5E-07	0.0E+00	0.0E+00	1.7E-06
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	(mg/kg-day)$^{-1}$	1.6E-07	1.0E-07	6.0E-08	0.0E+00	0.0E+00	1.6E-07
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	3.9E-05	2.5E-05	1.5E-05	0.0E+00	0.0E+00	3.9E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.1E-05	7.2E-06	4.3E-06	0.0E+00	0.0E+00	1.1E-05
			Exp. Route Total								4.3E-04					
			Dermal Absorption	**Organics**												
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	6.0E-06	3.7E-06	2.2E-06	0.0E+00	0.0E+00	6.0E-06
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.1E-04	6.9E-05	4.1E-05	0.0E+00	0.0E+00	1.1E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	2.0E-05	1.2E-05	7.5E-06	0.0E+00	0.0E+00	2.0E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	(mg/kg-day)$^{-1}$	6.3E-07	3.9E-07	2.4E-07	0.0E+00	0.0E+00	6.3E-07
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	(mg/kg-day)$^{-1}$	5.9E-08	3.7E-08	2.2E-08	0.0E+00	0.0E+00	5.9E-08
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.4E-05	8.9E-06	5.4E-06	0.0E+00	0.0E+00	1.4E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	4.2E-06	2.6E-06	1.6E-06	0.0E+00	0.0E+00	4.2E-06
			Exp. Route Total								1.6E-04					
		Exposure Point Total									5.8E-04					
	Exposure Media Total										5.8E-04					
	Air (Particulates)	Former Skeet Range	**Inhalation**	**Organics**												
				Benzo(a)anthracene	5.07E-06	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	2.4E-10	1.5E-10	9.2E-11	0.0E+00	0.0E+00	2.4E-10
				Benzo(a)pyrene	9.35E-06	µg/m^3	ADAF	µg/m^3	1.1E-03	(µg/m^3)$^{-1}$	4.5E-09	2.8E-09	1.7E-09	0.0E+00	0.0E+00	4.5E-09
				Benzo(b)fluoranthene	1.69E-05	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	8.1E-10	5.1E-10	3.1E-10	0.0E+00	0.0E+00	8.1E-10
				Benzo(k)fluoranthene	5.34E-06	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	2.6E-10	1.6E-10	9.7E-11	0.0E+00	0.0E+00	2.6E-10
				Chrysene	4.97E-06	µg/m^3	ADAF	µg/m^3	1.1E-05	(µg/m^3)$^{-1}$	2.4E-11	1.5E-11	9.0E-12	0.0E+00	0.0E+00	2.4E-11
				Dibenzo(a,h)anthracene	1.21E-06	µg/m^3	ADAF	µg/m^3	1.2E-03	(µg/m^3)$^{-1}$	6.4E-10	4.0E-10	2.4E-10	0.0E+00	0.0E+00	6.4E-10
				Indeno(1,2,3-cd)pyrene	3.55E-06	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	1.7E-10	1.1E-10	6.4E-11	0.0E+00	0.0E+00	1.7E-10
			Exp. Route Total								6.7E-09					
		Exposure Point Total									6.7E-09					
	Exposure Media Total										6.7E-09					
Surface Soil Total											5.8E-04					
Sediment	Sediment	Former Skeet Range	**Ingestion**	**Organics**												
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.8E-07	1.1E-07	6.6E-08	0.0E+00	0.0E+00	1.8E-07
			Exp. Route Total								1.8E-07					
			Dermal Absorption	**Organics**												
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	7.4E-08	4.6E-08	2.8E-08	0.0E+00	0.0E+00	7.4E-08
			Exp. Route Total								7.4E-08					
		Exposure Point Total									2.5E-07					
	Exposure Media Total										2.5E-07					
Sediment Total											2.5E-07					
										Total of Receptor Risks Across All Media	5.8E-04					

Conc in soil	
3.85E+00	mg/kg
7.10E+00	
1.28E+01	
4.06E+00	
3.77E+00	
9.19E-01	
2.70E+00	

N/A = Not Applicable.
ADAF = Age-Dependent Adjustment Factors were applied in estimating risks associated with early life exposures.

Attachment Table F-2.
Dose Calculations for Mutagenic PAHs using Age Dependent Adjustment Factors, Future Lifetime Resident

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF/Unit Risk Value	CSF/Unit Risk Units	Cancer Risk
					Cancer Risk Calculations						
Surface Soil	Surface Soil	Former Skeet Range	**Ingestion**	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.9E-05
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	3.5E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	6.3E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	(mg/kg-day)$^{-1}$	2.0E-06
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	(mg/kg-day)$^{-1}$	1.8E-07
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	4.5E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	1.3E-05
			Exp. Route Total								4.9E-04
			Dermal Absorption	**Organics**							
				Benzo(a)anthracene	3.85E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	6.7E-06
				Benzo(a)pyrene	7.10E+00	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.2E-04
				Benzo(b)fluoranthene	1.28E+01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	2.2E-05
				Benzo(k)fluoranthene	4.06E+00	mg/kg	ADAF	mg/kg-day	7.3E-02	(mg/kg-day)$^{-1}$	7.1E-07
				Chrysene	3.77E+00	mg/kg	ADAF	mg/kg-day	7.3E-03	(mg/kg-day)$^{-1}$	6.6E-08
				Dibenzo(a,h)anthracene	9.19E-01	mg/kg	ADAF	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.6E-05
				Indeno(1,2,3-cd)pyrene	2.70E+00	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	4.7E-06
			Exp. Route Total								1.7E-04
		Exposure Point Total									6.6E-04
	Exposure Media Total										6.6E-04
	Air (Particulates)	Former Skeet Range	**Inhalation**	**Organics**							
				Benzo(a)anthracene	5.07E-06	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	5.8E-10
				Benzo(a)pyrene	9.35E-06	µg/m^3	ADAF	µg/m^3	1.1E-03	(µg/m^3)$^{-1}$	1.1E-08
				Benzo(b)fluoranthene	1.69E-05	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	1.9E-09
				Benzo(k)fluoranthene	5.34E-06	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	6.1E-10
				Chrysene	4.97E-06	µg/m^3	ADAF	µg/m^3	1.1E-05	(µg/m^3)$^{-1}$	5.7E-11
				Dibenzo(a,h)anthracene	1.21E-06	µg/m^3	ADAF	µg/m^3	1.2E-03	(µg/m^3)$^{-1}$	1.5E-09
				Indeno(1,2,3-cd)pyrene	3.55E-06	µg/m^3	ADAF	µg/m^3	1.1E-04	(µg/m^3)$^{-1}$	4.1E-10
			Exp. Route Total								1.6E-08
		Exposure Point Total									1.6E-08
	Exposure Media Total										1.6E-08
Surface Soil Total											6.6E-04
Sediment	Sediment	Former Skeet Range	**Ingestion**	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	2.0E-07
			Exp. Route Total								2.0E-07
			Dermal Absorption	**Organics**							
				Benzo(b)fluoranthene	1.86E-01	mg/kg	ADAF	mg/kg-day	7.3E-01	(mg/kg-day)$^{-1}$	8.6E-08
			Exp. Route Total								8.6E-08
		Exposure Point Total									2.9E-07
	Exposure Media Total										2.9E-07
Sediment Total											2.9E-07
										Total of Receptor Risks Across All Medi	6.6E-04

ADAF

Age 0 - 2	Age 2 - 6	Age 6 - 16	Age 16 - 30	Total
1.0E-05	6.2E-06	1.6E-06	7.7E-07	1.9E-05
1.9E-04	1.1E-04	3.0E-05	1.4E-05	3.5E-04
3.4E-05	2.0E-05	5.5E-06	2.6E-06	6.3E-05
1.1E-06	6.5E-07	1.7E-07	8.1E-08	2.0E-06
1.0E-07	6.0E-08	1.6E-08	7.5E-09	1.8E-07
2.5E-05	1.5E-05	3.9E-06	1.8E-06	4.5E-05
7.2E-06	4.3E-06	1.2E-06	5.4E-07	1.3E-05

Age 0 - 2	Age 2 - 6	Age 6 - 16	Age 16 - 30	Total
3.7E-06	2.2E-06	5.0E-07	2.3E-07	6.7E-06
6.9E-05	4.1E-05	9.1E-06	4.3E-06	1.2E-04
1.2E-05	7.5E-06	1.6E-06	7.7E-07	2.2E-05
3.9E-07	2.4E-07	5.2E-08	2.4E-08	7.1E-07
3.7E-08	2.2E-08	4.9E-09	2.3E-09	6.6E-08
8.9E-06	5.4E-06	1.2E-06	5.5E-07	1.6E-05
2.6E-06	1.6E-06	3.5E-07	1.6E-07	4.7E-06

Conc in soil	
3.85E+00	mg/kg
7.10E+00	
1.28E+01	
4.06E+00	
3.77E+00	
9.19E-01	
2.70E+00	

Age 0 - 2	Age 2 - 6	Age 6 - 16	Age 16 - 30	Total
1.5E-10	9.2E-11	2.3E-10	1.1E-10	5.8E-10
2.8E-09	1.7E-09	4.2E-09	2.0E-09	1.1E-08
5.1E-10	3.1E-10	7.6E-10	3.6E-10	1.9E-09
1.6E-10	9.7E-11	2.4E-10	1.1E-10	6.1E-10
1.5E-11	9.0E-12	2.2E-11	1.0E-11	5.7E-11
4.0E-10	2.4E-10	6.0E-10	2.8E-10	1.5E-09
1.1E-10	6.4E-11	1.6E-10	7.5E-11	4.1E-10

Age 0 - 2	Age 2 - 6	Age 6 - 16	Age 16 - 30	Total
1.1E-07	6.6E-08	1.8E-08	8.3E-09	2.0E-07

Age 0 - 2	Age 2 - 6	Age 6 - 16	Age 16 - 30	Total
4.6E-08	2.8E-08	8.8E-09	4.1E-09	8.6E-08

N/A = Not Applicable.
ADAF = Age-Dependent Adjustment Factors were applied in estimating risks associated with early life exposures.

APPENDIX D

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT DATA

Table D-1
Data Used to Model Exposure[a] in the Indicator Wildlife Species
Picatinny Arsenal Former Skeet Range

Indicator Species	Body Weight Range (average) (kg)	Average Home Range (ha) [ac]	Maximum Dietary Intake[b] (kg[dw]/day)	Average Dietary Intake[c] (kg[dw]/day)	Sediment/Soil Intake[d] (%Diet) (Avg – Max) (kg[dw]/day)	Maximum Water Intake[e] (L/day)	Average Water Intake[f] (L/day)	Trophic Level	Dietary Composition
American Woodcock (*Scolopax minor*)	0.176 - 0.218 (0.197)	23.75 [59]	0.024	0.0224	(10.4% soil) 0.0023-0.0025	0.0213	0.0199	Primarily Insectivore	Inverts: 89.5% Plants: 10.5% (Terrestrial)
Bobwhite quail (*Colinus virginianus*)	0.154 - 0.194 (0.175)	10 [25]	0.0096	0.0088	(2.4% soil) 0.00021-0.00023	0.0197	0.0184	Omnivore	Plants: 86% Inverts: 14% (Terrestrial)
Marsh wren (*Cistothorus palustris*)	0.0090 - 0.0135 (0.011)	0.2 [0.5]	0.0034	0.0029	(10% sed) 0.00029-0.00034	0.0033	0.0029	Insectivore	Inverts: 100% (Aquatic)
Short-tailed shrew *(Blarina brevicauda)*	0.0125 - 0.0225 (0.015)	0.39 [0.96]	0.0026	0.002	(10.4% soil) 0.00021-0.00027	0.0033	0.0023	Insectivore	Inverts: 100% (Terrestrial)
Meadow vole (*Microtus pennsylvanicus*)	0.0170 - 0.0524 (0.037)	0.036 [0.089]	0.010	0.0083	(2.4% soil) 0.0002-0.00024	0.0070	0.0051	Herbivore	Plants: 100% (Terrestrial)
Raccoon (*Procyon lotor*)	3.67 - 6.76 (5.1)	52 [128]	0.171	0.141	(9.4% sed) 0.013-0.016	0.55	0.43	Omnivore	Fish: 2% Inverts: 51% Mammals: 5% Plants: 42% (Terrestrial)

[a] From USEPA (1993), except as noted.
[b] Dietary intake based on receptor-specific dry matter intake (DMI) value, using maximum body weight and class/guild appropriate regression equation as presented in Nagy (2001) [see details on next page].
[c] Dietary intake based on receptor-specific dry matter intake (DMI) value, using average body weight and class/guild appropriate regression equation as presented in Nagy (2001) [see details on next page].
[d] Soil and sediment ingestion rates based on estimated percent soil or sediment in diet (dry weight) and dietary intake (DMI).
[e] Maximum water intake based on appropriate allometric equation using maximum body weight, where: WI = water ingestion, Wt = body weight, kg = kilogram, L = liter and g = gram: WI (L/day) = 0.099 $Wt^{0.90}$ (Wt in kg) for mammals, WI (L/day) = 0.059 $Wt^{0.67}$ (Wt in kg) for birds.
[f] Average water intake based on appropriate allometric equation using average body weight, where: WI = water ingestion, Wt = body weight, kg = kilogram, L = liter and g = gram: WI (L/day) = 0.099 $Wt^{0.90}$ (Wt in kg) for mammals, WI (L/day) = 0.059 $Wt^{0.67}$ (Wt in kg) for birds.

ha = hectare, ac = acre (1.0 hectare = 2.471 acres).

Table D-1 (continued)
Data Used to Model Exposure[a] in the Indicator Wildlife Species
Picatinny Arsenal Former Skeet Range

- The soil ingestion rate for the shrew set equal to the rate for the American woodcock (10.4% of diet), as it feeds predominantly on invertebrates.
- The soil ingestion rate for the bobwhite set equal to the rate for the vole (2.4% of diet), as it feeds predominantly on plants.
-The sediment ingestion rate for the raccoon is 9.4% of the diet, as it feeds in the wetland environment.
-The sediment or soil ingestion rate set equal to 2%, if no other information available (lower limit presented in USEPA (1993).
-The sediment ingestion rate for the marsh wren set equal to 10%, based on USEPA (1993), that states that shorebirds have a soil (sediment) intake that ranges from 10%, to 60%, assuming that the wren adopts a somewhat similar feeding strategy in a marsh environment, although at the lower end of the range due to the fact that it does do not exclusively prey on sediment invertebrates as most shorebirds do.

Summary of Food Intake Rates for Tier 1 (maximum body weight):

Receptor	Class	Feeding Guild/Group	Regression Equation Input a	b	body mass (g)	Food Intake Result y (g DMI/d)
American Woodcock	Bird	Insectivore	0.54	0.705	218	24
Bobwhite Quail	Bird	Galliformes	0.088	0.891	194	9.6
Marsh Wren	Bird	Insectivore	0.54	0.705	13.5	3.4
Short-tailed Shrew	Mammal	Insectivore	0.373	0.622	22.5	2.6
Meadow Vole	Mammal	Herbivore	0.859	0.628	52.4	10.3
Raccoon	Mammal	Omnivore	0.432	0.678	6760	170.7

Regression equation and input values from Tables 2 (mammal) and 3 (bird): $y = a*(\text{maximum body mass})^b$ from Nagy 2001.
NA = Not applicable.

Summary of Food Intake Rates for Tier 2 (average body weight):

Receptor	Class	Feeding Guild/Group	Regression Equation Input a	b	body mass (g)	Food Intake Result y (g DMI/d)
American Woodcock	Bird	Insectivore	0.54	0.705	197	22.4
Bobwhite Quail	Bird	Galliformes	0.088	0.891	175	8.8
Marsh Wren	Bird	Insectivore	0.54	0.705	11	2.9
Short-tailed Shrew	Mammal	Insectivore	0.373	0.622	15	2
Meadow Vole	Mammal	Herbivore	0.859	0.628	37	8.3
Raccoon	Mammal	Omnivore	0.432	0.678	5100	141

Regression equation and input values from Tables 2 (mammal) and 3 (bird): $y = a*(\text{average body mass})^b$ from Nagy 2001.
NA = Not applicable.

TABLE D-2
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN WOODCOCK AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 1
American Woodcock

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Invert. BAF	Terr. Plant BAF	PDE Surface Water	PDE Soil	PDE Terr. Invert.	PDE Terr. Plants	Total PDE	NOAEL	EEQ N	LOAEL	EEQ L
					---------- unitless ----------		mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	
Arsenic	2.30E-02	mg/L	2.41E+01	mg/kg	9.47E-02	3.75E-02	2.78E-03	3.42E-01	2.79E-01	1.29E-02	6.37E-01	2.24E+00	2.84E-01	3.55E+00	1.79E-01
Copper	2.21E-02	mg/L	7.12E+01	mg/kg	5.15E-01	1.47E-01	2.67E-03	1.01E+00	4.48E+00	1.50E-01	5.64E+00	4.05E+00	**1.39E+00**	4.88E+00	**1.16E+00**
Lead	7.53E+00	mg/L	8.47E+04	mg/kg	9.00E-02	1.82E-03	9.11E-01	1.20E+03	9.30E+02	2.21E+00	2.14E+03	1.63E+00	**1.31E+03**	1.94E+00	**1.10E+03**
Zinc	6.63E-02	mg/L	1.55E+02	mg/kg	2.89E+00	5.09E-01	8.02E-03	2.20E+00	5.46E+01	1.13E+00	5.79E+01	6.61E+01	8.76E-01	6.65E+01	8.71E-01
Acenaphthene	0	mg/L	3.79E+00	mg/kg	1.47E+00	3.24E-04	0.00E+00	5.38E-02	6.80E-01	1.76E-05	7.34E-01	5.53E+02	1.33E-03	2.77E+03	2.65E-04
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	2.29E+01	4.25E-01	0.00E+00	3.59E-03	7.07E-01	1.54E-03	7.12E-01	5.53E+02	1.29E-03	2.77E+03	2.58E-04
Anthracene	0	mg/L	7.88E+00	mg/kg	2.42E+00	2.35E-01	0.00E+00	1.12E-01	2.33E+00	2.66E-02	2.47E+00	5.53E+02	4.46E-03	2.77E+03	8.92E-04
Benzo(a)anthracene	0	mg/L	2.76E+01	mg/kg	1.59E+00	1.74E-02	0.00E+00	3.92E-01	5.36E+00	6.86E-03	5.75E+00	5.53E+02	1.04E-02	2.77E+03	2.08E-03
Benzo(a)pyrene	0	mg/L	2.16E+01	mg/kg	1.33E+00	1.18E-01	0.00E+00	3.07E-01	3.51E+00	3.64E-02	3.85E+00	5.53E+02	6.96E-03	2.77E+03	1.39E-03
Benzo(b)fluoranthene	0	mg/L	2.71E+01	mg/kg	2.60E+00	3.10E-01	0.00E+00	3.85E-01	8.60E+00	1.20E-01	9.10E+00	5.53E+02	1.65E-02	2.77E+03	3.29E-03
Benzo(g,h,i)perylene	0	mg/L	1.42E+01	mg/kg	2.94E+00	6.40E-01	0.00E+00	2.02E-01	5.10E+00	1.30E-01	5.43E+00	5.53E+02	9.81E-03	2.77E+03	1.96E-03
Benzo(k)fluoranthene	0	mg/L	1.22E+01	mg/kg	2.60E+00	8.13E-02	0.00E+00	1.73E-01	3.87E+00	1.42E-02	4.06E+00	5.53E+02	7.34E-03	2.77E+03	1.47E-03
Chrysene	0	mg/L	2.62E+01	mg/kg	2.29E+00	1.77E-02	0.00E+00	3.72E-01	7.32E+00	6.65E-03	7.70E+00	5.53E+02	1.39E-02	2.77E+03	2.79E-03
Dibenz(a,h)anthracene	0	mg/L	4.88E+00	mg/kg	2.31E+00	1.30E-01	0.00E+00	6.93E-02	1.38E+00	9.08E-03	1.45E+00	5.53E+02	2.63E-03	2.77E+03	5.26E-04
Fluoranthene	0	mg/L	3.84E+01	mg/kg	3.04E+00	5.00E-01	0.00E+00	5.45E-01	1.42E+01	2.75E-01	1.51E+01	5.53E+02	2.72E-02	2.77E+03	5.45E-03
Fluorene	0	mg/L	3.70E+00	mg/kg	9.57E+00	3.39E-04	0.00E+00	5.26E-02	4.32E+00	1.80E-05	4.37E+00	5.53E+02	7.91E-03	2.77E+03	1.58E-03
Indeno(1,2,3-cd)pyrene	0	mg/L	1.65E+01	mg/kg	2.86E+00	1.10E-01	0.00E+00	2.34E-01	5.76E+00	2.60E-02	6.02E+00	5.53E+02	1.09E-02	2.77E+03	2.18E-03
Phenanthrene	0	mg/L	2.20E+01	mg/kg	1.72E+00	2.62E-01	0.00E+00	3.13E-01	4.62E+00	8.25E-02	5.01E+00	5.53E+02	9.07E-03	2.77E+03	1.81E-03
Pyrene	0	mg/L	9.30E+00	mg/kg	1.75E+00	7.20E-01	0.00E+00	1.32E-01	1.99E+00	9.59E-02	2.21E+00	5.53E+02	4.00E-03	2.77E+03	8.01E-04

Note: Actual Values in each Work Sheet Calculation Cell are in

Hazard Index (Total EEQ): 1.31E+03 1.10E+03

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0.105	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.895	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0025	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.024	kg/d
Body weight =	0.176	kg
Home range =	59	acres
Water intake rate =	0.0213	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-3
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN WOODCOCK AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 2
American Woodcock

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Invert. BAF	Terr. Plant BAF	PDE Surface Water	PDE Soil	PDE Terr. Invert.	PDE Terr. Plants	Total PDE	NOAEL	EEQ N	LOAEL	EEQ L
					----------	----------									
					unitless ----------	----------	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	
Arsenic	2.30E-02	mg/L	1.09E+01	mg/kg	1.20E-01	3.75E-02	4.24E-04	2.33E-02	2.42E-02	8.92E-04	4.88E-02	2.24E+00	2.18E-02	3.55E+00	1.37E-02
Copper	2.21E-02	mg/L	5.63E+01	mg/kg	5.15E-01	1.70E-01	4.07E-04	1.20E-01	5.38E-01	2.08E-02	6.79E-01	4.05E+00	1.68E-01	4.88E+00	1.39E-01
Lead	7.53E+00	mg/L	2.52E+04	mg/kg	1.14E-01	3.10E-03	1.39E-01	5.36E+01	5.32E+01	1.70E-01	1.07E+02	1.63E+00	**6.57E+01**	1.94E+00	**5.52E+01**
Zinc	6.63E-02	mg/L	9.29E+01	mg/kg	4.07E+00	6.40E-01	1.22E-03	1.98E-01	7.02E+00	1.29E-01	7.35E+00	6.61E+01	1.11E-01	6.65E+01	1.10E-01
Acenaphthene	0	mg/L	6.16E-01	mg/kg	1.47E+00	9.44E-03	0.00E+00	1.31E-03	1.68E-02	1.27E-05	1.81E-02	5.53E+02	3.28E-05	2.77E+03	6.56E-06
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	2.29E+01	4.25E-01	0.00E+00	5.39E-04	1.08E-01	2.34E-04	1.08E-01	5.53E+02	1.96E-04	2.77E+03	3.92E-05
Anthracene	0	mg/L	1.12E+00	mg/kg	2.42E+00	3.63E-01	0.00E+00	2.39E-03	5.04E-02	8.86E-04	5.37E-02	5.53E+02	9.70E-05	2.77E+03	1.94E-05
Benzo(a)anthracene	0	mg/L	3.85E+00	mg/kg	1.59E+00	3.86E-02	0.00E+00	8.19E-03	1.14E-01	3.23E-04	1.22E-01	5.53E+02	2.21E-04	2.77E+03	4.41E-05
Benzo(a)pyrene	0	mg/L	7.10E+00	mg/kg	1.33E+00	1.21E-01	0.00E+00	1.51E-02	1.75E-01	1.87E-03	1.92E-01	5.53E+02	3.47E-04	2.77E+03	6.95E-05
Benzo(b)fluoranthene	0	mg/L	1.28E+01	mg/kg	2.60E+00	3.10E-01	0.00E+00	2.73E-02	6.18E-01	8.65E-03	6.54E-01	5.53E+02	1.18E-03	2.77E+03	2.37E-04
Benzo(g,h,i)perylene	0	mg/L	2.11E+00	mg/kg	2.94E+00	4.52E-01	0.00E+00	4.49E-03	1.15E-01	2.08E-03	1.22E-01	5.53E+02	2.20E-04	2.77E+03	4.40E-05
Benzo(k)fluoranthene	0	mg/L	4.06E+00	mg/kg	2.60E+00	9.49E-02	0.00E+00	8.64E-03	1.96E-01	8.38E-04	2.05E-01	5.53E+02	3.71E-04	2.77E+03	7.42E-05
Chrysene	0	mg/L	3.77E+00	mg/kg	2.29E+00	3.89E-02	0.00E+00	8.03E-03	1.60E-01	3.20E-04	1.69E-01	5.53E+02	3.05E-04	2.77E+03	6.10E-05
Dibenz(a,h)anthracene	0	mg/L	9.19E-01	mg/kg	2.31E+00	1.30E-01	0.00E+00	1.96E-03	3.94E-02	2.60E-04	4.16E-02	5.53E+02	7.53E-05	2.77E+03	1.51E-05
Fluoranthene	0	mg/L	1.78E+01	mg/kg	3.04E+00	5.00E-01	0.00E+00	3.79E-02	1.00E+00	1.94E-02	1.06E+00	5.53E+02	1.92E-03	2.77E+03	3.84E-04
Fluorene	0	mg/L	5.66E-01	mg/kg	9.57E+00	1.10E-02	0.00E+00	1.21E-03	1.01E-01	1.36E-05	1.02E-01	5.53E+02	1.84E-04	2.77E+03	3.68E-05
Indeno(1,2,3-cd)pyrene	0	mg/L	2.70E+00	mg/kg	2.86E+00	1.10E-01	0.00E+00	5.74E-03	1.43E-01	6.45E-04	1.49E-01	5.53E+02	2.70E-04	2.77E+03	5.40E-05
Phenanthrene	0	mg/L	1.04E+01	mg/kg	1.72E+00	3.48E-01	0.00E+00	2.21E-02	3.32E-01	7.88E-03	3.62E-01	5.53E+02	6.55E-04	2.77E+03	1.31E-04
Pyrene	0	mg/L	6.69E+00	mg/kg	1.75E+00	7.20E-01	0.00E+00	1.42E-02	2.17E-01	1.05E-02	2.42E-01	5.53E+02	4.37E-04	2.77E+03	8.75E-05

Note: Actual Values in each Work Sheet Calculation Cell are ı

Hazard Index (Total EEQ): 6.60E+01 5.55E+01

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0.105	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.895	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0023	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0224	kg/d
Body weight =	0.197	kg
Home range =	59	acres
Water intake rate =	0.0199	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.82E-01	unitless

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TABLE D-4
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR BOBWHITE QUAIL AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 1
Northern Bobwhite Quail

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Invert. BAF	Terr. Plant BAF	PDE Surface Water	PDE Soil	PDE Terr. Invert.	PDE Terr. Plants	Total PDE	NOAEL	EEQ N	LOAEL	EEQ L
					---------- unitless ----------		mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	
Arsenic	2.30E-02	mg/L	2.41E+01	mg/kg	9.47E-02	3.75E-02	2.94E-03	3.60E-02	1.99E-02	4.85E-02	1.07E-01	2.24E+00	4.79E-02	3.55E+00	3.02E-02
Copper	2.21E-02	mg/L	7.12E+01	mg/kg	5.15E-01	1.47E-01	2.83E-03	1.06E-01	3.20E-01	5.61E-01	9.91E-01	4.05E+00	2.45E-01	4.88E+00	2.03E-01
Lead	7.53E+00	mg/L	8.47E+04	mg/kg	9.00E-02	1.82E-03	9.63E-01	1.27E+02	6.65E+01	8.26E+00	2.02E+02	1.63E+00	**1.24E+02**	1.94E+00	**1.04E+02**
Zinc	6.63E-02	mg/L	1.55E+02	mg/kg	2.89E+00	5.09E-01	8.48E-03	2.31E-01	3.90E+00	4.23E+00	8.38E+00	6.61E+01	1.27E-01	6.65E+01	1.26E-01
Acenaphthene	0	mg/L	3.79E+00	mg/kg	1.47E+00	3.24E-04	0.00E+00	5.66E-03	4.86E-02	6.59E-05	5.43E-02	5.53E+02	9.83E-05	2.77E+03	1.97E-05
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	2.29E+01	4.25E-01	0.00E+00	3.78E-04	5.06E-02	5.76E-03	5.67E-02	5.53E+02	1.03E-04	2.77E+03	2.05E-05
Anthracene	0	mg/L	7.88E+00	mg/kg	2.42E+00	2.35E-01	0.00E+00	1.18E-02	1.66E-01	9.95E-02	2.78E-01	5.53E+02	5.02E-04	2.77E+03	1.00E-04
Benzo(a)anthracene	0	mg/L	2.76E+01	mg/kg	1.59E+00	1.74E-02	0.00E+00	4.12E-02	3.83E-01	2.57E-02	4.50E-01	5.53E+02	8.14E-04	2.77E+03	1.63E-04
Benzo(a)pyrene	0	mg/L	2.16E+01	mg/kg	1.33E+00	1.18E-01	0.00E+00	3.23E-02	2.51E-01	1.36E-01	4.19E-01	5.53E+02	7.58E-04	2.77E+03	1.52E-04
Benzo(b)fluoranthene	0	mg/L	2.71E+01	mg/kg	2.60E+00	3.10E-01	0.00E+00	4.05E-02	6.15E-01	4.50E-01	1.11E+00	5.53E+02	2.00E-03	2.77E+03	4.00E-04
Benzo(g,h,i)perylene	0	mg/L	1.42E+01	mg/kg	2.94E+00	6.40E-01	0.00E+00	2.12E-02	3.64E-01	4.87E-01	8.73E-01	5.53E+02	1.58E-03	2.77E+03	3.16E-04
Benzo(k)fluoranthene	0	mg/L	1.22E+01	mg/kg	2.60E+00	8.13E-02	0.00E+00	1.82E-02	2.77E-01	5.32E-02	3.48E-01	5.53E+02	6.30E-04	2.77E+03	1.26E-04
Chrysene	0	mg/L	2.62E+01	mg/kg	2.29E+00	1.77E-02	0.00E+00	3.91E-02	5.24E-01	2.49E-02	5.88E-01	5.53E+02	1.06E-03	2.77E+03	2.13E-04
Dibenz(a,h)anthracene	0	mg/L	4.88E+00	mg/kg	2.31E+00	1.30E-01	0.00E+00	7.29E-03	9.84E-02	3.40E-02	1.40E-01	5.53E+02	2.53E-04	2.77E+03	5.05E-05
Fluoranthene	0	mg/L	3.84E+01	mg/kg	3.04E+00	5.00E-01	0.00E+00	5.74E-02	1.02E+00	1.03E+00	2.11E+00	5.53E+02	3.81E-03	2.77E+03	7.61E-04
Fluorene	0	mg/L	3.70E+00	mg/kg	9.57E+00	3.39E-04	0.00E+00	5.53E-03	3.09E-01	6.72E-05	3.15E-01	5.53E+02	5.69E-04	2.77E+03	1.14E-04
Indeno(1,2,3-cd)pyrene	0	mg/L	1.65E+01	mg/kg	2.86E+00	1.10E-01	0.00E+00	2.46E-02	4.12E-01	9.73E-02	5.34E-01	5.53E+02	9.65E-04	2.77E+03	1.93E-04
Phenanthrene	0	mg/L	2.20E+01	mg/kg	1.72E+00	2.62E-01	0.00E+00	3.29E-02	3.30E-01	3.09E-01	6.72E-01	5.53E+02	1.21E-03	2.77E+03	2.43E-04
Pyrene	0	mg/L	9.30E+00	mg/kg	1.75E+00	7.20E-01	0.00E+00	1.39E-02	1.42E-01	3.59E-01	5.15E-01	5.53E+02	9.31E-04	2.77E+03	1.86E-04

Note: Actual Values in each Work Sheet Calculation Cell are ı

Hazard Index (Total EEQ): 1.25E+02 1.05E+02

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0.86	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.14	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00023	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0096	kg/d
Body weight =	0.154	kg
Home range =	25	acres
Water intake rate =	0.0197	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-5
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR BOBWHITE QUAIL AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 2
Northern Bobwhite Quail

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Invert. BAF	Terr. Plant BAF	PDE Surface Water	PDE Soil	PDE Terr. Invert.	PDE Terr. Plants	Total PDE	NOAEL	EEQ N	LOAEL	EEQ L
					----------										
					unitless	----------	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	
Arsenic	2.30E-02	mg/L	1.09E+01	mg/kg	1.20E-01	3.75E-02	1.04E-03	5.64E-03	3.96E-03	7.63E-03	1.83E-02	2.24E+00	8.15E-03	3.55E+00	5.14E-03
Copper	2.21E-02	mg/L	5.63E+01	mg/kg	5.15E-01	1.70E-01	1.00E-03	2.91E-02	8.78E-02	1.78E-01	2.95E-01	4.05E+00	7.29E-02	4.88E+00	6.05E-02
Lead	7.53E+00	mg/L	2.52E+04	mg/kg	1.14E-01	3.10E-03	3.41E-01	1.30E+01	8.68E+00	1.45E+00	2.35E+01	1.63E+00	**1.44E+01**	1.94E+00	**1.21E+01**
Zinc	6.63E-02	mg/L	9.29E+01	mg/kg	4.07E+00	6.40E-01	3.00E-03	4.80E-02	1.15E+00	1.11E+00	2.30E+00	6.61E+01	3.49E-02	6.65E+01	3.46E-02
Acenaphthene	0	mg/L	6.16E-01	mg/kg	1.47E+00	9.44E-03	0.00E+00	3.18E-04	2.74E-03	1.08E-04	3.17E-03	5.53E+02	5.73E-06	2.77E+03	1.15E-06
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	2.29E+01	4.25E-01	0.00E+00	1.31E-04	1.76E-02	2.00E-03	1.97E-02	5.53E+02	3.56E-05	2.77E+03	7.12E-06
Anthracene	0	mg/L	1.12E+00	mg/kg	2.42E+00	3.63E-01	0.00E+00	5.79E-04	8.23E-03	7.57E-03	1.64E-02	5.53E+02	2.96E-05	2.77E+03	5.92E-06
Benzo(a)anthracene	0	mg/L	3.85E+00	mg/kg	1.59E+00	3.86E-02	0.00E+00	1.99E-03	1.85E-02	2.77E-03	2.33E-02	5.53E+02	4.21E-05	2.77E+03	8.42E-06
Benzo(a)pyrene	0	mg/L	7.10E+00	mg/kg	1.33E+00	1.21E-01	0.00E+00	3.66E-03	2.86E-02	1.60E-02	4.83E-02	5.53E+02	8.73E-05	2.77E+03	1.75E-05
Benzo(b)fluoranthene	0	mg/L	1.28E+01	mg/kg	2.60E+00	3.10E-01	0.00E+00	6.62E-03	1.01E-01	7.39E-02	1.81E-01	5.53E+02	3.28E-04	2.77E+03	6.56E-05
Benzo(g,h,i)perylene	0	mg/L	2.11E+00	mg/kg	2.94E+00	4.52E-01	0.00E+00	1.09E-03	1.88E-02	1.77E-02	3.76E-02	5.53E+02	6.81E-05	2.77E+03	1.36E-05
Benzo(k)fluoranthene	0	mg/L	4.06E+00	mg/kg	2.60E+00	9.49E-02	0.00E+00	2.09E-03	3.20E-02	7.17E-03	4.12E-02	5.53E+02	7.45E-05	2.77E+03	1.49E-05
Chrysene	0	mg/L	3.77E+00	mg/kg	2.29E+00	3.89E-02	0.00E+00	1.95E-03	2.62E-02	2.73E-03	3.08E-02	5.53E+02	5.58E-05	2.77E+03	1.12E-05
Dibenz(a,h)anthracene	0	mg/L	9.19E-01	mg/kg	2.31E+00	1.30E-01	0.00E+00	4.75E-04	6.43E-03	2.22E-03	9.13E-03	5.53E+02	1.65E-05	2.77E+03	3.30E-06
Fluoranthene	0	mg/L	1.78E+01	mg/kg	3.04E+00	5.00E-01	0.00E+00	9.20E-03	1.64E-01	1.66E-01	3.39E-01	5.53E+02	6.13E-04	2.77E+03	1.23E-04
Fluorene	0	mg/L	5.66E-01	mg/kg	9.57E+00	1.10E-02	0.00E+00	2.92E-04	1.64E-02	1.16E-04	1.68E-02	5.53E+02	3.04E-05	2.77E+03	6.08E-06
Indeno(1,2,3-cd)pyrene	0	mg/L	2.70E+00	mg/kg	2.86E+00	1.10E-01	0.00E+00	1.39E-03	2.34E-02	5.52E-03	3.03E-02	5.53E+02	5.47E-05	2.77E+03	1.09E-05
Phenanthrene	0	mg/L	1.04E+01	mg/kg	1.72E+00	3.48E-01	0.00E+00	5.37E-03	5.42E-02	6.74E-02	1.27E-01	5.53E+02	2.30E-04	2.77E+03	4.59E-05
Pyrene	0	mg/L	6.69E+00	mg/kg	1.75E+00	7.20E-01	0.00E+00	3.45E-03	3.55E-02	8.96E-02	1.29E-01	5.53E+02	2.32E-04	2.77E+03	4.65E-05

Note: Actual Values in each Work Sheet Calculation Cell are ı

Hazard Index (Total EEQ): 1.45E+01 1.22E+01

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0.86	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.14	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00021	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0088	kg/d
Body weight =	0.175	kg
Home range =	25	acres
Water intake rate =	0.0184	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	4.30E-01	unitless

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TABLE D-6
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR MARSH WRENS AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 1
Marsh Wren

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Aq. Invert. BAF ---------- ----------	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Aq. Invert. mg/kg-d	Total PDE mg/kg-d	NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	8.51E+02	mg/kg	6.90E-01	8.43E-03	3.21E+01	2.22E+02	2.54E+02	2.24E+00	**1.13E+02**	3.55E+00	**7.15E+01**
Copper	2.21E-02	mg/L	5.14E+02	mg/kg	5.25E+00	8.10E-03	1.94E+01	1.02E+03	1.04E+03	4.05E+00	**2.57E+02**	4.88E+00	**2.13E+02**
Lead	7.53E+00	mg/L	1.86E+05	mg/kg	6.07E-01	2.76E+00	7.03E+03	4.27E+04	4.97E+04	1.63E+00	**3.05E+04**	1.94E+00	**2.56E+04**
Zinc	6.63E-02	mg/L	6.29E+02	mg/kg	7.53E+00	2.43E-02	2.38E+01	1.79E+03	1.81E+03	6.61E+01	**2.74E+01**	6.65E+01	**2.73E+01**
Acenaphthene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Acenaphthylene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Anthracene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Benzo(a)anthracene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Benzo(a)pyrene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Benzo(b)fluoranthene	0	mg/L	1.86E-01	mg/kg	2.60E+00	0.00E+00	7.03E-03	1.83E-01	1.90E-01	5.53E+02	3.43E-04	2.77E+03	6.86E-05
Benzo(g,h,i)perylene	0	mg/L	1.69E+00	mg/kg	2.94E+00	0.00E+00	6.38E-02	1.88E+00	1.94E+00	5.53E+02	3.51E-03	2.77E+03	7.02E-04
Benzo(k)fluoranthene	0	mg/L	2.16E-01	mg/kg	2.60E+00	0.00E+00	8.16E-03	2.12E-01	2.20E-01	5.53E+02	3.98E-04	2.77E+03	7.97E-05
Chrysene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Dibenz(a,h)anthracene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Fluoranthene	0	mg/L	2.90E-01	mg/kg	3.04E+00	0.00E+00	1.10E-02	3.33E-01	3.44E-01	5.53E+02	6.22E-04	2.77E+03	1.24E-04
Fluorene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Indeno(1,2,3-cd)pyrene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Phenanthrene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Pyrene	0	mg/L	4.67E-01	mg/kg	1.75E+00	0.00E+00	1.76E-02	3.09E-01	3.26E-01	5.53E+02	5.90E-04	2.77E+03	1.18E-04

Note: Actual Values in each Work Sheet Calculation Cell are ı **Hazard Index (Total EEQ):** **3.09E+04** **2.59E+04**

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, x Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	1	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0.00034	kg/d
Food ingestion rate =	0.0034	kg/d
Body weight =	0.009	kg
Home range =	0.5	acres
Water intake rate =	0.0033	L/d
[Sediment] Site Area =	12.11	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-7
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR MARSH WRENS AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 2
Marsh Wren

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Aq. Invert. BAF ---------- ----------	PDE Surface Water mg/kg-d	PDE Sediment mg/kg-d	PDE Aq. Invert. mg/kg-d	Total PDE mg/kg-d	NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	8.51E+02	mg/kg	1.43E-01	6.06E-03	2.24E+01	3.21E+01	5.45E+01	2.24E+00	**2.43E+01**	3.55E+00	**1.54E+01**
Copper	2.21E-02	mg/L	3.57E+02	mg/kg	1.56E+00	5.83E-03	9.41E+00	1.46E+02	1.56E+02	4.05E+00	**3.85E+01**	4.88E+00	**3.19E+01**
Lead	7.53E+00	mg/L	1.86E+05	mg/kg	7.10E-02	1.99E+00	4.90E+03	3.48E+03	8.39E+03	1.63E+00	**5.15E+03**	1.94E+00	**4.32E+03**
Zinc	6.63E-02	mg/L	5.93E+02	mg/kg	1.94E+00	1.75E-02	1.56E+01	3.03E+02	3.18E+02	6.61E+01	**4.82E+00**	6.65E+01	**4.79E+00**
Acenaphthene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Acenaphthylene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Anthracene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Benzo(a)anthracene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Benzo(a)pyrene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Benzo(b)fluoranthene	0	mg/L	1.86E-01	mg/kg	2.60E+00	0.00E+00	4.91E-03	1.28E-01	1.33E-01	5.53E+02	2.40E-04	2.77E+03	4.79E-05
Benzo(g,h,i)perylene	0	mg/L	1.69E+00	mg/kg	2.94E+00	0.00E+00	4.46E-02	1.31E+00	1.35E+00	5.53E+02	2.45E-03	2.77E+03	4.90E-04
Benzo(k)fluoranthene	0	mg/L	2.16E-01	mg/kg	2.60E+00	0.00E+00	5.69E-03	1.48E-01	1.54E-01	5.53E+02	2.78E-04	2.77E+03	5.56E-05
Chrysene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Dibenz(a,h)anthracene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Fluoranthene	0	mg/L	2.90E-01	mg/kg	3.04E+00	0.00E+00	7.65E-03	2.32E-01	2.40E-01	5.53E+02	4.34E-04	2.77E+03	8.68E-05
Fluorene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Indeno(1,2,3-cd)pyrene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Phenanthrene	0	mg/L	0	mg/kg	NA	0.00E+00	0.00E+00	NA	0.00E+00	5.53E+02	0.00E+00	2.77E+03	0.00E+00
Pyrene	0	mg/L	4.67E-01	mg/kg	1.75E+00	0.00E+00	1.23E-02	2.15E-01	2.28E-01	5.53E+02	4.12E-04	2.77E+03	8.24E-05

Note: Actual Values in each Work Sheet Calculation Cell are ı

Hazard Index (Total EEQ): 5.21E+03 4.38E+03

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, x Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	1	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0.00029	kg/d
Food ingestion rate =	0.0029	kg/d
Body weight =	0.011	kg
Home range =	0.5	acres
Water intake rate =	0.0029	L/d
[Sediment] Site Area =	12.11	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-8
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR SHORT-TAILED SHREWS AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 1
Short-tailed Shrew

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Invert. BAF ---------- ----------	PDE Surface Water mg/kg-d	PDE Soil mg/kg-d	PDE Terr. Invert. mg/kg-d	Total PDE mg/kg-d	NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	2.41E+01	mg/kg	9.47E-02	6.07E-03	5.21E-01	4.75E-01	1.00E+00	1.04E+00	9.63E-01	1.66E+00	6.03E-01
Copper	2.21E-02	mg/L	7.12E+01	mg/kg	5.15E-01	5.83E-03	1.54E+00	7.63E+00	9.17E+00	5.60E+00	**1.64E+00**	5.78E+00	**1.59E+00**
Lead	7.53E+00	mg/L	8.47E+04	mg/kg	9.00E-02	1.99E+00	1.83E+03	1.59E+03	3.42E+03	4.70E+00	**7.27E+02**	5.00E+00	**6.83E+02**
Zinc	6.63E-02	mg/L	1.55E+02	mg/kg	2.89E+00	1.75E-02	3.35E+00	9.30E+01	9.64E+01	7.54E+01	**1.28E+00**	7.57E+01	**1.27E+00**
Acenaphthene	0	mg/L	3.79E+00	mg/kg	1.47E+00	0.00E+00	8.19E-02	1.16E+00	1.24E+00	6.56E+01	1.89E-02	1.10E+02	1.13E-02
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	2.29E+01	0.00E+00	5.46E-03	1.21E+00	1.21E+00	6.56E+01	1.85E-02	1.10E+02	1.10E-02
Anthracene	0	mg/L	7.88E+00	mg/kg	2.42E+00	0.00E+00	1.70E-01	3.97E+00	4.14E+00	6.56E+01	6.31E-02	1.10E+02	3.76E-02
Benzo(a)anthracene	0	mg/L	2.76E+01	mg/kg	1.59E+00	0.00E+00	5.96E-01	9.13E+00	9.72E+00	6.15E-01	**1.58E+01**	3.07E+00	**3.17E+00**
Benzo(a)pyrene	0	mg/L	2.16E+01	mg/kg	1.33E+00	0.00E+00	4.67E-01	5.98E+00	6.44E+00	1.00E+00	**6.44E+00**	1.00E+01	6.44E-01
Benzo(b)fluoranthene	0	mg/L	2.71E+01	mg/kg	2.60E+00	0.00E+00	5.85E-01	1.47E+01	1.52E+01	6.15E-01	**2.48E+01**	3.07E+00	**4.96E+00**
Benzo(g,h,i)perylene	0	mg/L	1.42E+01	mg/kg	2.94E+00	0.00E+00	3.07E-01	8.68E+00	8.99E+00	6.15E-01	**1.46E+01**	3.07E+00	**2.93E+00**
Benzo(k)fluoranthene	0	mg/L	1.22E+01	mg/kg	2.60E+00	0.00E+00	2.64E-01	6.60E+00	6.86E+00	6.15E-01	**1.12E+01**	3.07E+00	**2.23E+00**
Chrysene	0	mg/L	2.62E+01	mg/kg	2.29E+00	0.00E+00	5.66E-01	1.25E+01	1.30E+01	6.15E-01	**2.12E+01**	3.07E+00	**4.25E+00**
Dibenz(a,h)anthracene	0	mg/L	4.88E+00	mg/kg	2.31E+00	0.00E+00	1.05E-01	2.34E+00	2.45E+00	6.15E-01	**3.98E+00**	3.07E+00	7.98E-01
Fluoranthene	0	mg/L	3.84E+01	mg/kg	3.04E+00	0.00E+00	8.29E-01	2.43E+01	2.51E+01	6.15E-01	**4.08E+01**	3.07E+00	**8.18E+00**
Fluorene	0	mg/L	3.70E+00	mg/kg	9.57E+00	0.00E+00	7.99E-02	7.37E+00	7.44E+00	6.56E+01	1.13E-01	1.10E+02	6.77E-02
Indeno(1,2,3-cd)pyrene	0	mg/L	1.65E+01	mg/kg	2.86E+00	0.00E+00	3.56E-01	9.82E+00	1.02E+01	6.15E-01	**1.65E+01**	3.07E+00	**3.31E+00**
Phenanthrene	0	mg/L	2.20E+01	mg/kg	1.72E+00	0.00E+00	4.75E-01	7.87E+00	8.35E+00	6.56E+01	1.27E-01	1.10E+02	7.59E-02
Pyrene	0	mg/L	9.30E+00	mg/kg	1.75E+00	0.00E+00	2.01E-01	3.39E+00	3.59E+00	6.15E-01	**5.83E+00**	3.07E+00	**1.17E+00**

Note: Actual Values in each Work Sheet Calculation Cell are ı **Hazard Index (Total EEQ):** **8.92E+02** **7.19E+02**

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00027	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0026	kg/d
Body weight =	0.0125	kg
Home range =	0.96	acres
Water intake rate =	0.0033	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-9
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR SHORT-TAILED SHREWS AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 2
Short-tailed Shrew

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Invert. BAF ---------- ----------	PDE Surface Water mg/kg-d	PDE Soil mg/kg-d	PDE Terr. Invert. mg/kg-d	Total PDE mg/kg-d	NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	1.09E+01	mg/kg	1.20E-01	3.53E-03	1.53E-01	1.74E-01	3.31E-01	1.04E+00	3.18E-01	1.66E+00	1.99E-01
Copper	2.21E-02	mg/L	5.63E+01	mg/kg	5.15E-01	3.39E-03	7.88E-01	3.86E+00	4.65E+00	5.60E+00	8.31E-01	5.78E+00	8.05E-01
Lead	7.53E+00	mg/L	2.52E+04	mg/kg	1.14E-01	1.15E+00	3.53E+02	3.82E+02	7.36E+02	4.70E+00	**1.57E+02**	5.00E+00	**1.47E+02**
Zinc	6.63E-02	mg/L	9.29E+01	mg/kg	4.07E+00	1.02E-02	1.30E+00	5.04E+01	5.17E+01	7.54E+01	6.86E-01	7.57E+01	6.83E-01
Acenaphthene	0	mg/L	6.16E-01	mg/kg	1.47E+00	0.00E+00	8.62E-03	1.21E-01	1.29E-01	6.56E+01	1.97E-03	1.10E+02	1.18E-03
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	2.29E+01	0.00E+00	3.54E-03	7.72E-01	7.76E-01	6.56E+01	1.18E-02	1.10E+02	7.05E-03
Anthracene	0	mg/L	1.12E+00	mg/kg	2.42E+00	0.00E+00	1.57E-02	3.62E-01	3.78E-01	6.56E+01	5.76E-03	1.10E+02	3.43E-03
Benzo(a)anthracene	0	mg/L	3.85E+00	mg/kg	1.59E+00	0.00E+00	5.39E-02	8.16E-01	8.70E-01	6.15E-01	**1.41E+00**	3.07E+00	2.83E-01
Benzo(a)pyrene	0	mg/L	7.10E+00	mg/kg	1.33E+00	0.00E+00	9.93E-02	1.26E+00	1.36E+00	1.00E+00	**1.36E+00**	1.00E+01	1.36E-01
Benzo(b)fluoranthene	0	mg/L	1.28E+01	mg/kg	2.60E+00	0.00E+00	1.79E-01	4.44E+00	4.62E+00	6.15E-01	**7.51E+00**	3.07E+00	**1.50E+00**
Benzo(g,h,i)perylene	0	mg/L	2.11E+00	mg/kg	2.94E+00	0.00E+00	2.96E-02	8.28E-01	8.57E-01	6.15E-01	**1.39E+00**	3.07E+00	2.79E-01
Benzo(k)fluoranthene	0	mg/L	4.06E+00	mg/kg	2.60E+00	0.00E+00	5.68E-02	1.41E+00	1.46E+00	6.15E-01	**2.38E+00**	3.07E+00	4.77E-01
Chrysene	0	mg/L	3.77E+00	mg/kg	2.29E+00	0.00E+00	5.28E-02	1.15E+00	1.20E+00	6.15E-01	**1.96E+00**	3.07E+00	3.92E-01
Dibenz(a,h)anthracene	0	mg/L	9.19E-01	mg/kg	2.31E+00	0.00E+00	1.29E-02	2.83E-01	2.96E-01	6.15E-01	4.81E-01	3.07E+00	9.64E-02
Fluoranthene	0	mg/L	1.78E+01	mg/kg	3.04E+00	0.00E+00	2.49E-01	7.22E+00	7.47E+00	6.15E-01	**1.21E+01**	3.07E+00	**2.43E+00**
Fluorene	0	mg/L	5.66E-01	mg/kg	9.57E+00	0.00E+00	7.92E-03	7.22E-01	7.30E-01	6.56E+01	1.11E-02	1.10E+02	6.64E-03
Indeno(1,2,3-cd)pyrene	0	mg/L	2.70E+00	mg/kg	2.86E+00	0.00E+00	3.77E-02	1.03E+00	1.07E+00	6.15E-01	**1.73E+00**	3.07E+00	3.47E-01
Phenanthrene	0	mg/L	1.04E+01	mg/kg	1.72E+00	0.00E+00	1.46E-01	2.39E+00	2.53E+00	6.56E+01	3.86E-02	1.10E+02	2.30E-02
Pyrene	0	mg/L	6.69E+00	mg/kg	1.75E+00	0.00E+00	9.36E-02	1.56E+00	1.65E+00	6.15E-01	**2.69E+00**	3.07E+00	5.39E-01

Note: Actual Values in each Work Sheet Calculation Cell are ı

Hazard Index (Total EEQ): 1.91E+02 1.55E+02

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00021	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.002	kg/d
Body weight =	0.015	kg
Home range =	0.96	acres
Water intake rate =	0.0023	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-10
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR MEADOW VOLE AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 1
Meadow Vole

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Plant BAF ---------- ----------	PDE Surface Water mg/kg-d	PDE Soil mg/kg-d	PDE Terr. Plants mg/kg-d	Total PDE mg/kg-d	NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	2.41E+01	mg/kg	3.75E-02	9.47E-03	3.40E-01	5.32E-01	8.82E-01	1.04E+00	8.48E-01	1.66E+00	5.31E-01
Copper	2.21E-02	mg/L	7.12E+01	mg/kg	1.47E-01	9.10E-03	1.01E+00	6.16E+00	7.17E+00	5.60E+00	**1.28E+00**	5.78E+00	**1.24E+00**
Lead	7.53E+00	mg/L	8.47E+04	mg/kg	1.82E-03	3.10E+00	1.20E+03	9.06E+01	1.29E+03	4.70E+00	**2.74E+02**	5.00E+00	**2.58E+02**
Zinc	6.63E-02	mg/L	1.55E+02	mg/kg	5.09E-01	2.73E-02	2.19E+00	4.65E+01	4.87E+01	7.54E+01	6.45E-01	7.57E+01	6.43E-01
Acenaphthene	0	mg/L	3.79E+00	mg/kg	3.24E-04	0.00E+00	5.35E-02	7.23E-04	5.42E-02	6.56E+01	8.27E-04	1.10E+02	4.93E-04
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	4.25E-01	0.00E+00	3.57E-03	6.32E-02	6.68E-02	6.56E+01	1.02E-03	1.10E+02	6.07E-04
Anthracene	0	mg/L	7.88E+00	mg/kg	2.35E-01	0.00E+00	1.11E-01	1.09E+00	1.20E+00	6.56E+01	1.83E-02	1.10E+02	1.09E-02
Benzo(a)anthracene	0	mg/L	2.76E+01	mg/kg	1.74E-02	0.00E+00	3.90E-01	2.82E-01	6.72E-01	6.15E-01	**1.09E+00**	3.07E+00	2.19E-01
Benzo(a)pyrene	0	mg/L	2.16E+01	mg/kg	1.18E-01	0.00E+00	3.05E-01	1.50E+00	1.80E+00	1.00E+00	**1.80E+00**	1.00E+01	1.80E-01
Benzo(b)fluoranthene	0	mg/L	2.71E+01	mg/kg	3.10E-01	0.00E+00	3.83E-01	4.94E+00	5.32E+00	6.15E-01	**8.66E+00**	3.07E+00	**1.73E+00**
Benzo(g,h,i)perylene	0	mg/L	1.42E+01	mg/kg	6.40E-01	0.00E+00	2.00E-01	5.35E+00	5.55E+00	6.15E-01	**9.02E+00**	3.07E+00	**1.81E+00**
Benzo(k)fluoranthene	0	mg/L	1.22E+01	mg/kg	8.13E-02	0.00E+00	1.72E-01	5.84E-01	7.56E-01	6.15E-01	**1.23E+00**	3.07E+00	2.46E-01
Chrysene	0	mg/L	2.62E+01	mg/kg	1.77E-02	0.00E+00	3.70E-01	2.73E-01	6.43E-01	6.15E-01	**1.05E+00**	3.07E+00	2.09E-01
Dibenz(a,h)anthracene	0	mg/L	4.88E+00	mg/kg	1.30E-01	0.00E+00	6.89E-02	3.73E-01	4.42E-01	6.15E-01	7.19E-01	3.07E+00	1.44E-01
Fluoranthene	0	mg/L	3.84E+01	mg/kg	5.00E-01	0.00E+00	5.42E-01	1.13E+01	1.18E+01	6.15E-01	**1.92E+01**	3.07E+00	**3.86E+00**
Fluorene	0	mg/L	3.70E+00	mg/kg	3.39E-04	0.00E+00	5.22E-02	7.38E-04	5.30E-02	6.56E+01	8.08E-04	1.10E+02	4.82E-04
Indeno(1,2,3-cd)pyrene	0	mg/L	1.65E+01	mg/kg	1.10E-01	0.00E+00	2.33E-01	1.07E+00	1.30E+00	6.15E-01	**2.11E+00**	3.07E+00	4.24E-01
Phenanthrene	0	mg/L	2.20E+01	mg/kg	2.62E-01	0.00E+00	3.11E-01	3.39E+00	3.70E+00	6.56E+01	5.64E-02	1.10E+02	3.36E-02
Pyrene	0	mg/L	9.30E+00	mg/kg	7.20E-01	0.00E+00	1.31E-01	3.94E+00	4.07E+00	6.15E-01	**6.62E+00**	3.07E+00	**1.33E+00**

Note: Actual Values in each Work Sheet Calculation Cell are ir **Hazard Index (Total EEQ):** **3.29E+02** **2.71E+02**

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\,xCij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00024	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.01	kg/d
Body weight =	0.017	kg
Home range =	0.089	acres
Water intake rate =	0.007	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-11
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR MEADOW VOLE AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 2
Meadow Vole

Chemical	Surface Water Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Terr. Plant BAF ---------- ----------	PDE Surface Water mg/kg-d	PDE Soil mg/kg-d	PDE Terr. Plants mg/kg-d	Total PDE mg/kg-d	NOAEL mg/kg-d	EEQ N	LOAEL mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	1.09E+01	mg/kg	3.75E-02	3.17E-03	5.90E-02	9.19E-02	1.54E-01	1.04E+00	1.48E-01	1.66E+00	9.28E-02
Copper	2.21E-02	mg/L	5.63E+01	mg/kg	1.70E-01	3.05E-03	3.04E-01	2.14E+00	2.45E+00	5.60E+00	4.37E-01	5.78E+00	4.23E-01
Lead	7.53E+00	mg/L	2.52E+04	mg/kg	3.10E-03	1.04E+00	1.36E+02	1.75E+01	1.55E+02	4.70E+00	**3.29E+01**	5.00E+00	**3.09E+01**
Zinc	6.63E-02	mg/L	9.29E+01	mg/kg	6.40E-01	9.14E-03	5.02E-01	1.33E+01	1.39E+01	7.54E+01	1.84E-01	7.57E+01	1.83E-01
Acenaphthene	0	mg/L	6.16E-01	mg/kg	9.44E-03	0.00E+00	3.33E-03	1.30E-03	4.63E-03	6.56E+01	7.06E-05	1.10E+02	4.21E-05
Acenaphthylene	0	mg/L	2.53E-01	mg/kg	4.25E-01	0.00E+00	1.37E-03	2.41E-02	2.55E-02	6.56E+01	3.88E-04	1.10E+02	2.31E-04
Anthracene	0	mg/L	1.12E+00	mg/kg	3.63E-01	0.00E+00	6.06E-03	9.13E-02	9.74E-02	6.56E+01	1.48E-03	1.10E+02	8.85E-04
Benzo(a)anthracene	0	mg/L	3.85E+00	mg/kg	3.86E-02	0.00E+00	2.08E-02	3.33E-02	5.41E-02	6.15E-01	8.80E-02	3.07E+00	1.76E-02
Benzo(a)pyrene	0	mg/L	7.10E+00	mg/kg	1.21E-01	0.00E+00	3.84E-02	1.93E-01	2.31E-01	1.00E+00	2.31E-01	1.00E+01	2.31E-02
Benzo(b)fluoranthene	0	mg/L	1.28E+01	mg/kg	3.10E-01	0.00E+00	6.92E-02	8.91E-01	9.60E-01	6.15E-01	**1.56E+00**	3.07E+00	3.13E-01
Benzo(g,h,i)perylene	0	mg/L	2.11E+00	mg/kg	4.52E-01	0.00E+00	1.14E-02	2.14E-01	2.25E-01	6.15E-01	3.66E-01	3.07E+00	7.34E-02
Benzo(k)fluoranthene	0	mg/L	4.06E+00	mg/kg	9.49E-02	0.00E+00	2.19E-02	8.64E-02	1.08E-01	6.15E-01	1.76E-01	3.07E+00	3.53E-02
Chrysene	0	mg/L	3.77E+00	mg/kg	3.89E-02	0.00E+00	2.04E-02	3.29E-02	5.33E-02	6.15E-01	8.67E-02	3.07E+00	1.74E-02
Dibenz(a,h)anthracene	0	mg/L	9.19E-01	mg/kg	1.30E-01	0.00E+00	4.97E-03	2.68E-02	3.18E-02	6.15E-01	5.17E-02	3.07E+00	1.03E-02
Fluoranthene	0	mg/L	1.78E+01	mg/kg	5.00E-01	0.00E+00	9.63E-02	2.00E+00	2.09E+00	6.15E-01	**3.40E+00**	3.07E+00	6.82E-01
Fluorene	0	mg/L	5.66E-01	mg/kg	1.10E-02	0.00E+00	3.06E-03	1.40E-03	4.46E-03	6.56E+01	6.80E-05	1.10E+02	4.06E-05
Indeno(1,2,3-cd)pyrene	0	mg/L	2.70E+00	mg/kg	1.10E-01	0.00E+00	1.46E-02	6.65E-02	8.11E-02	6.15E-01	1.32E-01	3.07E+00	2.64E-02
Phenanthrene	0	mg/L	1.04E+01	mg/kg	3.48E-01	0.00E+00	5.62E-02	8.12E-01	8.68E-01	6.56E+01	1.32E-02	1.10E+02	7.89E-03
Pyrene	0	mg/L	6.69E+00	mg/kg	7.20E-01	0.00E+00	3.61E-02	1.08E+00	1.12E+00	6.15E-01	**1.81E+00**	3.07E+00	3.64E-01

Note: Actual Values in each Work Sheet Calculation Cell are u

Hazard Index (Total EEQ): 4.16E+01 **3.32E+01**

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, x Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0	unitless
Terr. Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0002	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0083	kg/d
Body weight =	0.037	kg
Home range =	0.089	acres
Water intake rate =	0.0051	L/d
[Soil] Site Area =	10.76	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-12
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RACCOONS AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 1
Raccoon

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Aq. Invert. BAF	Aq. Plant BAF	Soil to Mammal BAF	PDE Surface Water	PDE Sediment	PDE Fish	PDE Aq. Invert.	PDE Aq. Plants	PDE Mammals	Total PDE	NOAEL	EEQ N	LOAEL	EEQ L
							---------- unitless ----------													
							----------			mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	
Arsenic	2.30E-02	mg/L	8.51E+02	mg/kg	2.41E+01	mg/kg	6.90E-01	3.75E-02	4.41E-03	3.45E-03	3.71E+00	0.00E+00	1.40E+01	6.25E-01	8.74E-03	1.83E+01	1.04E+00	1.76E+01	1.66E+00	1.10E+01
Copper	2.21E-02	mg/L	5.14E+02	mg/kg	7.12E+01	mg/kg	5.25E+00	4.44E-02	2.00E-01	3.31E-03	2.24E+00	0.00E+00	6.41E+01	4.46E-01	2.40E-01	6.71E+01	5.60E+00	1.20E+01	5.78E+00	1.16E+01
Lead	7.53E+00	mg/L	1.86E+05	mg/kg	8.47E+04	mg/kg	6.07E-01	1.29E-03	1.92E-03	1.13E+00	8.11E+02	0.00E+00	2.68E+03	4.69E+00	8.34E-01	3.50E+03	4.70E+00	7.45E+02	5.00E+00	7.00E+02
Zinc	6.63E-02	mg/L	6.29E+02	mg/kg	1.55E+02	mg/kg	7.53E+00	2.73E-01	7.23E-01	9.94E-03	2.74E+00	0.00E+00	1.13E+02	3.36E+00	1.06E+00	1.20E+02	7.54E+01	1.59E+00	7.57E+01	1.58E+00
Acenaphthene	0	mg/L	0	mg/kg	3.79E+00	mg/kg	NA	NA	8.00E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Acenaphthylene	0	mg/L	0	mg/kg	2.53E-01	mg/kg	NA	NA	7.70E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Anthracene	0	mg/L	0	mg/kg	7.88E+00	mg/kg	NA	NA	6.40E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Benzo(a)anthracene	0	mg/L	0	mg/kg	2.76E+01	mg/kg	NA	NA	3.50E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Benzo(a)pyrene	0	mg/L	0	mg/kg	2.16E+01	mg/kg	NA	NA	2.80E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	1.00E+00	0.00E+00	1.00E+01	0.00E+00
Benzo(b)fluoranthene	0	mg/L	1.86E-01	mg/kg	2.71E+01	mg/kg	2.60E+00	3.10E-01	2.80E-01	0.00E+00	8.11E-04	NA	1.15E-02	1.13E-03	1.21E-04	1.36E-02	6.15E-01	2.20E-02	3.07E+00	4.41E-03
Benzo(g,h,i)perylene	0	mg/L	1.69E+00	mg/kg	1.42E+01	mg/kg	2.94E+00	4.34E-01	2.40E-01	0.00E+00	7.37E-03	NA	1.18E-01	1.43E-02	9.45E-04	1.41E-01	6.15E-01	2.29E-01	3.07E+00	4.58E-02
Benzo(k)fluoranthene	0	mg/L	2.16E-01	mg/kg	1.22E+01	mg/kg	2.60E+00	1.43E-01	2.90E-01	0.00E+00	9.42E-04	NA	1.33E-02	6.06E-04	1.46E-04	1.50E-02	6.15E-01	2.45E-02	3.07E+00	4.90E-03
Chrysene	0	mg/L	0	mg/kg	2.62E+01	mg/kg	NA	NA	3.50E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Dibenz(a,h)anthracene	0	mg/L	0	mg/kg	4.88E+00	mg/kg	NA	1.30E-01	2.00E-01	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Fluoranthene	0	mg/L	2.90E-01	mg/kg	3.84E+01	mg/kg	3.04E+00	5.00E-01	5.00E-01	0.00E+00	1.26E-03	NA	2.09E-02	2.84E-03	3.38E-04	2.54E-02	6.15E-01	4.13E-02	3.07E+00	8.27E-03
Fluorene	0	mg/L	0	mg/kg	3.70E+00	mg/kg	NA	NA	7.30E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Indeno(1,2,3-cd)pyrene	0	mg/L	0	mg/kg	1.65E+01	mg/kg	NA	1.10E-01	2.30E-01	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Phenanthrene	0	mg/L	0	mg/kg	2.20E+01	mg/kg	NA	NA	6.00E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Pyrene	0	mg/L	4.67E-01	mg/kg	9.30E+00	mg/kg	1.75E+00	7.20E-01	5.20E-01	0.00E+00	2.04E-03	NA	1.94E-02	6.58E-03	5.66E-04	2.86E-02	6.15E-01	4.65E-02	3.07E+00	9.32E-03

Note: Actual Values in each Work Sheet Calculation Cell are in ′

Hazard Index (Total EEQ): 7.76E+02 7.24E+02

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi \, x Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0.42	unitless
Terr. Plant diet fraction =	0	unitless
Fish diet fraction * =	0	unitless
Aq. Invert diet fraction =	0.51	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.05	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0.016	kg/d
Food ingestion rate =	0.171	kg/d
Body weight =	3.67	kg
Home range =	128	acres
Water intake rate =	0.55	L/d
[Sediment] Site Area =	12.11	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE D-13
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RACCOONS AT PICATINNY FORMER SKEET RANGE

Hazard Estimate - Tier 2
Raccoon

Chemical	Surface Water Exposure Point Concentration	Units	Sediment Exposure Point Concentration	Units	Soil Exposure Point Concentration	Units	Aq. Invert. BAF	Aq. Plant BAF	Soil to Mammal BAF	PDE Surface Water	PDE Sediment	PDE Fish	PDE Aq. Invert.	PDE Aq. Plants	PDE Mammals	Total PDE	NOAEL		LOAEL	
							---------- unitless ----------													
							----------			mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	EEQ L
Arsenic	2.30E-02	mg/L	8.51E+02	mg/kg	1.09E+01	mg/kg	1.43E-01	3.75E-02	5.09E-03	1.83E-04	2.05E-01	0.00E+00	1.62E-01	3.51E-02	5.67E-04	4.03E-01	1.04E+00	3.88E-01	1.66E+00	2.43E-01
Copper	2.21E-02	mg/L	3.57E+02	mg/kg	5.63E+01	mg/kg	1.56E+00	5.54E-02	2.45E-01	1.76E-04	8.61E-02	0.00E+00	7.41E-01	2.17E-02	1.14E-02	8.60E-01	5.60E+00	1.54E-01	5.78E+00	1.49E-01
Lead	7.53E+00	mg/L	1.86E+05	mg/kg	2.52E+04	mg/kg	7.10E-02	1.29E-03	3.79E-03	6.01E-02	4.49E+01	0.00E+00	1.76E+01	2.63E-01	9.21E-02	6.29E+01	4.70E+00	1.34E+01	5.00E+00	1.26E+01
Zinc	6.63E-02	mg/L	5.93E+02	mg/kg	9.29E+01	mg/kg	1.94E+00	2.80E-01	1.16E+00	5.29E-04	1.43E-01	0.00E+00	1.53E+00	1.82E-01	9.03E-02	1.95E+00	7.54E+01	2.58E-02	7.57E+01	2.57E-02
Acenaphthene	0	mg/L	0	mg/kg	6.16E-01	mg/kg	NA	NA	8.00E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Acenaphthylene	0	mg/L	0	mg/kg	2.53E-01	mg/kg	NA	NA	7.70E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Anthracene	0	mg/L	0	mg/kg	1.12E+00	mg/kg	NA	NA	6.40E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Benzo(a)anthracene	0	mg/L	0	mg/kg	3.85E+00	mg/kg	NA	NA	3.50E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Benzo(a)pyrene	0	mg/L	0	mg/kg	7.10E+00	mg/kg	NA	NA	2.80E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	1.00E+00	0.00E+00	1.00E+01	0.00E+00
Benzo(b)fluoranthene	0	mg/L	1.86E-01	mg/kg	1.28E+01	mg/kg	2.60E+00	3.10E-01	2.80E-01	0.00E+00	4.49E-05	NA	6.46E-04	6.34E-05	6.82E-06	7.61E-04	6.15E-01	1.24E-03	3.07E+00	2.48E-04
Benzo(g,h,i)perylene	0	mg/L	1.69E+00	mg/kg	2.11E+00	mg/kg	2.94E+00	4.34E-01	2.40E-01	0.00E+00	4.08E-04	NA	6.63E-03	8.05E-04	5.30E-05	7.89E-03	6.15E-01	1.28E-02	3.07E+00	2.57E-03
Benzo(k)fluoranthene	0	mg/L	2.16E-01	mg/kg	4.06E+00	mg/kg	2.60E+00	1.43E-01	2.90E-01	0.00E+00	5.21E-05	NA	7.49E-04	3.40E-05	8.19E-06	8.43E-04	6.15E-01	1.37E-03	3.07E+00	2.75E-04
Chrysene	0	mg/L	0	mg/kg	3.77E+00	mg/kg	NA	NA	3.50E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Dibenz(a,h)anthracene	0	mg/L	0	mg/kg	9.19E-01	mg/kg	NA	1.30E-01	2.00E-01	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Fluoranthene	0	mg/L	2.90E-01	mg/kg	1.78E+01	mg/kg	3.04E+00	5.00E-01	5.00E-01	0.00E+00	6.99E-05	NA	1.18E-03	1.59E-04	1.90E-05	1.42E-03	6.15E-01	2.32E-03	3.07E+00	4.64E-04
Fluorene	0	mg/L	0	mg/kg	5.66E-01	mg/kg	NA	NA	7.30E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Indeno(1,2,3-cd)pyrene	0	mg/L	0	mg/kg	2.70E+00	mg/kg	NA	1.10E-01	2.30E-01	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00E+00	6.15E-01	0.00E+00	3.07E+00	0.00E+00
Phenanthrene	0	mg/L	0	mg/kg	1.04E+01	mg/kg	NA	NA	6.00E-01	0.00E+00	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	6.56E+01	0.00E+00	1.10E+02	0.00E+00
Pyrene	0	mg/L	4.67E-01	mg/kg	6.69E+00	mg/kg	1.75E+00	7.20E-01	5.20E-01	0.00E+00	1.13E-04	NA	1.09E-03	3.69E-04	3.18E-05	1.60E-03	6.15E-01	2.61E-03	3.07E+00	5.22E-04

Note: Actual Values in each Work Sheet Calculation Cell are in **Hazard Index (Total EEQ): 1.40E+01** **1.30E+01**

Intake Equation:

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi \, x Cij}{BW} \right) \right] \right)$$

Where:
Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I)
BW = Body Weight

Notes:
Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Aq. Plant diet fraction =	0.42	unitless
Terr. Plant diet fraction =	0	unitless
Fish diet fraction * =	0	unitless
Aq. Invert diet fraction =	0.51	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.05	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0.013	kg/d
Food ingestion rate =	0.141	kg/d
Body weight =	5.1	kg
Home range =	128	acres
Water intake rate =	0.43	L/d
[Sediment] Site Area =	12.11	acres
Frac. home range (FHR) =	9.46E-02	unitless

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TABLE D-14

EXAMPLE CALCULATION FOR TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN WOODCOCK AT PICATINNY FORMER SKEET RANGE

	A	B	C	D	E	H	I	L
1	**Hazard Estimate - Tier 1**							
2	**American Woodcock**							
3								
4								
5				**Surface Water Exposure**		**Soil Exposure**		**Terr. Invert. BAF**
6	**Chemical**			**Point Concentration**	**Units**	**Point Concentration**	**Units**	**---------- u**
7								
8	Arsenic			0.023	mg/L	24.1	mg/kg	=IF(H8=0,"NA",EXP(0.706*LN(H8)-1.421)/H8)
9	Copper			0.0221	mg/L	71.2	mg/kg	0.515
10	Lead			7.53	mg/L	84700	mg/kg	=IF(H10=0,"NA",EXP(0.807*LN(H10)-0.218)/H10)
11	Zinc			0.0663	mg/L	155	mg/kg	=IF(H11=0,"NA",EXP(0.328*LN(H11)+4.449)/H11
12	Acenaphthene			0	mg/L	3.79	mg/kg	1.47
13	Acenaphthylene			0	mg/L	0.253	mg/kg	22.9
14	Anthracene			0	mg/L	7.88	mg/kg	2.42
15	Benzo(a)anthracene			0	mg/L	27.6	mg/kg	1.59
16	Benzo(a)pyrene			0	mg/L	21.6	mg/kg	1.33
17	Benzo(b)fluoranthene			0	mg/L	27.1	mg/kg	2.6
18	Benzo(g,h,i)perylene			0	mg/L	14.2	mg/kg	2.94
19	Benzo(k)fluoranthene			0	mg/L	12.2	mg/kg	2.6
20	Chrysene			0	mg/L	26.2	mg/kg	2.29
21	Dibenz(a,h)anthracene			0	mg/L	4.88	mg/kg	2.31
22	Fluoranthene			0	mg/L	38.4	mg/kg	3.04
23	Fluorene			0	mg/L	3.7	mg/kg	9.57
24	Indeno(1,2,3-cd)pyrene			0	mg/L	16.5	mg/kg	2.86
25	Phenanthrene			0	mg/L	22	mg/kg	1.72
26	Pyrene			0	mg/L	9.3	mg/kg	1.75
27								
28								
29	**Note: Actual Values in each Work Sheet Calculation Cell are in Table D-2**							
30								
31								
32	***Intake Equation:***							
33								
34								
35								
36								
37								
38								
39								
40								
41	Where:							
42	Ej = Total Exposure to Chemical							
43	A = Site Area							
44	HR = Home Range							
45	m = Total number of ingested media							
46	i = counter							
47	IRi = Consumption Rate for Medium							
48	Cij = Chemical concentration (j) in medium (I)							
49	BW = Body Weight							

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, x Cij}{BW} \right) \right] \right)$$

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box), see values in text tables.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

TABLE D-14

EXAMPLE CALCULATION FOR TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN WOODCOCK AT PICATINNY FORMER SKEET RANGE

	A	N	Q	R	S
1	**Hazard Estimate - Tier 1**				
2	**American Woodcock**				
3					
4					
5		**Terr. Plant BAF**	**PDE Surface Water**	**PDE Soil**	**PDE Terr. Invert.**
6	**Chemical**	**nitless ----------**	**mg/kg-d**	**mg/kg-d**	**mg/kg-d**
7					
8	Arsenic	0.03752	=$W$45*D8*$W$47/$W$43	=$W$40*H8*$W$47/$W$43	=IF(L8="NA","NA",$W$37*H8*L8*$W$42*$W$47/$W$43)
9	Copper	=IF(H9=0,"NA",EXP(0.394*LN(H9)+0.668)/H9)	=$W$45*D9*$W$47/$W$43	=$W$40*H9*$W$47/$W$43	=IF(L9="NA","NA",$W$37*H9*L9*$W$42*$W$47/$W$43)
10	Lead	=IF(H10=0,"NA",EXP(0.561*LN(H10)-1.328)/H10)	=$W$45*D10*$W$47/$W$43	=$W$40*H10*$W$47/$W$43	=IF(L10="NA","NA",$W$37*H10*L10*$W$42*$W$47/$W$43)
11	Zinc	=IF(H11=0,"NA",EXP(0.554*LN(H11)+1.575)/H11)	=$W$45*D11*$W$47/$W$43	=$W$40*H11*$W$47/$W$43	=IF(L11="NA","NA",$W$37*H11*L11*$W$42*$W$47/$W$43)
12	Acenaphthene	=IF(H12=0,"NA",EXP(-0.8556*LN(H12)-5.562)/H12)	=$W$45*D12*$W$47/$W$43	=$W$40*H12*$W$47/$W$43	=IF(L12="NA","NA",$W$37*H12*L12*$W$42*$W$47/$W$43)
13	Acenaphthylene	=IF(H13=0,"NA",EXP(0.791*LN(H13)-1.144)/H13)	=$W$45*D13*$W$47/$W$43	=$W$40*H13*$W$47/$W$43	=IF(L13="NA","NA",$W$37*H13*L13*$W$42*$W$47/$W$43)
14	Anthracene	=IF(H14=0,"NA",EXP(0.7784*LN(H14)-0.9887)/H14)	=$W$45*D14*$W$47/$W$43	=$W$40*H14*$W$47/$W$43	=IF(L14="NA","NA",$W$37*H14*L14*$W$42*$W$47/$W$43)
15	Benzo(a)anthracene	=IF(H15=0,"NA",EXP(0.5944*LN(H15)-2.7078)/H15)	=$W$45*D15*$W$47/$W$43	=$W$40*H15*$W$47/$W$43	=IF(L15="NA","NA",$W$37*H15*L15*$W$42*$W$47/$W$43)
16	Benzo(a)pyrene	=IF(H16=0,"NA",EXP(0.975*LN(H16)-2.0615)/H16)	=$W$45*D16*$W$47/$W$43	=$W$40*H16*$W$47/$W$43	=IF(L16="NA","NA",$W$37*H16*L16*$W$42*$W$47/$W$43)
17	Benzo(b)fluoranthene	0.31	=$W$45*D17*$W$47/$W$43	=$W$40*H17*$W$47/$W$43	=IF(L17="NA","NA",$W$37*H17*L17*$W$42*$W$47/$W$43)
18	Benzo(g,h,i)perylene	=IF(H18=0,"NA",EXP(1.1829*LN(H18)-0.9313)/H18)	=$W$45*D18*$W$47/$W$43	=$W$40*H18*$W$47/$W$43	=IF(L18="NA","NA",$W$37*H18*L18*$W$42*$W$47/$W$43)
19	Benzo(k)fluoranthene	=IF(H19=0,"NA",EXP(0.8595*LN(H19)-2.1579)/H19)	=$W$45*D19*$W$47/$W$43	=$W$40*H19*$W$47/$W$43	=IF(L19="NA","NA",$W$37*H19*L19*$W$42*$W$47/$W$43)
20	Chrysene	=EXP(0.5944*LN(H20)-2.7078)/H20	=$W$45*D20*$W$47/$W$43	=$W$40*H20*$W$47/$W$43	=IF(L20="NA","NA",$W$37*H20*L20*$W$42*$W$47/$W$43)
21	Dibenz(a,h)anthracene	0.13	=$W$45*D21*$W$47/$W$43	=$W$40*H21*$W$47/$W$43	=IF(L21="NA","NA",$W$37*H21*L21*$W$42*$W$47/$W$43)
22	Fluoranthene	0.5	=$W$45*D22*$W$47/$W$43	=$W$40*H22*$W$47/$W$43	=IF(L22="NA","NA",$W$37*H22*L22*$W$42*$W$47/$W$43)
23	Fluorene	=IF(H23=0,"NA",EXP(-0.8556*LN(H23)-5.562)/H23)	=$W$45*D23*$W$47/$W$43	=$W$40*H23*$W$47/$W$43	=IF(L23="NA","NA",$W$37*H23*L23*$W$42*$W$47/$W$43)
24	Indeno(1,2,3-cd)pyrene	0.11	=$W$45*D24*$W$47/$W$43	=$W$40*H24*$W$47/$W$43	=IF(L24="NA","NA",$W$37*H24*L24*$W$42*$W$47/$W$43)
25	Phenanthrene	=IF(H25=0,"NA",EXP(0.6203*LN(H25)-0.1665)/H25)	=$W$45*D25*$W$47/$W$43	=$W$40*H25*$W$47/$W$43	=IF(L25="NA","NA",$W$37*H25*L25*$W$42*$W$47/$W$43)
26	Pyrene	0.72	=$W$45*D26*$W$47/$W$43	=$W$40*H26*$W$47/$W$43	=IF(L26="NA","NA",$W$37*H26*L26*$W$42*$W$47/$W$43)
27					
28					
29	**Note: Actual Values in each Work Sheet Calculation**				
30					
31					
32	***Intake Equation:***				
33					
34					
35					
36					
37					
38					
39					
40					
41	Where:				
42	Ej = Total Exposure to Chemical				
43	A = Site Area				
44	HR = Home Range				
45	m = Total number of ingested media				
46	i = counter				
47	IRi = Consumption Rate for Medium				
48	Cij = Chemical concentration (j) in medium (I)				
49	BW = Body Weight				

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, x Cij}{BW} \right) \right] \right)$$

TABLE D-14

EXAMPLE CALCULATION FOR TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN WOODCOCK AT PICATINNY FORMER SKEET RANGE

	A	T	U	V	W	X	Y
1	**Hazard Estimate - Tier 1**						
2	**American Woodcock**						
3							
4							
5		**PDE Terr. Plants**	**Total PDE**	**NOAEL**		**LOAEL**	
6	**Chemical**	**mg/kg-d**	**mg/kg-d**	**mg/kg-d**	**EEQ N**	**mg/kg-d**	**EEQ L**
7							
8	Arsenic	=IF(N8="NA","NA",$W$34*H8*N8*$W$42*$W$47/$W$43)	=SUM(Q8:T8)	2.24	=(U8/V8)	3.55	=(U8/X8)
9	Copper	=IF(N9="NA","NA",$W$34*H9*N9*$W$42*$W$47/$W$43)	=SUM(Q9:T9)	4.05	**=(U9/V9)**	4.88	**=(U9/X9)**
10	Lead	=IF(N10="NA","NA",$W$34*H10*N10*$W$42*$W$47/$W$43)	=SUM(Q10:T10)	1.63	**=(U10/V10)**	1.94	**=(U10/X10)**
11	Zinc	=IF(N11="NA","NA",$W$34*H11*N11*$W$42*$W$47/$W$43)	=SUM(Q11:T11)	66.1	=(U11/V11)	66.5	=(U11/X11)
12	Acenaphthene	=IF(N12="NA","NA",$W$34*H12*N12*$W$42*$W$47/$W$43)	=SUM(Q12:T12)	553	=(U12/V12)	2765	=(U12/X12)
13	Acenaphthylene	=IF(N13="NA","NA",$W$34*H13*N13*$W$42*$W$47/$W$43)	=SUM(Q13:T13)	553	=(U13/V13)	2765	=(U13/X13)
14	Anthracene	=IF(N14="NA","NA",$W$34*H14*N14*$W$42*$W$47/$W$43)	=SUM(Q14:T14)	553	=(U14/V14)	2765	=(U14/X14)
15	Benzo(a)anthracene	=IF(N15="NA","NA",$W$34*H15*N15*$W$42*$W$47/$W$43)	=SUM(Q15:T15)	553	=(U15/V15)	2765	=(U15/X15)
16	Benzo(a)pyrene	=IF(N16="NA","NA",$W$34*H16*N16*$W$42*$W$47/$W$43)	=SUM(Q16:T16)	553	=(U16/V16)	2765	=(U16/X16)
17	Benzo(b)fluoranthene	=IF(N17="NA","NA",$W$34*H17*N17*$W$42*$W$47/$W$43)	=SUM(Q17:T17)	553	=(U17/V17)	2765	=(U17/X17)
18	Benzo(g,h,i)perylene	=IF(N18="NA","NA",$W$34*H18*N18*$W$42*$W$47/$W$43)	=SUM(Q18:T18)	553	=(U18/V18)	2765	=(U18/X18)
19	Benzo(k)fluoranthene	=IF(N19="NA","NA",$W$34*H19*N19*$W$42*$W$47/$W$43)	=SUM(Q19:T19)	553	=(U19/V19)	2765	=(U19/X19)
20	Chrysene	=IF(N20="NA","NA",$W$34*H20*N20*$W$42*$W$47/$W$43)	=SUM(Q20:T20)	553	=(U20/V20)	2765	=(U20/X20)
21	Dibenz(a,h)anthracene	=IF(N21="NA","NA",$W$34*H21*N21*$W$42*$W$47/$W$43)	=SUM(Q21:T21)	553	=(U21/V21)	2765	=(U21/X21)
22	Fluoranthene	=IF(N22="NA","NA",$W$34*H22*N22*$W$42*$W$47/$W$43)	=SUM(Q22:T22)	553	=(U22/V22)	2765	=(U22/X22)
23	Fluorene	=IF(N23="NA","NA",$W$34*H23*N23*$W$42*$W$47/$W$43)	=SUM(Q23:T23)	553	=(U23/V23)	2765	=(U23/X23)
24	Indeno(1,2,3-cd)pyrene	=IF(N24="NA","NA",$W$34*H24*N24*$W$42*$W$47/$W$43)	=SUM(Q24:T24)	553	=(U24/V24)	2765	=(U24/X24)
25	Phenanthrene	=IF(N25="NA","NA",$W$34*H25*N25*$W$42*$W$47/$W$43)	=SUM(Q25:T25)	553	=(U25/V25)	2765	=(U25/X25)
26	Pyrene	=IF(N26="NA","NA",$W$34*H26*N26*$W$42*$W$47/$W$43)	=SUM(Q26:T26)	553	=(U26/V26)	2765	=(U26/X26)
27							
28							
29	**Note: Actual Values in each Work Sheet Calculation**			**Hazard Index (Total EE(**	**=SUM(W8:W26)**		**=SUM(Y8:Y26)**
30							
31							
32	***Intake Equation:***				***Species-Specific Factors***		
33					Aq. Plant diet fraction =	0	unitless
34					Terr. Plant diet fraction =	0.105	unitless
35					Fish diet fraction =	0	unitless
36					Aq. Invert diet fraction =	0	unitless
37					Terr. Invert diet fraction =	0.895	unitless
38					Mammal diet fraction =	0	unitless
39					Bird diet fraction =	0	unitless
40					Soil ingestion rate =	0.0025	kg/d
41	Where:				Sediment ingestion rate =	0	kg/d
42	Ej = Total Exposure to Chemical				Food ingestion rate =	0.024	kg/d
43	A = Site Area				Body weight =	0.176	kg
44	HR = Home Range				Home range =	59	acres
45	m = Total number of ingested media				Water intake rate =	0.0213	L/d
46	i = counter				[Soil] Site Area =	10.76	acres
47	IRi = Consumption Rate for Medium				Frac. home range (FHR) =	1	unitless
48	Cij = Chemical concentration (j) in medium (I)						
49	BW = Body Weight						

$$Ej = \left(\frac{A}{HR} \left[\sum_{i=1}^{m} \left(\frac{IRi\, x Cij}{BW} \right) \right] \right)$$

Table D-15
Recommended Bioaccumulation/Bioconcentration Factors or Regression Equations Utilized for the Soil/Sediment-to-Plant Pathway
Picatinny Arsenal Former Skeet Range

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Alternate Regression Equation [b]	Alternate BAF/BCF	Recommended Tier 1 BAF/BCF	Rationale for Recommended Tier 1 BAF/BCF	Recommended Tier 2 BAF/BCF	Rationale for Recommended Tier 2 BAF/BCF
Arsenic	Pc= 0.03752(soil)	--	--	3.75E-02	Recommended BAF (USEPA 2007)	3.75E-02	Recommended BAF (USEPA 2007)
Copper	ln (Pc)= 0.394(ln[soil])+0.668	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Lead	ln (Pc)= 0.561(ln[soil])-1.328	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Zinc	ln (Pc)= 0.554(ln[soil])+1.575	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Acenaphthene	ln (Pc)= -0.8556(ln[soil])-5.562	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Acenaphthylene	ln (Pc)= 0.791(ln[soil])-1.144	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Anthracene	ln (Pc)= 0.7784(ln[soil])-0.9887	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(a)anthracene	ln (Pc)= 0.5944(ln[soil])-2.7078	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(a)pyrene	ln (Pc)= 0.9750(ln[soil])-2.0615	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(b)fluoranthene	Pc= 0.31(soil)	--	--	3.10E-01	Recommended BAF from USEPA (2007)	3.10E-01	Recommended BAF from USEPA (2007)
Benzo(g,h,i)perylene	ln (Pc)= 1.1829(ln[soil])-0.9313	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Benzo(k)fluoranthene	ln (Pc)= 0.8595(ln[soil])-2.1579	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Chrysene	ln (Pc)= 0.5944(ln[soil])-2.7078	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Dibenzo(a,h)anthracene	Pc= 0.13(soil)	--	--	1.30E-01	Recommended BAF from USEPA (2007)	1.30E-01	Recommended BAF from USEPA (2007)
Fluoranthene	Pc= 0.50(soil)	--	--	5.00E-01	Recommended BAF from USEPA (2007)	5.00E-01	Recommended BAF from USEPA (2007)
Fluorene	ln (Pc)= -0.8556(ln[soil])-5.562	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Indeno(1,2,3-cd)pyrene	Pc= 0.11(soil)	--	--	1.10E-01	Recommended BAF from USEPA (2007)	1.10E-01	Recommended BAF from USEPA (2007)
Phenanthrene	ln (Pc)= 0.6203(ln[soil])-0.1665	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Pyrene	Pc= 0.72(soil)	--	--	7.20E-01	Recommended BAF from USEPA (2007)	7.20E-01	Recommended BAF from USEPA (2007)

Notes:
Pc (plant tissue concentration [mg/kg d.w.]); soil (concentration in soil [mg/kg d.w.]) or (concentration in sediment [mg/kg d.w.] when appropraite); BAF/BCF (bioaccumulation/bioconcentration factor); log Kow (octanol/water partition coefficient).
Soil to terrestrial plant uptake assumed for terrestrial omnivores and herbivores, while sediment to rooted aquatic plant uptake assumed for aquatic omnivores and herbivores.
If a soil to plant BAF/BCF was not available from USEPA, 2007, Ecological Soil Screening Level Guidance, an alternate value was used (see "b" below).
[a] USEPA, 2007, Ecological Soil Screening Level Guidance, Soil to Plant Uptake Equations, OSWER Directive 9285.7-55.
[b] Efroymson, R.A., et al., 2001, Uptake of Inorganic Chemicals from Soil by Plant Leaves: Regressions of Field Data, Environ. Tox. Chem., 20:2561-2571.
[c] -- indicates that a BAF/BCF or regression equation is not available or not applicable.

Table D-16
Recommended Bioaccumulation/Bioconcentration Factors or Regression Equations Utilized for the Soil-to-Earthworm Pathway
Picatinny Arsenal Former Skeet Range

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample, et al. 1998 [b]			Sample et al. 1999 [c]	Recommended Tier 1 BAF/BCF	Rationale for Recommended Tier 1 BAF/BCF	Recommended Tier 2 BAF/BCF	Rationale for Recommended Tier 2 BAF/BCF
		Median BAF/BCF	90th Percentile BAF/BCF	Maximum BAF/BCF	Regression Equation				
Arsenic	ln (EW)= 0.706(ln[soil])-1.421	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Copper	(EW)= 0.515(soil)	--	--	--	--	5.15E-01	Recommended BAF (USEPA 2007)	5.15E-01	Recommended BAF (USEPA 2007)
Lead	ln (EW)= 0.807(ln[soil])-0.218	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Zinc	ln (EW)= 0.328(ln[soil])+4.449	--	--	--	--	Regression Eq.	Recommended Equation (USEPA 2007)	Regression Eq.	Recommended Equation (USEPA 2007)
Acenaphthene	(EW)= 1.47(soil)	--	--	--	--	1.47E+00	Recommended BAF (USEPA 2007)	1.47E+00	Recommended BAF (USEPA 2007)
Acenaphthylene	(EW)= 22.9(soil)	--	--	--	--	2.29E+01	Recommended BAF (USEPA 2007)	2.29E+01	Recommended BAF (USEPA 2007)
Anthracene	(EW)= 2.42(soil)	--	--	--	--	2.42E+00	Recommended BAF (USEPA 2007)	2.42E+00	Recommended BAF (USEPA 2007)
Benzo(a)anthracene	(EW)= 1.59(soil)	--	--	--	--	1.59E+00	Recommended BAF (USEPA 2007)	1.59E+00	Recommended BAF (USEPA 2007)
Benzo(a)pyrene	(EW)= 1.33(soil)	--	--	--	--	1.33E+00	Recommended BAF (USEPA 2007)	1.33E+00	Recommended BAF (USEPA 2007)
Benzo(b)fluoranthene	(EW)= 2.6(soil)	--	--	--	--	2.60E+00	Recommended BAF (USEPA 2007)	2.60E+00	Recommended BAF (USEPA 2007)
Benzo(g,h,i)perylene	(EW)= 2.94(soil)	--	--	--	--	2.94E+00	Recommended BAF (USEPA 2007)	2.94E+00	Recommended BAF (USEPA 2007)
Benzo(k)fluoranthene	(EW)= 2.6(soil)	--	--	--	--	2.60E+00	Recommended BAF (USEPA 2007)	2.60E+00	Recommended BAF (USEPA 2007)
Chrysene	(EW)= 2.29(soil)	--	--	--	--	2.29E+00	Recommended BAF (USEPA 2007)	2.29E+00	Recommended BAF (USEPA 2007)
Dibenz(a,h)anthracene	(EW)= 2.31(soil)	--	--	--	--	2.31E+00	Recommended BAF (USEPA 2007)	2.31E+00	Recommended BAF (USEPA 2007)
Fluoranthene	(EW)= 3.04(soil)	--	--	--	--	3.04E+00	Recommended BAF (USEPA 2007)	3.04E+00	Recommended BAF (USEPA 2007)
Fluorene	(EW)= 9.57(soil)	--	--	--	--	9.57E+00	Recommended BAF (USEPA 2007)	9.57E+00	Recommended BAF (USEPA 2007)
Indeno(1,2,3-cd)pyrene	(EW)= 2.86(soil)	--	--	--	--	2.86E+00	Recommended BAF (USEPA 2007)	2.86E+00	Recommended BAF (USEPA 2007)
Phenanthrene	(EW)= 1.72(soil)	--	--	--	--	1.72E+00	Recommended BAF (USEPA 2007)	1.72E+00	Recommended BAF (USEPA 2007)
Pyrene	(EW)= 1.75(soil)	--	--	--	--	1.75E+00	Recommended BAF (USEPA 2007)	1.75E+00	Recommended BAF (USEPA 2007)

Notes: EW (earthworm tissue concentration [mg/kg d.w.]); soil (concentration in soil [mg/kg d.w.]); BAF/BCF (bioaccumulation/bioconcentration factor); log Kow (octanol/water partition coefficient); -- indicates that a BAF/BCF or regression equation is not available or not applicable.

Hierarchy for Selection of BAFs:

[a] USEPA, 2007, Ecological Soil Screening Level Guidance (Eco-SSL), Soil to Earthworm Uptake Equations, OSWER Directive 9285.7-55.

[b] Sample, B. E, et. al., 1998. Development and Validation of Bioaccumulation Models for Earthworms, ES/ER/TM-220.

[c] Sample, B.E, et. al., 1999, Literature-Derived Bioaccumulation Models for Earthworms: Development and Validation, Environ. Toxicol. Chem., 18(9): 2110-2120 (models from Table 3 of publication).

Table D-17
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Soil-To-Small Mammal and Bird Pathways
Picatinny Arsenal Former Skeet Range

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample et al., 1998 [b]						Recommended Tier 1 BAF/BCF	Rationale for Recommended Tier 1 BAF/BCF	Recommended Tier 2 BAF/BCF	Rationale for Recommended Tier 2 BAF/BCF
		Insectivore Median BAF/BCF	Herbivore Median BAF/BCF	Omnivore Median BAF/BCF	General [c] Median BAF/BCF	General [c] Maximum BAF/BCF	General [c] 90th percentile BAF/BCF				
Arsenic	ln(mam)= 0.8188(ln[soil])-4.8471	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Copper	ln(mam)= 0.144(ln[soil])+2.042	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Lead	ln(mam)= 0.4422(ln[soil])+0.0761	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Zinc	ln(mam)= 0.0706(ln[soil])+4.3632	--	--	--	--	--	--	Regression Eq.	Recommended Regression Eq. (USEPA 2007)	Regression Eq.	Recommended Regression Eq. (USEPA 2007)
Acenaphthene	Mam = 0 [e] (0.80) [f]	--	--	--	--	--	--	8.00E-01	Based on regression equation (Brandt, 2002)	8.00E-01	Based on regression equation (Brandt, 2002)
Acenaphthylene	Mam = 0 [e] (0.77) [f]	--	--	--	--	--	--	7.70E-01	Based on regression equation (Brandt, 2002)	7.70E-01	Based on regression equation (Brandt, 2002)
Anthracene	Mam = 0 [e] (0.64) [f]	--	--	--	--	--	--	6.40E-01	Based on regression equation (Brandt, 2002)	6.40E-01	Based on regression equation (Brandt, 2002)
Benzo(a)anthracene	Mam = 0 [e] (0.35) [f]	--	--	--	--	--	--	3.50E-01	Based on regression equation (Brandt, 2002)	3.50E-01	Based on regression equation (Brandt, 2002)
Benzo(a)pyrene	Mam = 0 [e] (0.28) [f]	--	--	--	--	--	--	2.80E-01	Based on regression equation (Brandt, 2002)	2.80E-01	Based on regression equation (Brandt, 2002)
Benzo(b)fluoranthene	Mam = 0 [e] (0.28) [f]	--	--	--	--	--	--	2.80E-01	Based on regression equation (Brandt, 2002)	2.80E-01	Based on regression equation (Brandt, 2002)
Benzo(g,h,i)perylene	Mam = 0 [e] (0.24) [f]	--	--	--	--	--	--	2.40E-01	Based on regression equation (Brandt, 2002)	2.40E-01	Based on regression equation (Brandt, 2002)
Benzo(k)fluoranthene	Mam = 0 [e] (0.29) [f]	--	--	--	--	--	--	2.90E-01	Based on regression equation (Brandt, 2002)	2.90E-01	Based on regression equation (Brandt, 2002)
Chrysene	Mam = 0 [e] (0.35) [f]	--	--	--	--	--	--	3.50E-01	Based on regression equation (Brandt, 2002)	3.50E-01	Based on regression equation (Brandt, 2002)
Dibenz(a,h)anthracene	Mam = 0 [e] (0.20) [f]	--	--	--	--	--	--	2.00E-01	Based on regression equation (Brandt, 2002)	2.00E-01	Based on regression equation (Brandt, 2002)
Fluoranthene	Mam = 0 [e] (0.50) [f]	--	--	--	--	--	--	5.00E-01	Based on regression equation (Brandt, 2002)	5.00E-01	Based on regression equation (Brandt, 2002)
Fluorene	Mam = 0 [e] (0.73) [f]	--	--	--	--	--	--	7.30E-01	Based on regression equation (Brandt, 2002)	7.30E-01	Based on regression equation (Brandt, 2002)
Indeno(1,2,3-cd)pyrene	Mam = 0 [e] (0.23) [f]	--	--	--	--	--	--	2.30E-01	Based on regression equation (Brandt, 2002)	2.30E-01	Based on regression equation (Brandt, 2002)
Phenanthrene	Mam = 0 [e] (0.60) [f]	--	--	--	--	--	--	6.00E-01	Based on regression equation (Brandt, 2002)	6.00E-01	Based on regression equation (Brandt, 2002)
Pyrene	Mam = 0 [e] (0.52) [f]	--	--	--	--	--	--	5.20E-01	Based on regression equation (Brandt, 2002)	5.20E-01	Based on regression equation (Brandt, 2002)

Notes: mam (mammal or bird tissue concentration [mg/kg d.w.]); diet (concentration in diet [mg/kg d.w.] assuming 100% earthworm consumption); soil (concentration in soil [mg/kg d.w.]); BAF/BCF (bioaccumulation/bioconcentration factor).
Bird BAF/BCF values were based on the recommended small mammal BAF/BCF values, as bird uptake values are not readily available. See text for discussion.

[a] USEPA, 2007, Ecological Soil Screening Level Guidance, Soil to Small Mammal Uptake Equations, OSWER Directive 9285.7-55, unless otherwise noted.
[b] Sample et al., 1998, Development and Validation of Bioaccumulation Models for Small Mammals, ES/ER/TM-219.
[c] General = combination dataset used for insectivore, herbivore, and omnivore receptors to estimate a "general" receptor BAF/BCF value.
[d] "--" indicates that a BAF/BCF is not available or not applicable.
[e] Uptake assumed to be negligible (USEPA 2007); however, Brandt et al. (2002) measured PAH uptake and those BAFs are used herein.
[f] PAH BAFs estimated using log Kows and number of alkyl groups, based on regression equation presented in Brandt et al. (2002), Distribution of polycyclic aromatic hydrocarbons in soils and terrestrial biota after a spill of crude oil in Trecate, Italy, Environmental Toxicology and Chemistry, Vol. 21 (8): 1638-1643. See next page for calculations.

Table D-17
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Soil-To-Small Mammal and Bird Pathways
Picatinny Arsenal Former Skeet Range

Constituent	USEPA (2007) Eco-SSL Uptake Equation [a]	Sample et al., 1998 [b]						Recommended Tier 1 BAF/BCF	Rationale for Recommended Tier 1 BAF/BCF	Recommended Tier 2 BAF/BCF	Rationale for Recommended Tier 2 BAF/BCF
		Insectivore Median BAF/BCF	Herbivore Median BAF/BCF	Omnivore Median BAF/BCF	General [c] Median BAF/BCF	General [c] Maximum BAF/BCF	General [c] 90th percentile BAF/BCF				

Estimation of Biota Soil Accumulation Factors (BSAFs) (Uptake Factors) for PAHs:

*Regression Equation : Log mouse BSAF = 1.72 - 0.487 * LogKow + 0.411 * No. of Alkyl Groups*

PAH	Log Kow	No. Alkyl Groups	Log Mouse BSAF	Mouse BSAF
Acenaphthene	3.98	0	-0.22	0.80
Acenaphthylene	4.07	0	-0.26	0.77
Anthracene	4.45	0	-0.45	0.64
Benz(a)anthracene	5.66	0	-1.04	0.35
Benzo(a)pyrene	6.16	0	-1.28	0.28
Benzo(b)fluoranthene	6.12	0	-1.26	0.28
Benzo(g,h,i)perylene	6.5	0	-1.45	0.24
Benzo(k)fluoranthene	6.06	0	-1.23	0.29
Chrysene	5.66	0	-1.04	0.35
Dibenz(a,h)anthracene	6.84	0	-1.61	0.20
Fluoranthene	4.95	0	-0.69	0.50
Fluorene	4.18	0	-0.32	0.73
Indeno(1,2,3-cd)pyrene	6.58	0	-1.48	0.23
Phenanthrene	4.57	0	-0.51	0.60
Pyrene	4.88	0	-0.66	0.52

Log Kow values from ATSDR, 1995, Toxicological Profile for PAHs.

Brandt, C.A., J.M. Brecker, and A. Porta, 2002, *Distribution of PAHs in Soils and Terrestrial Biota after a Spill of Crude Oil in Trecate, Italy* , **Environmental Toxicology and Chemistry**, Vol. 21, No. 8: 1638-1643.

Table D-18
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Sediment-to-Aquatic Invertebrate Pathway
Picatinny Arsenal Former Skeet Range

Constituent	Bechtel Jacobs [a]			Recommended Tier 1 BAF/BCF [b]	Recommended Tier 2 BAF/BCF [b]	Rationale for Recommended Tier 2 BAF/BCF
	Median BAF/BCF	90th Percentile BAF/BCF	Maximum BAF/BCF			
Arsenic	1.43E-01	6.90E-01	4.33E+00	6.90E-01	1.43E-01	Median sediment BAF/BCF
Copper	1.56E+00	5.25E+00	2.39E+01	5.25E+00	1.56E+00	Median sediment BAF/BCF
Lead	7.10E-02	6.07E-01	7.08E+00	6.07E-01	7.10E-02	Median sediment BAF/BCF
Zinc	1.94E+00	7.53E+00	1.45E+01	7.53E+00	1.94E+00	Median sediment BAF/BCF
Benzo(b)fluoranthene	-- [c]	--	--	2.60E+00	2.60E+00	Soil Tier 2 BAF/BCF
Benzo(g,h,i)perylene	--	--	--	2.94E+00	2.94E+00	Soil Tier 2 BAF/BCF
Benzo(k)fluoranthene	--	--	--	2.60E+00	2.60E+00	Soil Tier 2 BAF/BCF
Fluoranthene	--	--	--	3.04E+00	3.04E+00	Soil Tier 2 BAF/BCF
Pyrene	--	--	--	1.75E+00	1.75E+00	Soil Tier 2 BAF/BCF

Notes:
All BAF/BCF values for infauna, unless noted.
[a] Bechtel Jacobs Company LLC, 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation, BJC/OR-112. (Depurated and nondepurated results used). 90th percentile value for Tier 1, median value for Tier 2.
[b] If a sediment BAF/BCF was not available for an organic constituent, soil-to-invertebrate BAFs/BCFs were used. See soil-to-earthworm BAF/BCF appendix table for derivation of alternate BAF/BCF values.
[c] -- indicates that a BAF/BCF is not available.

Table D-19
NOAEL Toxicity Reference Values Used to Derive Wildlife Toxicity Benchmarks for COPECs
Picatinny Arsenal Former Skeet Range

COPEC	Mammalian Data				Avian Data			
	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference
Arsenic	--	1.04E+00	dog	Eco-SSL (2005)	--	2.24E+00	chicken	Eco-SSL (2005)
Copper	--	5.60E+00	pig	Eco-SSL (2007)	--	4.05E+00	chicken	Eco-SSL (2007)
Lead	--	4.70E+00	rat	Eco-SSL (2005)	--	1.63E+00	chicken	Eco-SSL (2005)
Zinc	--	7.54E+01	geo-mean [1]	Eco-SSL (2007)	--	6.61E+01	geo-mean [1]	Eco-SSL (2007)
Acenaphthene	--	6.56E+01	rat	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Acenaphthylene	--	6.56E+01	rat	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Anthracene	--	6.56E+01	rat	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)anthracene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)pyrene	--	1.00E+00	mouse	Sample, et. al. (1996)	--	5.53E+02	mallard duck	Eisler (1987)
Benzo(b)fluoranthene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(g,h,i)perylene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(k)fluoranthene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Chrysene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Dibenz(a,h)anthracene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Fluoranthene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Fluorene	--	6.56E+01	rat	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler, 1987
Indeno(1,2,3-cd)pyrene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Phenanthrene	--	6.56E+01	rat	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)
Pyrene	--	6.15E-01	mouse	EcoSSL (EPA, 2007)	--	5.53E+02	mallard duck	Based on B(a)P, Eisler (1987)

[1] TRV is based on geometric mean of NOAELs from multiple test species, as presented in the Eco-SSL guidance.

As recommended by Wentsel, et. al. (1996), Tri-Service Procedural Guidelines for Ecological Risk Assessments, the following adjustments were made to toxicity data when NOAEL or LOAEL data were not available:

- Subchronic LOAELs were converted to chronic NOAELs by dividing by a factor of 20.
- Chronic NOAELs were converted to chronic LOAELs by multiplying by a factor of 5.0.
- Subchronic NOAELs/LOAELs were converted to chronic NOAELs/LOAELs by dividing by a factor of 10.
- Chronic LOAELs were converted to chronic NOAELs by dividing by a factor of 10.

Table D-19
NOAEL Toxicity Reference Values Used to Derive Wildlife Toxicity Benchmarks for COPECs
Picatinny Arsenal Former Skeet Range

COPEC	Mammalian Data				Avian Data			
	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference

- LD_{50} concentrations were converted to chronic NOAELs by dividing by a factor of 100.
- LD_{50} concentrations were converted to chronic LOAELs by dividing by a factor of 20.

Hierarchy for Selection of TRVs:
(1) USEPA, Ecological Screening Levels (Eco-SSL), various publication dates.
(2) Sample, et al., 1996, Toxicological Benchmarks for Wildlife.
(3) Eisler, 1987, PAH Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.

Table D-20
LOAEL Toxicity Reference Values Used to Derive Wildlife Toxicity Benchmarks for COPECs
Picatinny Arsenal Former Skeet Range

COPEC	Mammalian Data				Avian Data			
	Toxicity Value	LOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	LOAEL (mg/kg/d)	Test Species	Reference
Arsenic	--	1.66E+00	dog	Eco-SSL (2005)	--	3.55E+00	chicken	Eco-SSL (2005)
Copper	--	5.78E+00	rat	Eco-SSL (2007)	--	4.88E+00	turkey	Eco-SSL (2007)
Lead	--	5.00E+00	rat	Eco-SSL (2005)	--	1.94E+00	quail	Eco-SSL (2005)
Zinc	--	7.57E+01	sheep	Eco-SSL (2007)	--	6.65E+01	chicken	Eco-SSL (2007)
Acenaphthene	--	1.10E+02	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Acenaphthylene	--	1.10E+02	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Anthracene	--	1.10E+02	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)anthracene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(a)pyrene	--	1.00E+01	mouse	Sample, et. al. (1996)	553 (NOAEL)	2.77E+03	mallard duck	Eisler (1987)
Benzo(b)fluoranthene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(g,h,i)perylene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Benzo(k)fluoranthene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Chrysene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Dibenz(a,h)anthracene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Fluoranthene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Fluorene	--	1.10E+02	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on Benzo(a)pyrene, Eisler 1987
Indeno(1,2,3-cd)pyrene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Phenanthrene	--	1.10E+02	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)
Pyrene	--	3.07E+00	mouse	EcoSSL (EPA, 2007)	553 (NOAEL)	2.77E+03	mallard duck	Based on B(a)P, Eisler (1987)

As recommended by Wentsel, et. al. (1996), Tri-Service Procedural Guidelines for Ecological Risk Assessments, the following adjustments were made to toxicity data when NOAEL or LOAEL data were not available:

- Subchronic LOAELs were converted to chronic NOAELs by dividing by a factor of 20.
- Chronic NOAELs were converted to chronic LOAELs by multiplying by a factor of 5.0.
- Subchronic NOAELs/LOAELs were converted to chronic NOAELs/LOAELs by dividing by a factor of 10.
- Chronic LOAELs were converted to chronic NOAELs by dividing by a factor of 10.
- LD_{50} concentrations were converted to chronic NOAELs by dividing by a factor of 100.
- LD_{50} concentrations were converted to chronic LOAELs by dividing by a factor of 20.

Hierarchy for Selection of TRVs:
(1) USEPA, Ecological Screening Levels (Eco-SSL), various publication dates.

Table D-20
LOAEL Toxicity Reference Values Used to Derive Wildlife Toxicity Benchmarks for COPECs
Picatinny Arsenal Former Skeet Range

COPEC	Mammalian Data				Avian Data			
	Toxicity Value	LOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	LOAEL (mg/kg/d)	Test Species	Reference

(2) Sample, et al., 1996, Toxicological Benchmarks for Wildlife.
(3) Eisler, 1987, PAH Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.

APPENDIX E

SITE PHOTOGRAPHS

Photograph #1 – Fragments of clay targets within the former Skeet Range.

Photograph #2 – Area of accumulated clay targets at the former Skeet Range.

Photograph #3 – Location of former shooting area within the former Skeet Range, looking north.

Photograph #4 – Southeastern corner of former Skeet Range, looking southwest.

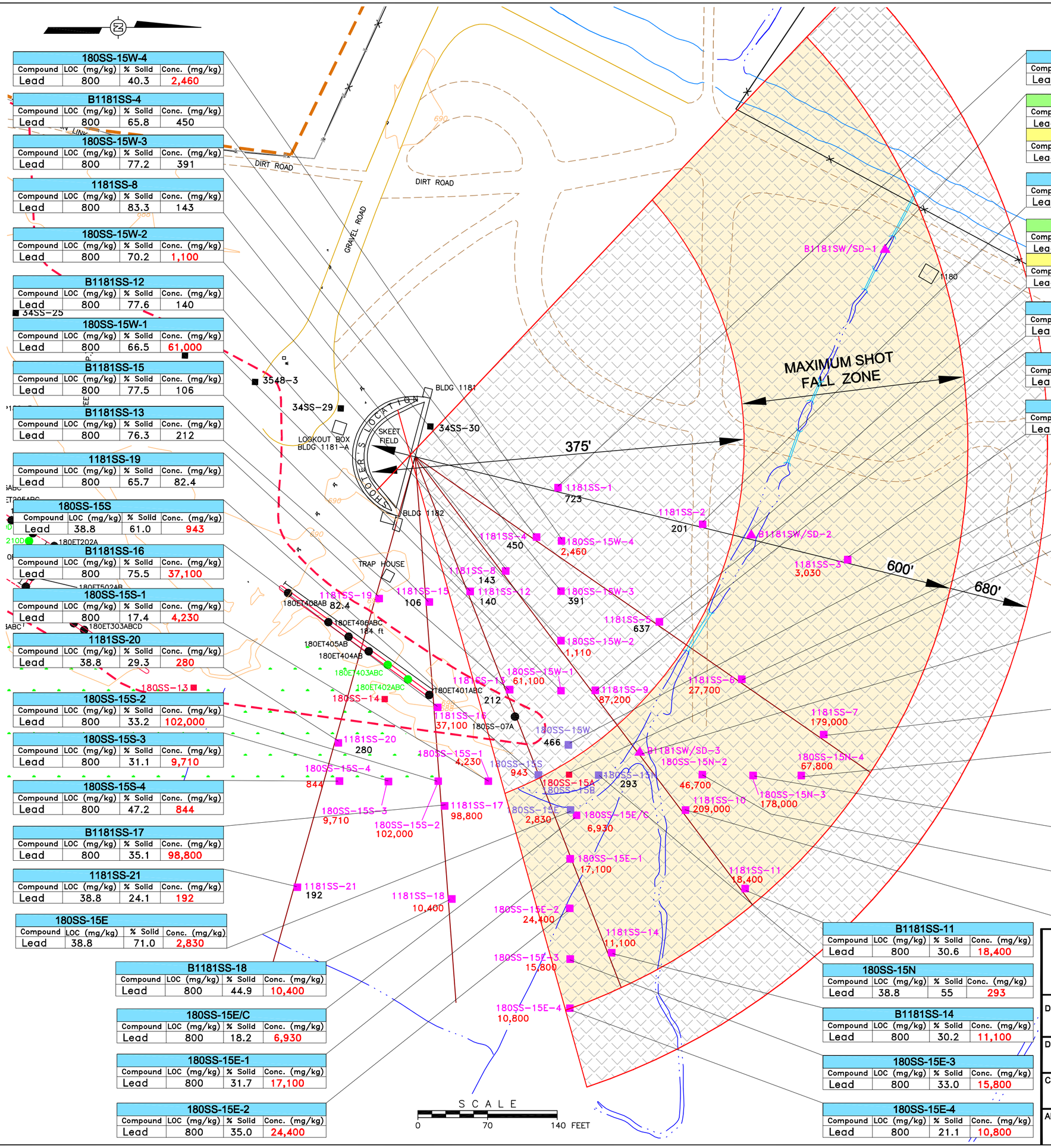
Photograph #5 – Drainage ditch within the former Skeet Range.

Photograph #6 – Drainage ditch within the former Skeet Range.

APPENDIX F

HISTORICAL SITE FIGURES

OFFICE Mt Arlington, NJ | DRAWING NUMBER C_111307.dwg



180SS-15W-4			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	40.3	2,460

B1181SS-4			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	65.8	450

180SS-15W-3			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	77.2	391

1181SS-8			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	83.3	143

180SS-15W-2			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	70.2	1,100

B1181SS-12			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	77.6	140

180SS-15W-1			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	66.5	61,000

B1181SS-15			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	77.5	106

B1181SS-13			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	76.3	212

1181SS-19			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	65.7	82.4

180SS-15S			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	61.0	943

B1181SS-16			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	75.5	37,100

180SS-15S-1			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	17.4	4,230

1181SS-20			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	29.3	280

180SS-15S-2			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	33.2	102,000

180SS-15S-3			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	31.1	9,710

180SS-15S-4			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	47.2	844

B1181SS-17			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	35.1	98,800

1181SS-21			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	24.1	192

180SS-15E			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	71.0	2,830

B1181SS-18			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	44.9	10,400

180SS-15E/C			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	18.2	6,930

180SS-15E-1			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	31.7	17,100

180SS-15E-2			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	35.0	24,400

1181SS-1			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	37.0	723

B1181SW-1		
Compound	LOC ug/L	Conc. ug/L
Lead	3.2	35.8

B1181SD-1			
Compound	LOC mg/kg	% Solid	Conc.mg/kg
Lead	38.8	44.5	1,004

B1181SS-2			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	86.8	201

B1181SW-2		
Compound	LOC ug/L	Conc. ug/L
Lead	3.2	101

B1181SD-2			
Compound	LOC mg/kg	% Solid	Conc.mg/kg
Lead	38.8	75.8	104

B1181SS-5			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	79.4	637

1181SS-9			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	85.3	87,200

B1181SS-3			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	57.0	3,030

180SS-15W			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	31	466

B1181SS-6			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	69.0	27,700

180SS-15A			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	75	587

180SS-15B			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	65	386

B1181SW-3		
Compound	LOC ug/L	Conc. ug/L
Lead	3.2	354

B1181SD-3			
Compound	LOC mg/kg	% Solid	Conc.mg/kg
Lead	38.8	21.2	21,500

B1181SS-7			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	37.4	179,000

180SS-15N-4			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	28.5	67,800

180SS-15N-3			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	49.1	178,000

180SS-15N-2			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	77.5	46,700

B1181SS-10			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	40.7	209,000

B1181SS-11			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	30.6	18,400

180SS-15N			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	38.8	55	293

B1181SS-14			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	30.2	11,100

180SS-15E-3			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	33.0	15,800

180SS-15E-4			
Compound	LOC (mg/kg)	% Solid	Conc. (mg/kg)
Lead	800	21.1	10,800

LEGEND

- SOIL SAMPLE WITH AT LEAST ONE LOC EXCEEDANCE (180ET210D)
- SOIL SAMPLE WITH NO EXCEEDANCES (180ET210D)
- TEST PIT WITH AT LEAST ONE LOC EXCEEDANCE (TP180-2)
- EXCAVATED SECTION OF TRENCH
- SURFACE SOIL SAMPLE
- UNEXCAVATED SECTION OF TRENCH
- EXCAVATED SECTION OF PROPOSED TRENCH
- TREE LINE
- FENCE
- BUILDING (BLDG NO.)
- FORMER BUILDING
- EARTH MOUND
- SWAMP
- WATER
- DRAINAGE DITCHES AND STREAMS
- TRANSFORMER (TR-732)
- PAVED ROAD
- UNPAVED ROAD
- COVERED WALKWAY
- NOVEMBER 2005 SOIL SAMPLE
- ADDITIONAL 2006 SOIL SAMPLE
- JUNE 2008 SURFACE SOIL SAMPLE
- JUNE 2008 SURFACE WATER/SEDIMENT SAMPLE
- SKEET RANGE IMPACT FAN
- MAXIMUM SHOT FALL ZONE

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw™ Shaw Environmental, Inc.

DESIGNED BY: S. Wiafe	DRAWN BY: S. Wiafe	CHECKED BY: G. Maresca	APPROVED BY: --

LEAD SAMPLING AND ANALYSIS AREA

SITE 180 & SKEET RANGE REPORT

PICATINNY ARSENAL, DOVER, NEW JERSEY

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Plotted By: stephen.Wiafe

DRAWING NUMBER C_082010.dwg

APPROVED BY -- --

CHECKED BY C. Cook 08/17/10

DRAWN BY S. Wiafe 08/17/10

B1181SS-30	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.301
% Solid	NA	89

B1811SS-29	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.302
% Solid	NA	72

B1181SS-24	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.935
Dibenz(a,h)anthracene	0.2	0.628
% Solid	NA	91

B1181SS-25	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.405
% Solid	NA	86

B1181SS-28	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.393
Dibenz(a,h)anthracene	0.2	0.379
% Solid	NA	71

B1181SS-23	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	27.6
Benzo(a)pyrene	0.2	21.6
Benzo(b)fluoranthene	2	27.1
Dibenz(a,h)anthracene	0.2	4.88
Indeno(1,2,3-c,d)pyrene	2	16.5
% Solid	NA	86

B1181SS-27	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	3.61
Benzo(a)pyrene	0.2	3.17
Benzo(b)fluoranthene	2	4.39
Dibenz(a,h)anthracene	0.2	1.14
Indeno(1,2,3-c,d)pyrene	2	2.66
% Solid	NA	63

B1181SS-22	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.366
Dibenz(a,h)anthracene	0.2	0.289
% Solid	NA	88

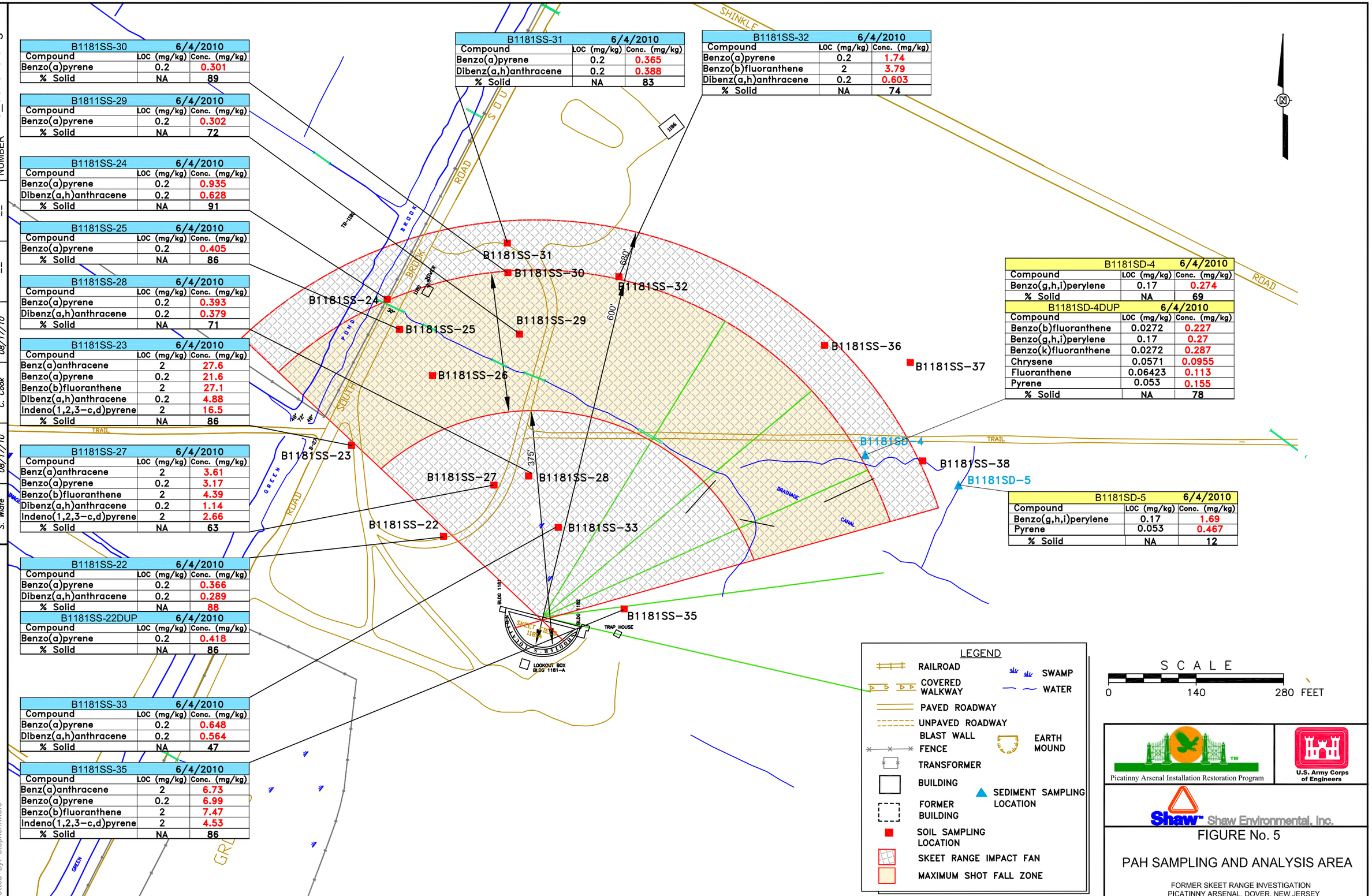
B1181SS-22DUP	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.418
% Solid	NA	86

B1181SS-33	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.648
Dibenz(a,h)anthracene	0.2	0.564
% Solid	NA	47

B1181SS-35	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benz(a)anthracene	2	6.73
Benzo(a)pyrene	0.2	6.99
Benzo(b)fluoranthene	2	7.47
Indeno(1,2,3-c,d)pyrene	2	4.53
% Solid	NA	86

B1181SS-31	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	0.365
Dibenz(a,h)anthracene	0.2	0.388
% Solid	NA	83

B1181SS-32	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(a)pyrene	0.2	1.74
Benzo(b)fluoranthene	2	3.79
Dibenz(a,h)anthracene	0.2	0.603
% Solid	NA	74



B1181SD-4	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(g,h,i)perylene	0.17	0.274
% Solid	NA	69

B1181SD-4DUP	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(b)fluoranthene	0.0272	0.227
Benzo(g,h,i)perylene	0.17	0.27
Benzo(k)fluoranthene	0.0272	0.287
Chrysene	0.0571	0.0955
Fluoranthene	0.06423	0.113
Pyrene	0.053	0.155
% Solid	NA	78

B1181SD-5	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Benzo(g,h,i)perylene	0.17	1.69
Pyrene	0.053	0.467
% Solid	NA	12

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE No. 5

PAH SAMPLING AND ANALYSIS AREA

FORMER SKEET RANGE INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

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Plotted By: stephen.Wiafe

B1181SS-30	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	233
% Solid	NA	89

B1181SS-24	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	160
% Solid	NA	91

B1181SS-25	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	56,500
% Solid	NA	86

B1181SS-26	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	46,100
% Solid	NA	85

B1181SS-28	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	386
% Solid	NA	71

B1181SS-23	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	97
% Solid	NA	86

B1181SS-27	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	299
% Solid	NA	63

B1181SS-22	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	9.64
% Solid	NA	88

B1181SS-22DUP	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	11.9
% Solid	NA	86

B1181SS-31	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	114
% Solid	NA	83

B1181SS-29	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	1,230
% Solid	NA	72

B1181SS-32	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	84,700
% Solid	NA	74

B1181SS-36	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	1,760
% Solid	NA	27

B1181SS-37	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	923
% Solid	NA	15

B1181SD-4	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	38.8	31.9
% Solid	NA	69

B1181SD-4DUP	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	38.8	11.8
% Solid	NA	78

B1181SS-38	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	800	26.4
% Solid	NA	83

B1181SD-5	6/4/2010	
Compound	LOC (mg/kg)	Conc. (mg/kg)
Lead	38.8	387
% Solid	NA	12

B1181SS-31 B1181SS-30 B1181SS-32 B1181SS-24 B1181SS-25 B1181SS-29 B1181SS-3 B1181SS-7 180SS-15N-4 B1181SS-36 B1181SS-37 B1181SS-26 180SS-15N-3 B1181SS-11 B1181SS-6 180SS-15N-2 B1181SS-10 B1181SS-2 B1181SS-5 B1181SS-14 B1181SD-4 B1181SS-38 B1181SS-23 B1181SS-27 B1181SS-28 180SS-15W-1 180SS-15E/C 180SS-15E-2 B1181SD-5 B1181SS-9 180SS-15W-4 180SS-15W-3 180SS-15E-4 180SS-15E-3 B1181SS-22 B1181SS-1 B1181SS-33 180SS-15W-2 180SS-15E-1 B1181SS-4 180SS-15 180SS07A B1181SS-8 180SS-15S-1 B1181SS-12 B1181SS-13 B1181SS-17 B1181SS-18 B1181SS-16 180SS-15S-2 B1181SS-15 B1181SS-35 180SS-15S-3 180SS-14 B1181SS-19 180SS-15S-4 B1181SS-20 B1181SS-21 180SS-13 180SS-12

680' 600' 375'

TRAP HOUSE

LOOKOUT BOX BLDG 1181-A

SCALE

0 140 280 FEET

LEGEND

- RAILROAD
- COVERED WALKWAY
- PAVED ROADWAY
- UNPAVED ROADWAY
- BLAST WALL
- FENCE
- TRANSFORMER
- BUILDING
- FORMER BUILDING
- SOIL SAMPLING LOCATION
- SKEET RANGE IMPACT FAN
- MAXIMUM SHOT FALL ZONE
- SWAMP
- WATER
- EARTH MOUND
- SEDIMENT SAMPLING LOCATION

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE No. 6

2010 LEAD SAMPLING AND ANALYSIS AREA

FORMER SKEET RANGE INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWING NUMBER C_082010.dwg

APPROVED BY -- --

CHECKED BY C. Cook 08/17/10

DRAWN BY S. Wiafe 08/17/10

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